Inland Empire
UTILITIES AGENCY *

DRAFT
2005
Urban Water Management Plan
Chino Desalter Authority

October 2005

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ACRONONYMS AND ABBREVIATIONS

Act	Urban Water Management Planning Act
AF	acre feet
AFY	acre feet per year
Agency	Inland Empire Utilities Agency
ASR	Aquifer Storage & Recovery Program
BMP	Best Management Practice
CALFED	California State and Federal Agencies
CBFIP	Chino Basin Facilities Improvement Project
CBWCD	Chino Basin Water Conservation District
CBWM	Chino Basin Watermaster
CCWRP	Carbon Canyon Water Recycling Plant
CCR	California Code of Regulations
CDA	Chino Desalting Authority
CEQA	California Environmental Quality Act
CII	Commercial/Industrial/Institutional
CIM	California Institution for Men
CIP	Capital Improvement Plan
Corps	U.S. Army Corps of Engineers
CRA	Colorado River Aqueduct
CUWA	California Urban Water Agencies
CUWCC	California Urban Water Conservation Council
CVP	Central Valley Project
CVWD	Cucamonga Valley Water District
DBCP	1,2-Dibromo-3-Chloropropane
DCE	Dichloroethene
DHS	California Department of Health Services
DMM	Demand Management Measures
DWR	California Department of Water Resources
DYY	Dry Year Yield
EPA	Environmental Protection Agency
GCPD	Gallons Per Capita Daily
GIES	Garden In Every School Program
HECW	High Efficiency Clothes Washer
HET	High Efficiency Toilet (1 Gallon per Flush)
IID	Imperial Irrigation District
IEUA	Inland Empire Utilities Agency
IRP	Integrated Resources Planning
IWP	Integrated Watershed Plan
IX	Ion Exchange
LAA	Los Angeles Aqueduct
LEED	Leadership in Energy & Environmental Design

LPP	Local Projects Program
LRP	Local Resources Program
M&I	Municipal and Industrial
MCL	Maximum Contaminant Level
MGD	Million Gallons per Day
Mg/L	Milligrams per Liter
MOU	Memorandum of Understanding
MTBE	Methyl Tertiary Butyl Ether
MVWD	Monte Vista Water District
MWD	Metropolitan Water District of Southern California
MZ	Management Zone
NDMA	N-nitrosodimethylamine
NEPA	National Environmental Policy Act
NTC	National Theatre for Children
NRW Line	Non-Recoverable Waste Line
O&M	Operations and Maintenance
OBMP	Optimum Basin Management Plan
PBMZ	Prado Basin Management Zone
PCE	Tetrachloroethene
RO	Reverse Osmosis
RP	Regional Treatment Plant
RTS	Readiness-To-Serve
RWIP	2005 Recycled Water Implementation Plan
RWQCB	Regional Water Quality Control Board
SARI Line	Santa Ana Regional Interceptor
SARWQCB	Santa Ana Regional Water Quality Control Board
SAV-A-BUC	MWD's CII Rebate Program
SAWPA	Santa Ana Watershed Project Authority
SB	Senate Bill
SCAG	Southern California Association of Governments
SNWA	Southern Nevada Water Authority
SWP	State Water Project
SWRCB	State Water Resources Control Board
TCE	Trichloroethene
TCP	Trichloropropane
TDS	Total Dissolved Solids
Title 22	California Title 22 Drinking Water Standards
TMDL	Total Maximum Daily Load
TOC	Total Organic Carbon
TVMWD	Three Valleys Municipal Water District
TYCIP	Ten-Year Capital Improvement Plan
µg/L	Microgram per Liter
ULFT	Ultra-Low Flush Toilet (1.6 Gallons per Flush)
USEPA	United States Environmental Protection Agency
UWMP	Urban Water Management Plan
VOC	Volatile Organic Compounds

Watermaster	Chino Basin Watermaster
WEWAC	Water Education Water Awareness Committee
WFA	Water Facilities Authority
WRP	Water Recycling Plant
WSDM	Water Surplus and Drought Management

Executive Summary

The Chino Desalter Authority (CDA) draft Urban Water Management Plan (UWMP) was prepared by the staff of the Inland Empire Utilities Agency in cooperation with the staffs of member agencies of the CDA. This is the first UWMP for the CDA since it was formed on September 25, 2001. CDA is a Joint Exercise of Powers Agreement (or commonly called a JPA) between the Jurupa Community Services District, the Santa Ana River Water Company, the Cities of Chino, Chino Hills, Norco and Ontario and the Inland Empire Utilities Agency (IEUA). The CDA purifies brackish groundwater extracted from the lower Chino Basin with the Chino 1 and 2 Desalter facilities and distributes the drinking water to member agencies. The Chino 1 Desalter commenced operation in 2001 and was expanded in 2005. The Chino 2 Desalter is under construction and will be operational in December 2005.

Each of the six retail members of the CDA has contractual commitments to purchase water produced by the CDA. These commitments total 24,600 acre-feet per year (AFY). Voting rights of each agency are proportional to their commitment to purchase potable water recovered from groundwater by the CDA facilities.

The population in the member agency service areas totals about 420,000 and the population of this area is expected to grow to over 600,000 people in the next twenty years. The climate of the service area is classified as semi-arid desert.

In June 2000, the Optimum Basin Management Program (OBMP) was adopted by the Chino Basin Watermaster (CBWM) and approved by the Superior Court to address water quality problems within the groundwater basin and to increase and improve the water supply available from this source. The OBMP identifies groundwater recovery in the southern portion of the basin, as a way to improve basin water supplies.

Groundwater in the southern portion of the Chino Basin is high in salts and nitrates. The “Maximum Benefit” Basin Plan for managing the Chino Groundwater Basin (Basin) was approved by the SARWQCB in February, 2004 as part of the Santa Ana River Basin Plan update. It provided that “hydraulic control” and groundwater quality improvement projects could be implemented to prevent degradation of downstream Santa Ana River flows into Orange County. The lower Chino Basin area was identified with the intent to control and manage outflow of groundwater high in salts and nitrates from the Chino Basin into the Santa Ana River.

The CDA owns and operates two groundwater treatment desalination systems known as Chino 1 and 2 Desalters. Both of these facilities include groundwater extraction wells, pumps and pipelines that provide water to advanced treatment

facilities that include processes for pretreatment, filtration, air stripping of volatile organic compounds, ion exchange for removal of nitrates, and reverse osmosis for removal of salts. This treated water is then blended and disinfected to produce high quality drinking water that is delivered to its member agencies by a system of pipelines, pumps and reservoirs.

Concentrated brine from the reverse osmosis process is discharged to the Santa Ana River Interceptor (SARI) line as non-reclaimable water (NRW) and is conveyed to the Orange County Sanitation District (OCSD) for treatment and ultimate disposal in the Pacific Ocean. Brine disposal will export over 20,000 tons per year of salt out of the Chino Basin.

The main benefits of the CDA are:

1. A reliable, local source of drinking water is produced by desalination;

2. Improved water supply reliability through enhanced local supplies and less dependency on MWD imported supplies;

3. Salt and nitrates are removed from the groundwater basin to clean up the Chino Basin; and,

4. Hydraulic control of groundwater is enhanced by the location of groundwater extraction wells. This helps prevent groundwater that is high in salinity and nitrates from “spilling over” the Chino Basin southern barrier into the Santa Ana River.

The CDA through the interconnected pipeline delivery system with the retail water agencies has the capability of transferring “surplus” water produced by the Desalters and to assist member agencies with emergency outages of other supplies. In cases of emergency and water shortages, the Chino Desalters will serve as a stable and reliable potable water source in the Basin.

The retail members of the CDA have other sources of water (groundwater, surface water and imported water) in addition to the recovered groundwater produced by the CDA. The cities of Chino, Chino Hills, and Ontario are located in San Bernardino County and are entirely within the boundaries of the IEUA. The Jurupa Community Services District (JCSD), the Santa Ana River Water Company (SARWC), and the City of Norco are within the Western Municipal Water District (WMWD), located in Riverside County. Both IEUA and WMWD are members of the Metropolitan Water District of Southern California (MWD) with responsibility to provide wholesale imported water to the retail agencies within their respective service areas.

CHAPTER 1
INTRODUCTION

The Chino Basin Desalter Authority Urban Water Management Plan 2005 (CDA UWMP) was prepared by Inland Empire Utilities Agency (IEUA) (an ex-officio member of the CDA) as a *companion document* to the IEUA UWMP (2005). This is the initial CDA UWMP, 2005.

1.1 CHINO BASIN DESALTER AUTHORITY

The "Chino Basin Desalter Authority" (CDA) was formed under a Joint Exercise of Powers Agreement (JPA) on September 25, 2001 (See Appendix A). The Jurupa Community Services District (JCSD), the Santa Ana River Water Company (SARWC), the Cities of Chino, Chino Hills, Norco and Ontario and the Inland Empire Utilities Agency (IEUA) are members of the CDA. The CDA purifies brackish groundwater extracted from the lower Chino Basin with the Chino 1 and 2 Desalter facilities and distributes the drinking water to member agencies.

A six-member Board of Directors governs the CDA; each director is designated and appointed by the governing body of the entity that he or she represents. IEUA's representative serves as an ex-officio member. Characteristics of each of the CDA member agencies are summarized in Table 1-1.

Table 1-1 CDA Member Agency Characteristics

CDA Members in San Bernardino County and Inland Empire Utilities Agency Service Area	
City of Chino	The City of Chino serves water to approximately 73,000 residents of the City and some unincorporated areas in San Bernardino County.
City of Chino Hills	The City of Chino Hills provides water to approximately 79,000 residents of the City.
City of Ontario	The City of Ontario supplies water to approximately 169,000 residents of the City and some unincorporated areas of San Bernardino County. The City of Ontario also serves a small portion of the City of Rancho Cucamonga.
Inland Empire Utilities Agency	The IEUA serves as an ad-hoc member of the CDA Board; and provides assistance with financial commitments, seeking grant funds, loans, etc. The Agency also assists with design, bidding and construction.
CDA Members in Riverside County and Western Municipal Water District Service Area	
City of Norco	The City of Norco supplies water to approximately 25,500 residents of the City. The areas that receive water from CDA are within the Jurupa Community Service Water District, usually the northern portion of the District.
Santa Ana River Water Company	The Santa Ana River Water Company provides water to a population of 7,920 in northwestern Riverside County. The SARWC will receive water from CDA Desalters 1 and 2.
Jurupa Community Services District	The Jurupa Community Services District provides water to a population of 55,000 residents in its service area, plus portions of the City of Norco.

The cities of Chino, Chino Hills, and Ontario are located in San Bernardino County and are entirely within the boundaries of the IEUA. The Jurupa Community Services District (JCSD), the Santa Ana River Mutual Water Company (SARWC), and the City of Norco are within the Western Municipal Water District (WMWD), located in Riverside County. Both IEUA and WMWD are members of the Metropolitan Water District of Southern California (MWD) with responsibility to provide wholesale imported water to the retail agencies within their respective service areas. The IEUA and WMWD boundaries are shown in Figure 1-1. Figure 1-2 shows general locations of CDA entities.

A six-member Board of Directors governs the CDA. The Board selects from the membership of the Board, a Chairperson and Vice-Chairperson. The Board also appoints a Secretary who may be a Director. The Treasurer is the Executive Manager of Finance and Administration of IEUA, who serves in the combined office of Treasurer and Auditor.

As provided in the Joint Powers of Agreement, each member of the Board is entitled to vote. A voting Member's vote is weighted according to the relative proportion of each Member's existing firm commitment to purchase water proportional to the total quantity of water then available for purchase from the CDA by all of its Members. The weighting of votes as initially established is shown in Table 1-2.

Table 1-2 Weighted Voting % by Commitment to Purchase Water

Joint Exercise of Powers Agreement (Sept. 25, 2001)

Member Agency of CDA	Weight Vote	Commitment to Purchase AFY
Jurupa Community Services District	33.33%	8,200
City of Chino	20.33%	5,000
City of Ontario	20.33%	5,000
City of Chino Hills	17.07%	4,200
Santa Ana River Water Company	4.88%	1,200
City of Norco	4.07%	1,000
TOTAL	**100%**	**24,600**

Bonds were issued by the CDA pursuant to an Indenture of Trust, dated as June 1, 2004, by and between the Authority and U.S. Bank National Association, as Trustee, and will be payable from the sources described in the bond documents. The issuance of Bonds totaled $110,500,000, due June 1, 2035.[1] The bonds were issued to refinance the 2002 Chino I Desalter Project by (i) refunding the

[1] Chino Basin Desalter Authority Adjustable Rate Desalter Revenue Refunding Bonds Series 2004A-1and Series 2004A-2, June 2004.

Figure 1-1 IEUA and WMWD Boundaries Relative to the Chino Basin

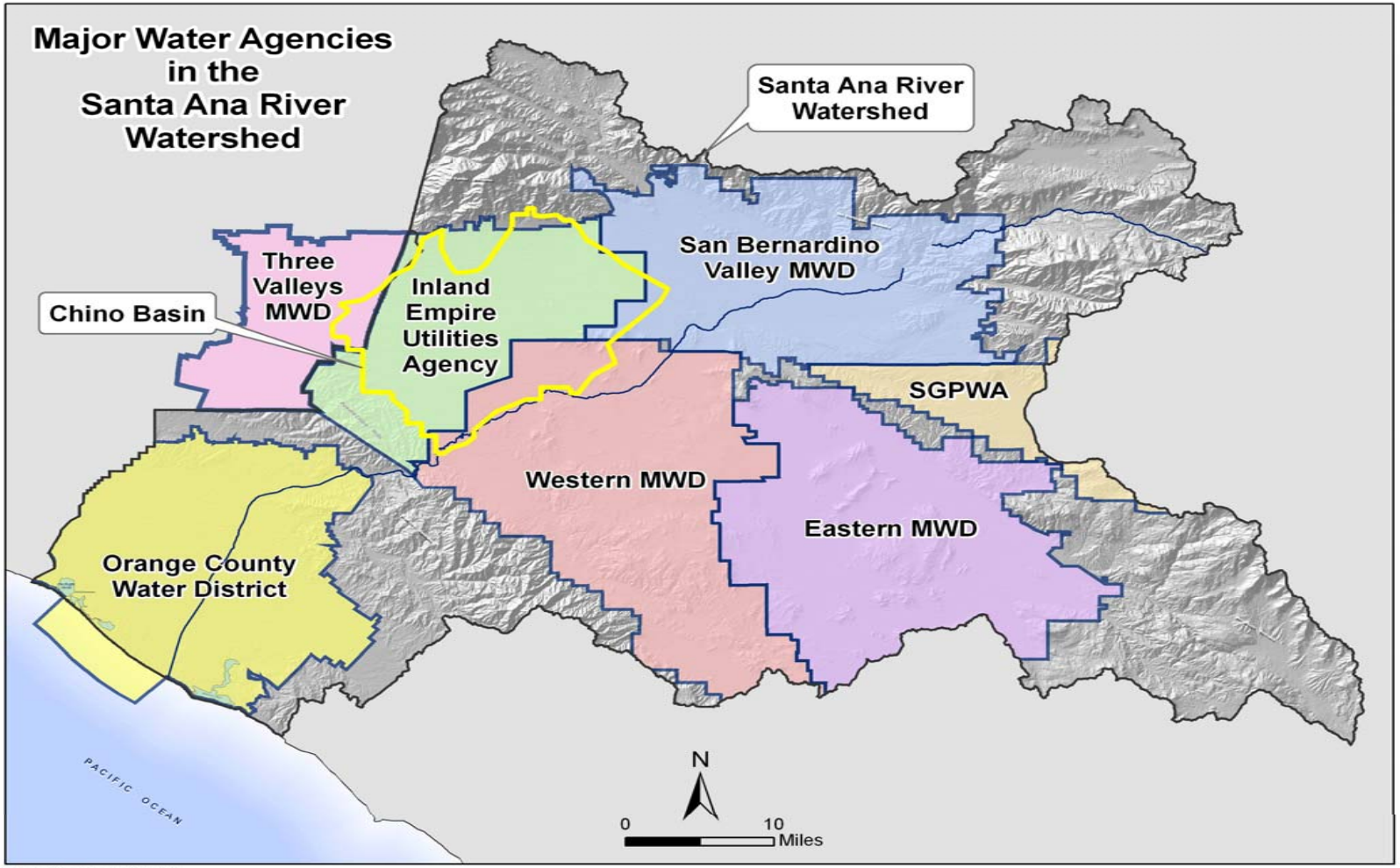

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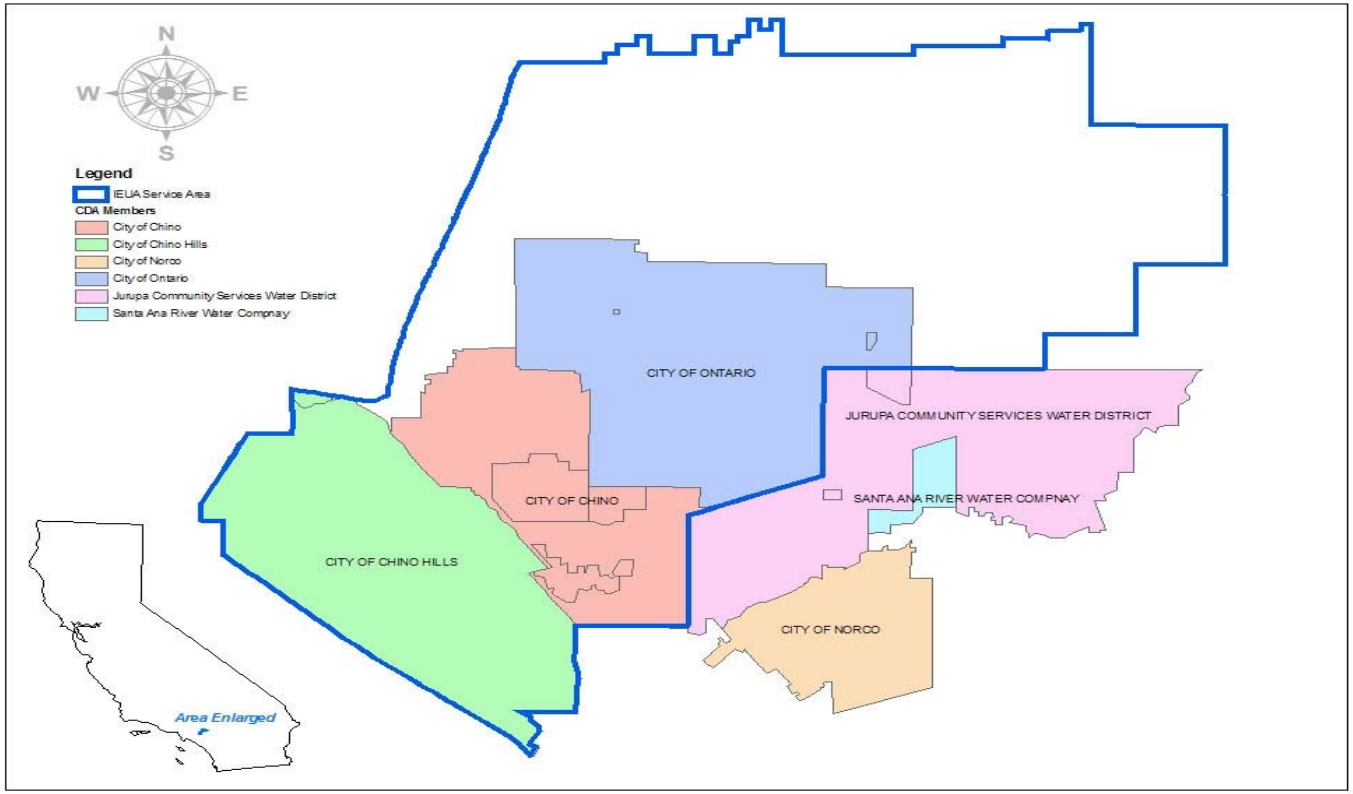
Figure 1-2 Service Areas of CDA Entities



$100,000,000 outstanding principal amount of the Chino Basin Desalter Authority Variable Rate Demand Desalter Revenue Bonds, Series 2002A, (ii) to provide additional financing for the 2002 Project, (iii) to acquire a debt service reserve fund surety bond, and (iv) to pay the cost of issuance for the Bonds.

1.2 URBAN WATER MANAGEMENT PLANNING ACT

The CDA UWMP 2005 (Plan) is consistent with the State of California Water Code Sections 10610 through 10656, known as the Urban Water Management Planning Act (Act). Originally enacted in 1983, the Act requires that every urban water supplier (providing water for municipal purposes to more than 3,000 customers or supplying more than 3,000 acre-feet of water annually) prepare and adopt an urban water management plan. The Act requires urban water suppliers to prepare plans that describe and evaluate reasonable and practical efficient water uses, recycling and conservation activities. These plans must be filed with the California Department of Water Resources every five years.

Since 1983, many amendments have been added to the Act (the most recent occurring in 2004). These amendments require additional actions addressing urban water management plan preparation and consideration for such issues as: metering, drought contingency planning, and water recycling. A copy of the Urban Water Management Plan Act is included in Appendix A of the IEUA UWMP, June 2005.

1.3 DWR GUIDANCE

The Department of Water Resources (DWR) has provided detailed background information to guide water districts in developing the 2005 Urban Water Management Plans. Appendix G of the IEUA UWMP 2005 has a copy of DWR's check list for preparing an UWMP in compliance with the water code. Additional information can be found on DWR's web page (*wwwd.water.ca.gov*). IEUA staff has followed the DWR guidelines and checklist in the development of both the CDA and IEUA Urban Water Management Plans. In addition, IEUA has contacted DWR[2] directly to solicit guidance on this CDA UWMP.

1.4 REGIONAL WATER AGENCY COORDINATION

The six CDA voting agencies are involved in water management within the lower Chino Basin. These include JCSD, SARWC, and the cities of Chino, Chino Hills, Norco and Ontario. Each of these agencies is preparing their own UWMP that describes the water supplies and urban development within both residential housing, industrial, and commercial expansion that is occurring within their respective service areas. The Chino Basin Optimum Basin Management Plan

[2]Telephone conversation with David Inouye of DWR

(OBMP), dated August 19, 1999, guides the development of water resources in the area. Other key agencies involved in the CDA water supply project include: the Inland Empire Utilities Agency (IEUA), the Western Municipal Water District (WMWD), the California Regional Water Quality Control Board (RWQCB), the Chino Basin Watermaster (CBWM), the Santa Ana Watershed Project Authority (SAWPA), and the Metropolitan Water District of Southern California (MWD). Each of these agencies is discussed in detail in the IEUA UWMP.

1.5 CITY AND COUNTY NOTIFICATION OF CHANGES TO THE UWMP

As required by amendments to the Urban Water Management Planning Act, water suppliers are required to send notifications to all cities and counties in the supplier's service area that an Urban Water Management Plan is being prepared or updated, and that they are invited to provide comments during the preparation of the document or the updating process. The notice of preparation was mailed to XX agencies in San Bernardino and Riverside Counties on _____XXXXXXX, 2005. A copy of the notification is included in the CDA UWMP 2005, Appendix B. On September 27, 2005, IEUA distributed to members of the CDA and WMWD a CD containing the draft CDA UWMP for review and comment.

1.6 CDA COORDINATION WITH LOCAL AGENCIES

The CDA (assisted by IEUA as an ex-officio member) is required to coordinate UWMP preparation with local and regional agencies by soliciting their input during the planning process for each UWMP. Table 1-3 provides a list of local and regional agencies and their level of involvement in preparation of this CDA UWMP 2005.

1.7 STRATEGIC OBJECTIVE FOR GROUNDWATER MANAGEMENT

The principal drainage for the Chino Groundwater Basin is the Santa Ana River. It flows sixty-nine miles across the Santa Ana Watershed from its origin in the San Bernardino Mountains to the Pacific Ocean. The Santa Ana River enters the Basin at the Riverside Narrows and flows along the southern Chino Basin boundary to the Prado Flood Control Reservoir where it is eventually discharged through the outlet or spillway of the Prado Dam and ultimately to the Pacific Ocean. Several intermittent streams in the Chino Basin drain to the River. Year-round flow occurs along the entire reach of the Santa Ana River due to surface inflows at Riverside Narrows, discharges from municipal water recycling plants to the Santa Ana River, and rising groundwater.

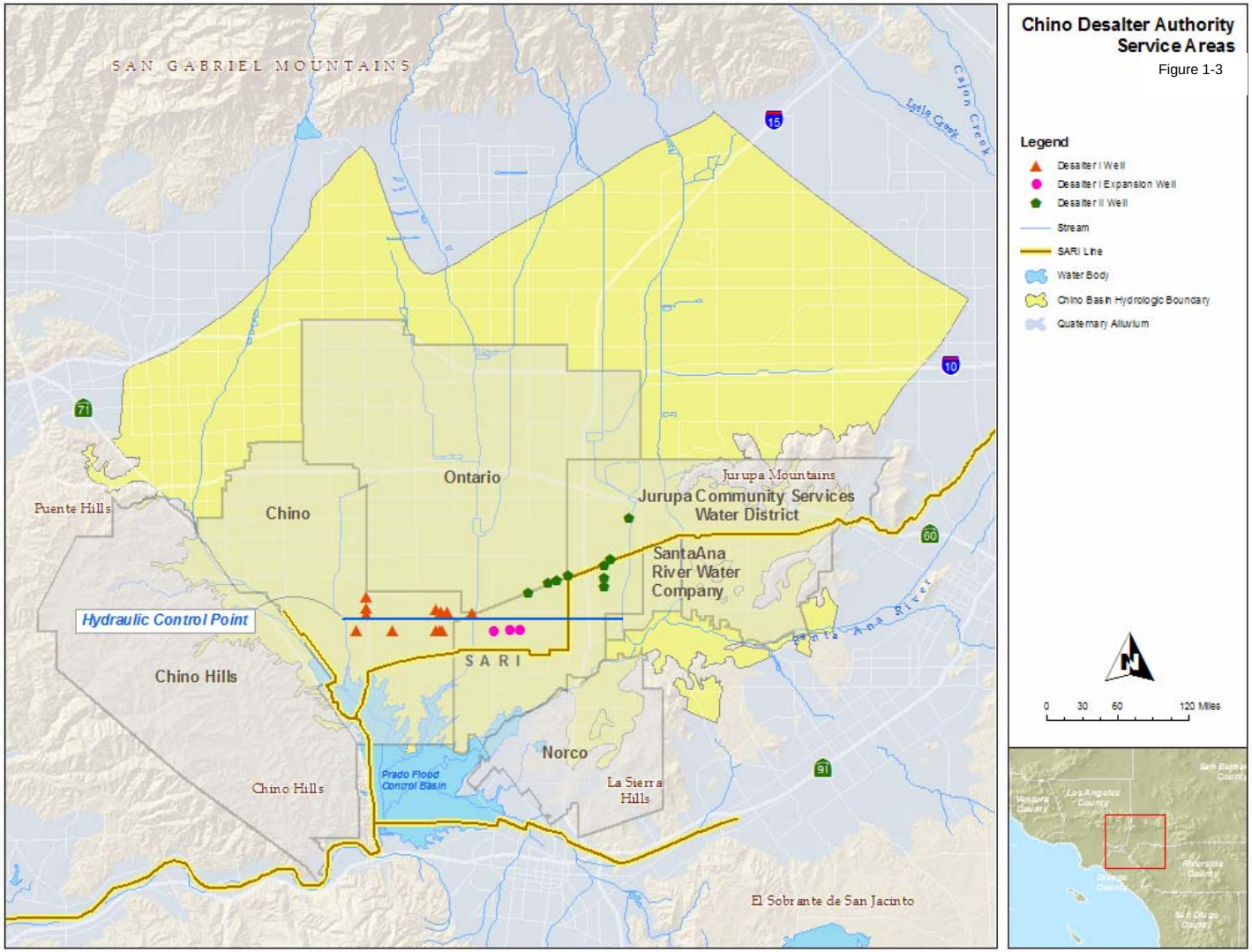
Table 1-3 Agencies Involved in CDA UWMP 2005 Preparation

	Participated in CDA UWMP Development	Commented on CDA UWMP Draft	Attended Public Meetings	Sent Notice of Preparation	Received Copy of Draft CDA UWMP	Sent Notice of Intention to Adopt
MWDSC						
Inland Empire Utilities Agency	X	X			X	
City of Chino	X				X	
City of Chino Hills	X	X			X	
City of Fontana						
City of Montclair						
City of Ontario	X				X	
City of Upland						
City of Rancho Cucamonga						
City of Norco	X				X	
Jurupa Community Services District	X				X	
Cucamonga Valley Water District						
Monte Vista Water District						
Fontana Water Company						
San Antonio Water Company						
Santa Ana River Water Company	X				X	
Western Municipal Water District	X				X	
Santa Ana Watershed Project Authority						
Santa Ana Regional Water Quality Board						
County of San Bernardino						
County of Riverside						
City of Corona						

Groundwater in the southern portion of the Chino Basin is high in salts and nitrates. The "Maximum Benefit" concept for managing the Chino Groundwater Basin (Basin) was approved by the SARWQCB in the 2004 Santa Ana River Basin Plan update. It provided that "hydraulic control" and groundwater quality improvement projects could be implemented to prevent degradation of adjacent downstream water supplies, and in particular, the Santa Ana River. The lower Basin area was identified with the intent to control and manage outflow of

groundwater high in salts and nitrates from the Basin into the Santa Ana River. The Chino Basin Desalter Authority (CDA), and its service area, was established to reclaim the lower Chino Basin groundwater as a potable water resource. It is estimated that as much as 50,000 AFY of groundwater will need to be extracted from the lower Basin to maintain "hydraulic control." This would be done through a series of well fields along an east-west line at the south end of the Basin. If the contaminated water is treated for potable use through desalination, not only will the extracted water provide a reliable water supply, but it will also reverse degradation of water quality and provide hydraulic control in the south end of the Chino Basin.

Figure 1-3 illustrates the relative location of the six water purveyors in the southern part of the Basin, the location of the east-west hydraulic control line, groundwater extraction wells, and the Santa Ana Watershed Project Authority's (SAWPA) Santa Ana Regional Interceptor (SARI) brine disposal system.


SAN GABRIEL MOUNTAINS
Cajon Creek
Lytle Creek
15
10
71
60
91
Ontario
Chino
Puente Hills
Jurupa Mountains
Jurupa Community Services Water District
SantaAna River Water Company
Santa Ana River
Hydraulic Control Point
SARI
Chino Hills
Norco
Prado Flood Control Basin
La Sierra Hills
Chino Hills
El Sobrante de San Jacinto
Chino Desalter Authority Service Areas
Figure 1-3
Legend
Desalter I Well
Desalter I Expansion Well
Desalter II Well
Stream
SARI Line
Water Body
Chino Basin Hydrologic Boundary
Quaternary Alluvium
N
0 30 60 120 Miles
San Bernardino County
Ventura County
Los Angeles County
Riverside County
Orange County
San Diego County

CHAPTER 2
POPULATION AND WATER USE

The Chino 1 and 2 Desalters are owned by the CDA and serve the dual purpose of providing a reliable water supply and managing groundwater quantity and quality in the region. To make the desalter projects financially viable, each of the CDA member agencies agrees to purchase a minimum amount of the Desalters' production. Purchase commitments through 2006 are presented in Table 1-2. Rather than being demand driven, these minimum purchase commitments form a fixed portion of the water supply portfolios of each of the retail CDA water agencies.

The service areas and the characteristics of each of the CDA retail water agencies are described in detail in each agency's own UWMP. The present population of each agency is tabulated below in Table 2-1. It is important to note however, that these populations are not entirely served by the CDA supply. Rather, only a portion of each agency's population is actually served by the CDA Desalters and there has been no attempt to quantify what proportion of the population currently receives the service. Accordingly, the function of the CDA, and the construction and operation of the existing and future Chino Basin Desalters is not necessarily a condition of population and water demand; but is more a function of water quality management and hydraulic control to prevent low quality groundwater from migrating out of the Chino Basin and surfacing in the Santa Ana River.

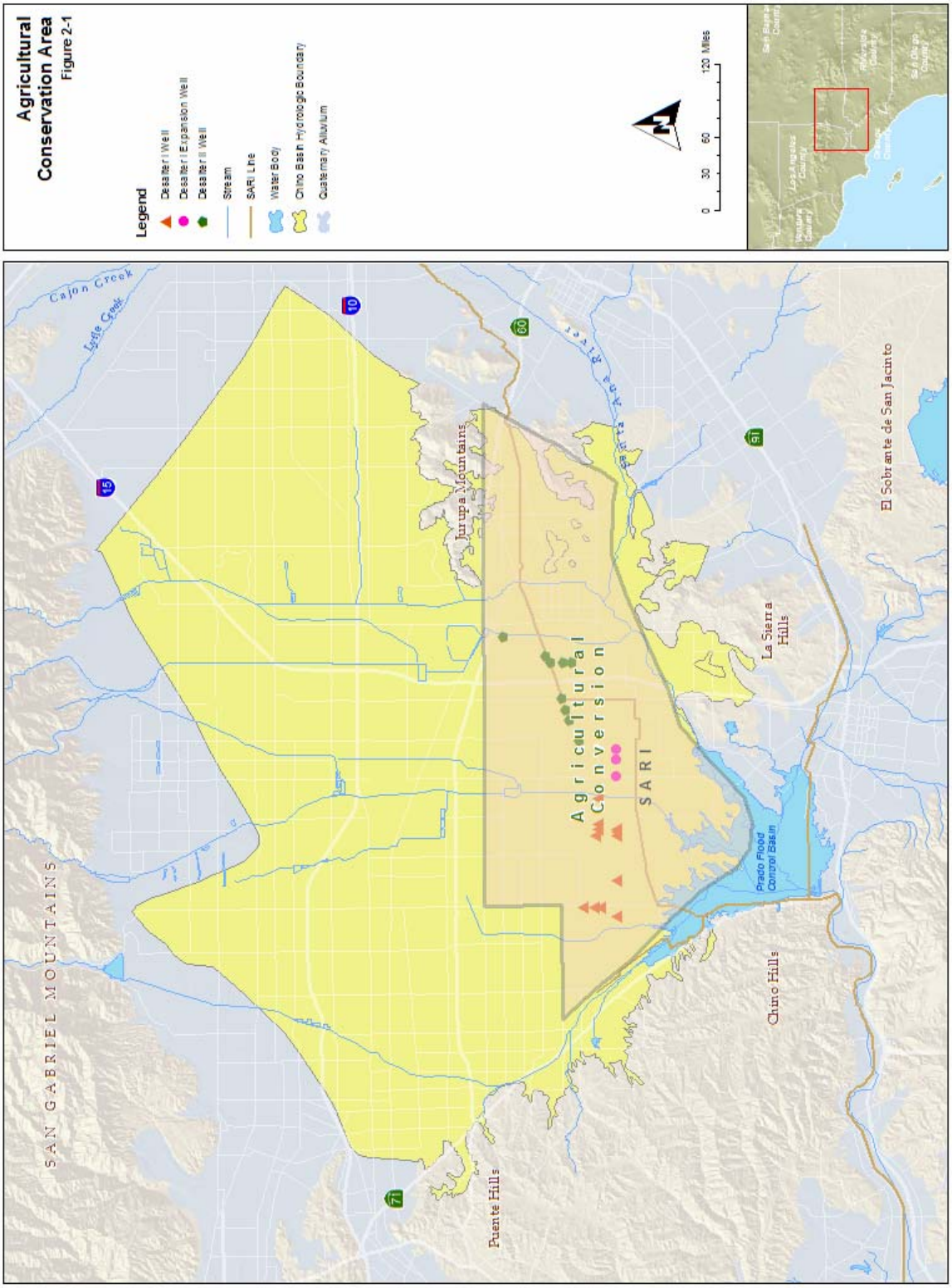
Table 2-1 Population 2005 CDA Member Agency Service Area

Member Agency		Population in 2005
City of Chino		73,000
City of Chino Hills		79,000
City of Ontario		169,000
City of Norco		25,500
Santa Ana River Water Company		7,920
Jurupa Community Services District		65,000
Total CDA Population		**419,420**

CDA member agencies service areas are experiencing rapid urban growth. Much of the historic agricultural and dairy land use is undergoing conversion to urban land uses, Figure 2-1 shows the area of expected conversion of agricultural land (in the former San Bernardino Agricultural Preserve and agricultural land in Riverside County) to urban use. This area is projected to add in excess of 200,000 people and increase water demand by 60,000 AFY.[1] A large portion of this demand will be satisfied from desalter production and

[1] Estimated value based on 270 gpd per person.

recycled water. Recycled water is not a service provided by the CDA, but is discussed in detail in the member agency's UWMP including the IEUA and WMWD UWMPs.


Agricultural Conservation Area
Figure 2-1
Legend
Desalter I Well
Desalter I Expansion Well
Desalter II Well
Stream
SARI Line
Water Body
Chino Basin Hydrologic Boundary
Quaternary Alluvium
0 30 60 120 Miles
SAN GABRIEL MOUNTAINS
Cajon Creek
Lytle Creek
Jurupa Mountains
Santa Ana River
Agricultural Conversion
SARI
La Sierra Hills
El Sobrante de San Jacinto
Prado Flood Control Basin
Chino Hills
Puente Hills
15
10
60
91
71

CHAPTER 3
WATER SUPPLIES

Both local and imported water supplies are used by the CDA retail water agencies. Local sources include groundwater, surface water, recycled water and recovered groundwater treated by the CDA Desalters. Imported State Water Project (SWP) water is available to these areas through wholesale distribution to local retail agencies within IEUA's and WMWD's service area. The source of MWD's imported water used in the Chino Basin is the State Water Project. This source is used because of the Regional Board's water quality restrictions that prohibit the use of Colorado River water is prohibited from use in the Chino Basin.

3.1 CHINO GROUNDWATER BASIN

The Chino 1 and 2 Desalters exclusively use groundwater from the southern portion of the Chino Basin. The Chino Basin is the largest groundwater basin in the Upper Santa Ana Watershed. It currently contains approximately 5,000,000 AF of water in storage, with an additional unused storage capacity (based upon historic water levels in the basin) of approximately 1,000,000 AF. About 140,000 acre-feet per year (AFY) is pumped for municipal and industrial purposes. In addition, 300 to 400 agricultural users pump about 40,000 AFY from the Chino Basin. Accordingly, total groundwater production from the Chino Basin is currently 180,000 AFY.

In June 2000, the Optimum Basin Management Program (OBMP) was adopted by the Chino Basin Watermaster (CBWM) and approved by the member agencies to address water quality problems within the Basin and to increase and improve the water supply available from this source. A more thorough discussion of management of the Chino Basin is contained in Chapter 6 and in the Chino Basin OBMP[1]. The OBMP identifies groundwater recovery in the southern portion of the basin, as a way to improve basin water supplies.

3.2 AVAILABLE GROUNDWATER SUPPLY

Water rights within the Chino Basin have been adjudicated (1978 Judgment).[2] The *safe-yield* of the Basin is approximately 145,000 AFY. The safe yield is allocated among three pools as follows: (1) Overlying Agricultural Pool: 82,800 AFY; (2) Overlying Non-Agricultural Pool: 7,366 AFY; and (3) Appropriative Pool: 49,834 AFY.

Production in excess of the safe yield from the groundwater basin must be replaced with replenishment water. In addition to local sources of recycled water and storm water, imported water is purchased from IEUA by the Chino Basin Watermaster (CBWM) to replenish the Chino Groundwater Basin. It is projected that ultimately half of the production water from the Chino Desalters extracted by

[1] Chino Basin Optimum Basin Management Program, August 19, 1999
[2] Judgment – Case No. 164327, January 30, 1978, Chino Basin Municipal Water District vs. City of Chino, et.al.

the Desalter wells will come from new induced recharge from the Santa Ana River to the Basin. The induced recharge to the Chino Basin from the Santa Ana River will be the result of the hydraulic control program.[3]

3.3 GROUNDWATER QUALITY IN THE LOWER CHINO BASIN[4]

Groundwater in the lower Chino Basin historically has exceeded State Title 22 mandated objectives for total dissolved solids (salinity or salt) and nitrogen (nitrate). The primary purpose of the CDA facilities is to recover this groundwater and treat it with advanced water treatment process to produce potable water.

Total Dissolved Solids (TDS)

In the California Code of Regulations, Title 22, TDS is regulated as a secondary contaminant. The recommended drinking water maximum contaminant level (MCL) for TDS is 500 mg/L; however, the upper limit is 1,000 mg/L. TDS concentrations in the lower Chino Basin generally exceed 500 mg/L as discussed in Chapter 9.

Nitrates

Nitrate is regulated in drinking water by Title 22 with a maximum contaminant level (MCL) of 10 mg/L (as nitrogen). By convention, all nitrate values are reported as nitrate-nitrogen (NO_3-N) in this document. Hence, the values of nitrate-nitrogen reported in this document should be compared with an MCL of 10 mg/L.

In the Chino Basin, areas south of the 60 Freeway have somewhat elevated nitrate concentrations. In particular, areas east of the Puente and Chino Hills, south of the Jurupa Hills, along the Santa Ana River, and downgradient from the former RP-1 discharge point have elevated nitrate concentrations. Nitrate concentrations in the southern part of the basin typically exceed the 10 mg/L MCL and frequently exceed 20 mg/L.

Volatile Organic Chemicals (VOCs)

Volatile organic chemicals (VOCs) are among other constituents of potential concern in the groundwater of the Chino Basin. The following five VOCs were detected at or above their MCL in more than 10 wells:

1.1-dichloroethene;
1,2,3-trichloropropane;
Cis-1,2-dichloroethene;
Tetrachloroethene (PCE); and
Trichloroethene (TCE)

Tetrachloroethene (PCE) and Trichloroethene (TCE)

PCE and TCE were/are widely used industrial solvents; PCE is commonly used in the dry-cleaning industry. TCE is commonly used for degreasing metals. Both

[3] Chino Basin Optimum Basin Management Program, State of the Basin Report 2004 (July 2005)
[4] Chino Basin Optimum Basin Management Program, State of the Basin Report 2004 (July 2005)

chemicals are found in the Milliken Landfill, south and west of the Ontario Airport and along the margins of the City of Chino Hills. These chemicals have also been found in wells around the Stringfellow plume.

Dichloroethene, and cis-1,2-dichloroethene

Dichloroethene, and cis-1,2-dichloroethene are degradation by-products of PCE and TCE (Dragun, l988) formed by the reductive dehalogenation. In the majority of wells of the Chino Basin, Dichloroethene, and cis-1,2-dichloroethene are not found. Dichloroethene is found in groundwater near the Milliken Landfill, south and west of the Ontario Airport, and at the head of the Stringfellow plume.

1,2,3-Trichloropropane

1,2,3-Trichloropropane (1,2,3,-TCP) is a colorless liquid that is used primarily as a chemical intermediate in the production of polysulfone liquid polymers and dichloropropene, synthesis of hexafluropropylene, and as a cross linking agent in the synthesis of polysulfides. 1,2,3-TCP is found in the Chino Airport VOC plume. In addition, there is a cluster of wells that have 1,2,3-TCP in concentrations greater that the DHS "Notification Level" north of the Chino Airport and a scattering of wells exceed the Notification Level on the western margins of the basin.

3.4 CHINO BASIN DESALTER AUTHORITY FACILITIES & OPERATION

The Chino Basin Desalter Project is a win/win/win situation by; 1) providing a new local source of potable water, 2) improving the quality of groundwater by removing salt and nitrate, and 3) reducing contamination of the Santa Ana River. The projected ultimate development of the Chino Basin Desalter Program will produce 52,000 AFY of potable water; and extract an estimated 54,000 tons of salt from the Chino Basin aquifers annually. It will also stop migration of groundwater out of Chino Basin into the Santa Ana River. As a result, the program will clean up the area's groundwater and protect surface water while helping to meet the increased potable water demands in the lower Chino Basin.[5]

Table 3-1 lists the respective phases of the Chino Basin Desalter Program and presents the planned production volume. The Chino 1 Desalter was originally built in 2000 and was recently expanded (2005). The Chino 2 Desalter is presently under construction with operation commencing in December 2005. The values shown in Table 3-1 represent nominal treatment system production values.

[5] Chino Basin Optimum Basin Management Program, State of the Basin Report 2004 (July 2005)

Table 3-1 Chino Basin Desalters Projected Production

Acre Feet per Year (AFY) of Product Water

Desalter	Year Constructed	2000	2005	2010	2015	2020	2025
Chino 1	2000	9,000	15,900	15,900	15,900	15,900	15,900
Chino 2	2005		11,200[1]	20,000	20,000	20,000	20,000
Chino 3	2010 – 2015		0	0	10,000	12,900	15,900
Total AFY		**9,000**	**27,100**	**35,900**	**45,900**	**48,800**	**51,800**

[1] Chino 2 Desalter begins operation in December 2005
CDA's application for a permit to increase pumping and treatment to 15 MGD (approximately 16,800 AFY) is pending.

Initial Implementation

SAWPA served as the initial contracting entity for the construction of the Chino 1 Desalter and drilled the initial eleven extraction wells. When the Chino Desalter Authority (CDA) was first organized, September 25, 2001, the CDA contracted with IEUA to take over the operation of the facility. IEUA currently operates the Chino 1 Desalter; while JCSD operates and maintains the groundwater extraction wells.

Chino 1 Desalter – Current Operations

The Chino 1 Desalter, located at 6905 Kimball Avenue in Chino, California, was the beginning component of the innovative Chino Basin Desalination Program. When the Chino 1 Desalter was commissioned and began operations in the summer of 2000, it had a capacity of 9,000 AFY. The initial 11 extraction wells delivered brackish water to the Chino 1 Desalter. The reverse osmosis (RO) system treats 76% of the well production, which is then blended with low TDS groundwater producing 9,000 AFY of potable water that is then delivered to the cities of Chino and Chino Hills and Jurupa Community Services District (JCSD). Concentrated brine from the RO process is discharged to the Santa Ana River Interceptor (SARI) line as non-reclaimable water (NRW) and is conveyed to the Orange County Sanitation District (OCSD) for treatment and ultimate disposal in the Pacific Ocean. Brine disposal exports approximately 10,000 tons per year of salt from the Chino Basin. The Chino 1 Desalter was expanded in capacity (Chino 1 Expansion), and came on line in August 2005.

The initial treatment processes employed at the Chino 1 Desalter were:

1. Pretreatment
2. Filtration
3. Reverse osmosis
4. Disinfection
5. Disposal of concentrated brine, and
6. Blending of product water, followed by
7. Distribution

Actual historical production of groundwater treated at the Chino 1 Desalter is tabulated in Table 3-2, between the years 2000 and 2005.

Table 3-2 Historic Production from Chino 1 Desalter, AFY

Agency	Contract Value AFY	2001[1]	2002	2003	2004	2005 YTD[2]
City of Chino	5,000	1,450	3,476	2,853	2,697	2,164
City of Chino Hills	4,200	746	2,318	1,855	1,353	1,116
City of Ontario	5,000	0	0	0	0	0
Subtotal IEUA	**14,200**	**2,196**	**5,794**	**4,708**	**4,050**	**3,280**
Jurupa CSD	8,200	1,292	4,422	3,833	4,515	3,007
SARWC	1,200	0	0	0	0	0
City of Norco	1,000	0	0	0	0	0
Subtotal WMWD	**10,400**	**1,292**	**4,422**	**3,833**	**4,515**	**3,007**
Totals AFY	**24,600**	**3,488**	**10,216**	**8,541**	**8,565**	**6,287**

1. Desalter production 7/1/01 through 12/31/01
2. Desalter production 1/1/05 through 9/20/05

Chino I Expansion

An increased demand in contracted water deliveries to the City of Chino Hills, the City of Chino, the City of Ontario and JCSD necessitated the expansion of the Chino I Desalter. It was determined an Ion Exchange Treatment System and Volatile Organics (VOCs) Stripping Towers should be added to increase the Chino I Desalter's product water flow from 9,000 AFY to 15,900 AFY.

As mentioned previously, the initial treatment process included blending of low TDS well water (bypass wells) with the RO treated well water that reduced the high nitrates (40 mg/L as N) and TDS (1,080 mg/L) to acceptable potable water levels. In April 2005, the facility added stripping towers to treat the water from the low TDS wells for removal of volatile organics (VOCs). The Ion Exchange System came online in July 2005 bringing the total facility capacity to 15,900 AFY.

Chino 1 Desalter Extraction Wells

Table 3-3 lists the original 11 wells that are operated to deliver water to the Chino 1 Desalter. Table 3-4 lists the three wells drilled for the Chino 1 Expansion; (also see Figure 3-1 for locations of the respective wells).

In addition to the extraction wells, there are monitoring wells, raw water pipelines, reservoirs, product water pipelines, pump stations, brine disposal lines and other offsite facilities that make up the Chino 1 and 2 Desalter systems.

Table 3-3 Chino 1 Desalter Extraction Wells (2001)

Well No.	Location of Well	Horsepower	Flow Capacity GPM	MGD	AFY
I-1	15000 Euclid Avenue, Chino CA	75	600	0.86	964
I-2	15200 Euclid Avenue, Chino CA	40	300	0.43	482
I-3	15300 Euclid Avenue, Chino CA	75	600	0.86	964
I-4	7600 Kimball Avenue, Chino CA	40	600	0.86	964
I-5	8500 Kimball Avenue, Chino CA	125	1,200	1.72	1,927
I-6	8600 Kimball Avenue, Chino CA	125	1,200	1.72	1,927
I-7	8650 Kimball Avenue, Chino CA	125	1,200	1.72	1,927
I-8	15250 Walker Avenue, Riverside Co.	100	900	1.29	1,446
I-9	8700 Remington Street, Riverside Co	100	1,200	1.72	1,927
I-10	8800 Remington Street, Riverside Co	100	1,200	1.72	1,927
I-11	9300 Remington Street, Riverside Co	125	1,200	1.72	1,927

Table 3-4 CDA Chino 1 Expansion Extraction Wells (2005)*

Well No.	Location of Well	Horsepower	Flow Capacity GPM	MGD	AFY
I-13	14156 Bay Circle, Riverside Co.	250	2,200	3.2	3,600
I-14	13844 Blue Ribbon Lane, Riverside Co.	250	2,000	2.9	3,250
I-15	6577 Cedar Creek Road	250	2,000	2.9	3,250

*Well No. 1-12 was drilled but never developed due to poor production characteristics.

Chino 2 Desalter

The Chino 2 Desalter was initiated by the CDA to provide 11,200 AFY of water deliveries to JCSD, the City of Ontario, the City of Norco and the Santa Ana River Water Company. The Chino 2 Desalter is located at the JCSD Headquarters at 11202 Harrel Street in Mira Loma, California. The Desalter is presently under construction. Commissioning of this facility is anticipated for late December 2005. Groundwater from the eight wells in the Mira Loma area will be treated using an RO system and an Ion Exchange treatment system. This Desalter will have a treatment capacity to produce 11,200 AFY of potable water. The water will be pumped to, and commingled in the Desalter distribution system for delivery to the municipal water supply systems of the CDA entities (Figure 3-2). An expansion to Chino 2 Desalter is likely to be completed by the year 2010. The expansion would increase the Chino 2 Desalter capacity to 20,000 AFY.

The eight Chino 2 Desalter wells are described in Table 3-5 and their locations are shown on Figure 3-1.

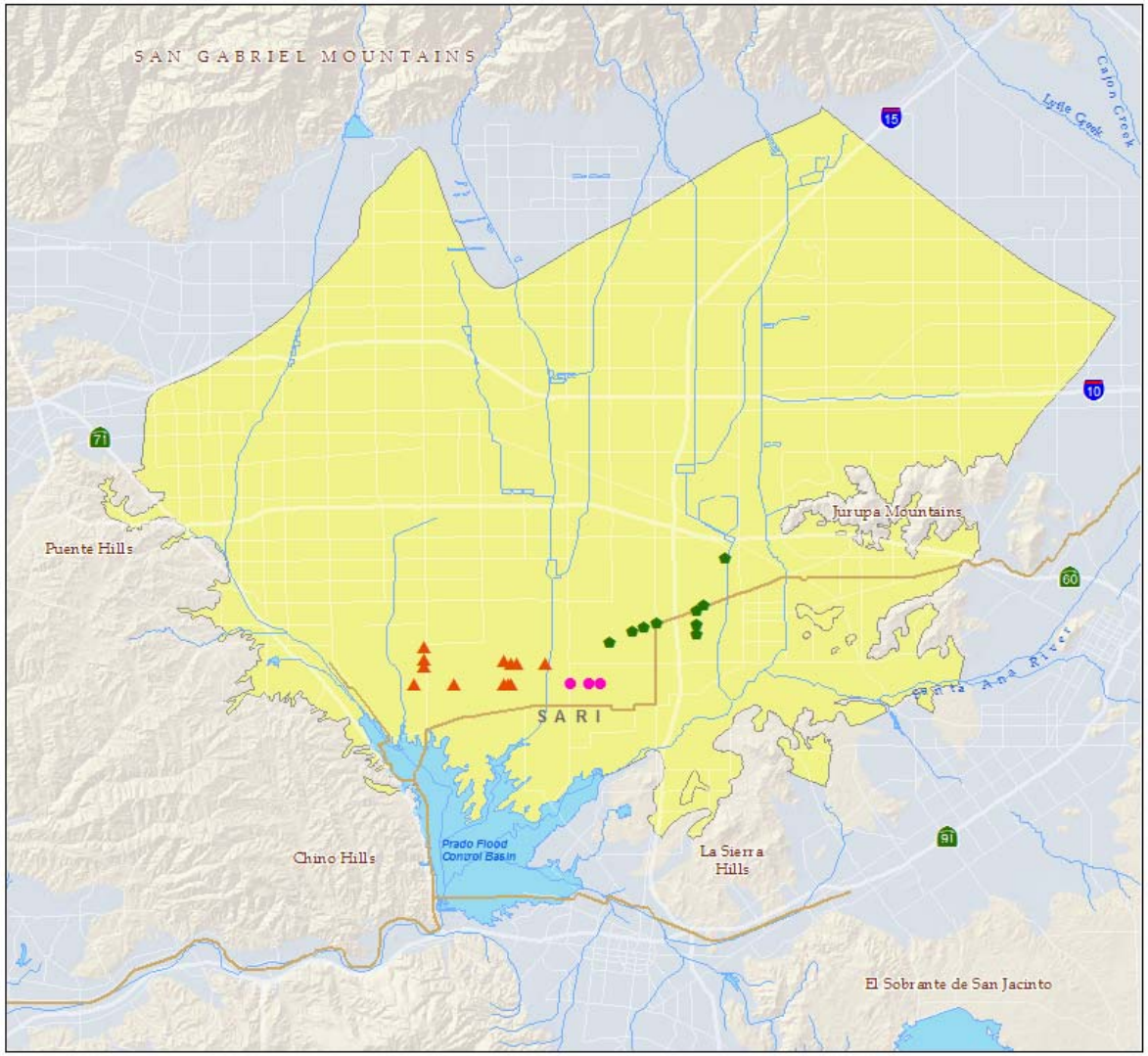
Table 3-5 Chino 2 Desalter Extraction Wells*

Well No.	Location of Well In Mira Loma, CA	Horsepower	Flow Capacity Design Rate GPM	MGD	AFY
II-1	5815 Summer Avenue	300	2,000	2.9	3,250
II-2	3955 Bellegrave Avenue	300	2,000	2.9	3,250
II-3	4155 Bellegrave Avenue	300	2,000	2.9	3,250
II-4	5240 Hamner Avenue	300	2,000	2.9	3,250
II-6	12080 Bellegrave Avenue	300	2,000	2.9	3,250
II-7	5339 Wineville Avenue	250	1,500	2.2	2,465
II-8	5559 Wineville Avenue	200	1,500	2.2	2,465
II-9a	11766 Bellegrave Avenue	300	2,000	2.9	3,250

* Well No. 1-5 and Well No. 1-9 were drilled but never developed due to poor production characteristics.

Pursuant to design and construction of the Chino I Expansion and Chino II Desalter Projects, Tom Dodson & Associates and RBF Consulting prepared the Chino I Expansion and Chino II Desalter Project Environmental Impact Report in November 2001.[6] The document was adopted in its final form with comments, January 25, 2002, by the CDA.

[6] Chino I Desalter Expansion and Chino II Desalter Project EIR, November 2001, TDA & RBF Consulting.



Existing CDA Extraction Wells

Figure 3-1

Legend

- Desalter I Well
- Desalter I Expansion Well
- Desalter II Well
- Stream
- SARI Line
- Water Body
- Chino Basin Hydrologic Boundary
- Quaternary Alluvium

N

0 30 60 120 Miles

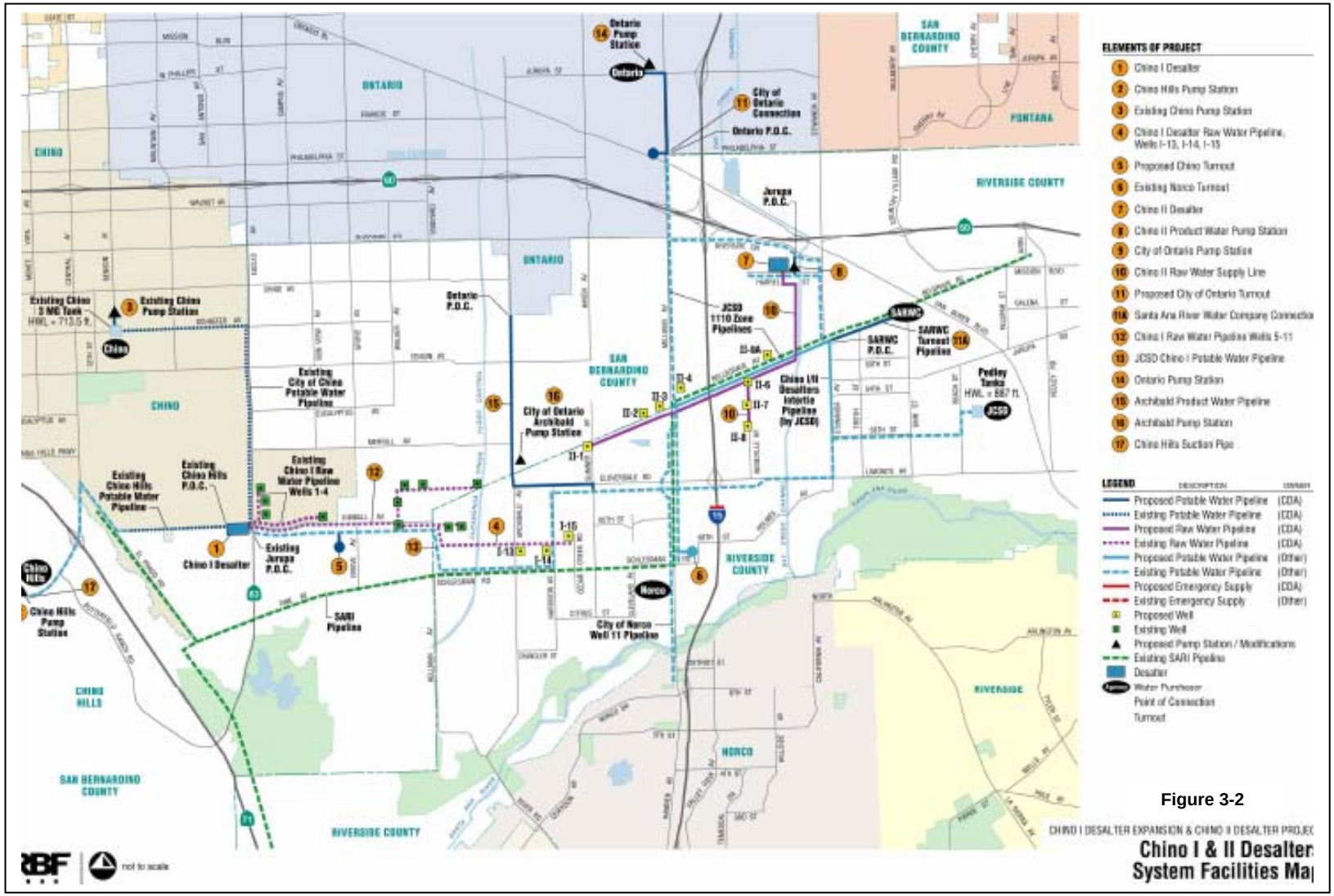


Figure 3-2

CHINO I DESALTER EXPANSION & CHINO II DESALTER PROJEC

Chino I & II Desalter System Facilities Ma

CHAPTER 4
WATER CONSERVATION PROGRAM

4.1 OVERVIEW

Conservation is an important component of water resource management for CDA retail water agencies. Although the CDA as an agency does not have a water conservation program, each of its retail member agencies does. In addition, both IEUA and WMWD have wholesale water conservation programs that supplement retail programs. Over the last five years, a variety of specific programs and educational approaches have been undertaken to encourage greater participation and awareness of the need for conservation and for retail water agencies to meet their water management goals. The various programs are summarized in this chapter.

For a variety of reasons, the Inland Empire region remains one of the top growth areas in the country. This growth in population and industry puts pressure on the local retail water agencies in the CDA service area to meet the anticipated water demand over the next 10 to 20 years. Implementing conservation programs now, helps reduce expected future increases in demand. Conservation programs are also cost-effective because, when viewed as a water supply option, it is one of the least expensive sources of new water.

The Inland Empire Utilities Agency (IEUA) and Western Municipal Water District (WMWD) are signatories to the Memorandum of Understanding (MOU) regarding Urban Water Conservation in California and are members of the California Urban Water Conservation Council (CUWCC). IEUA and WMWD have made the 14 Best Management Practices (BMP's) the cornerstone of their respective conservation programs and a key element in the overall water resource management strategy for the region.

Members of the CUWCC are required to provide BMP "Activity Reports" every two years. These reports provide specific details of IEUA and WMWD's efforts to implement each particular BMP. The BMPs are functionally equivalent to the Demand Management Measures (DMM) written in Water Code Section 10631 of the Urban Water Management Planning Act (Act). The Act requires an agency to describe each of the DMMs that have been implemented unless the agency is a signatory to the MOU. The Act allows an agency to provide the BMP Activity Report in-lieu of describing each of the DMMs. Therefore, IEUA and WMWD have both included their Fiscal Year (FY) 2001-02 and FY 2003-04 BMP Activity Reports in the appendix of their respective 2005 Urban Water Management Plans. For expanded conservation information for each CDA retail agency, please refer to each agency's 2005 UWMP.

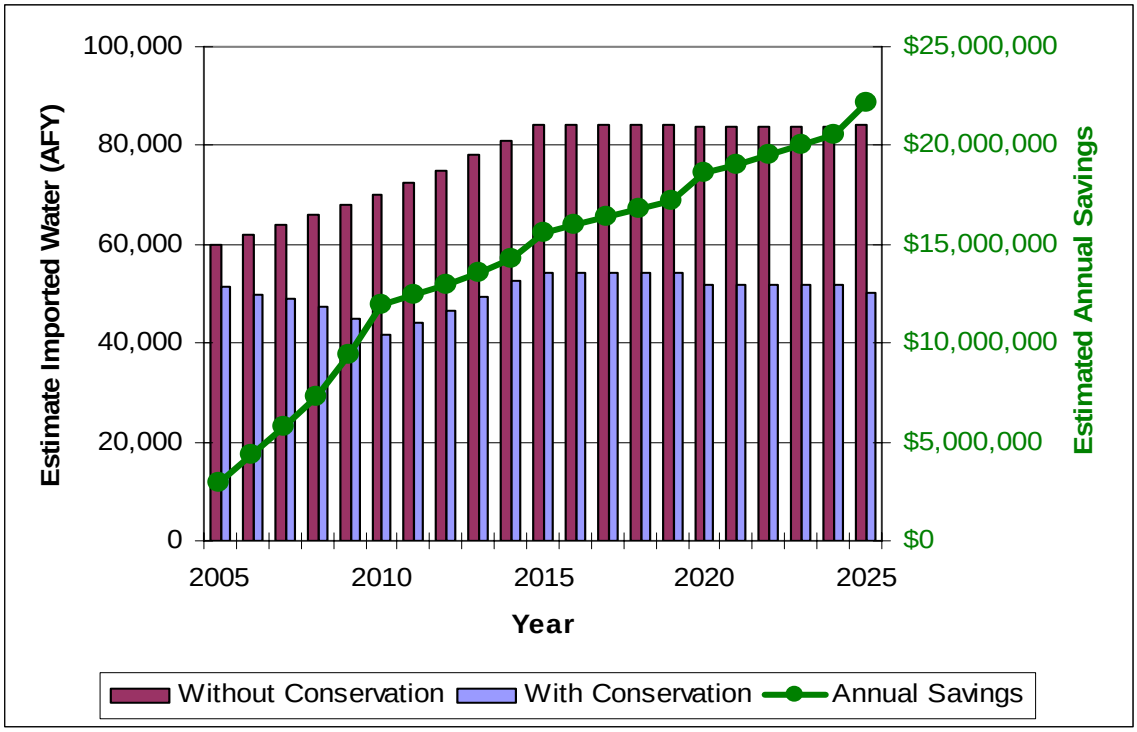
4.2 VALUE OF CONSERVATION

Over the last five years, IEUA, WMWD, and the CDA as part of the regional retail water agencies have developed a strong partnership and an aggressive approach to demand management measures that reduce water use at the source. Conservation has multiple benefits, one of which is the value of conservation to the region's ratepayers.

When the Metropolitan Water District of Southern California (MWD) changed their rate structure in 2003 for the purchase of imported water, they created a two-tier system. Each member agency can purchase imported water up to an amount equal to a base allocation which is Tier I. At that point, any additional purchases will fall into Tier II, which is about 25 percent higher than Tier I. The purpose is to create a financial incentive for member agencies to stay within their Tier I allocation.

Figure 4-1 quantifies the value of conservation to the IEUA region by comparing projected imported water purchases with and without conservation. Using conservation savings estimates for the next twenty years, the region can save over and estimated $250 million (future dollars) by reducing the amount of imported water purchased.

Figure 4-1
Estimated Reduction in Imported Water and Cost Savings with Conservation



Another benefit for maintaining a strong support for conservation is the reduced dependence on imported water from the California Bay-Delta (Bay-Delta). The Bay-Delta is the single most important link in California's water supply system. Two major water supply projects, the State Water Project (SWP) and the Central Valley Project convey Bay-Delta water to more than 22 million Californians and 7 million acres of farmland.

The IEUA and WMWD service areas receive a significant portion of their supply from the SWP via Metropolitan Water District. Local water supply projects such as conservation help limit the amount of water taken out of the Bay-Delta for water supply, thus enhancing the Bay-Delta water supply, water quality, environmental protection, and energy savings.

4.3 CONSERVATION OPPORTUNITIES

According to the Pacific Institute for Studies in Development, Environment and Security, the way we as Californians are using water is simply unsustainable, both environmentally and politically. In their study, "Waste Not, Want Not: The Potential for Urban Water Conservation in California," the Pacific Institute points out that there are a combination of factors that affect water policy in California. These factors include surface water allocations, controversies over the Colorado River, groundwater over-pumping and associated ecological damages, growing populations and the threat of climate change. For the IEUA and the WMWD service areas, the drivers for conservation are much the same.

The Inland Empire remains one of the fastest growing areas in the nation. In 2004, over 5,300 new single-family homes were constructed in the IEUA service area. This averages out to about 440 new homes per month. Other water districts in the Inland Empire are experiencing even higher growth rates. In the Western Municipal Water District service area, as many as 1,000 new homes per month are being constructed in some areas. This kind of growth results in substantial demand on the local retail agencies to provide a high-quality and reliable water supply.

In 2005, the Public Policy Institute of California (PPIC) released a report entitled "Water for Growth: California's New Frontier." The report concluded that per capita water use is greater in the inland areas of the state versus coastal areas, primarily due to land use patterns and climate. The PPIC report also concluded that conservation will become increasingly important, not only in existing homes but also in newly constructed homes, to guard against future increases in landscape irrigation demands.

This approach to conservation adds to the regional resource mix much the same as the CDA desalter projects. Both create a dependable, new water supply that is not limited by weather conditions.

4.4 CONSERVATION PROGRAMS TO DATE

Over the last five years, IEUA, WMWD, and the CDA member agencies have dramatically increased local conservation programs from a minimal ultra-low flush (ULF) toilet distribution program to a series of diverse residential, commercial, industrial, institutional (CII), and school education incentive programs. The cornerstone of IEUA's efforts over the last five years, for example has been the development of programs that meet the requirements of the Memorandum of Understanding (MOU) regarding Urban Water Conservation Best Management Practices (BMP).

Implementing the BMPs

One of IEUA and WMWD's highest conservation priorities is seeing that good-faith efforts are being made to implement the BMP's locally in the CDA's service area. The 14 BMP are listed below in Table 4-1.

Table 4-1

List of Best Management Practices

Water Retailer BMP	
BMP 1	Water Survey Programs For Single Family Residential and Multi-Family Residential Customers
BMP 2	Residential Plumbing Retrofit
BMP 3	System Water Audits
BMP 4	Metering with Commodity Rates For All New and Retrofit of Existing Connections
BMP 5	Large Landscape Conservation Programs
BMP 6	High Efficiency Clothes Washing Machine Financial Incentive Programs
BMP 7	Public Information Programs
BMP 8	School Education Programs
BMP 9	Conservation Program For Commercial, Industrial, and Institutional (CII) Accounts
BMP 11	Conservation Pricing
BMP 12	Conservation Coordinator
BMP 13	Water Waste Prohibition
BMP 14	Residential ULFT Replacement Programs
Water Wholesaler BMP	
BMP 3	System Water Audits
BMP 7	Public Information Programs
BMP 8	School Education Programs
BMP 10	Wholesale Agency Assistance Programs
BMP 11	Conservation Pricing
BMP 12	Conservation Coordinator

Inland Empire Utilities Agency

Below is a list of the three CDA service area retail water agencies that are within the IEUA service area and their conservation programs currently under way.

City of Chino

- Ultra-Low Flush (ULF) Toilet Exchange
- ULF Toilet Rebate
- High Efficiency Clothes Washer (HECW) Rebate
- National Theatre for Children
- Commercial/Industrial/Institutional (CII) Rebate (Save-A-Buck)
- Garden In Every School
- Landscape Water Audits
- Water Awareness Water Education Committee (WEWAC)
- (For more detailed information on these and other water conservation programs, please refer to the City of Chino's 2005 Urban Water Management Plan)

City of Chino Hills

- Edible Aquifer School Program
- Metropolitan Water District's (MWD) Solar Cup
- School Poster Contest
- WEWAC
- ULF Toilet Exchange
- ULF Toilet Rebate
- HECW Rebate
- National Theatre for Children
- CII Rebate (Save-A-Buck)

- Garden In Every School
- Landscape Water Audits
- (For more detailed information on these and other water conservation programs, please refer to the City of Chino Hills' 2005 Urban Water Management Plan)

City of Ontario

- WEWAC
- Ontario Cares
- ULF Toilet Exchange
- ULF Toilet Rebate
- HECW Rebate
- National Theatre for Children
- CII Rebate (Save-A-Buck)
- Garden In Every School
- Landscape Water Audits
- (For more detailed information on these and other water conservation programs, please refer to the City of Ontario's 2005 Urban Water Management Plan)

<u>Western Municipal Water District</u>

Below is a list of the three CDA service area retail water agencies that are within the WMWD service area and their conservation programs currently under way.

City of Norco

- HECW Rebate Program
- ULF Toilet Rebate Program
- Weather Based Irrigation Controller Program
- CII Rebate Program (Save-A-Buck)
- (For more detailed information on these and other water conservation programs, please refer to the City of Norco's 2005 Urban Water Management Plan)

Jurupa Community Services District

- HECW Rebate Program
- ULF Toilet Rebate Program
- Weather Based Irrigation Controller Program
- CII Rebate Program (Save-A-Buck)
- (For more detailed information on these and other water conservation programs, please refer to Jurupa Community Services District's 2005 Urban Water Management Plan)

Santa Ana River Water Company

- HECW Rebate Program
- ULF Toilet Rebate Program
- Weather Based Irrigation Controller Program
- CII Rebate Program (Save-A-Buck)
- (For more detailed information on these and other water conservation programs, please refer to the Santa Ana River Water Company's 2005 Urban Water Management Plan)

4.5 CONSERVATION PROGRAMS 2005-2025

As signatories to the MOU, IEUA and WMWD will continuously develop new conservation programs over the next twenty years to meet the requirements of each of the fourteen BMP's. Developing technology, opportunities, and funding will dictate the direction of these programs in both service areas. Additional information on water conservation is contained in the IEUA, WMWD and CDA retail agency UWMP's.

CHAPTER 5
RECYCLED WATER PROGRAM

5.1 OVERVIEW

IEUA, an ex-officio member of the CDA and the Regional agency responsible for wastewater treatment, has organized a program to encourage water reuse within its service area and the adjacent JCSD service area. The Cities of Corona and Norco are responsible for water recycling in their service areas. The establishment of new supplemental funding sources through federal, state and regional programs now provides significant financial incentives for local agencies of the CDA to use recycled water. While the CDA as an agency does not provide or distribute recycled water, recycled water is an important element of the water supply portfolios of the CDA retail agencies. The primary water supply for population growth associated with the conversion of agricultural land to urban uses in the southern part of the Chino Basin will come from either recycled water or reclaimed groundwater distributed by the CDA.

5.2 IEUA's REGIONAL RECYCLED WATER PROGRAM

IEUA is working closely with the CDA retail agencies to develop a regional recycled water distribution program that will maximize water reuse in the southern portion of the Chino Basin. IEUA has recently completed a Recycled Water Implementation Plan that coordinates the interface of retail recycled water distribution systems with implementation of IEUA's wholesale recycled water distribution network. Through this Implementation Plan (that is discussed in detail in Chapter 5 of IEUA's UWMP), recycled water will provide a substantial water supply to the southern Chino Basin. IEUA is also working with CDA retail agencies on future programs such as dual plumbing for residential use of recycled water for outdoor irrigation and other non-potable water uses.

5.3 RECHARGE OF RECYCLED WATER IN THE CHINO BASIN

With the signing and establishment of the Principles of Agreement – Recharge of Recycled Water in the Chino Basin Management Zone – 3 (MZ-3) on the 5th of June 2002, IEUA agreed to provide recycled water to the JCSD. The Agreement provided for the delivery of recycled water to JCSD at a 20% surcharge over the IEUA wholesale rate. Additionally, it was agreed that grant funds and local funds would be sought to design and construct the IEUA Regional Recycled Water Distribution System, and to develop a groundwater recharge system that could take advantage of local storm flow, recycled water and imported water for groundwater replenishment in MZ-3.

5.4 IEUA's HISTORICAL RECYCLED WATER DISTRIBUTION SYSTEM

Beginning in the early 1990's, IEUA initiated the construction of Phase I of the Carbon Canyon Recycled Water Project (CCRWP). This series of projects includes treatment facilities and distribution pipelines to serve recycled water customers in Chino and Chino Hills. In conjunction with the construction of Phase I of the CCRWP, IEUA began planning for an IEUA Regional Recycled Water Distribution System to provide recycled water throughout its service area. This planning effort culminated with the completion of the IEUA Regional Recycled Water Program Feasibility Study in January 2002. The Feasibility Study identified facilities to deliver over 70,000 acre-feet per year (AFY) of recycled water to customers and recharge sites throughout the IEUA service area.

The following are significant events leading up to the 2004 Implementation Plan:

- 1993 Recycled Water Master Plan
- 1995 Carbon Canyon Recycled Water System Plan
- 1998 Carbon Canyon Recycled Water System Initial Deliveries
- 2000 State of California Proposition 13 – Construction Grants
- 2001 Recycled Water Facilities Planning Study
- 2002 Regional Recycled Water Program Feasibility Study
- 2002 Recharge of RW – Chino Basin MZ-3 Agreement
- 2002 Programmatic EIR (certified by IEUA Board)
- 2003 SWRCB Grant ($5 million) Loan ($22 million) Approved
- 2003 Initiate Construction of Phase I Facilities
- 2005 Regional Recycled Water Program Implementation Plan

5.5 GRANT FOR GROUNDWATER REPLENISHMENT FACILITIES

In 2000, under the State of California Proposition 13, IEUA received a $19 million grant through SAWPA to expand the initial Chino Groundwater Basin groundwater recharge system. The construction grant project was named the Chino Basin Facilities Improvement Program (CBFIP) and provided for the redevelopment and new construction of groundwater recharge facilities. The grant funds were matched with local funds to complete the $38.7 million construction program. Storm water conservation began in 2004 and recycled water recharge began in the summer of 2005.

5.6 IEUA RECYCLED WATER DISTRIBUTION

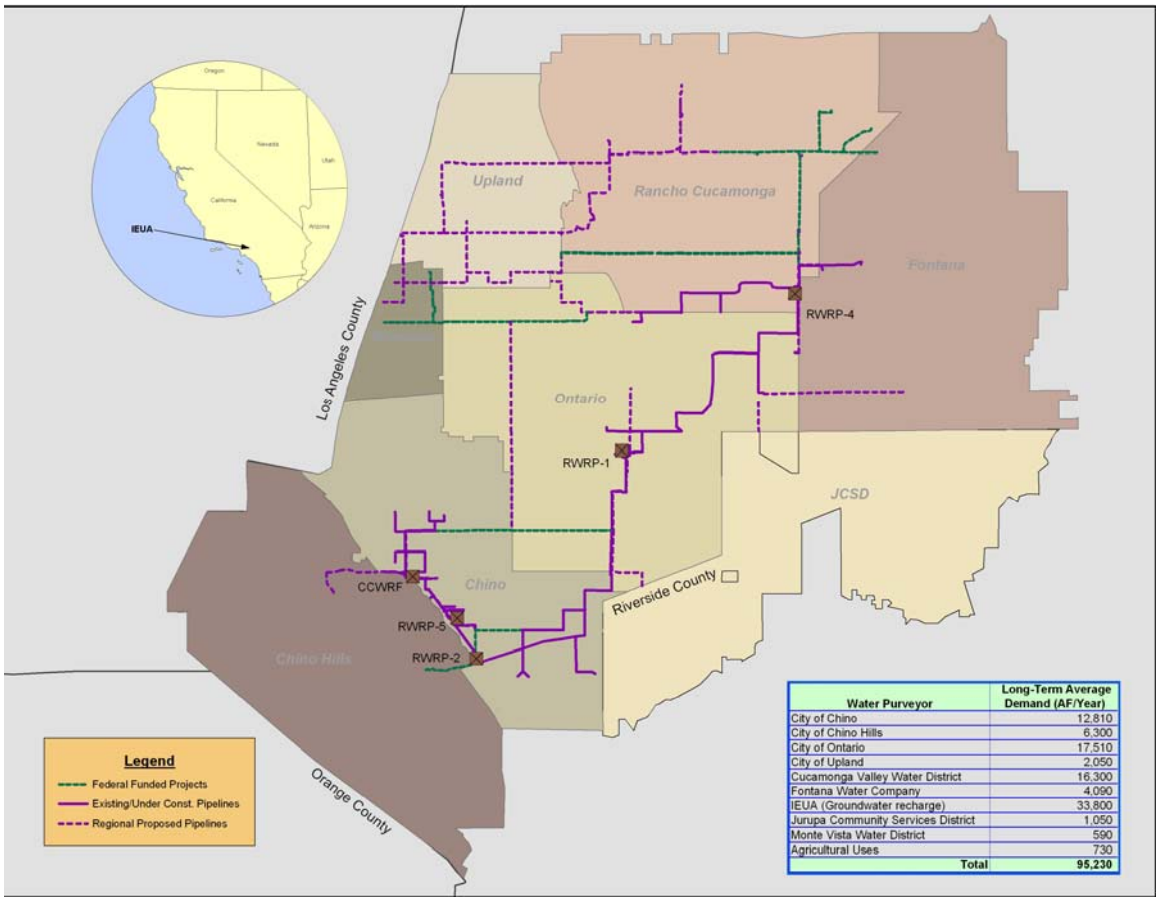
The CDA member cities of Chino, Chino Hills, and Ontario receive recycled water as Contracting Agencies to IEUA. Through the Principles of Agreement –

Recharge of Recycled Water in the Chino Basin Management Zone – 3, other members of the CDA (namely, Jurupa Community Service District, the City of Norco, and the Santa Ana River Water Company) are able to purchase recycled water from IEUA.

The plans for IEUA's Regional Recycled Water Distribution System includes over 50 projects which include separate pipelines, pump stations and storage reservoirs for recycled water. These projects have been grouped into five implementation phases, which are scheduled in two-year increments. The priority of each phase was determined based on the amount of recycled water each phase could serve and the proximity of each phase to one of the regional water recycling plants or existing recycled water transmission mains. Phase I and II of the program will deliver recycled water to most of the groundwater recharge sites, since recharge represent a significant use of recycled water. The existing and proposed Recycled Water Program facilities are shown in Figure 5-1.

Figure 5-1

Recycled Water Distribution Lines and Regional Plants



Water Purveyor	Long-Term Average Demand (AF/Year)
City of Chino	12,810
City of Chino Hills	6,300
City of Ontario	17,510
City of Upland	2,050
Cucamonga Valley Water District	16,300
Fontana Water Company	4,090
IEUA (Groundwater recharge)	33,800
Jurupa Community Services District	1,050
Monte Vista Water District	590
Agricultural Uses	730
Total	95,230

CHAPTER 6
GROUNDWATER MANAGEMENT PROGRAMS

6.1 CHINO BASIN GROUNDWATER MANAGEMENT

Chino Basin groundwater is the only water source for the CDA. Chino Basin is one of the largest groundwater basins in Southern California. Management of the Chino Basin is guided by the 1978 Judgment, the "Peace Agreement" (2000) and the "Optimum Basin Management Program" (OBMP) (updated every five years). Region-wide implementation of recharge and conjunctive use projects is vital to the enhancement and protection of the safe yield and water quality of the Chino Basin.

1978 Chino Basin Judgment

The Chino Basin Watermaster (CBWM) was established in 1978 under a Judgment entered in the Superior Court of the State of California for the County of San Bernardino. The Judgment adjudicated the groundwater rights in Chino Basin and required that the basin operated in accordance with the provisions of the Judgment under the direction of a court-appointed Watermaster (See Appendix D). The Judgment mandated that the CBWM develop an *Optimum Basin Management Plan (OBMP)*[1].

Optimum Basin Management Plan (OBMP)

Four primary management goals for the OBMP (See Appendix E) were developed during a series of meetings to address the issues, needs and interests of the water producers in the Chino Basin. They were:

- **Goal No. 1 - Enhance Basin Water Supplies**
  This goal applies not only to local groundwater, but also to all sources of water available for the enhancement of the Chino Groundwater Basin;
- **Goal No. 2 - Protect and Enhance Water Quality**
  This goal will be accomplished by implementing activities that capture and dispose of contaminated groundwater, treat contaminated groundwater for direct high-priority beneficial uses, and encourage better management of waste discharges that impact groundwater.
- **Goal No. 3 - Enhance Management of the Basin**
  This goal will be achieved by implementing activities that will lead to optimal management of the Chino Basin.
- **Goal No. 4 - Equitably Finance the OBMP**
  This goal will establish an equitable financing plan among the groundwater producers for each individual project required in the OBMP.

[1] Chino Basin Watermaster, Optimum Basin Management Program, Phase I Report, WEI, August 19, 1999

Peace Agreement

As part of the development of the OBMP, a historic *Chino Basin Peace Agreement*[2] (Peace Agreement) between all affected stakeholders in the Basin was finalized in June 2000 (See Appendix G). As described in Chapter 1, Article VII of the Chino Basin Peace Agreement, the Peace Agreement sets forth various terms and conditions for the construction and operation of Chino Basin desalters and a general template for the purchase and sale of desalted water. With finalization of the Peace Agreement, the CBWM developed the *Chino Basin Recharge Master Plan*[3] to identify and prioritize opportunities for groundwater recharge within the Chino Basin. In response to this, IEUA completed a *Recycled Water Feasibility Study*[4] in 2002 and is presently developing a *Recycled Water Implementation Plan*[5] to fully integrate its recycled water program into the CBWM's goals and objectives for the OBMP and the Chino Basin Recharge Master Plan.

The 1978 Chino Basin Judgment and subsequent agreements, require ensuring of adequate water supplies in times of severe drought. In addition, basin-wide groundwater recharge capability, enhanced storage of higher quality water, and increased pumping capacity to extract the groundwater are critical elements to basin management. The extraction of saline groundwater in the south portion of the Chino Basin is a key element of the groundwater management strategy. In addition, if the Basin is to be operated under the RWQCB's "Maximum Benefit" concept, hydraulic control must be achieved and demonstrated. A more thorough discussion of Chino Basin groundwater management is contained in the OBMP and subsequent status of the basin reports. The discussion here is intended to focus on the CDA and the desalter programs.

To administer the construction, management and operations of the specified Desalters, the CDA was formed under a Joint Exercise of Powers Agreement (JPA), creating the "Chino Basin Desalter Authority" (CDA) the 25th day of September, 2001. The CDA is administered by and among the Jurupa Community Services District (JCSD), the Santa Ana River Water Company (SARWC), the cities of Chino, Chino Hills, Norco, Ontario and the Inland Empire Utilities Agency (IEUA).

6.2 MAXIMUM BENEFIT

The "*Maximum benefit*" concept of groundwater quality management is included as part of the 2004 Basin Plan update (See Appendix H). CBWM and IEUA proposed that the TDS and nitrate-nitrogen objectives in the Chino North Management Zone be established based on "*maximum benefit"* and not on

[2] Chino Basin Watermaster, Peace Agreement, June 29, 2000
[3] Chino Basin Recharge Master Plan, August 2001
[4] Recycled Water Feasibility Study, January 2002
[5] IEUA, Recycled Water Implementation Plan (DRAFT), July 2005

antidegradation. Accordingly, the Regional Board requires proof that raising the TDS objective to 420 milligrams per liter (mg/L) and the nitrate-nitrogen objective to 5 mg/L will not adversely impact the quality of the Santa Ana River for downstream beneficial uses. Demonstrating "*hydraulic control*" will show that downstream beneficial uses are not impaired by management activities in the Chino North Management Zone.[6]

6.3 HYDRAULIC CONTROL

The main benefits of the CDA are:

1. A reliable, local source of drinking water is produced by desalination;

2. Improved water supply reliability through enhanced local supplies and less dependency on MWD imported supplies;

3. Salt and nitrates are removed from the groundwater basin to clean up the Chino Basin; and,

4. Hydraulic control of groundwater is enhanced by the location of groundwater extraction wells. This helps prevent groundwater that is high in salinity and nitrates from "spilling over" the Chino Basin southern barrier into the Santa Ana River.

The Hydraulic Control Program established in the 2004 Basin Plan Update is being implemented through the CDA, IEUA and CBWM. These agencies will fine tune groundwater production and recharge in the Basin to maximize yield and prevent outflow. The 22 raw water supply wells for Chino 1 and 2 Desalters provide for hydraulic control in the lower Chino Basin and are described below.

A major investment has been made in the redevelopment and new development of groundwater recharge basins and facilities in the Chino Basin that will be operated to better balance the water quality of water blended in the lower 1/5 of the Chino Basin. The lower portion of the Chino Basin encompasses the CDA area for hydraulic control and groundwater quality improvement.

Hydraulic Control Wells – Chino 1 Desalter and Expansion

The Chino 1 Desalter is located at 6905 Kimball Avenue, just west of Euclid Avenue, in the City of Chino, CA. A total of eleven Chino 1 Desalter extraction wells (2000) were drilled to extract brackish water from the lower Chino Basin. Since that time, an additional three wells have been drilled in conjunction with the Chino 1 Expansion (2005), bringing the total number of wells extracting and delivering water to Chino 1 Desalter to fourteen wells. The fourteen wells are all located west of Haven Avenue spanning the lower basin to Euclid Avenue and are located near the San Bernardino and Riverside county line.

[6] Chino Basin OBMP, State of the Basin Report 2004, July 2005, p 8-1

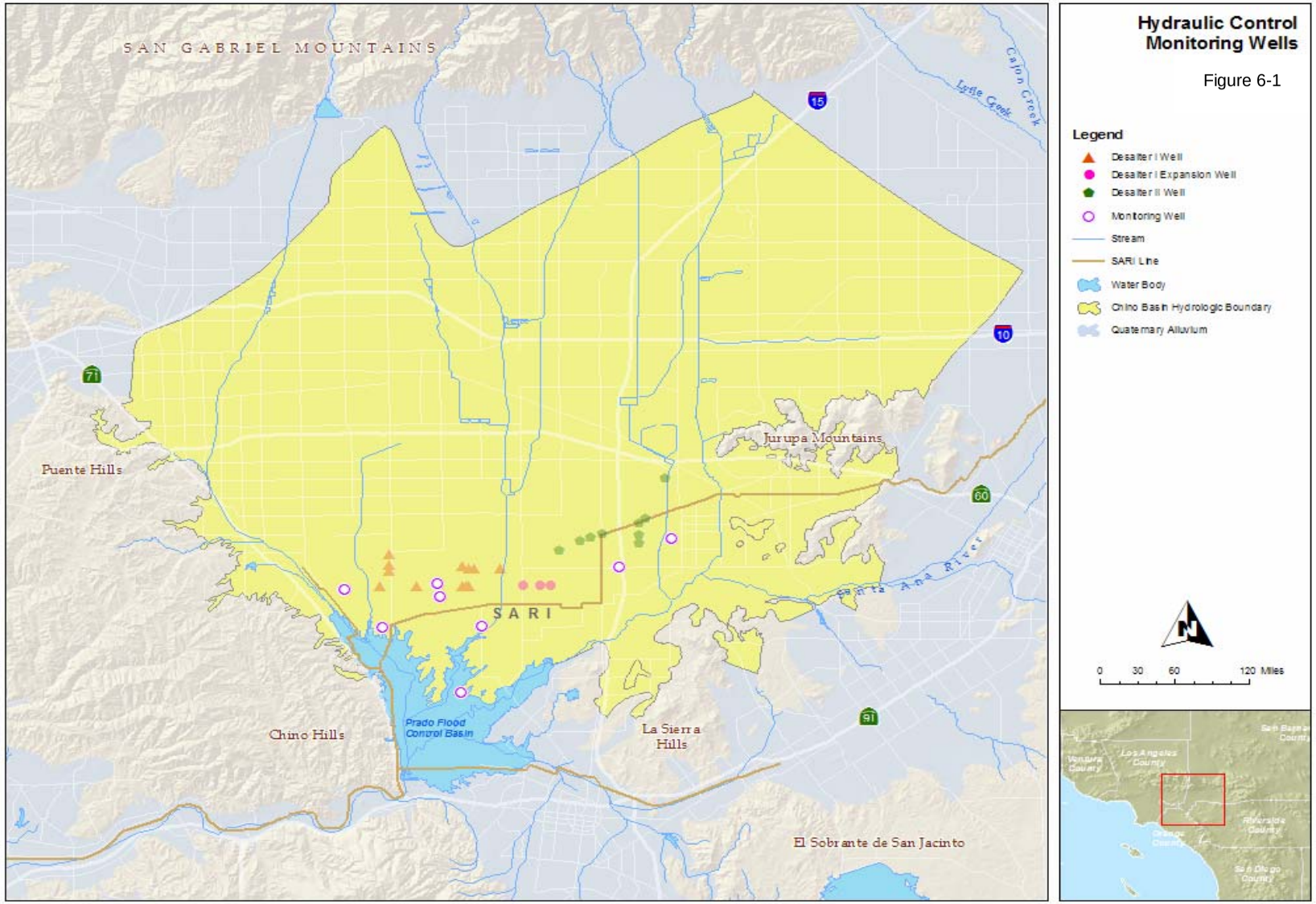
Hydraulic Control Wells – Chino 2 Desalter

Chino 2 Desalter is located at 11202 Harrel Street adjacent to the JCSD offices in Mira Loma, CA. The Chino 2 Desalter (2005) has a total of 8 extraction wells. Six of the wells are located along the San Bernardino / Riverside county line from Haven Avenue on the west to just east of Wineville Avenue, with two being located south of the county line along Wineville Avenue. The locations of groundwater extraction wells for Chino 1 and 2 Desalters is shown on Figure 3-1 and the characteristics of these wells are summarized in Tables 3-3 through 3-5 of Chapter 3.

Hydraulic Control Monitoring Wells

To verify the establishment of hydraulic control, IEUA and the US Bureau of Reclamation (USBR) installed nine "*nested*" groundwater monitoring wells ("piezometers") to provide supplemental information to the existing groundwater monitoring network. To assure hydraulic control in the Chino Basin, the nine groundwater monitoring wells were strategically locate south of the hydraulic control extraction wells of both Chino 1 and 2 Desalters. The location of the nine new monitoring wells is shown in Figure 3-7.

(The reader is directed to the IEUA UWMP Chapter 6 for more detail on Groundwater storage and management within the Chino Basin, pp. 99 - 120; and California Regional Water Quality Control Board, Santa Ana Region, Order No. R8-2005-0033, Water Recycling Requirements for IEUA and CBWM, Phase I, Chino Basin Recycled Water Groundwater Recharge Project, San Bernardino County, dated April 18, 2005)


Hydraulic Control Monitoring Wells
Figure 6-1
Legend
Desalter I Well
Desalter I Expansion Well
Desalter II Well
Monitoring Well
Stream
SARI Line
Water Body
Chino Basin Hydrologic Boundary
Quaternary Alluvium
0 30 60 120 Miles
SAN GABRIEL MOUNTAINS
Lytle Creek
Cajon Creek
Jurupa Mountains
Puente Hills
SARI
Santa Ana River
Chino Hills
Prado Flood Control Basin
La Sierra Hills
El Sobrante de San Jacinto
15
10
71
60
91

CHAPTER 7
ALTERNATIVE WATER SUPPLIES

Alternative water supplies available to the CDA include the compliment of water supplies in each CDA retail agency portfolio that are available through system interconnections. In particular, several CDA retail service agencies have imported water available through IEUA and the Water Facilities Authority (WFA). Also, certain agencies have access to recovered groundwater produced at the Arlington Desalter. Expanded groundwater production capacity is also available from the Chino Basin Dry Year Yield Program Facilities.

7.1 WATER SYSTEM INTERCONNECTIONS

Interagency Transfer of Water

The OBMP (1999)[1] and the Peace Agreement (2000)[2] provides for interagency transfer of water. Under the auspices of the CBWM, all water purveying agencies have interconnections that allows for the transfer of potable water from one agency to another in case of emergency. Also, the aforementioned agreements allow for intra-basin transfers of stored water in the Basin aquifer from one agency to another.

The CDA Interconnections and transfers

With interconnections at the respective Desalters, the CDA has the capability of transferring “excess” water produced by the Desalters. The CDA is required by the JPA Agreement to produce a minimum of 24,600 AFY of desalted water. Surplus water available from the Desalters in excess of the amounts described in the Agreement may be sold by the CDA. The price of desalted water delivered from the Facilities shall be a uniform per acre-foot amount for all CDA members (Purchasers), and will be set to recover all fixed and variable cost incurred by the CDA. Also, there is to be no additional costs for wheeling or transportation of water made available by the CDA to each Purchaser’s designated point of delivery. The price of desalted water sold to entities which are not Purchasers and which have not become Members of the CDA shall be determined in the sole discretion of the CDA Board. Thus, water wheeled to outside agencies is accomplished by the CDA Board and not by an individual CDA Member.

Members of the CBWM Appropriative Pool and the State of California have the first priority right to purchase “excess” desalted water developed by the Chino 2 Desalter and the Chino 1 Expansion on an equal basis, pursuant to a water

[1] CBWM OBMP, August 19, 1999, p. 4-33
[2] CBWM Peace Agreement Chino Basin, June 29, 2000, p. 47 – 49.

supply contract. The terms and conditions for the purchase or sale of water from the Chino 1 Desalter areas provided through separate agreement.[3]

7.2 ALTERNATIVE WATER SUPPLIES

Treated Potable Water Sources

As a member of MWD, IEUA provides wholesale State Project Water (SWP) to the Water Facilities Authority (WFA) that operates a water purification plant located at Benson Avenue and 18th Street in the City of Upland, CA. Three CDA entities are members/owners of the WFA, (the cities of Chino, Chino Hills and Ontario) and receive treated SPW from the WFA water purification plant.

As a member of MWD, WMWD provides wholesale Colorado River Water (CRW), treated as potable water, to the City of Norco, through the City of Corona's potable water distribution system. The City of Norco also has access to water from the Arlington Desalter, located near the SAWPA office in Riverside, CA. Colorado River water is not allowed in the IEUA system.

Groundwater

Groundwater is the primary source of potable water for all CDA agencies. All entities have potable water wells that extract water from the aquifers in their areas. The cities of Chino, Chino Hills and Ontario, the JCSD and the Santa Ana River Water Company all pump water from the *Chino Basin*. The City of Norco has groundwater wells that extract water from the *Temescal Basin* on the west side of the Santa Ana River.

Recycled Water in Chino Basin

Recycled water from the IEUA Regional Water Recycling Facilities produce a Title 22 quality water that is suitable for all water needs except direct potable use. This valuable commodity is now available to the cities of Chino, Chino Hills and Ontario, and soon will be available to the JCSD.

The recharge of water in the Chino Basin has taken on new intensity with the completion of the Chino Basin Facilities Improvement Program (CBFIP). The CBFIP had provided for; 1) the redevelopment of 16 existing groundwater recharge sites, the development of two new sites (totaling 42 recharge basins), 2) the construction of two new pump stations and two pressure pipelines, and 3) five rubber dams and three drop inlets to enhance the recharge of storm, imported and recycled water. A Supervisory Control and Data Acquisition System (SCADA) remotely controls and monitors the recharge system. The recharged storm water, imported and recycled water are accounted for, and allocated to, the respective retail agencies who are members of the CBWM.

[3] CBWM Peace Agreement Chino Basin, June 29, 2000, p. 47.

CHAPTER 8
WATER SHORTAGE CONTINGENCY PLAN

The Chino Desalter Authority (CDA) water supply is groundwater in the southern portion of Chino Basin. Groundwater is a stable source of supply that is not impacted by climate or other causes of potential water shortage common to imported water supplies. The CDA facilities, therefore serve as a contingency source for local CDA water supply agencies, and through mutual aid, other adjacent water supply agencies.

For example, during June 2004, treated imported water supply was interrupted when there was an unplanned shutdown of the Rialto Feeder pipeline for repairs. The Chino 1 Desalter was in full operation, producing 8 mgd. The CDA member agencies, the cities of Chino, and Chino Hills did not suffer a water shortage. Retail agencies in the northern Chino Basin did experience water shortage. The CDA entities did curtail their water usage as was directed by wholesale agencies MWD, CBWM and IEUA. The CDA curtailments were on stand-by to supply directly effected agencies if necessary.

8.1 MUTUAL AID AGREEMENT – REGIONAL AGENCIES

The IEUA and the Regional Contracting Agencies (consisting of the Cities of Chino, Chino Hills, Fontana, Montclair, Ontario, Upland and the Cucamonga Valley Water District) agreed[2] (See Appendix I) that, in the event of any disruption or damage to the ability of either the IEUA or Regional Contracting Agencies to continue to serve the public or its customers with water service, sewage service or sewage treatment service, the other party will cooperate to the maximum extent possible (as determined in its discretion) to provide mutual aid assistance as requested.

This Agreement provides for mutual aid assistance when requested by an agency or agencies in the event of any disruption or damage to any agency's infrastructure. This includes even the delivery of water from one agency's system to another under catastrophic conditions or during drought periods.

8.2 PLANNING FOR A CATASTROPHE – DESALTER WATER SERVES AS A BACKUP

Southern California's three imported water supplies (State Water Project, Colorado River Aqueduct and the Los Angeles Aqueduct) cross the San Andreas Fault. Many other fault lines bisect major water facilities throughout the region. Experts consider it likely that one or more of these supplies will be disrupted in the event of a major earthquake.

[2] Mutual Aid Agreement between IEUA and Regional Contracting Agencies, April 21, 2004

MWD estimates that restoring service on any of these facilities following a catastrophic outage could take up to six months. This, in turn, could reduce annual deliveries by up to 50% for MWD-supplied water. The UWMP requires agencies to consider the effect of a 50% cutback in water supplies. This corresponds approximately to the degree of cutback contemplated by MWD's earthquake disruption scenario.

In 2000, IEUA updated its 1996 emergency response plan for its service area. IEUA expects to meet emergency demands within the region through extraordinary conservation and groundwater pumping measures. Multiple sources of power exist within the service area, making any electrical shortages a temporary disruption. The more stable supplies, like groundwater provided by the CDA and the dry year yield (DYY) programs, form the basis of the emergency response program.

The Chino Desalters will serve as a major potable water backup source in the Basin. Soon, the Desalters will produce 24,600 AFY of potable water. When the program is fully developed in 2025, the Desalters will produce 52,000 AFY. With the CDA Agreement of September 21, 2001 and the Mutual Aid Agreement of April 21, 2004, water can also be wheeled to agencies outside the CDA service area.

8.3 DRY YEAR YIELD

In 2002, IEUA executed an agreement with the MWD to utilize the Chino Basin for dry year storage of up to 100,000 acre-feet of surplus imported water. The Dry-Year Yield (DYY) Program is a conjunctive use project that consists of $28.5 million worth of infrastructure improvements at water agency facilities throughout the Chino Basin and is funded entirely by MWD. The project includes well-treatment facilities, new wells, and conveyance pipeline improvements.

As shown in the IEUA UWMP, Table 6-4, in a dry-year-scenario when MWD's water sources are significantly cut, MWD can request Chino Basin water agencies involved in the DYY program to pump up to 33,000 acre-feet per year, for up to three years, in-lieu of taking full-service, imported water. The agreement allows MWD to reduce its direct deliveries to the Chino Basin while increasing their reliability throughout Southern California.

Project construction is scheduled to be completed by 2006 with surplus water deliveries beginning shortly after that. The DYY program is scheduled to become effective in 2008.

CHAPTER 9
WATER QUALITY IMPACTS ON RELIABILITY

The Chino Basin Desalter Authority owns and operates groundwater collection wells, pipelines, pumps, reservoirs and advanced treatment facilities to extract, treat and distribute groundwater. The advanced treatment facilities of Chino Desalters 1 and 2 included air stripping for removal of volatile organic compounds, ion exchange and reverse osmosis for removal of other contaminates (primarily nitrates and total dissolved solids). These treatment processes are state-of-the-art in water treatment and remove most all of any contaminates in water. With these advanced water treatment processes, water quality impacts on reliability are minimized by the systems ability to remove contaminates.

The reader is referred to the CBWM's State of the Basin Report (Appendix F) for a general discussion of water quality impacts on reliability of Chino Basin groundwater.

9.1 GROUNDWATER QUALITY IN CHINO BASIN

The results of all OBMP planning efforts of IEUA and the Chino Basin Watermaster and its member agencies have emphasized the central importance of water quality. The primary challenges facing the agencies supplies, particularly *in the lower Chino Basin* are: (1) water quality problems, (2) future droughts, and (3) the potential for a catastrophic event that interrupts water service to the region. Mitigation efforts are needed in the projected long-term planning effort to meet the future water needs within the Basin, such as:

1. *Desalters*: Desalination is needed to cleanup existing problems within the lower Basin aquifer.

2. *Wellhead treatment:* In the mid and upper Basin, wellhead treatment of groundwater is needed where degradation has caused wells to be taken out of service due to decline in water quality.

3. *Industrial plumes:* Cleanup of all known existing industrial plumes is needed.

The aforementioned methods of water quality treatment constitute a waste of approximately 15 percent of the processed water and results in high concentrations of dissolved solids and other contaminates that require disposal.

Vigilance must be maintained regarding the water quality of imported water during drought/low yield water years to assure continued maintenance of the

Basin's aquifer for future use by the agencies in the Basin and for long-term storage of water for Southern California agencies outside the Basin boundaries.

The groundwater quality in the southern portion of the Basin becomes increasingly poor south of the 60 Freeway, with very high total dissolved solids (TDS) and nitrate concentrations in the southern half of the basin. In addition, new contaminants such as perchlorate have been discovered in the region and other contaminants (particularly VOCs) threaten the future expanded use of the Chino Groundwater Basin.[1]

For the most part, the groundwater quality in the northern and central portions of the Chino Basin is good and most areas meet the California Department of Health Services' (CDHS) Safe Drinking Water Standards. Chino Basin groundwater quality is discussed in detail in the Chino Basin OBMP, State of the Basin Report – 2004, June 2005.[2] The discussion below is excerpted from the same reference and the reader is referred to this source for additional information.

In the State of the Basin Report 2004 (July 2005),[4] Figure 4-1 shows all wells that have groundwater quality monitoring results for the period ranging from 1999 to 2004. Figure 4-1 also shows the location of the proposed future desalter supply wells. This figure is reproduced here-in as Figure 9-1.

Numerous water quality standards are in place and governed by Federal and State agencies. Primary "maximum contaminant levels" (MCL) are enforceable criteria established to improve human health and environmental effects. Secondary standards are related to aesthetic qualities of the water such as taste and odor. In addition, for some chemicals there are "notification level" criteria set by the state. These notification levels have been established to meet health concerns but are not enforceable. Table 9-1 lists the constituents which exceed at least one water quality criteria for more than 10 wells in the Chino Basin groundwater for the period January 1999 through June 2004.

Figures 9-1 through 9-13 show the Chino Basin wells with one or more sets of water quality results included in the State of the Basin Report, 2005; additionally, Figure 9-14 shows the locations of plumes in the Basin aquifer with high volatile organic compounds (VOC's). In the Figures that depict distributions of water quality in Chino Basin, the following convention is typically followed in setting the class intervals in the legend (where WQS is the applicable water quality standard). Variations from this convention may be employed to highlight certain aspects of data.

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[1] Chino Basin OBMP, State of the Basin Report – 2004, June 2005, Wildermuth Environmental, Inc. pp 4-10 to 4-12
[2] Chino Basin OBMP, State of the Basin Report – 2004, June 2005 Wildermuth Environmental, Inc.
[4] Chino Basin OBMP, State of the Basin Report – 2004, June 2005 Wildermuth Environmental, Inc. pp 4-34 to 4-60

Table 9-1 Constituents that Exceed MCL in Water Wells

Analyte Group /Constituent	Wells with Exceedances
Inorganic Constituents	
Total Dissolved Solids	479
Nitrate	606
Aluminum	57
Arsenic	12
Chloride	50
Fluoride	11
Iron	75
Manganese	40
Perchlorate	128
Sulfate	69
General Physical	
Color	13
Odor	14
Chlorinate VOC's	
1,1-dichloroethene	12
1,2,3-trichloropropane	55
cis-1,2-dichloroethene	10
tetrachloroethene (PCE)	30
trichloroethene (TCE)	101
Radiological	
gross alpha	153
total radon 222	21

Table 9-2 General Legend for Scheme for Figures 9-2 through 9-13

Symbol	Class Interval
○	Not Detected
○	<0.5.WQS, but detected
○	0.5.WQS to WQS
○	WQS to 2.WQS
○	2.WQS to 4.WQS
○	>4.WQS

Total Dissolved Solids (TDS)

In CDHS Title 22, TDS is regulated as a secondary contaminant. The recommended drinking water *maximum contaminant level* (MCL) for TDS is 500 mg/L; however, the upper limit is 1,000 mg/L.

TDS concentrations in the northeast part of Chino Basin range from about 170 to about 300 mg/L for the pre-1980 period with typical concentrations in the mid to low 200s. TDS concentrations in excess of 200 mg/L would indicate degradation from overlying land use. With a few exceptions, areas with either significant

irrigated land use or dairy waste disposal histories overlie groundwater with elevated TDS concentrations. The exceptions are areas where point sources have contributed to TDS degradation; i.e., the former Kaiser Steel site in Fontana and the former wastewater disposal ponds near the IEUA *Regional Plant No. 1* (RP-1) south of the 60 Freeway and west of Archibald Avenue in the City of Ontario, CA.

Figure 9-2 illustrates the distribution of TDS concentrations in the Chino Groundwater Basin from 1999 to 2004. In some places, wells with low TDS concentrations are found to be proximate to wells with higher TDS concentrations, suggesting a vertical stratification of water quality.

Nitrate-Nitrogen (NO_3-N)

In CDHS Title 22, nitrate is regulated in drinking water with an MCL of 10 mg/L (as nitrogen). By convention, all nitrate values are reported in this document as *nitrate-nitrogen* (NO_3-N). Hence, the values of nitrate-nitrogen reported in this document should be compared with a NO_3-N MCL of 10 mg/L. Nitrate measurements in the surface water flows from the San Gabriel Mountains and in the ground water near the foot of these mountains are generally less than 0.5 mg/L. Nitrate concentrations in excess of 0.5 mg/L may indicate degradation from overlying land use.

Figure 9-3 shows the distribution of nitrate-nitrogen concentrations in Chino Basin for the period 1999 through 2004.

This sampling period primarily reflects data in the southern portion of Chino Basin. The results of comprehensive monitoring indicated that about eighty-three percent of the private wells had nitrate concentrations greater than the MCL and 60 percent are more than 2.5 times greater than the MCL. As with TDS, each consecutive sampling program saw a shift toward higher nitrate concentrations.

The following areas, south of the 60 Freeway, have somewhat elevated nitrate concentrations; east of the Puente and Chino Hills, south of the Jurupa Hills, along the Santa Ana River, the Temescal and Riverside Basins, and downgradient of the former RP-1 discharge point. Several wells in the southern portion of Chino Basin have nitrate concentrations greater than the MCL and 21 wells exceed 40 mg/L (4 times the MCL).

As explained earlier, areas with either significant irrigated land use or dairy waste disposal histories overlie groundwater with elevated nitrate concentrations. The primary areas of nitrate degradation are the areas formerly or currently overlain by dairy areas in the southern parts of the Chino-North Management Zone (MZ), the Chino-South MZ, the Chino-East MZ, and the Prado Basin MZ.

Over the same period, nitrate concentrations have increased significantly in the southern parts of the Chino-North MZ, the Chino-South MZ, the Chino-East MZ, and the Prado Basin MZ.[5]

Other Constituents of Concern

This section discusses the constituents whose water quality standards were exceeded in ten or more wells in Chino Basin (with the exception of nitrate and total dissolved solids). The details of these exceedances are displayed graphically in Figures 9-4 through 9-12. Chromium, hexavalent chromium and Methyl-tert-butyl ether (MTBE) are not discussed in the section that follows because standards were not exceeded in 10 or more wells. However, in the future, these constituents may be problematic, depending on the promulgation of future standards.

VOC's

The following five volatile organic chemicals (VOCs) were detected at or above their MCL in more than 10 wells:

- Tetrachloroethene (PCE);
- Trichloroethene (TCE);
- 1,1-dichloroethene;
- *Cis*-1,2-dichloroethene; and
- 1,2,3-trichloropropane.

Tetrachloroethene and Trichloroethene

PCE and TCE were/are widely used industrial solvents. PCE is commonly used in the dry-cleaning industry. About 80 percent of all dry cleaners use PCE as their primary cleaning agent (Oak Ridge National Laboratory, 1989). TCE is commonly used for metal degreasing and as a food extractant. The aerial distributions of PCE and TCE are shown in Figures 9-4 and 9-5 respectively. In general PCE is below detection limits for wells in the Chino Basin. The wells with detectable levels tend to occur in clusters such as those seen around Milliken Landfill, south and west of the Ontario Airport, and along the margins of the Chino Hills. The spatial distribution of TCE resembles that of PCE. TCE was not detectable in most of the wells in the basin. Similar clustering of wells was also seen around Milliken Landfill, south and west of Ontario Airport, south of Chino Airport and in the Stringfellow plume.

[5] CBWM OBMP; Phase I Report. Prepared for the Chino Basin Watermaster, August 19, 1999; Wildermuth Environmental, Inc. 1999.

Dichloroethene and *cis*-1, 2-Dichloroethene

Dichloroethene (1, 1-DCE) and *cis*-1, 2-dichloroethene (*cis*-1,2-DCE) are degradation by-products of PCE and TCE (Dragun, 1988) formed by the reductive dehalogenation, and their aerial distribution as shown in Figures 9-6 and 9-7 respectively. In a majority of wells in the Chino Basin, dichloroethene and *cis*-1,2-dichloroethene is not detected. Dichloroethene is found near the Milliken Landfill, south and west of the Ontario Airport, south of Chino Airport and at the head of the Stringfellow plume. The compound *cis*-1,2-dichloroethene is found in the same general locations.

1,2,3-Trichloropropane

1,2,3-Trichloropropane (1,2,3-TCP) is a colorless liquid that is used primarily as a chemical intermediate in the production of polysulfone liquid polymers and dichloropropene, synthesis of hexafluoropropylene, and as a cross linking agent in the synthesis of polysulfides. It has been used as a solvent, extractive agent, paint and varnish remover, cleaning and degreasing agent, and it has been formulated with dichloropropene in the manufacturing of soil fumigants, such as D-D.

The current California State Notification Level for 1,2,3-TCP is 0.005 micrograms per liter (µg/L). The adoption of the Unregulated Chemicals Monitoring Requirements (UCMR) regulations occurred before a method capable of achieving the required detection limit for reporting (DLR) was available. According to DHS, some utilities moved ahead with monitoring and the samples were analyzed using higher DLRs. Unfortunately, findings of non-detect with a DLR higher than 0.005 µg/L do not provide DHS with adequate information needed for possible standard setting. New methodologies to analyze for 1,2,3-TCP with a DLR of 0.005 µg/L have since been developed and the DHS is requesting that any utility with 1,2,3-TCP findings of nondetect with reporting levels of 0.01 µg/L or higher do follow-up sampling using a DLR of 0.005 µg/L. Private wells monitored in 1999 through 2001 were analyzed for 1,2,3-TCP at a DLR of 50 µg/L. Because 1,2,3-TCP may be a basin-wide water quality issue, all private wells are being retested at a lower detection limit - 0.005 µg/L.

Figure 9-8 shows the distribution of 1,2,3-trichloropropane (1,2,3-TCP) in Chino Basin, based on the data limitations discussed previously, using the legend convention typically employed throughout this report. Figure 9-8 shows that the very high values of 1,2,3-TCP are associated with the Chino Airport VOC plume. In addition, there is a cluster of wells that contain 1,2,3-TCP in concentrations greater than the Notification Level north of the Chino Airport along the western margins of the basin.

Aluminum, Arsenic, Fluoride, Iron and Manganese

The concentrations of aluminum, arsenic, iron, and manganese depend on mineral solubility, ion exchange reactions, surface complexations, and soluble ligands. These speciation and mineralization reactions, in turn, depend on pH, oxidation-reduction potential, and temperature.

Aluminum and Iron

In general, across the Chino Basin, aluminum and iron were non-detect (Figures 9-9 and 9-10, respectively). However, both constituents were high in the Stringfellow plume. Furthermore, iron was found at detectable levels (but still below one-half the MCL) in 2 clusters of wells on either side of Ontario Airport. Outside of the Stringfellow plume, there were 18 wells with concentrations greater than the MCL. Aluminum concentrations exceeded the primary California MCL in 5 wells outside of the Stringfellow plume. Exceedances may be an artifact of sampling methodology – relatively high concentrations of aluminum, iron, and trace metals are often the result of dissolution of aluminosilicate particulate matter and colloids caused by the acid preservative in unfiltered samples.

Arsenic

The current arsenic MCL is 50 µg/L. In January 2001, EPA mandated that compliance with the new federal arsenic MCL of 10 µg/L would be required by 2006. After adopting 10 µg/L as the new standard for arsenic in drinking water, the US EPA decided to review the decision to ensure that the final standard was based on sound science and accurate estimates of costs and benefits. In October 2001, the US EPA decided to move forward with implementing the 10 µg/L standard for arsenic in drinking water (US EPA, 2001). Figure 9-11 shows the distribution in Chino Basin. Fourteen wells in the Chino Basin had arsenic concentrations that exceed the 2006 MCL. Only 4 wells in the basin exceeded the current MCL of 50 µg/L. Three of these wells belong to the City of Chino Hills, the remaining well is at the northern tip of the Stringfellow plume. Higher concentrations of arsenic in the Chino Hills area are found at depths greater than about 350 feet below ground surface (Table 9-3).

Chino Hills 1A is a production well that is located about 30 feet from Chino Hills 1B, the well with the highest concentration of arsenic in the period from 1999 to 2004. During this period samples from Chino Hills 1A (perforated interval: 166-217 ft. bgs) were all non-detect.

Table 9-3 Arsenic Concentrations in Water Wells

Well	Arsenic Concentrations 1999-2004 (mg/L)			Perforated Intervals (ft bgs)
	Minimum	Maximum	Average	
Chino Hills 16	ND	67	39	430-940
Chino Hills 15B	13	72	51	360-440 480-900
Chino Hills 1B	58	80	66	440-470 49-610 720-900 940-1180

Fluoride

Fluoride occurs naturally in groundwater in concentrations ranging from less than 0.1 mg/L to 10-20 mg/L (Freeze and Cherry, 1979). Fluoride was detected in 954 wells within the basin, only 7 of which have concentrations that exceed the California primary MCL.

Manganese

Manganese is a naturally occurring element that is a component of over 100 minerals. Because of the natural release of manganese into the environment by the weathering of manganese-rich rocks and sediments, manganese occurs ubiquitously at low levels in soil, water, air, and food. Manganese compounds are used in a variety of products and applications including water and wastewater treatment, matches, dry-cell batteries, fireworks, fertilizer, varnish, livestock supplements, and as precursors for other manganese compounds. Manganese is often found near landfills especially when oxidation-reduction conditions promote its mobility in groundwater. Neither manganese nor any manganese compounds are regulated in drinking water. However, the US EPA has set a secondary standard MCL of 0.05 mg/L as has California. All these standards though are non-enforceable. Most of the wells sampled for manganese have resulted in non-detect. High concentrations of manganese in groundwater have been observed along the Santa Ana River in Reach 3, scattered throughout the southern portion of Chino Basin and near the Milliken Landfill (Figure 9-12).

Perchlorate

Perchlorate has recently been detected in several wells in the Chino Basin (Figure 9-13), in other basins in California, and in other states in the West. The probable reason that perchlorate was not detected in groundwater until recently is that analytical methodologies did not previously exist that could attain a low

enough detection limit. Prior to 1996, the method detection limit for perchlorate was 400 µg/L. By March 1997, an ion chromatographic method was developed with a detection limit of 1 µg/L and a reporting limit of 4 µg/L.

Perchlorate (ClO_4) originates as a contaminant in the environment from the solid salts of ammonium perchlorate (NH_4ClO_4), potassium perchlorate ($KClO_4$), or sodium perchlorate ($NaClO_4$). The perchlorate salts are quite soluble in water. The perchlorate anion (ClO_4) is exceedingly mobile in soil and groundwater environments. Because of its resistance to react with other available constituents, it can persist for many decades under typical groundwater and surface water conditions.

Perchlorate has been detected in 152 wells in the Chino Basin. Historical values of perchlorate exceeding the State Action Level have occurred in areas of the Chino Basin. Areas where perchlorate is found that are of interest to the CDA are:

- Downgradient of the Stringfellow Superfund Site. Concentrations have exceeded 600,000 µg/L in on-site observation wells and the plume has likely reached Pedley Hills and may extend as far as Limonite Avenue.

- Wells in the City of Ontario water service area, south of the Ontario Airport (source(s) unknown).

- Scattered wells in the City of Chino water service area (source(s) unknown).

Several types of treatment systems designed to reduce perchlorate concentrations are operating in the United States, reducing perchlorate to below the 4 ppb quantization level. Biological treatment and ion (anion) exchange systems are among the technologies that are being used, with additional treatment technologies under development.

Additional Constituents

Radon is a radioactive gas found in nature. It has no color, odor, or taste and is chemically inert. Higher concentrations of radon and gross alpha in groundwater typically occur near granitic bedrock outcrops; one might expect to see higher occurrences of these constituents near the San Gabriel Mountains, Jurupa Hills, Puente Hills, and Chino Hills and along fault zones- Rialto-Colton Fault, San Jose Fault, and the Red Hill Fault. The aerial distributions of radon and gross alpha do not show the expected pattern however, there are no spatial patterns or outside evidence to suggest a source other than naturally-occurring. Based on water quality results from 1999 to the present, 58 wells in the basin are at or above the US EPA proposed MCL for Radon. Based on the same sampling record,165 wells are at or above the USEPA MCL for gross alpha.

Chloride and sulfate both exceeded secondary MCLs. As discussed previously, secondary MCLs apply to chemicals in drinking water that adversely affect its aesthetic qualities and are not based on direct health effects associated with the chemical. Chloride and sulfate are major anions associated with TDS. Most wells in the basin had detectable levels of sulfate but most were less than 125 mg/L (one-half the water quality standard). A total of 83 wells had concentrations at or above the sulfate MCL. In general, these wells were distributed in the southern portion of the basin, along the margins of the Chino Hills and in the Stringfellow plume. All wells had detectable levels of chloride but most concentrations were less than 125 mg/L (one-half the MCL). The secondary MCL for chloride is exceeded in 68 wells almost all of which are located in the southern portions of the basin.

Color, odor and turbidity were detected at greater than their secondary MCLs in more than 10 wells in the last 5 years. These parameters are monitored purely for aesthetic reasons and should not limit water quality in Chino Basin.

9.2 POINT SOURCES OF CONCERN

The previous water quality discussion broadly described water quality conditions across the entire basin. The discussion presented below describes the water quality anomalies associated with known point source discharges to groundwater. Figure 9-14 shows the location of various point sources and areas of water quality degradation associated with these sources.

Chino Airport

The Chino Airport is located approximately four miles east of the City of Chino and six miles south of Ontario International Airport, and occupies an area of about 895 acres. From the early 1940s until 1948, the airport was owned by the federal government and used for flight training and aircraft storage. The County of San Bernardino acquired the airport in 1948 and has operated and/or leased portions of the facility ever since. Since 1948, past and present businesses and activities at the airport include modification of military aircraft, crop dusting, aircraft-engine repair, aircraft painting, stripping and washing, dispensing of fir-retardant chemicals to fight forest fires, and general aircraft maintenance. The use of organic solvents for various manufacturing and industrial purposes has been widespread throughout the airport's history (RWQCB, 1990). From 1986 to 1988, a number of groundwater quality investigations were performed in the vicinity of Chino Airport. Analytical results from groundwater sampling revealed the presence of VOCs above MCLs in six wells down-gradient of Chino Airport. The most common VOC detected above its MCL was TCE. TCE concentrations in the contaminated wells ranged from 6.0 to 75.0 µg/L.

Figure 9-14 shows the approximate aerial extent of TCE in groundwater in the vicinity of Chino Airport at concentrations exceeding its MCL as of 2002. The plume is elongate in shape, up to 3,600 feet wide and extends approximately 14,200 feet from the airport's northern boundary in a south to southwestern direction. During the period from 1997 to 2002, the maximum TCE concentration in groundwater detected at an individual well within the Chino Airport plume was 570 µg/L.

In 2002, the County of San Bernardino submitted a work plan to the Regional Board for installing up to five monitoring wells at and around Chino Airport in the summer 2003. The concentrations of TCE observed by the five monitoring wells are entirely consistent with a conceptual mode of a plume that has migrated away form Chino Airport. These new data corroborate other data generated by the Watermaster and others.

California Institute for Men

The California Institute for Men (CIM) located in Chino is bounded on the north by Edison Avenue, on the east by Euclid Avenue, on the south by Kimball Avenue, and on the west by Central Avenue. CIM is a state correctional facility and has been in existence since 1939. It occupies approximately 2,600 acres – about 2,000 acres are used for dairy and agricultural uses and about 600 acres are used for housing inmates and related support activities (Geometric Consultants, 1996). In 1990, PCE was detected at a concentration of 26 µg/L in a sample of water collected for a CIM drinking water supply well. Analytical results from groundwater sampling indicated that the most common VOCs detected in groundwater underlying CIM were PCE and TCE. Other VOCs detected included carbon tetrachloride, chloroform, 1,2-DCE, bromodichloromethane, 1,1,1-trichloroethane (1,1,1-TCA), and toluene. The maximum PCE concentration in groundwater detected at an individual monitoring well (GWS-12) was 290 µg/L. The maximum TCE concentration in groundwater detected at an individual monitoring well (MW-6) was 160 µg/L (Geometric Consultants, 1996).

Figure 9-14 shows the approximate aerial extent of VOCs in groundwater at concentrations exceeding MCLs as of 2004. The plume is up to 2,900 feet wide and extends about 5, 800 feet from north to south. During the period from 1999 to 2004, the maximum PCE and TCE concentrations in groundwater detected at an individual well within the CIM plume were 1,990 µg/L and 141 µg/L respectively.

VOC Anomaly – South of the Ontario Airport

A VOC plume containing primarily TCE exists south of the Ontario Airport. The plume extends approximately from State Route 60 on the north and Haven Avenue on the east to Cloverdale Road on the south and South Grove Avenue

on the west. Figure 9-14 shows the approximate aerial extent of the plume as of 2004. The plume is up to 17,700 feet wide and 20,450 feet long. During the period from 1999 to 2004, the maximum TCE concentrations in groundwater detected at an individual well within this plume was 83 µg/L.

9.3 CURRENT STATE OF GROUNDWATER QUALITY IN CHINO BASIN[6]

The baseline for the Initial State of the Basin is on or about July 1, 2000 – the point in time that represents the start of OBMP implementation. This initial state or baseline is one metric that can be used to measure progress from implementation of the OBMP.

The groundwater quality in Chino Basin is generally very good, with better groundwater quality found in the northern portion of Chino Basin where recharge occurs. Salinity (TDS) and nitrate concentrations increase in the southern portion of Chino Basin. Twenty-eight percent of the private wells south of the 60 Freeway (169 wells) had TDS concentrations below the secondary MCL. About 83 percent of the private wells south of the 60 Freeway had nitrate concentrations greater than the MCL.

The other constituents that have the potential to impact groundwater quality from a regulatory or Basin Plan standpoint are certain VOCs, arsenic, and perchlorate. As discussed above there are a number of point source releases of VOCs in Chino Basin. These are in various stages of investigation or cleanup. Likewise, there are known point source releases of perchlorate as well as what appears to be non-point source related perchlorate contamination from currently undetermined sources. Arsenic at levels above its water quality standards appears to be limited to the deeper aquifer zone near the City of Chino Hills. Total chromium and hexavalent chromium, while currently not a groundwater issue for Chino Basin, may become so, depending on the promulgation of future standards.

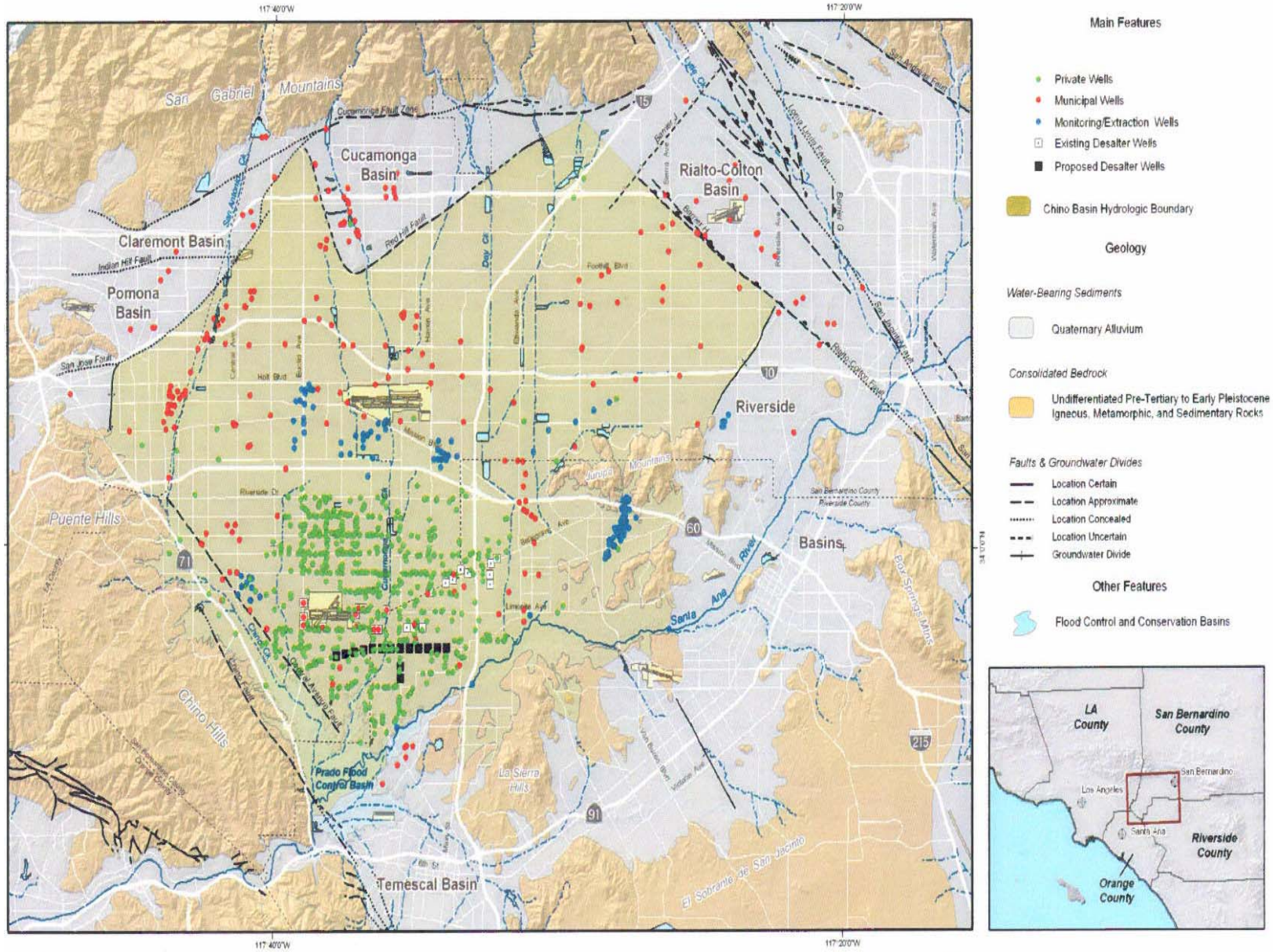
9.4 IMPACT OF WATER QUALITY ON RELIABILITY

The Chino Desalters are designed to recover contaminated groundwater and as such have a high degree of reliability. Reliability issues generally result from new unknown compounds that are discovered because of more sensitive detection limits or a plume that has migrated to an extraction well for the first time.

The Chino 1 Desalter had to shut down one of the initial raw water wells because of VOC contamination as the project was being initiated. The well has since come back on-line with the addition of air stripping and ion exchange at the

[6] CBWM OBMP, State of the Basin Report – 2004, Published January 2005.

Chino 1 Desalter. Any future water quality related issue is expected to be handled using a well head treatment technology such as air stripping, ion-exchange, reverse osmosis or a biological system. In addition, the Chino Basin Watermaster is actively working on remediation of known sources of pollution with the California Regional Water Quality Control Board.



Main Features

- Private Wells
- Municipal Wells
- Monitoring/Extraction Wells
- Existing Desalter Wells
- Proposed Desalter Wells
- Chino Basin Hydrologic Boundary

Geology

Water-Bearing Sediments

- Quaternary Alluvium

Consolidated Bedrock

- Undifferentiated Pre-Tertiary to Early Pleistocene Igneous, Metamorphic, and Sedimentary Rocks

Faults & Groundwater Divides

- Location Certain
- Location Approximate
- Location Concealed
- Location Uncertain
- Groundwater Divide

Other Features

- Flood Control and Conservation Basins

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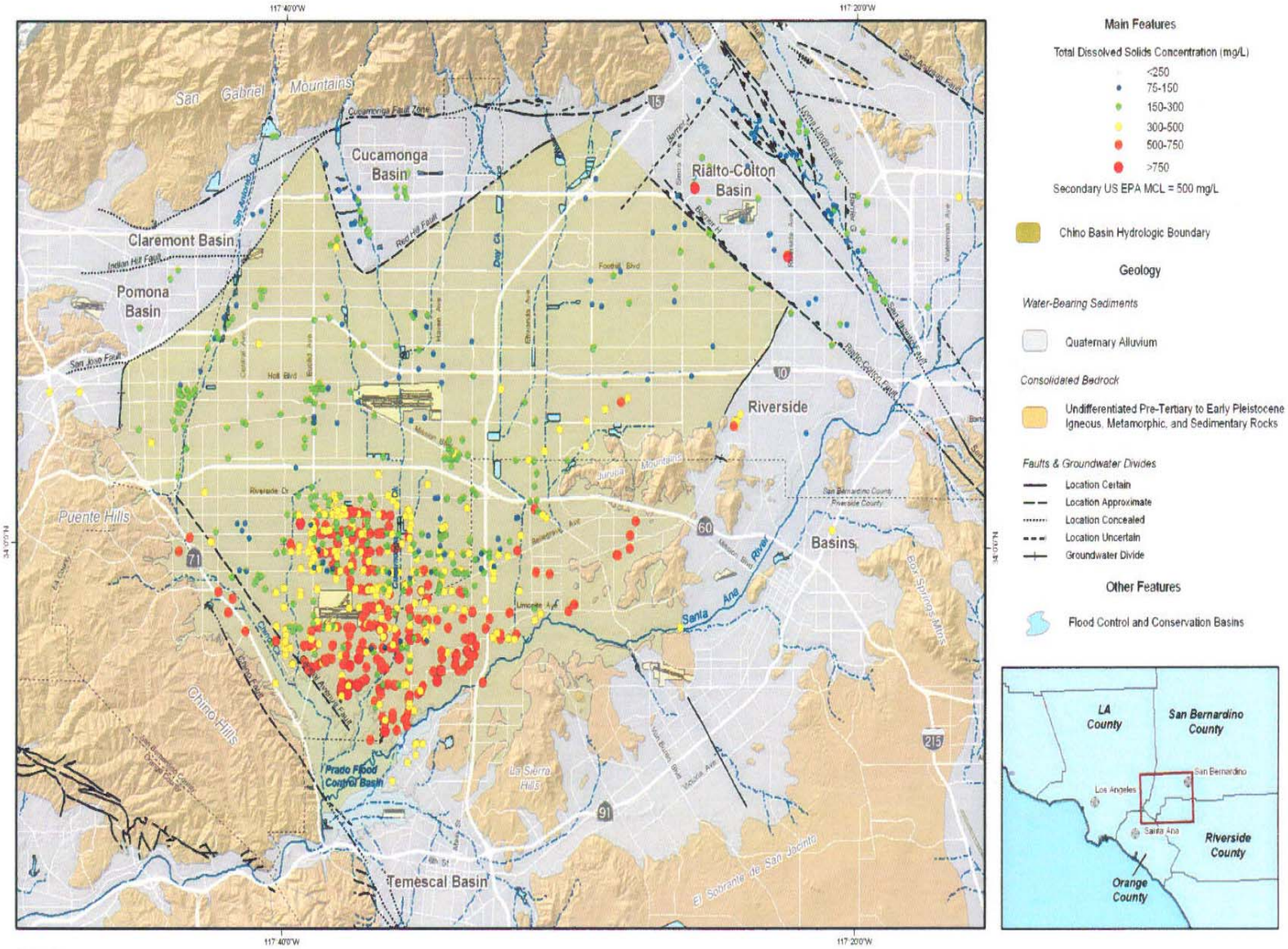
Date: 20050104
File: Figure_4-1.mxd

0 1 2 3 4 Miles
0 2 4 6 KM

State of the Basin Report – 2004
Groundwater Quality

Groundwater Wells with Water Quality Data
(1999-2004)

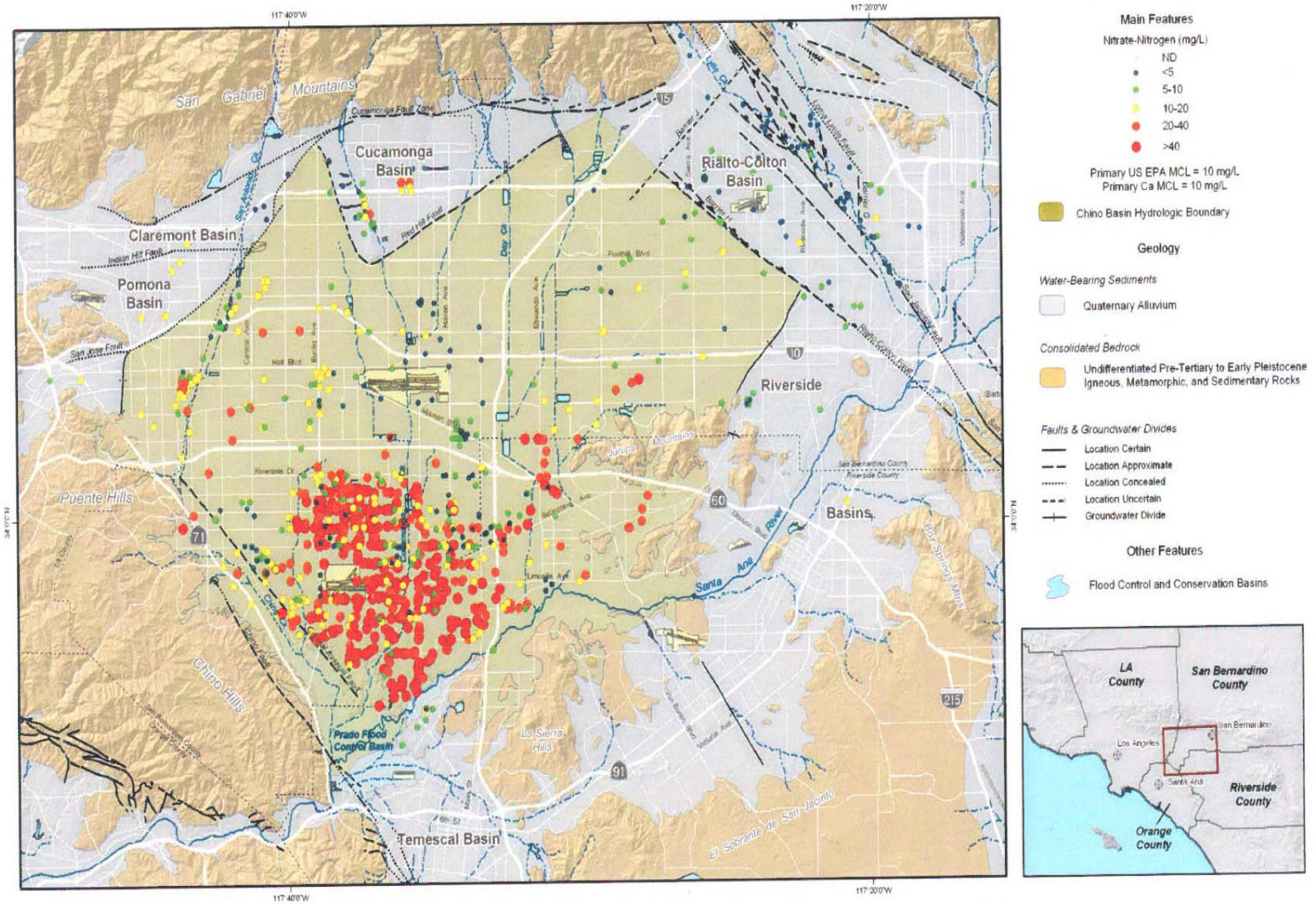
Figure 9-1



Total Dissolved Solids in Groundwater

Maximum Concentration (1999-2004)

Figure 9-2


Main Features
Nitrate-Nitrogen (mg/L)
ND
<5
5-10
10-20
20-40
>40
Primary US EPA MCL = 10 mg/L
Primary Ca MCL = 10 mg/L
Chino Basin Hydrologic Boundary
Geology
Water-Bearing Sediments
Quaternary Alluvium
Consolidated Bedrock
Undifferentiated Pre-Tertiary to Early Pleistocene Igneous, Metamorphic, and Sedimentary Rocks
Faults & Groundwater Divides
Location Certain
Location Approximate
Location Concealed
Location Uncertain
Groundwater Divide
Other Features
Flood Control and Conservation Basins
San Gabriel Mountains
Cucamonga Basin
Rialto-Colton Basin
Claremont Basin
Pomona Basin
Riverside
Basins
Puente Hills
Chino Hills
Prado Flood Control Basin
Temescal Basin
Santa Ana River
LA County
San Bernardino County
Riverside County
Orange County
Los Angeles
Santa Ana
117°40'0"W
117°20'0"W
34°0'0"N
Miles
KM
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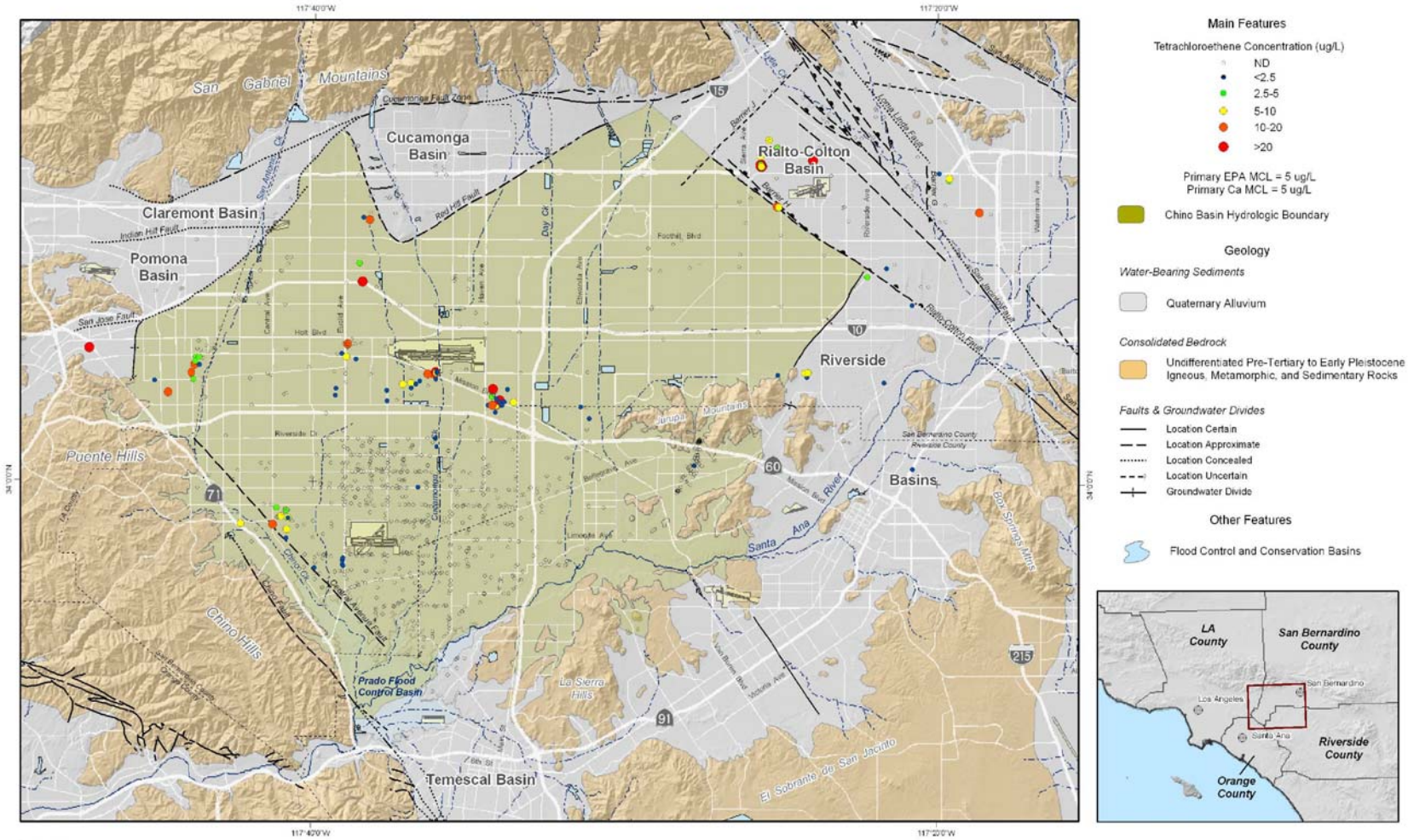
State of the Basin Report -- 2004
Groundwater Quality
Nitrate in Groundwater
Maximum Concentration (1999-2004)

F Figure 9-3



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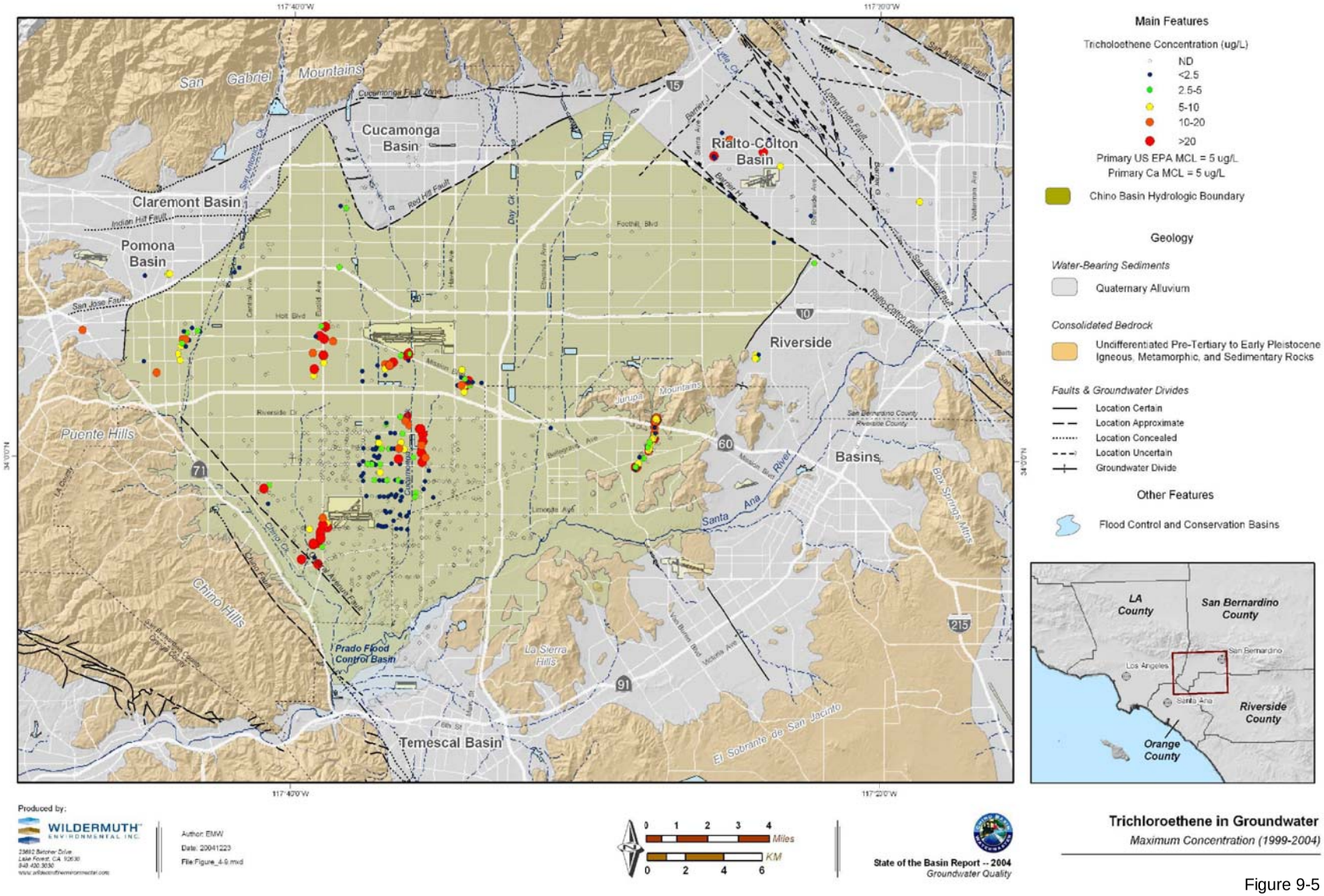
0 1 2 3 4 Miles
0 2 4 6 KM

State of the Basin Report -- 2004
Groundwater Quality

Tetrachloroethene in Groundwater
Maximum Concentration (1999-2004)

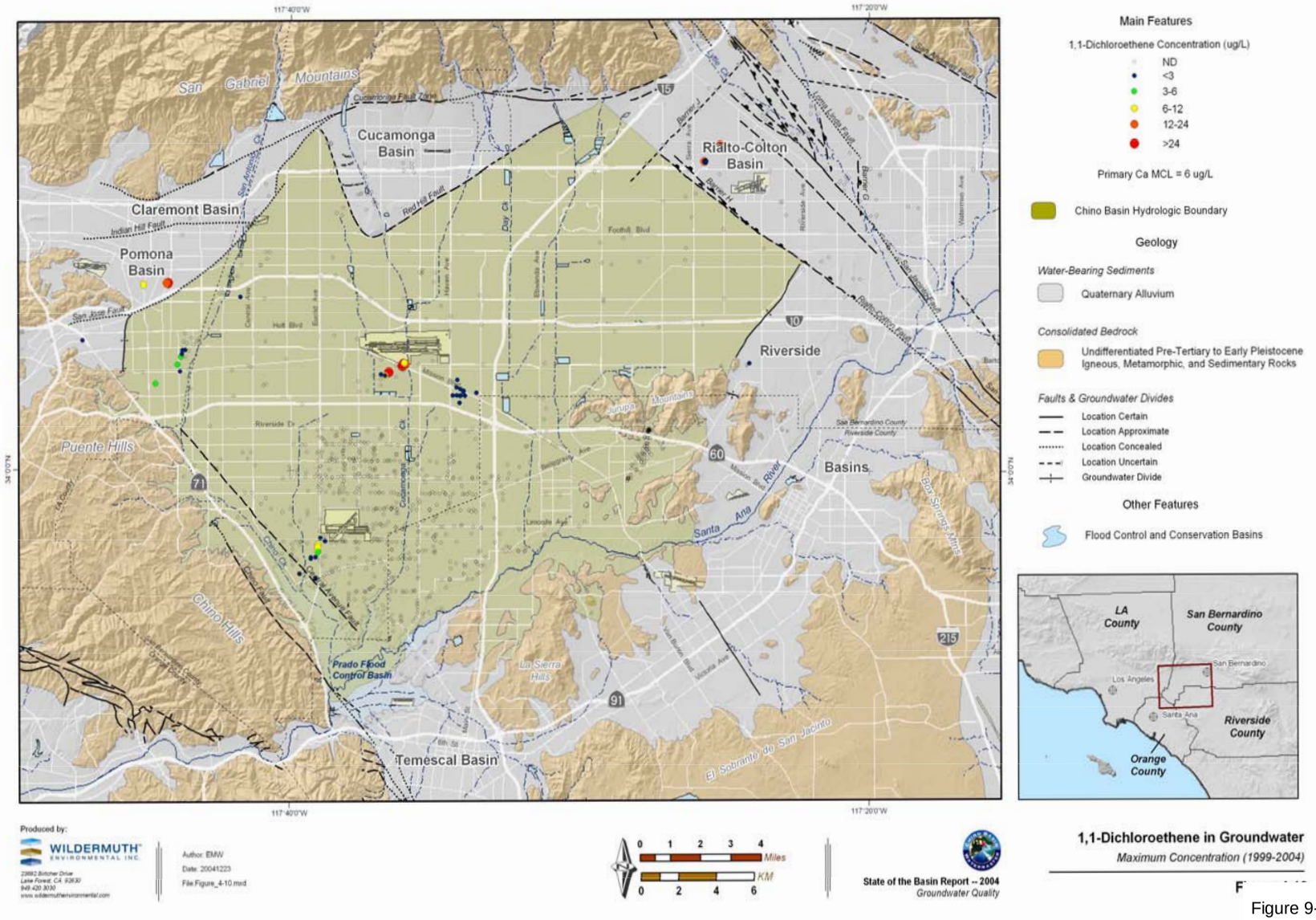
Figure 9-4



Trichloroethene in Groundwater

Maximum Concentration (1999-2004)

Figure 9-5


Main Features
1,1-Dichloroethene Concentration (ug/L)
ND
<3
3-6
6-12
12-24
>24
Primary Ca MCL = 6 ug/L
Chino Basin Hydrologic Boundary
Geology
Water-Bearing Sediments
Quaternary Alluvium
Consolidated Bedrock
Undifferentiated Pre-Tertiary to Early Pleistocene Igneous, Metamorphic, and Sedimentary Rocks
Faults & Groundwater Divides
Location Certain
Location Approximate
Location Concealed
Location Uncertain
Groundwater Divide
Other Features
Flood Control and Conservation Basins
Cucamonga Basin
Rialto-Colton Basin
Claremont Basin
Pomona Basin
Riverside
Basins
Temescal Basin
Prado Flood Control Basin
San Gabriel Mountains
Puente Hills
Chino Hills
Santa Ana River
LA County
San Bernardino County
Riverside County
Orange County
Los Angeles
Santa Ana
Miles
KM
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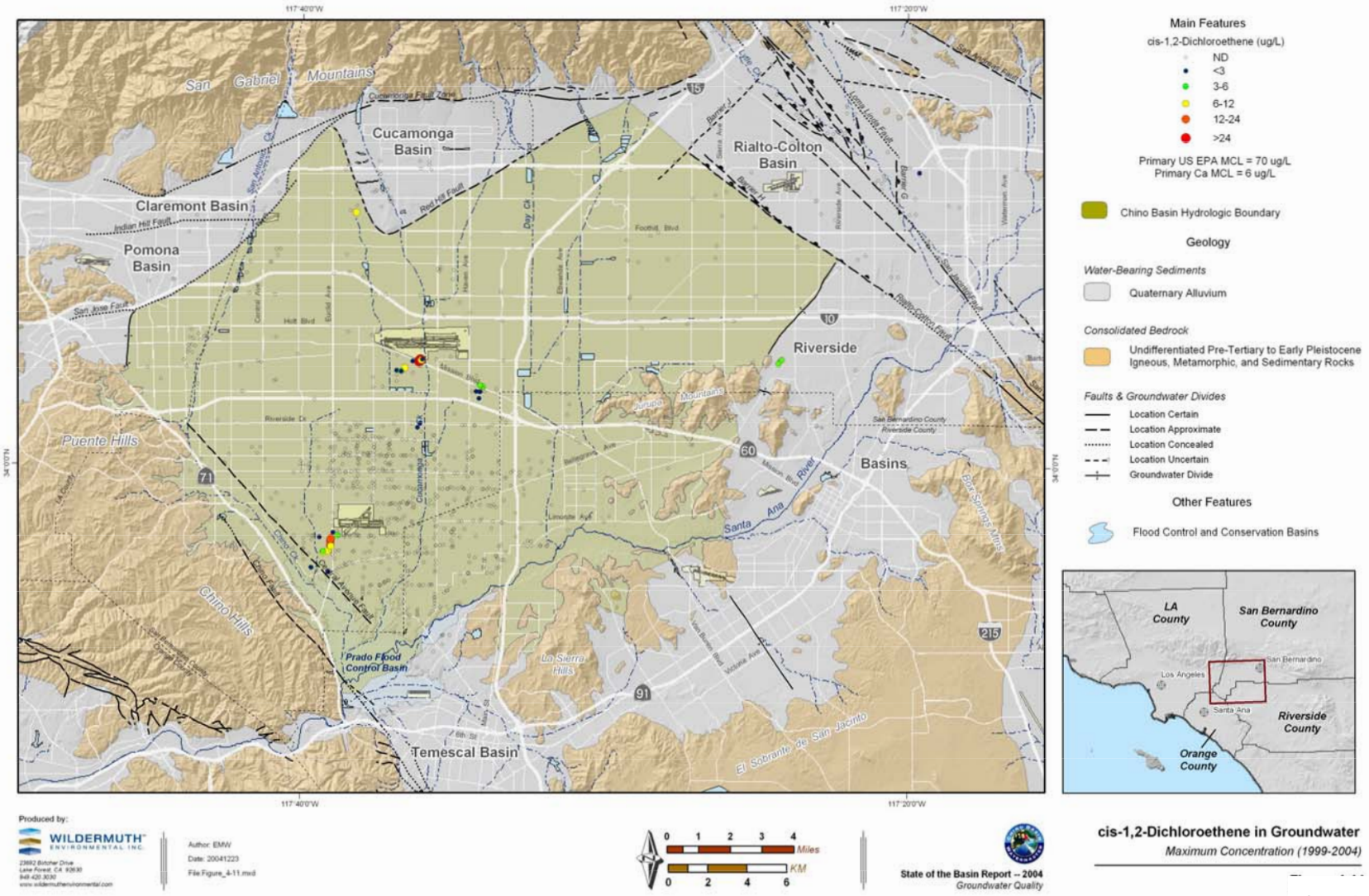
State of the Basin Report -- 2004
Groundwater Quality
1,1-Dichloroethene in Groundwater
Maximum Concentration (1999-2004)

Figure 9-6


Main Features
cis-1,2-Dichloroethene (ug/L)
ND
<3
3-6
6-12
12-24
>24
Primary US EPA MCL = 70 ug/L
Primary Ca MCL = 6 ug/L
Chino Basin Hydrologic Boundary
Geology
Water-Bearing Sediments
Quaternary Alluvium
Consolidated Bedrock
Undifferentiated Pre-Tertiary to Early Pleistocene Igneous, Metamorphic, and Sedimentary Rocks
Faults & Groundwater Divides
Location Certain
Location Approximate
Location Concealed
Location Uncertain
Groundwater Divide
Other Features
Flood Control and Conservation Basins
San Gabriel Mountains
Cucamonga Basin
Rialto-Colton Basin
Claremont Basin
Pomona Basin
Riverside
Basins
Puente Hills
Chino Hills
Prado Flood Control Basin
Temescal Basin
La Sierra Hills
Santa Ana River
El Sobrante de San Jacinto
LA County
San Bernardino County
Riverside County
Orange County
Los Angeles
San Bernardino
Santa Ana
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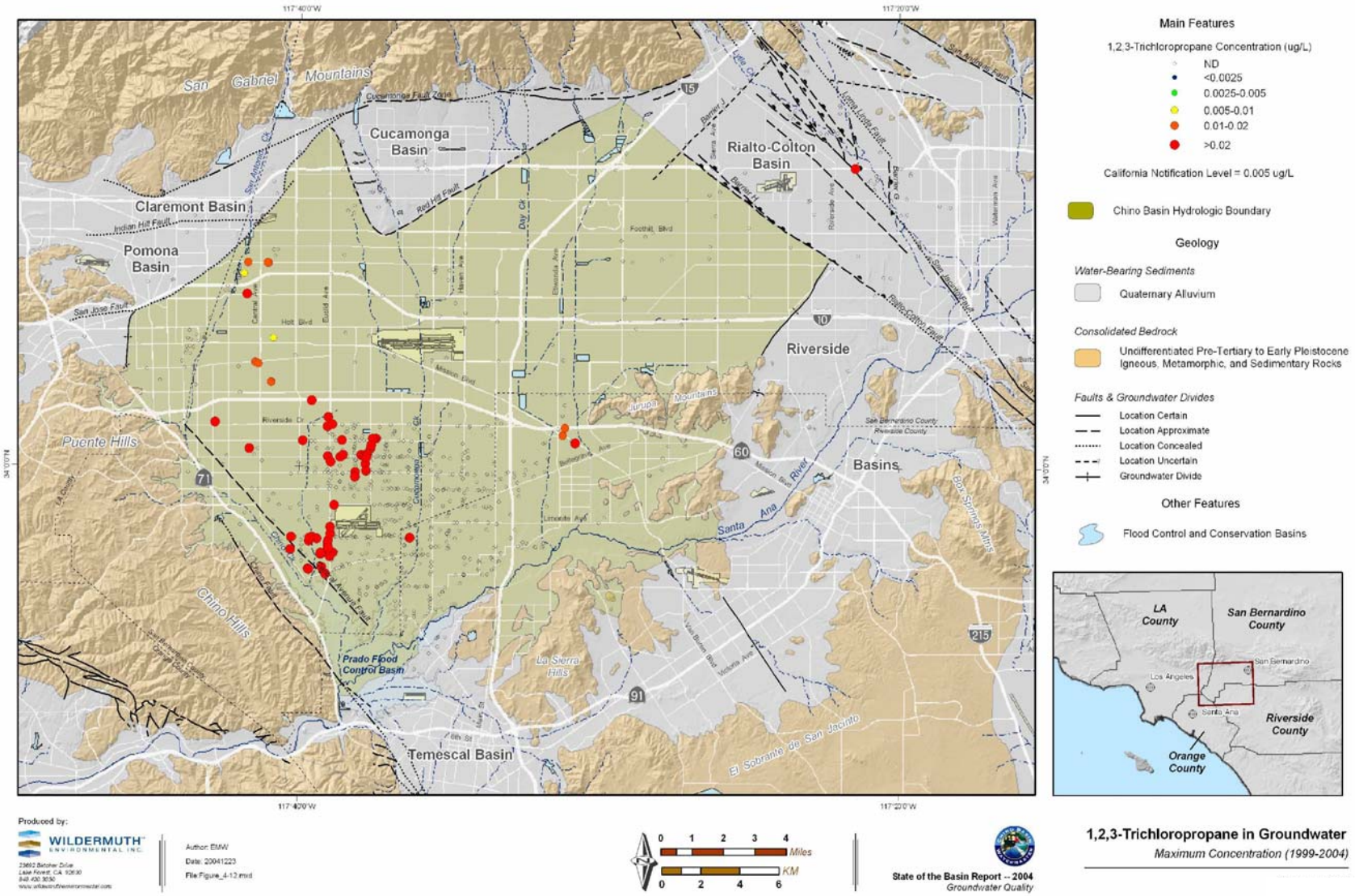
Miles
KM
State of the Basin Report -- 2004
Groundwater Quality
cis-1,2-Dichloroethene in Groundwater
Maximum Concentration (1999-2004)

Figure 9-7


Main Features
1,2,3-Trichloropropane Concentration (ug/L)
ND
<0.0025
0.0025-0.005
0.005-0.01
0.01-0.02
>0.02
California Notification Level = 0.005 ug/L
Chino Basin Hydrologic Boundary
Geology
Water-Bearing Sediments
Quaternary Alluvium
Consolidated Bedrock
Undifferentiated Pre-Tertiary to Early Pleistocene Igneous, Metamorphic, and Sedimentary Rocks
Faults & Groundwater Divides
Location Certain
Location Approximate
Location Concealed
Location Uncertain
Groundwater Divide
Other Features
Flood Control and Conservation Basins
San Gabriel Mountains
Cucamonga Basin
Claremont Basin
Pomona Basin
Rialto-Colton Basin
Riverside Basins
Puente Hills
Chino Hills
Prado Flood Control Basin
Temescal Basin
Santa Ana River
LA County
San Bernardino County
Riverside County
Orange County
Los Angeles
San Bernardino
Santa Ana
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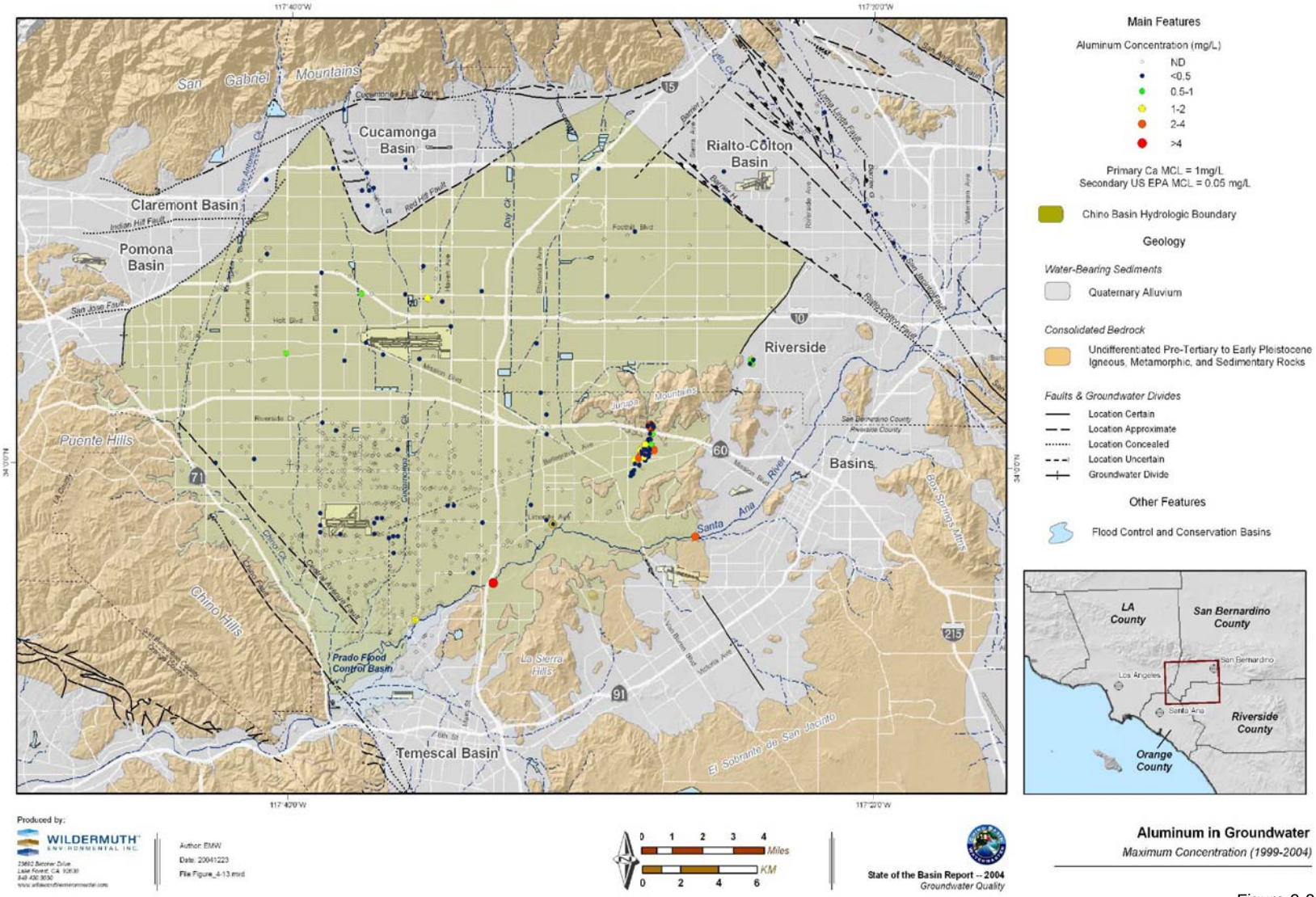
State of the Basin Report -- 2004
Groundwater Quality
1,2,3-Trichloropropane in Groundwater
Maximum Concentration (1999-2004)

Figure 9-8


Main Features
Aluminum Concentration (mg/L)
ND
<0.5
0.5-1
1-2
2-4
>4
Primary Ca MCL = 1mg/L
Secondary US EPA MCL = 0.05 mg/L
Chino Basin Hydrologic Boundary
Geology
Water-Bearing Sediments
Quaternary Alluvium
Consolidated Bedrock
Undifferentiated Pre-Tertiary to Early Pleistocene Igneous, Metamorphic, and Sedimentary Rocks
Faults & Groundwater Divides
Location Certain
Location Approximate
Location Concealed
Location Uncertain
Groundwater Divide
Other Features
Flood Control and Conservation Basins
San Gabriel Mountains
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Claremont Basin
Pomona Basin
Riverside
Basins
Puente Hills
Chino Hills
Prado Flood Control Basin
La Sierra Hills
Temescal Basin
Santa Ana River
Jurupa Mountains
Box Springs Mtns
El Sobrante de San Jacinto
LA County
San Bernardino County
Riverside County
Orange County
Los Angeles
San Bernardino
Santa Ana
Miles
KM
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State of the Basin Report -- 2004
Groundwater Quality
Aluminum in Groundwater
Maximum Concentration (1999-2004)

Figure 9-9

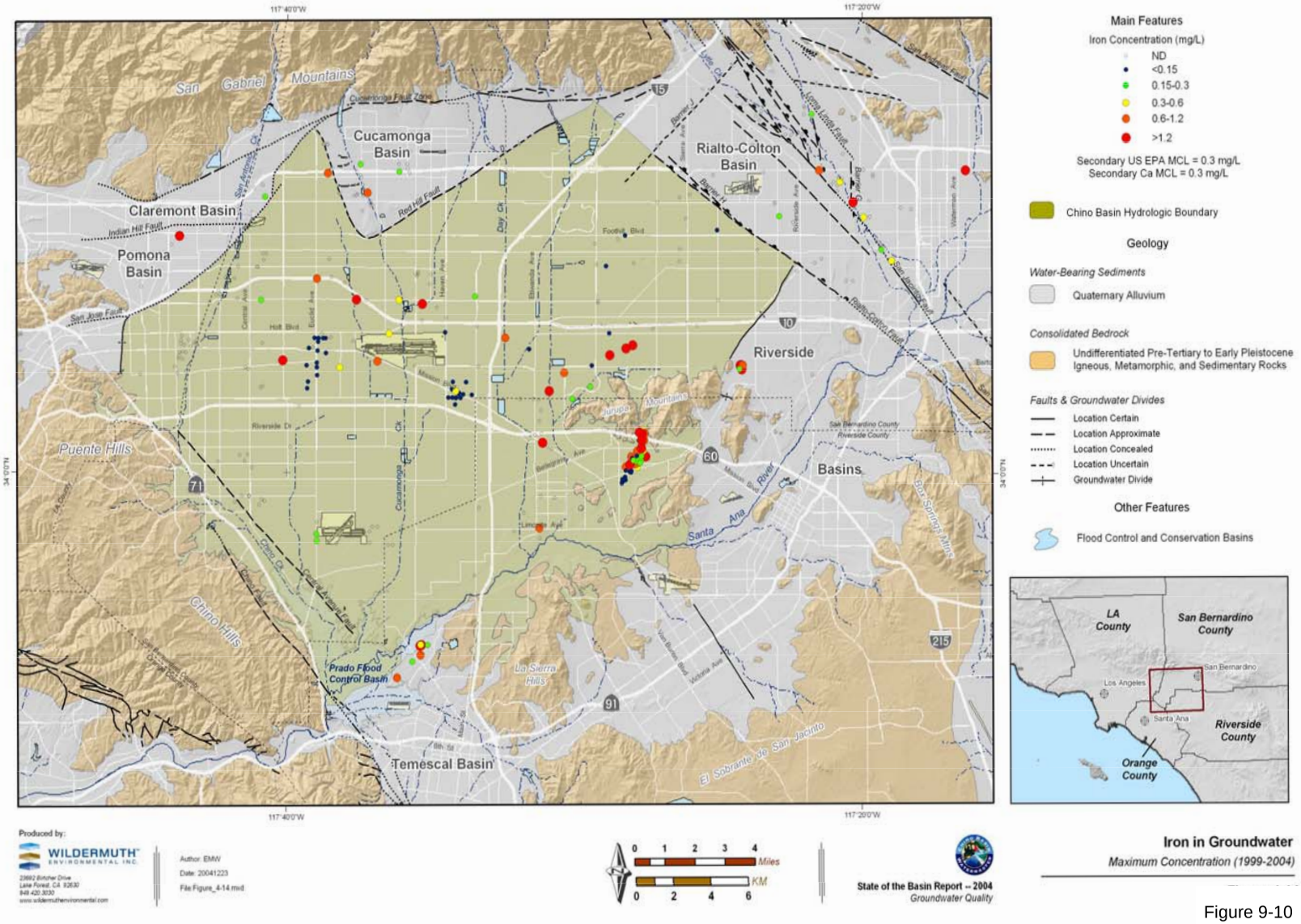

Main Features
Iron Concentration (mg/L)
ND
<0.15
0.15-0.3
0.3-0.6
0.6-1.2
>1.2
Secondary US EPA MCL = 0.3 mg/L
Secondary Ca MCL = 0.3 mg/L
Chino Basin Hydrologic Boundary
Geology
Water-Bearing Sediments
Quaternary Alluvium
Consolidated Bedrock
Undifferentiated Pre-Tertiary to Early Pleistocene Igneous, Metamorphic, and Sedimentary Rocks
Faults & Groundwater Divides
Location Certain
Location Approximate
Location Concealed
Location Uncertain
Groundwater Divide
Other Features
Flood Control and Conservation Basins
San Gabriel Mountains
Cucamonga Basin
Rialto-Colton Basin
Claremont Basin
Pomona Basin
Riverside
Basins
Puente Hills
Chino Hills
Prado Flood Control Basin
Temescal Basin
Santa Ana River
LA County
San Bernardino County
Riverside County
Orange County
Los Angeles
Santa Ana
Produced by:
WILDERMUTH ENVIRONMENTAL INC.
Author: EMW
Date: 20041223
File Figure_4-14.mxd
Miles
KM
State of the Basin Report – 2004
Groundwater Quality
Iron in Groundwater
Maximum Concentration (1999-2004)

Figure 9-10

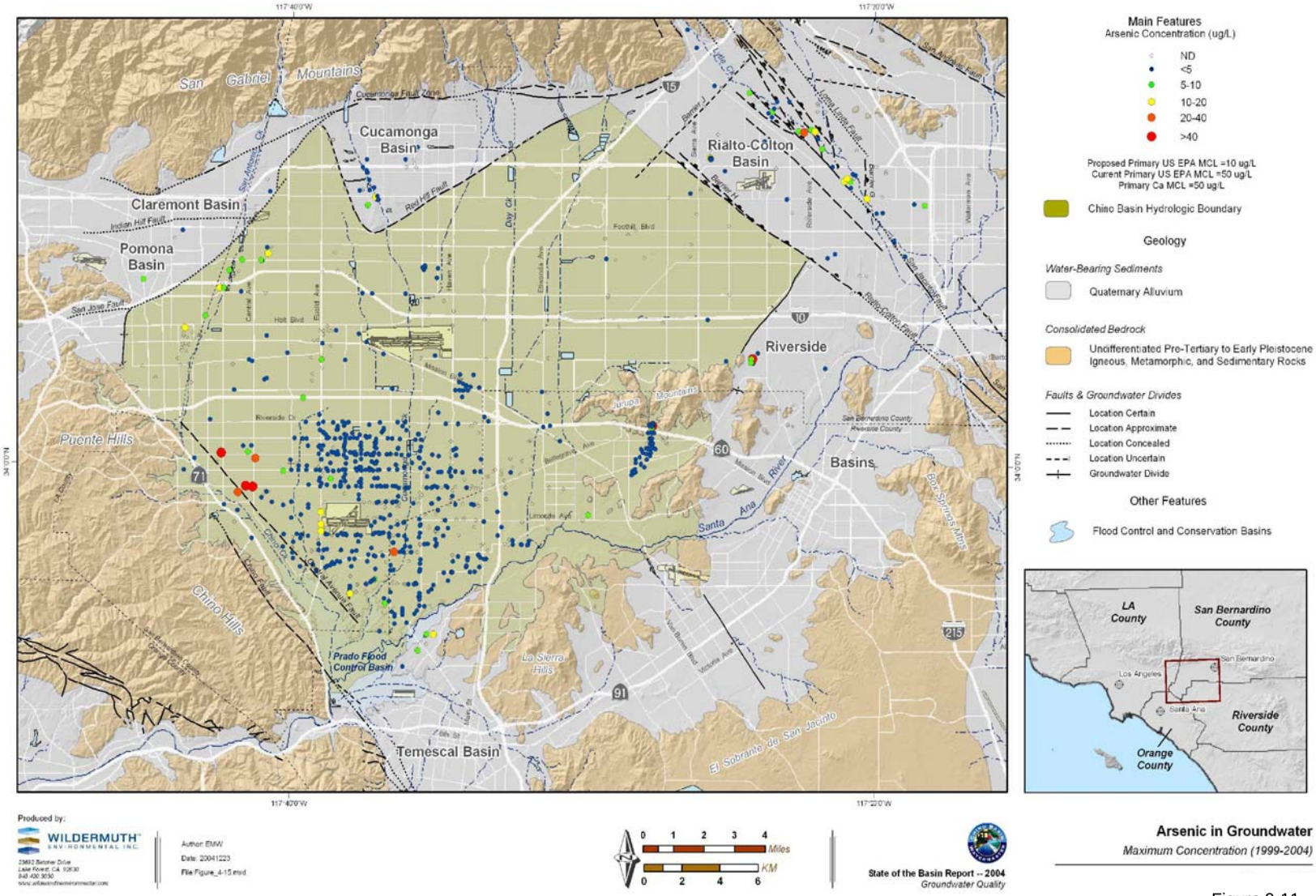

Main Features
Arsenic Concentration (ug/L)
ND
<5
5-10
10-20
20-40
>40
Proposed Primary US EPA MCL =10 ug/L
Current Primary US EPA MCL =50 ug/L
Primary Ca MCL =50 ug/L
Chino Basin Hydrologic Boundary
Geology
Water-Bearing Sediments
Quaternary Alluvium
Consolidated Bedrock
Undifferentiated Pre-Tertiary to Early Pleistocene Igneous, Metamorphic, and Sedimentary Rocks
Faults & Groundwater Divides
Location Certain
Location Approximate
Location Concealed
Location Uncertain
Groundwater Divide
Other Features
Flood Control and Conservation Basins
San Gabriel Mountains
Cucamonga Basin
Rialto-Colton Basin
Claremont Basin
Pomona Basin
Riverside
Basins
Puente Hills
Chino Hills
Prado Flood Control Basin
Temescal Basin
La Sierra Hills
Santa Ana River
LA County
San Bernardino County
Riverside County
Orange County
Los Angeles
Santa Ana
Produced by:
WILDERMUTH ENVIRONMENTAL INC.
Author: EMW
Date: 20041223
File: Figure_4-15.mxd
Miles
KM
State of the Basin Report -- 2004
Groundwater Quality
Arsenic in Groundwater
Maximum Concentration (1999-2004)

Figure 9-11

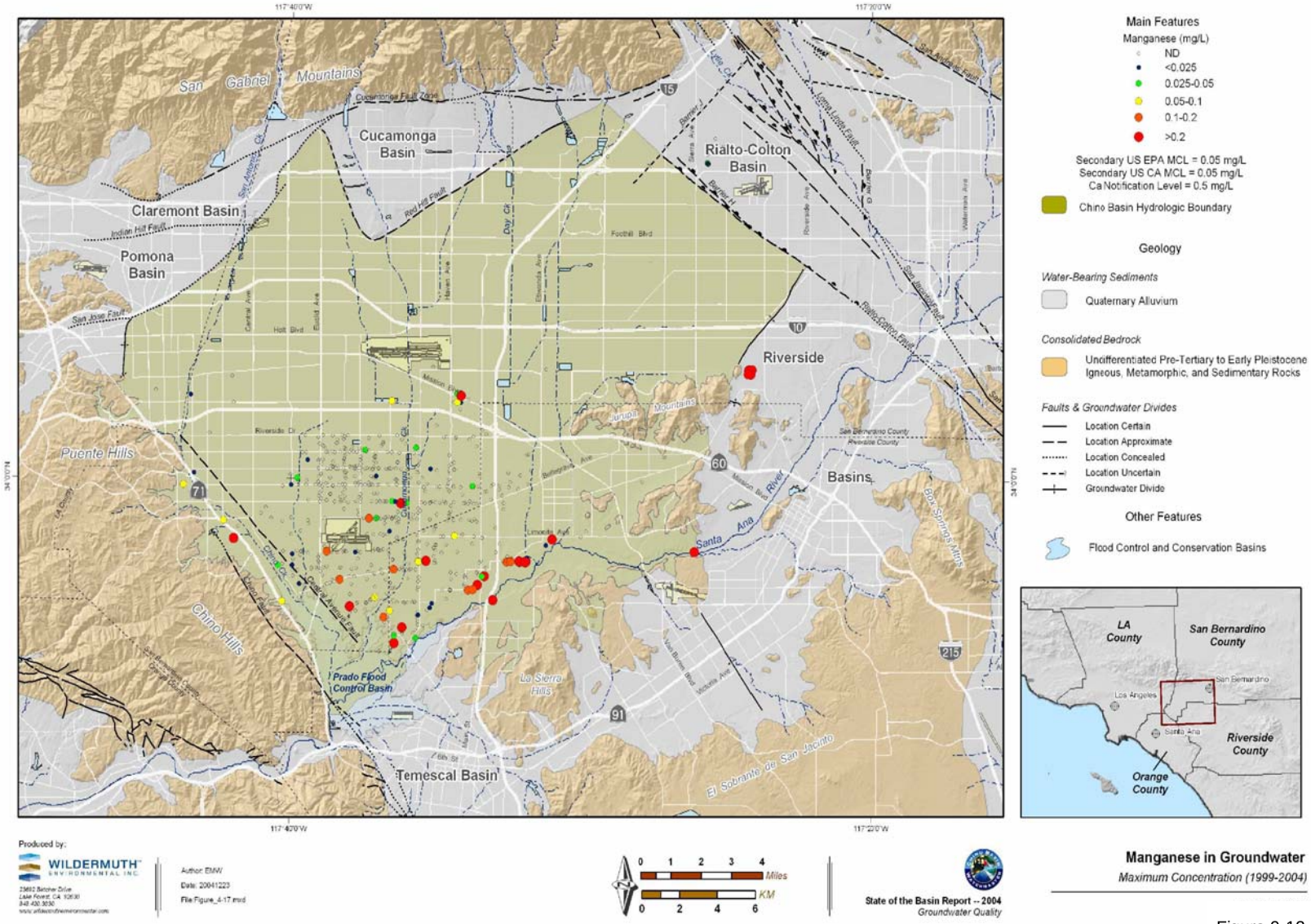
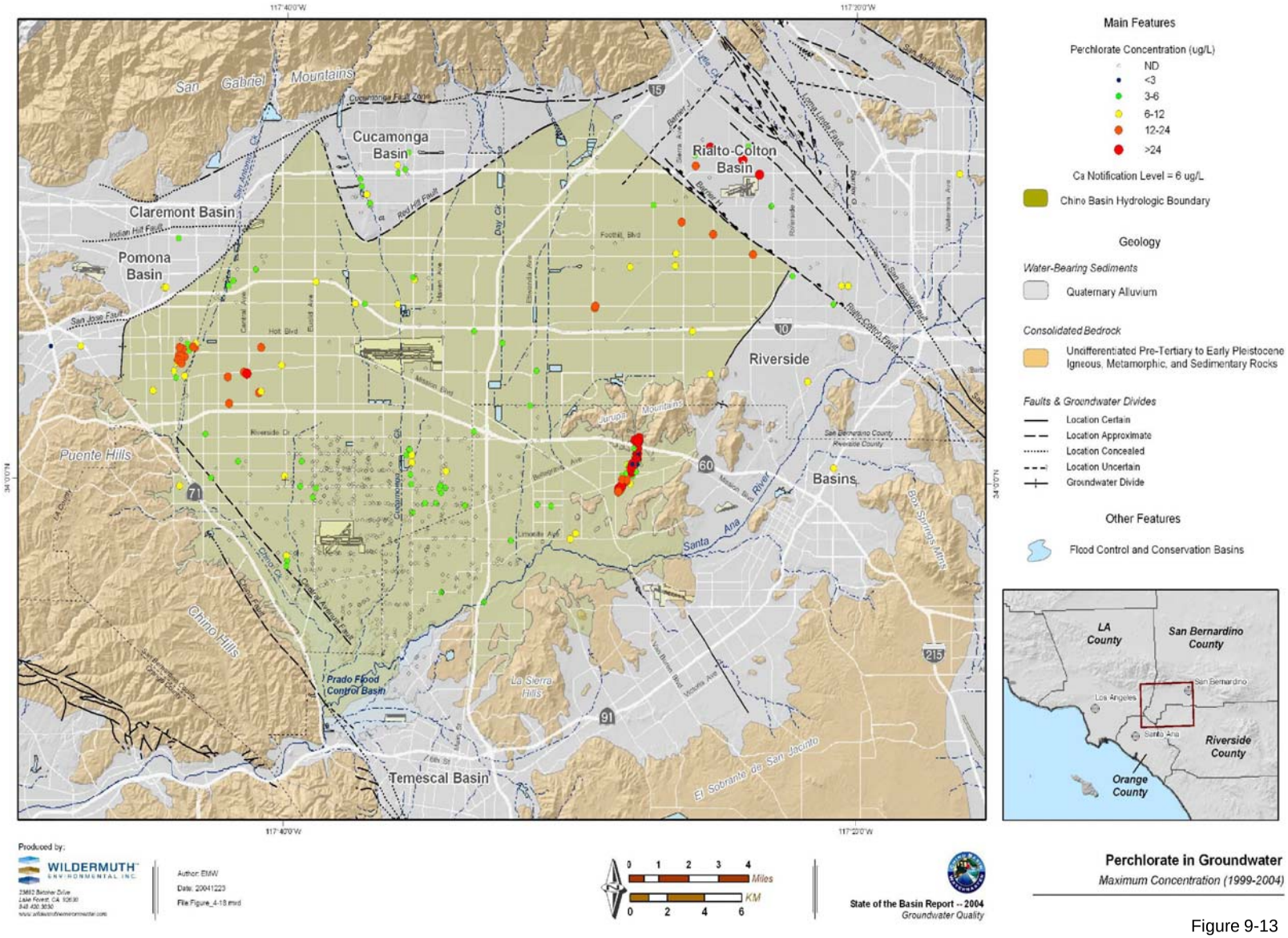

Main Features
Manganese (mg/L)
ND
<0.025
0.025-0.05
0.05-0.1
0.1-0.2
>0.2
Secondary US EPA MCL = 0.05 mg/L
Secondary US CA MCL = 0.05 mg/L
Ca Notification Level = 0.5 mg/L
Chino Basin Hydrologic Boundary
Geology
Water-Bearing Sediments
Quaternary Alluvium
Consolidated Bedrock
Undifferentiated Pre-Tertiary to Early Pleistocene Igneous, Metamorphic, and Sedimentary Rocks
Faults & Groundwater Divides
Location Certain
Location Approximate
Location Concealed
Location Uncertain
Groundwater Divide
Other Features
Flood Control and Conservation Basins
San Gabriel Mountains
Cucamonga Basin
Rialto-Colton Basin
Claremont Basin
Pomona Basin
Riverside
Puente Hills
Chino Hills
Prado Flood Control Basin
Temescal Basin
Santa Ana River
Jurupa Mountains
La Sierra Hills
El Sobrante de San Jacinto
Box Springs Mtns
LA County
San Bernardino County
Riverside County
Orange County
Los Angeles
Santa Ana
San Bernardino
Produced by:
WILDERMUTH ENVIRONMENTAL INC.
Author: EMW
Date: 20041223
File: Figure_4-17.mxd
Miles
KM
State of the Basin Report -- 2004
Groundwater Quality
Manganese in Groundwater
Maximum Concentration (1999-2004)

Figure 9-12


Main Features
Perchlorate Concentration (ug/L)
ND
<3
3-6
6-12
12-24
>24
Ca Notification Level = 6 ug/L
Chino Basin Hydrologic Boundary
Geology
Water-Bearing Sediments
Quaternary Alluvium
Consolidated Bedrock
Undifferentiated Pre-Tertiary to Early Pleistocene Igneous, Metamorphic, and Sedimentary Rocks
Faults & Groundwater Divides
Location Certain
Location Approximate
Location Concealed
Location Uncertain
Groundwater Divide
Other Features
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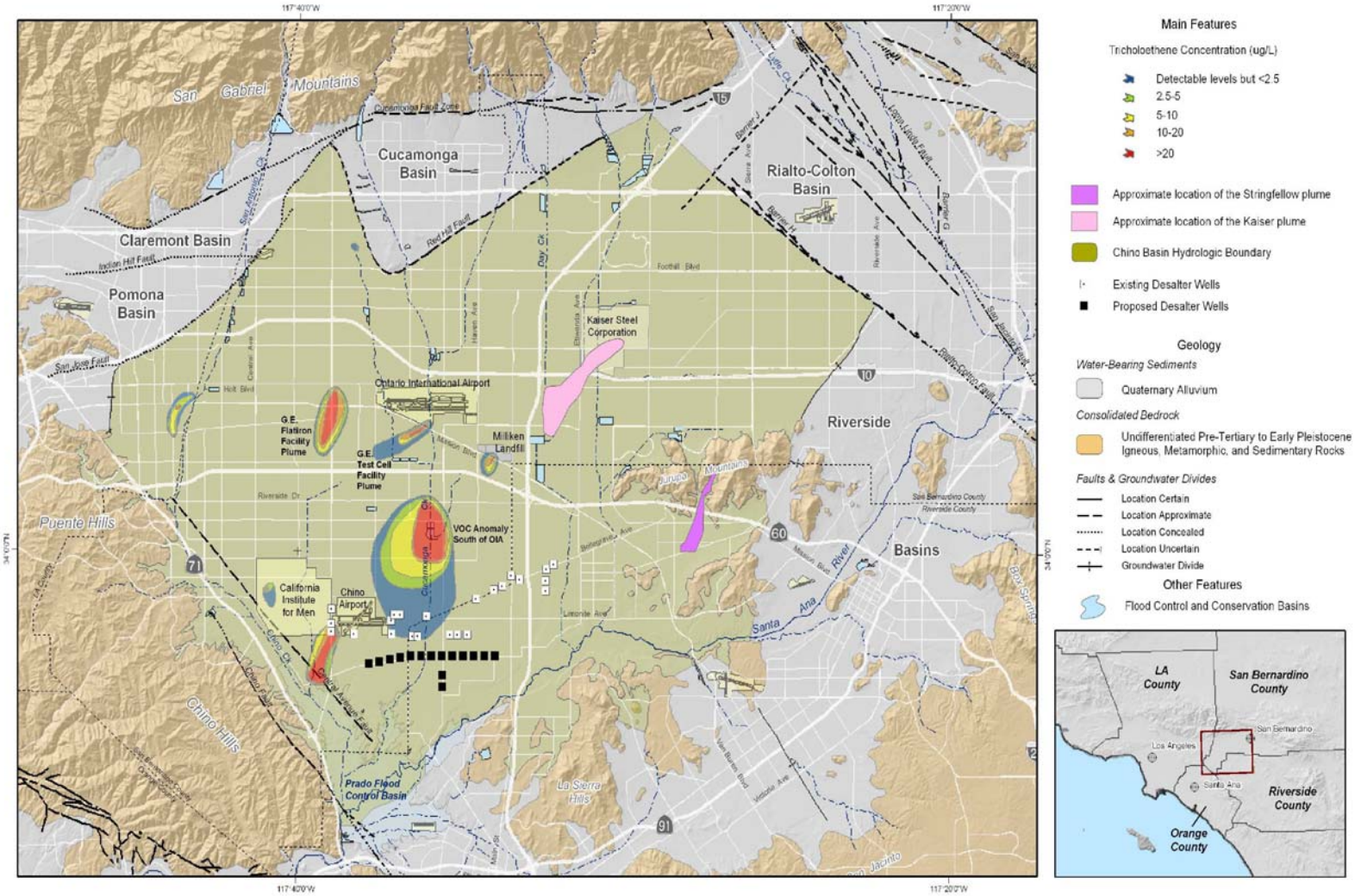
Claremont Basin
Pomona Basin
Riverside Basins
Temescal Basin
Prado Flood Control Basin
Puente Hills
Chino Hills
San Gabriel Mountains
Santa Ana River
LA County
San Bernardino County
Riverside County
Orange County
Produced by:
WILDERMUTH ENVIRONMENTAL INC.
Author: EMW
Date: 20041223
File: Figure_4-18.mxd
Miles
KM
State of the Basin Report -- 2004
Groundwater Quality
Perchlorate in Groundwater
Maximum Concentration (1999-2004)

Figure 9-13



VOC plumes in the Chino Basin

Represented by Maximum TCE Concentration (1999-2004)

Figure 9-14

CHAPTER 10
WATER SERVICE RELIABILITY

The desalter program is not impacted by wet/dry cycles since the primary source of supply is groundwater. The Chino Basin is one of the largest groundwater basins in southern California, holding an estimated 5,000,000 AF. The safe yield has been established for the basin and overdraft in excess of safe yield is replenished by groundwater recharge using storm, recycled and imported water. Accordingly, the desalter system adds reliability to CDA member agency systems that contain other climate variable sources of supply such as surface water and imported water.

JOINT EXERCISE OF POWERS AGREEMENT
creating the
CHINO BASIN DESALTER AUTHORITY
("CDA")

This Joint Exercise of Powers Agreement ("Agreement") is made and entered into as of the 25th day of Sept., 2001, by and among the Jurupa Community Services District ("JCSD"), the Santa Ana River Water Company ("SARWC"), the cities of Chino, Chino Hills, Norco and Ontario and the Inland Empire Utilities Agency ("IEUA") (collectively the "Parties" and individually, a "Party").

RECITALS

A. The Parties to this Agreement all have an interest in the successful management of groundwater resources in the Chino Basin.

B. The Parties are subject to the Judgment entered in Chino Basin Municipal Water District v. City of Chino (San Bernardino Case No. RCV 51010) that called for the development of an Optimum Basin Management Program ("OBMP").

C. With the exception of the Santa Ana River Water Company, the Parties all executed the Peace Agreement on or before August 1, 2000 to facilitate and enable the implementation of the OBMP. The Santa Ana River Water Company, while not a party to the Peace Agreement, did approve of the Peace Agreement through minute order of its governing board.

D. Article VII of the Peace Agreement set forth various terms and conditions for the construction and operation of Chino Basin desalters and a general template for the purchase and sale of desalted water.

E. The Parties, "Purchasers" in that fully executed document entitled "Integrated Chino-Arlington Desalters System Term Sheet" ("Term Sheet") attached hereto and incorporated herein as Exhibit "A," elected to discharge their respective rights and obligations under Article VII of the Peace Agreement in accordance with the terms and conditions set forth in such Term Sheet.

F. The Parties acknowledge that this Agreement to form a Joint Powers Authority is in fulfillment of the Purchasers' collective obligation to form a Joint Enterprise Group ("JEG") in accordance with Section 2(b)(vi) of the Term Sheet.

2.2 **Membership.** The Members of the CDA shall be the original Parties to this Agreement, including IEUA as an ex-officio Member, and such other entities which execute an Amendment to this Agreement and each Amendment thereto, and which have not withdrawn from the CDA pursuant to the provisions of Article IX hereof. Notwithstanding any other provision of this Agreement SARWC shall have an independent unilateral right to withdraw from this Agreement without incurring any liability of the Members, Parties, or CDA. SARWC must exercise this right by written notice delivered to all other Members no later than thirty (30) days after execution by all necessary parties of the last of the following agreements: (i) an agreement with SAWPA in accordance with Section 2(b)(i) of the Term Sheet; (ii) all transportation agreements as referenced in Section 12.1(a) of this Agreement; (iii) all operations and management agreements as referenced in Section 12.1(b) of this Agreement; and (iv) all water purchase agreements between the CDA and each of its voting Members. Upon exercise of this option to withdraw, SARWC shall purchase water from the CDA in the amount specified by Section 5.1(b) hereof, and in accordance with the Term Sheet, without being a Member of the CDA. The voting rights of the remaining Members shall be adjusted accordingly. If SARWC does not exercise this right, then it may withdraw from the CDA only in accordance with Section 9.1 hereof.

2.3 **Names.** The names, particular capacities, and addresses of the Members shall be as set forth in this Agreement and in any Amendment hereof.

2.4 **Board of Directors.** The CDA shall be governed by a Board of Directors ("Board") comprised of one representative from each Member of the CDA. The representative of IEUA, however, shall serve as the representative of an ex-officio Member only.

2.5 **Selection of Directors.** Within thirty (30) days after the execution of this Agreement by all of the Original Members, each Member shall designate and appoint, by resolution of its governing body, a representative to serve as a Director on the Board. Each Member also shall appoint an alternate Director to serve in the absence of the regular Director, to assume all rights and duties of the absent Director. At least one of either the Director or the alternate Director shall have technical expertise relevant to the operations and maintenance of the desalter facilities as determined by each Member. Each Member shall give written notice to the CDA of the names of its Director and alternate Director. Each Director and alternate Director shall hold office from the first meeting of the Board after the appointment of the Director or alternate Director until a successor is selected and qualified. Directors and alternate Directors shall serve at the pleasure of the governing body of their appointing Members and may be removed at any time, with or without cause, at the sole discretion of such governing body.

2.6 **Stipend.** The CDA shall pay a stipend to the Members of the Board, including its ex-officio Member, in the amount of $150.00 per meeting for a maximum of four meetings per year. In addition, a Director or alternate Director shall be reimbursed for reasonable expenses incurred in the conduct of the business of the CDA.

2.7 **Voting.** Unless otherwise provided herein, each Member, other than its ex-officio Member, shall be entitled to vote. A voting Member's vote shall be weighted according to the relative proportion that each Member's then existing firm commitment to purchase water bears to the total quantity of water then available for purchase from the CDA by all of its Members. The initial weighting of votes shall be as provided in Exhibit "A-3" to the Term Sheet and as more fully set forth immediately below. However, IEUA, as an ex-officio Member, shall be entitled to full access to all information provided to the Board, and entitled to full participation in deliberation of matters before the Board, but shall not be entitled to vote.

	Entity	Acre-Feet	Weighted Vote
a.	JCSD	8,200 afy	33.33%
b.	Chino	5,000 afy	20.33%
c.	Ontario	5,000 afy	20.33%
d.	Chino Hills	4,200 afy	17.07%
e.	SARWC	1,200 afy	4.88%
f.	Norco	1,000 afy	4.07%
	Totals:	*24,600 afy*	*100%*

2.8 **Principal Office.** The principal office of the CDA shall be established by resolution of the Board.

2.9 **Meetings.** The Board shall meet at the CDA principal office or such other place designated by the Board. The time and place of regular meetings of the Board shall be determined by resolution adopted by the Board, with a copy of such resolution furnished to each Member. Regular meetings of the Board shall occur once every quarter, and the first meeting of the fiscal year shall occur within thirty (30) days of the beginning of the fiscal year. In addition to its four regular meetings, the Board may hold special meetings upon the written request of at least two-thirds (2/3) of the voting power of the Board. All meetings of the Board shall be adjourned, sine die or to a time and place certain, by a majority vote of the voting power present at the meeting.

2.10 **Quorum.** For the purposes of transacting the business of the Board, a quorum shall consist of two-thirds (2/3) of the voting power of the Board.

2.11 **Officers.** There shall be selected from the membership of the Board, a Chairperson and a Vice-Chairperson. The Board shall also appoint a Secretary who may be a Director. The Treasurer shall be the Treasurer of IEUA who shall serve in the combined office of Treasurer and Auditor.

(a) Treasurer. The Treasurer shall be the depositary and have custody of all money of the CDA from whatever source, and shall draw all warrants and pay demands against the CDA as approved by the Board. The Treasurer shall function as the combined offices of Treasurer and Auditor pursuant to Government Code § 6505.6.

(b) Additional Officers. The Board shall have the power to appoint such additional officers as it deems necessary.

(c) Terms. The Chairperson, Vice-Chairperson, and Secretary shall hold office for a period of one year commencing January 1st of each fiscal year; provided, however, the first Chairperson, Vice-Chairperson and Secretary appointed shall hold office from the date of appointment to December 31st of the ensuing fiscal year.

(d) Qualifications. Any officer, employee or agent of the Board also may be an officer, employee or agent of any of the Members. The public officer or officers or persons who have charge of, handle, or have any access to any money or property of the CDA shall be bonded, and the amount of their bond shall be designated and fixed in the budget for each fiscal year pursuant to Government Code § 6505.1. The Treasurer may be changed only by a two-thirds (2/3) vote of the Members, and only then if IEUA is not acting as a financial representative of the CDA for securing loans, grants, commercial paper or other funding for the benefit of the CDA.

(e) Privileges, Liability and Immunity. All of the privileges and immunities from liability, exemption from laws, ordinances and rules, all pension, relief, disability, workmen's compensation and other benefits which apply to the activities of officers, agents, or employees of any of the Members when performing their respective functions shall apply to the same degree and extent while such individuals are engaged in the performance of any of the functions and other duties under this Agreement. None of the officers, agents, or employees appointed by the Board shall be deemed by reason of their employment by the Board to be employed by any of the Members or subject to any of the requirements of such Members.

2.12 **Staff.** CDA shall have no full time staff. The Member who appoints the Director who serves as the Chairperson of the Board shall provide administrative staff support as needed by the CDA. The cost of this administrative staff time shall be borne by the Member who appoints the Director who serves as Chairperson.

2.13 **Minutes.** The Secretary of the Board shall cause minutes of all meetings of the Board to be kept, and shall cause a copy of such minutes to be forwarded to each Director and alternate Director.

2.14 **Rules.** The Board may adopt from time to time such rules and regulations for the conduct of its affairs as it may deem necessary.

III.

PURPOSE AND POWERS

3.1 **Purpose.** Each Member has in common the power to study, plan, develop, finance, acquire, lease, design, construct, maintain, repair, manage, operate, control and dispose of the Facilities, either alone or in cooperation with other public or private entities, as provided in the Term Sheet and to purchase water from facilities owned and operated by other entities. The purpose of this Agreement is to jointly exercise some or all of the foregoing common powers, as appropriate, and for the exercise of such additional powers as may be authorized by law in the manner herein set forth, in order to effectuate the purposes of the Term Sheet. Nothing contained in this Agreement shall obligate any Member to participate in projects other than with regard to the Facilities that may be undertaken by any other Member.

3.2 **Powers and Responsibilities.** All of the power and authority of the CDA shall be exercised by the Board. On an annual basis, at its first meeting of each fiscal year, the Board shall:

(a) Adopt an Operating Plan for the Facilities and direct IEUA and JCSD to implement that plan in accordance with the terms and conditions of the contracts between CDA and IEUA and JCSD for operation and maintenance of the Facilities, entered into pursuant to Section 3.3 hereof;

(b) Adopt a Capital Facilities Plan that generally will describe the operations of the Facilities and any alterations to the Facilities, including construction, lease, purchase acquisition, or divestiture of capital improvements in a manner consistent with the Term Sheet and this Agreement;

(c) Adopt a budget for the CDA for the ensuing fiscal year;

(d) Set the rate at which CDA will sell water; and

(e) Ensure that the Facilities are operated in such a manner that the minimum quantity and quality requirements for desalted water specified in the Term Sheet are satisfied.

3.3 **Operations.** Operations and management of the Facilities will be provided by IEUA and JCSD under contracts with the CDA, execution of both of which shall be an express condition subsequent to this Agreement as provided in Section 12.1(b) hereof. Under such operation and management contracts, IEUA shall be responsible for operation and management of the Chino I Desalter and Chino I Expansion, and JCSD shall be responsible for operation and management of the Chino II Desalter. IEUA and JCSD shall report to the Board as provided in the contracts, and as is otherwise prudent under the circumstances. However, in the event of termination, breach or other failure of performance of such contracts, CDA, in its sole discretion may secure substitute operation and management service on terms and conditions acceptable to the Board.

3.4 **ICADS Term Sheet.** The CDA shall have the power generally to exercise all rights and obligations of the JEG described in the Term Sheet.

3.5 **Manner of Exercising Powers.** In exercising the foregoing powers, the CDA is subject to the restrictions upon the manner of exercising the powers of the City of Ontario.

3.6 **Consultants.** The Board shall have the authority and discretion to hire consultants determined by it to be needed by the CDA. If the Board determines that the CDA needs legal counsel, it shall hire legal counsel that does not represent any Member, or the Chino Basin Watermaster, or any other entity that purchases water from the CDA, unless all Members waive conflicts and consent to representation by such counsel.

IV.

FINANCING

4.1 **Recovery of Costs.** The CDA shall recover all of its costs, including but not limited to capital, operation, maintenance and administrative expenses of any kind, through contracts for the delivery of minimum quantities of desalted water to the Members and through the contracts for sale of water to others as provided in the Term Sheet.

4.2 **Purchase of Water.** Each of the Parties to this Agreement agrees to execute contracts to purchase the quantities of desalted water from the CDA as provided in Sections 5.1(a) and (b) hereof.

4.3 **Price of Desalted Water.** The price of desalted water delivered from the Facilities shall be a uniform per acre-foot amount for all Purchasers, and shall be set to recover all fixed and variable costs incurred by the CDA. However, there shall be no separate or additional costs for wheeling or transportation of water made available by CDA to each Purchaser's designated point of delivery. The price of desalted water to entities which are not Purchasers and which have not become Members of the CDA shall be determined in the sole discretion of the Board.

4.4 **Excess Revenue.** Any excess revenue collected from the sale of water by the CDA shall be applied to reduce the cost of water in the following year on a pro-rated basis according to the then existing relative quantity commitments to purchase water from the CDA. In the alternative, a Purchaser may elect to receive its share of excess revenue in the form of an immediate rebate. Proceeds from the divestment of Facilities shall not be considered in the calculation of excess revenue.

4.5 **Revenue Deficit.** If insufficient revenue is collected from the sale of water by the CDA to satisfy all costs of the CDA described in Section 4.3 hereof, then such deficiency will be assessed by the CDA against all Purchasers on a pro-rated basis according to the relative quantity commitments to purchase water from the CDA for the preceding fiscal year in which such deficit was incurred. The CDA also may set the price of water sold to entities which are not Purchasers and which have not become Members of the CDA at a level which will ameliorate revenue deficiencies.

4.6 **Budget Reserves.** The Board shall determine on an annual basis, prior to the beginning of the fiscal year, a level of reasonable cash reserves to be accumulated by the CDA. This reserve shall be accumulated from revenues collected in excess of all actual costs of the CDA. Once the targeted reserve level is reached, all additional revenues collected in excess of the actual costs of the CDA shall be considered excess revenue, and dispersed according to Section 4.4 above.

V.

QUANTITY AND QUALITY

5.1 **Quantities of Water.**

(a) Minimum Quantity. CDA shall produce a minimum of 24,600 acre-feet of desalted water per year.

(b) Minimum Quantity Commitments. The Members shall purchase the minimum quantity of desalted water provided in the Term Sheet and as set forth below during each fiscal year, at the price provided by Section 4.3 hereof, without regard to whether they actually take delivery of such water.

(1)	JCSD:	8,200 acre-feet per year ("afy")
(2)	Ontario:	5,000 afy
(3)	Chino:	5,000 afy
(4)	Chino Hills:	4,200 afy
(5)	SARWC:	1,200 afy
(6)	Norco	1,000 afy
	Total:	*24,600 afy*

(c) Surplus Water. CDA shall make any water available from the Facilities in excess of the amounts described in Section 5.1(b) above or otherwise subject to a contract to sell by the CDA, as provided in the Term Sheet.

5.2 Abatement:

(a) Reduction as a Result of Equipment Failure or Force Majeure. Except as provided in Section 5.2(c) hereof, if there is insufficient water available from the CDA Facilities to satisfy all contractual entitlements of the Members, then the amount of water delivered will be abated in an amount proportional to the amount that Member contracts-for from the CDA relative to the amount then contracted-for by the other Members.

(b) Reduction as a Result of Request by State of California. In the event the State of California elects to request the firm delivery of desalted water from the CDA in an amount no greater than 100 acre-feet per year in accordance with the provisions of Section 8(b)(i) of the Term Sheet, but cannot receive its full requested delivery amount, each Member shall abate its delivery in proportion to the amount of desalted water that Member contracts-for from the CDA relative to the amount then contracted-for by the other Members, if necessary.

(c) SARWC Request. If the SARWC cannot receive its full allocation of 1,200 acre-feet of water as provided in the Term Sheet, then JCSD and Ontario shall abate their respective deliveries of desalted water on a pro-rata basis to ensure that SARWC can receive its full allocation from CDA. However, JCSD and Ontario shall only have this obligation if SARWC's demand is constant or at a "steady-rate" of 744 gpm.

5.3 **Quality**: The quality of desalted water at the point of delivery for each purchaser under the Term Sheet shall meet the minimum standards of not more than 25 ppm for nitrates and not more than 350 ppm for total dissolved solids, unless an individual purchaser waives such requirements at its point of delivery.

VI.

ACCOUNTING

6.1 **Accounting Procedures.** Full books and accounts shall be maintained for the CDA in accordance with practices established by, or consistent with, those utilized by the Controller of the State of California for like public entities. In particular, the Treasurer shall comply strictly with requirements for the statute governing joint powers agencies, Chapter 5, Division 7, Title 1 of the Government Code.

6.2 **Audit.** On an annual fiscal year basis, the Board shall contract with an independent certified public accountant to perform a financial audit of the accounts and records of the CDA. Copies of such audit reports shall be filed with the State Controller and each Member within six months of the end of the audited fiscal year.

VII.

FACILITIES

7.1 **Description of Facilities.** The Facilities are those generally described as ICADS Project Alternative 10A, depicted in Exhibit "A-2" to the Term Sheet, with the exception of the Arlington Desalter, and also including proper substitutions, modifications and additions. The Facilities may also include those facilities described in Appendix I to this Agreement. The Parties to this Agreement shall exercise good faith and mutual best efforts to promptly and efficiently agree upon changes or substitutions to the Facilities that do not compromise the purposes of the CDA by (a) reducing production quantities below those set forth in Section 5.1 herein or (b) unreasonably increasing the price of the desalted water, unless no Member objects to the price and (c) the Members of CDA assume the full legal and financial responsibility associated with any changes or substitutions.

7.2 **Ownership of Facilities.** All Facilities constructed or acquired by the CDA shall be held in the name of the CDA for the benefit of its Members in accordance with the terms of this Agreement and the Term Sheet.

7.3 **Acquisition, Construction and Improvement of Facilities.** Consistent with Section 7.1 hereof, the Facilities may be acquired, constructed, changed, substituted and improved by the CDA by a majority vote of the Board for the common benefit of the Members. CDA may also acquire, construct or improve Facilities ("improvements") for the benefit of less than all Members, so long as it allocates the cost of such improvements on the basis of benefits received.

7.4 **Divestment of Facilities.** The CDA may sell or otherwise dispose of Facilities by a two-thirds (2/3) approval vote of the Board. However, divestment may only occur if the CDA receives Fair Market Value for the Facilities. Also, no sale, lease, encumbrance or other divestment of a CDA Facility shall occur if it will cause financial harm to a Member or if the divestment adversely impacts the ability of CDA to meet the quantity and quality commitments set forth in Section 5.3, and any adversely affected Member objects to the divestment. The Board shall determine how to utilize the proceeds of the divestment according to the provisions of this Agreement. However, any disbursement of proceeds from the divestment of Facilities shall be made to Members on a pro-rata basis according to their then relative quantity commitments to purchase water from the CDA.

7.5 **Right of First Refusal of Members.** Each Member shall possess a right of first refusal to acquire Facilities that are to be divested by the CDA. In the event that two or more Members of the CDA wish to exercise the right of first refusal with regard to any portion of the Facilities, the entity in whose service area the Facility is located shall have a priority right to exercise that right. If the Facility is not located in the service area of any of the entities who wish to exercise the right, then the Board will determine which Member shall be entitled to acquire the Facility, and the terms and conditions of such acquisition, by majority vote.

VIII.

LIABILITY

8.1 **Liabilities.** The debts, liabilities and obligations of the CDA shall be the debts, liabilities or obligations of the CDA alone and not of the Members, including ex officio Members. However, a Member separately may contract for, or otherwise assume responsibility for specific debts, liabilities, or obligations of the CDA, and no other Member then shall be liable therefore.

IX.

ADDITION AND WITHDRAWAL OF MEMBERS

9.1 **Voluntary Withdrawal.** Except as provided in Section 2.2 hereof with regard to SARWC, any Member may withdraw from the CDA at any time upon giving each of the other Members written notice 180 days prior to the end of the fiscal year; provided, however, any withdrawing Member shall be obligated for all liabilities and expenses of the CDA and its interim pre-formation representative, JCSD, incurred prior to withdrawal, including any commitments to purchase water from the CDA and any other diminution of revenue caused by such withdrawal, unless those obligations are assigned and assumed.

9.2 **Assignment.** A Member may assign its rights under this Agreement subject to the following conditions.

a. Assignments to Members. A Member may assign its right to another Member upon approval by majority vote of the Board, which approval shall not be unreasonably withheld.

b. Assignments to Non-Members. A Member may assign its rights and obligations under this Agreement to entities other than a Member upon prior approval by majority vote of the Board, which approval shall not be unreasonably withheld. However, the CDA and each individual Member shall have a right of first refusal to assume the assigning Member's rights and obligations under the same terms and conditions negotiated by the assigning Member.

(i) As between CDA and any Member, CDA shall have first priority right to exercise the right of first refusal. If the CDA declines to exercise this right, then any individual Member may exercise this right.

(ii) In the event that two or more Members wish to exercise this right of first refusal then the Board will determine which Member shall be entitled to exercise this right by a majority vote of the Board.

(iii) The Member proposing the assignment shall not be permitted to vote on the question of the approval of the assignment, but may vote on the question of who shall be entitled to exercise the right of first refusal.

(iv) The voting rights of the assignee under this Agreement shall be determined in the sole discretion of CDA as provided in Section 9.4.

9.3 **Condemnation or Purchase – Voting.** Where the withdrawal of a Member is the result of condemnation or purchase of that Member by another Member of the CDA, the Board representation of the withdrawing Member shall be eliminated and the other Member shall still have only one representative on the Board, but that representative then shall have the weighted voting rights of the withdrawing Member, and shall assume all financial commitments of the withdrawing Member including any commitments to purchase water from the CDA.

9.4 **Admission of New Members.** Additional entities may become Members of the CDA upon such terms and conditions as may be provided by the Board with the consent of two-thirds (2/3rds) vote of the Board, and evidenced by the execution of a written Amendment to this Agreement by all Members, including the additional Member. The addition of new Members shall not affect any other rights of existing Members without the consent of all affected Members.

X.

DISSOLUTION

10.1 **Term.** The CDA shall continue in existence until dissolved in accordance with the terms of this Article X.

10.2 **Dissolution.** The CDA shall not be dissolved until all debts and liabilities of the CDA have been eliminated.

10.3 **Dissolution Vote.** Subject to Section 10.2 above and the rights and obligations set forth in the Term Sheet, the CDA may be dissolved by a two-thirds (2/3) affirmative vote of the Board, or by the failure of a condition subsequent.

10.4 **Disposition of Property Upon Dissolution.** Upon dissolution of the CDA, any surplus funds on hand shall be returned to the then Members in proportion to the contributions made which proportion shall be defined as the then existing relative quantity commitments to purchase water from the CDA, plus the return of any property contributed by a Member to the CDA for use as part of the Facilities without payment by the CDA to that Member for such use. Upon an affirmative vote to dissolve in accordance with Section 10.3 above, the Board shall offer any Facilities, rights and interests of the CDA for sale to the Members at not less than Fair Market Value. In the event that two or more Members of the CDA wish to purchase any portion of the Facilities, the entity in whose service area the Facility is located shall have a priority right to purchase the Facilities. If the Facility is not located in the service area of any of the entities who wish to purchase it, then the Board will determine who shall be entitled to acquire the Facility by majority vote. If no such sale is consummated within a reasonable period of time, the Board shall then offer such Facilities, rights and interests for sale to any other third party for good and adequate consideration which shall not be less than

Fair Market Value. The net proceeds from any sale shall be distributed among the then Members in proportion to the contributions made which proportion shall be defined as the then existing relative quantity commitments to purchase water from the CDA. The Members shall arrange for the salvage of any remaining Facilities.

XI.

MISCELLANEOUS

11.1 **Amendments.** This Agreement may be amended upon written approval of any Amendment by all Members. The approval by a Member of an Amendment to this Agreement shall not be effective until a certified copy of the resolution of the governing body of such Member is filed with the Secretary of the CDA, together with a fully executed original of such amendment.

11.2 **Notice.** Any notice required to be given or delivered hereunder shall be delivered via the United States Postal Service.

11.3 **Choice of Law.** This Agreement shall be governed by the laws of the State of California.

11.4 **Severability.** If one or more clauses, sentences, paragraphs or provisions of this Agreement shall be held to be unlawful, invalid or unenforceable, it is hereby agreed by the Members that the remainder of the Agreement shall not be affected thereby.

11.5 **Initial Notice.** Within thirty (30) days of the effective date of this Agreement, the CDA shall cause a notice of the Agreement to be prepared in the manner set forth in Section 6503.5 of the Government Code and filed with the Office of the Secretary of State.

11.6 **Additional Notices.** Within thirty (30) days of the effective date of any amendment to this Agreement the CDA shall prepare and file with the Office of the Secretary of State the notice required by Section 6503.5 of the Government Code.

XII

EXPRESS CONDITIONS SUBSEQUENT

12.1 **Mutual Agreements**. This Agreement is subject to satisfaction of the following two express conditions subsequent within ninety (90) days after execution of this Agreement:

(a) Transportation Agreements. The CDA shall execute an agreement with each of its Members that set forth the terms and conditions for transportation of water from the CDA to each of the Members which is acceptable to all Members. Any such agreement shall require the return of any property contributed by a Member to the CDA for use as part of the Facilities without payment by the CDA to that Member for such use.

(b) Operations and Management Agreements. The CDA shall execute an agreement with IEUA for the operation and management of the Chino I Desalter and the Chino I Expansion, and with JCSD for the operation and management of the Chino II Desalter which is acceptable to all Members.

12.2 **Failure of Condition Subsequent.** CDA shall dissolve forthwith in accordance with the provisions of Article X above, unless the conditions subsequent set forth in Section 12.1 above are satisfied within 90 days of the execution of this Agreement, or unless the conditions subsequent are waived by all Parties.

:ity o

APPENDIX I

LIST OF INITIAL EXISTING CHINO I FACILITIES

Wells

Well 1	15000 Euclid Avenue	75 HP	600 GPM
Well 2	15200 Euclid Avenue	40 HP	300 GPM
Well 3	15300 Euclid Avenue	75 HP	600 GPM
Well 4	7600 Kimball Avenue	40 HP	600 GPM
Well 5	8500 Kimball Avenue	125 HP	1,200 GPM
Well 6	8600 Kimball Avenue	125 HP	1,200 GPM
Well 7	8650 Kimball Avenue	125 HP	1,200 GPM
Well 8	15250 Walker Avenue	100 HP	900 GPM
Well 9	8700 Remington Street	100 HP	1,200 GPM
Well 10	8800 Remington Street	100 HP	1,200 GPM
Well 11	9300 Remington Street	125 HP	1,200 GPM

Treatment Facility

9.3 MGD (9,200 AFY) treatment facility Located 6905 Kimball Avenue. Treatment process includes pretreatment, filtration, RO, disinfection and blending.

Offsite Facilities

Jurupa/Norco's Product Waterline

Approximately 62,000 LF of waterline traversing from the Chino I facility to Jurupa's point of connection on 56th Street.

(of this 62,000 LF, 14,000 LF of 30" is located in San Bernardino County and 48,000 LF of 24" and 30" is in Riverside County) (Jurupa paid to upsize the pipeline from 24" to 30" from the County line to Wineville Avenue and therefore owns the capacity difference between the 24" and 30" on this section)

Jurupa's Reservoir

5 MG steel reservoir constructed on Jurupa's property located at Indian Palms Drive and Star View Drive.

City of Chino's Product Waterline

Approximately 23,500 LF of 16" waterline traversing from the Chino 1 treatment facility to reservoir site on Schaefer Avenue.

City of Chino's Reservoir

3 MG steel reservoir constructed on the City of Chino's property located on Schaefer Avenue

CITY OF ONTARIO

DATED: 8/21/01

By: _____
City Manager

DATED: 8/21/01

Attested: _____
City Clerk

_____
Approved as to Form

JURUPA COMMUNITY SERVICES DISTRICT

DATED: 8/6/01 By: _____ President

DATED: 8/6/01 Attested: _____ Secretary

_____
Approved as to Form

CITY OF CHINO

DATED: 9 - 4 - 2001 By: _____
Mayor Pro Tem

DATED: 9-4-01 Attested: _____
City Clerk

_____
Approved as to Form

CITY OF CHINO HILLS

DATED: 10-23-01 By: _____
Mayor

DATED: 10-24-01 Attested: _____
City Clerk

_____
Approved as to Form

CITY OF NORCO

DATED: 8/7/01 By: Hal H Clark
Mayor

DATED: 8/8/01 Attested: [illegible]
City Clerk

[illegible]
Approved as to Form

SANTA ANA RIVER WATER COMPANY

DATED: August 15, 2001

By: Viki R. Rupe
Viki R. Rupe President

DATED: August 15, 2001

Attested: J. Arnold Rodriguez
J. Arnold Rodriguez Secretary

Michele A. Staples
Approved as to Form
Michele A. Staples Esq.

INLAND EMPIRE UTILITIES AGENCY

DATED: August 15, 2001

By: John L. Anderson
President

DATED: August 15, 2001

Attested: Anna Rosales
Secretary

Approved as to Form

The undersigned certifies that this is a true copy as on file in the permanent records of the Agency. This stamp must be in purple ink to constitute a certified copy.
Inland Empire Utilities Agency*
* A Municipal Water District
Date 10 · 18 · 01

STATE OF CALIFORNIA)
) ss.
COUNTY OF SAN BERNARDINO)

I, CAROLE A. MC GREEVY, Secretary of the Board of Directors of the Chino Basin Desalter Authority, do hereby certify that the above and foregoing is a full, true and correct copy of the Joint Exercise of Powers Agreement creating the Chino Basin Desalter Authority dated September 25, 2001.

DATED: February 21, 2002

(SEAL)

Secretary of the Board of Directors

STATE OF CALIFORNIA)
) ss.
COUNTY OF SAN BERNARDINO)

I, CAROLE A. MC GREEVY, Secretary of the Board of Directors of the Chino Basin Desalter Authority, do hereby certify that the above and foregoing is a full, true and correct copy of Amendment No. 1 to the Joint Exercise of Powers Agreement Creating The Chino Basin Desalter Authority dated December 25, 2001.

DATED: February 21, 2002

(SEAL)

Secretary of the Board of Directors

AMENDMENT NO. 1
TO THE JOINT EXERCISE OF POWERS AGREEMENT
CREATING THE CHINO BASIN DESALTER AUTHORITY

This Amendment No. 1 ("Amendment") to the Joint Exercise of Powers Agreement creating the Chino Basin Desalter Authority is made and entered into as of December 25, 2001, by and among the Jurupa Community Services District ("JCSD"), the Santa Ana River Water Company ("SARWC"), the cities of Chino, Chino Hills, Norco and Ontario and the Inland Empire Utilities Agency ("IEUA") (collectively the "Parties" and individually, a "Party").

RECITALS

A. The Parties have previously entered into the Joint Exercise of Powers Agreement creating the Chino Basin Desalter Authority (the "Agreement").

B. The parties desire to amend the Agreement to increase the time during which certain conditions subsequent can be fulfilled.

NOW THEREFORE, THE PARTIES MUTUALLY AGREE AS FOLLOWS:

1. Incorporation By Reference. This amendment hereby incorporates by reference all terms and conditions set forth in the Agreement, unless specifically modified by this Amendment. All terms and conditions set forth in the Agreement which are not specifically modified by this Amendment shall remain in full force and effect.

2. Terms of Amendment.

A. Section 12.2 of the Agreement is hereby amended to read as follows:

"CDA shall dissolve forthwith in accordance with the provisions of Article X above, unless the conditions subsequent set forth in Section 12.1 above are satisfied within 180 days of the execution of this Agreement, or unless the conditions subsequent are waived by all Parties."

IN WITNESS WHEREOF the parties do hereby agree to the full performance of the terms set forth herein.

JURUPA COMMUNITY SERVICES DISTRICT

By: _____

Title: President
Date: 12/18/01

Attest:

By: _____

Title:
Date: _____

Approved as to form

By: _____

Title:
Date: _____

SANTA ANA RIVER WATER COMPANY

By: _____

Title:
Date: _____

Attest:

By: _____

Title:
Date: _____

Approved as to form

By: _____

Title:
Date: _____

CITY OF CHINO

By: _____

Title:
Date: _____

Attest:

By: _____

Title:
Date: _____

Approved as to form

By: _____

Title:
Date: _____

CITY OF CHINO HILLS

By: _____

Title:
Date: _____

Attest:

By: _____

Title:
Date: _____

Approved as to form

By: _____

Title:
Date: _____

IN WITNESS WHEREOF the parties do hereby agree to the full performance of the terms set forth herein.

JURUPA COMMUNITY SERVICES DISTRICT

By: _____

Title:
Date: _____

Attest:

By: _____

Title:
Date: _____

Approved as to form

By: _____

Title:
Date: _____

SANTA ANA RIVER WATER COMPANY

By: _____

Title:
Date: _____

Attest:

By: _____

Title:
Date: _____

Approved as to form

By: _____

Title:
Date: _____

CITY OF CHINO

By: [signature]

Title: Mayor
Date: 12-18-01

Attest:

By: [signature]

Title: City Clerk
Date: 12-18-01

Approved as to form

By: [signature]

Title: City Attorney
Date: 12-18-01

CITY OF CHINO HILLS

By: _____

Title:
Date: _____

Attest:

By: _____

Title:
Date: _____

Approved as to form

By: _____

Title:
Date: _____

IN WITNESS WHEREOF the parties do hereby agree to the full performance of the terms set forth herein.

JURUPA COMMUNITY SERVICES DISTRICT

By: _____

Title:
Date: _____

Attest:

By: _____

Title:
Date: _____

Approved as to form

By: _____

Title:
Date: _____

SANTA ANA RIVER WATER COMPANY

By: Vicki R. Rupe
Vicki R. Rupe
Title: President
Date: December 12, 2001

Attest:

By: J. Arnold Rodriguez
J. Arnold Rodriguez
Title: Secretary
Date: December 12, 2001

Approved as to form

By: Michele A. Staples

Title: Special Legal Counsel
Date: 12/12/2001

CITY OF CHINO

By: _____

Title:
Date: _____

Attest:

By: _____

Title:
Date: _____

Approved as to form

By: _____

Title:
Date: _____

CITY OF CHINO HILLS

By: _____

Title:
Date: _____

Attest:

By: _____

Title:
Date: _____

Approved as to form

By: _____

Title:
Date: _____

IN WITNESS WHEREOF the parties do hereby agree to the full performance of the terms set forth herein.

JURUPA COMMUNITY SERVICES DISTRICT

By: _____

Title:
Date: _____

Attest:

By: _____

Title:
Date: _____

Approved as to form

By: _____

Title:
Date: _____

SANTA ANA RIVER WATER COMPANY

By: _____

Title:
Date: _____

Attest:

By: _____

Title:
Date: _____

Approved as to form

By: _____

Title:
Date: _____

CITY OF CHINO

By: _____

Title:
Date: _____

Attest:

By: _____

Title:
Date: _____

Approved as to form

By: _____

Title:
Date: _____

CITY OF ~~CHINO~~ HILLS

By: _____

Title: Mayor
Date: Dec. 11, 2001

Attest:

By: Mary M McDuffee

Title: Asst. City Clerk
Date: Dec. 11, 2001

Approved as to form

By: _____

Title:
Date: 12/11/01

CITY OF NORCO

By: _____

Title: Mayor
Date: January 2, 2002

Attest:

By: _____

Title: Acting City Clerk
Date: January 2, 2002

Approved as to form

By: _____

Title:
Date: _____

CITY OF ONTARIO

By: _____

Title:
Date: _____

Attest:

By: _____

Title:
Date: _____

Approved as to form

By: _____

Title:
Date: _____

INLAND EMPIRE UTILITIES AGENCY

By: _____

Title:
Date: _____

Attest:

By: _____

Title:
Date: _____

Approved as to form

By: _____

Title:
Date: _____

CITY OF NORCO

By: _____

Title:
Date: _____

Attest:

By: _____

Title:
Date: _____

Approved as to form

By: _____

Title:
Date: _____

CITY OF ONTARIO

By: _____

Title:
Date: _____

Attest:

By: _____

Title:
Date: _____

Approved as to form

By: _____

Title:
Date: _____

INLAND EMPIRE UTILITIES AGENCY

By: [signature]

Title: GENERAL MANAGER
Date: 12/6/01

Attest:

By: [signature]

Title:
Date: 12/10/01

Approved as to form

By: [signature]

Title: General Counsel
Date:

DOCSOC\862287v3\24429.0003

CITY OF NORCO

By: _____

Title:
Date: _____

Attest:

By: _____

Title:
Date: _____

Approved as to form

By: _____

Title:
Date: _____

CITY OF ONTARIO

By: _____

Title: City Manager
Date: 12/04/01

Attest:

By: _____

Title: Assistant City Clerk
Date: 12/04/01

Approved as to form

By: _____

Title: City Attorney
Date: 12/04/01

INLAND EMPIRE UTILITIES AGENCY

By: _____

Title:
Date: _____

Attest:

By: _____

Title:
Date: _____

Approved as to form

By: _____

Title:
Date: _____

DONALD D. STARK
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Attorneys for Plaintiff

FILED
'78 JAN 30 AM 11 41

FILED - West District
San Bernardino County Clerk
DOCT 26 1989

SUPERIOR COURT OF THE STATE OF CALIFORNIA

FOR THE COUNTY OF SAN BERNARDINO

MICROFILMED

CHINO BASIN MUNICIPAL WATER DISTRICT, Plaintiff, v. CITY OF CHINO, et al. Defendants.	No. 164327

REC 51010

JUDGMENT

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(714) 752-8971
Appeal
Exhibits
Supervisor
Other
Secretary
Index
Routing

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JUDGMENT

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SUPERIOR COURT OF THE STATE OF CALIFORNIA

FOR THE COUNTY OF SAN BERNARDINO

CHINO BASIN MUNICIPAL WATER DISTRICT, Plaintiff, v. CITY OF CHINO, et al. Defendants.	No. 164327 JUDGMENT

I. INTRODUCTION

1. Pleadings, Parties and Jurisdiction. The complaint herein was filed on January 2, 1975, seeking an adjudication of water rights, injunctive relief and the imposition of a physical solution. A first amended complaint was filed on July 16, 1976. The defaults of certain defendants have been entered, and certain other defendants dismissed. Other than defendants who have been dismissed or whose defaults have been entered, all defendants have appeared herein. By answers and order of this Court, the issues have been made those of a full inter se adjudication between the

parties. This Court has jurisdiction of the subject matter of this action and of the parties herein.

2. Stipulation For Judgment. Stipulation for entry of judgment has been filed by and on behalf of a majority of the parties, representing a majority of the quantitative rights herein adjudicated.

3. Trial; Findings and Conclusions. Trial was commenced on December 16, 1977, as to the non-stipulating parties, and findings of fact and conclusions of law have been entered disposing of the issues in the case.

4. Definitions. As used in this Judgment, the following terms shall have the meanings herein set forth:

(a) Active Parties. All parties other than those who have filed with Watermaster a written waiver of service of notices, pursuant to Paragraph 58.

(b) Annual or Year -- A fiscal year, July 1 through June 30, following, unless the context shall clearly indicate a contrary meaning.

(c) Appropriative Right -- The annual production right of a producer from the Chino Basin other than pursuant to an overlying right.

(d) Basin Water -- Ground water within Chino Basin which is part of the Safe Yield, Operating Safe Yield, or replenishment water in the Basin as a result of operations under the Physical Solution decreed herein. Said term does not include Stored Water.

(e) CBMWD -- Plaintiff Chino Basin Municipal Water District.

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(f) Chino Basin or Basin -- The ground water basin underlying the area shown as such on Exhibit "B" and within the boundaries described in Exhibit "K".

(g) Chino Basin Watershed -- The surface drainage area tributary to and overlying Chino Basin.

(h) Ground Water -- Water beneath the surface of the ground and within the zone of saturation, i.e., below the existing water table.

(i) Ground Water Basin -- An area underlain by one or more permeable formations capable of furnishing substantial water storage.

(j) Minimal Producer -- Any producer whose production does not exceed five acre-feet per year.

(k) MWD -- The Metropolitan Water District of Southern California.

(l) Operating Safe Yield -- The annual amount of ground water which Watermaster shall determine, pursuant to criteria specified in Exhibit "I", can be produced from Chino Basin by the Appropriative Pool parties free of replenishment obligation under the Physical Solution herein.

(m) Overdraft -- A condition wherein the total annual production from the Basin exceeds the Safe Yield thereof.

(n) Overlying Right -- The appurtenant right of an owner of lands overlying Chino Basin to produce water from the Basin for overlying beneficial use on such lands.

(o) Person. Any individual, partnership, association, corporation, governmental entity or agency, or other organization.

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(p) PVMWD -- Defendant Pomona Valley Municipal Water District.

(q) Produce or Produced -- To pump or extract ground water from Chino Basin.

(r) Producer -- Any person who produces water from Chino Basin.

(s) Production -- Annual quantity, stated in acre feet, of water produced.

(t) Public Hearing -- A hearing after notice to all parties and to any other person legally entitled to notice.

(u) Reclaimed Water -- Water which, as a result of processing of waste water, is suitable for a controlled use.

(v) Replenishment Water -- Supplemental water used to recharge the Basin pursuant to the Physical Solution, either directly by percolating the water into the Basin or indirectly by delivering the water for use in lieu of production and use of safe yield or Operating Safe Yield.

(w) Responsible Party -- The owner, co-owner, lessee or other person designated by multiple parties interested in a well as the person responsible for purposes of filing reports hereunder.

(x) Safe Yield -- The long-term average annual quantity of ground water (excluding replenishment or stored water but including return flow to the Basin from use of replenishment or stored water) which can be produced from the Basin under cultural conditions of a particular year without causing an undesirable result.

(y) SBVMWD -- San Bernardino Valley Municipal Water

LAW OFFICES
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District.

(z) State Water -- Supplemental Water imported through the State Water Resources Development System, pursuant to Chapter 8, Division 6, Part 6 of the Water Code.

(aa) Stored Water -- Supplemental water held in storage, as a result of direct spreading, in lieu delivery, or otherwise, for subsequent withdrawal and use pursuant to agreement with Watermaster.

(bb) Supplemental Water -- Includes both water imported to Chino Basin from outside Chino Basin Watershed, and reclaimed water.

(cc) WMWD -- Defendant Western Municipal Water District of Riverside County.

5. List of Exhibits. The following exhibits are attached to this Judgment and made a part hereof:

"A" -- "Location Map of Chino Basin" showing boundaries of Chino Basin Municipal Water District, and other geographic and political features.

"B" -- "Hydrologic Map of Chino Basin" showing hydrologic features of Chino Basin.

"C" -- Table Showing Parties in Overlying (Agricultural) Pool.

"D" -- Table Showing Parties in Overlying (Non-agricultural Pool and Their Rights.

"E" -- Table Showing Appropriators and Their Rights.

"F" -- Overlying (Agricultural) Pool Pooling Plan.

"G" -- Overlying (Non-agricultural) Pool Pooling Plan.

"H" -- Appropriative Pool Pooling Plan.

LAW OFFICES
DONALD D. STARK
A PROFESSIONAL CORPORATION
SUITE 201
2061 BUSINESS CENTER DRIVE
IRVINE, CALIFORNIA 92715
(714) 752-8971

"I" -- Engineering Appendix.

"J" -- Map of In Lieu Area No. 1.

"K" -- Legal Description of Chino Basin.

II. DECLARATION OF RIGHTS

A. HYDROLOGY

6. Safe Yield. The Safe Yield of Chino Basin is 140,000 acre feet per year.

7. Overdraft and Prescriptive Circumstances. In each year for a period in excess of five years prior to filing of the First Amended Complaint herein, the Safe Yield of the Basin has been exceeded by the annual production therefrom, and Chino Basin is and has been for more than five years in a continuous state of overdraft. The production constituting said overdraft has been open, notorious, continuous, adverse, hostile and under claim of right. The circumstances of said overdraft have given notice to all parties of the adverse nature of such aggregate over-production.

B. WATER RIGHTS IN SAFE YIELD

8. Overlying Rights. The parties listed in Exhibits "C" and "D" are the owners or in possession of lands which overlie Chino Basin. As such, said parties have exercised overlying water rights in Chino Basin. All overlying rights owned or exercised by parties listed in Exhibits "C" and "D" have, in the aggregate, been limited by prescription except to the extent such rights have been preserved by self-help by said parties. Aggregate preserved overlying rights in the Safe Yield for agricultural pool use, including the rights of the State of California, total 82,800 acre feet per year. Overlying rights for non-agricultural pool use

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total 7,366 acre feet per year and are individually decreed for each affected party in Exhibit "D". No portion of the Safe Yield of Chino Basin exists to satisfy unexercised overlying rights, and such rights have all been lost by prescription. However, uses may be made of Basin Water on overlying lands which have no preserved overlying rights pursuant to the Physical Solution herein. All overlying rights are appurtenant to the land and cannot be assigned or conveyed separate or apart therefrom.

9. Appropriative Rights. The parties listed in Exhibit "E" are the owners of appropriative rights, including rights by prescription, in the unadjusted amounts therein set forth, and by reason thereof are entitled under the Physical Solution to share in the remaining Safe Yield, after satisfaction of overlying rights and rights of the State of California, and in the Operating Safe Yield in Chino Basin, in the annual shares set forth in Exhibit "E".

(a) Loss of Priorities. By reason of the long continued overdraft in Chino Basin, and in light of the complexity of determining appropriative priorities and the need for conserving and making maximum beneficial use of the water resources of the State, each and all of the parties listed in Exhibit "E" are estopped and barred from asserting special priorities or preferences, inter se. All of said appropriative rights are accordingly deemed and considered of equal priority.

(b) Nature and Quantity. All rights listed in Exhibit "E" are appropriative and prescriptive in nature. By reason of the status of the parties, and the provisions of Section

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1007 of the Civil Code, said rights are immune from reduction or limitation by prescription.

10. Rights of the State of California. The State of California, by and through its Department of Corrections, Youth Authority and Department of Fish and Game, is a significant producer of ground water from and the State is the largest owner of land overlying Chino Basin. The precise nature and scope of the claims and rights of the State need not be, and are not, defined herein. The State, through said departments, has accepted the Physical Solution herein decreed, in the interests of implementing the mandate of Section 2 of Article X of the California Constitution. For all purposes of this Judgment, all future production by the State or its departments or agencies for overlying use on State-owned lands shall be considered as agricultural pool use.

C. RIGHTS TO AVAILABLE GROUND WATER STORAGE CAPACITY

11. Available Ground Water Storage Capacity. There exists in Chino Basin a substantial amount of available ground water storage capacity which is not utilized for storage or regulation of Basin Waters. Said reservoir capacity can appropriately be utilized for storage and conjunctive use of supplemental water with Basin Waters. It is essential that said reservoir capacity utilization for storage and conjunctive use of supplemental water be undertaken only under Watermaster control and regulation, in order to protect the integrity of both such Stored Water and Basin Water in storage and the Safe Yield of Chino Basin.

12. Utilization of Available Ground Water Capacity. Any person or public entity, whether a party to this action or not, may make reasonable beneficial use of the available ground water

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storage capacity of Chino Basin for storage of supplemental water; provided that no such use shall be made except pursuant to written agreement with Watermaster, as authorized by Paragraph 28. In the allocation of such storage capacity, the needs and requirements of lands overlying Chino Basin and the owners of rights in the Safe Yield or Operating Safe Yield of the Basin shall have priority and preference over storage for export.

III. INJUNCTION

13. Injunction Against Unauthorized Production of Basin Water. Each party in each of the respective pools is enjoined, as follows:

(a) Overlying (Agricultural) Pool. Each party in the Overlying (Agricultural) Pool, its officers, agents, employees, successors and assigns, is and they each are ENJOINED AND RESTRAINED from producing ground water from Chino Basin in any year hereafter in excess of such party's correlative share of the aggregate of 82,800 acre feet allocated to said Pool, except pursuant to the Physical Solution or a storage water agreement.

(b) Overlying (Non-Agricultural) Pool. Each party in the Overlying (Non-agricultural) Pool, its officers, agents, employees, successors and assigns, is and they each are ENJOINED AND RESTRAINED from producing ground water of Chino Basin in any year hereafter in excess of such party's decreed rights in the Safe Yield, except pursuant to the provisions of the Physical Solution or a storage water agreement.

(c) Appropriative Pool. Each party in the

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Appropriative Pool, its officers, agents, employees, successors and assigns, is and they are each ENJOINED AND RESTRAINED from producing ground water of Chino Basin in any year hereafter in excess of such party's decreed share of Operating Safe Yield, except pursuant to the provisions of the Physical Solution or a storage water agreement.

14. Injunction Against Unauthorized Storage or Withdrawal of Stored Water. Each party, its officers, agents, employees, successors and assigns is and they each are ENJOINED AND RESTRAINED from storing supplemental water in Chino Basin for withdrawal, or causing withdrawal of, water stored by that party, except pursuant to the terms of a written agreement with Watermaster and in accordance with Watermaster regulations. Any supplemental water stored or recharged in the Basin, except pursuant to such a Water-master agreement, shall be deemed abandoned and not classified as Stored Water. This paragraph has no application, as such, to supplemental water spread or provided in lieu by Watermaster pursuant to the Physical Solution.

IV. CONTINUING JURISDICTION

15. Continuing Jurisdiction. Full jurisdiction, power and authority are retained and reserved to the Court as to all matters contained in this judgment, except:

(a) The redetermination of Safe Yield, as set forth in Paragraph 6, during the first ten (10) years of operation of the Physical Solution;

(b) The allocation of Safe Yield as between the several pools as set forth in Paragraph 44 of the Physical Solution;

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(c) The determination of specific quantitative rights and shares in the declared Safe Yield or Operating Safe Yield herein declared in Exhibits "D" and "E"; and

(d) The amendment or modification of Paragraphs 7(a) and (b) of Exhibit "H", during the first ten (10) years of operation of the Physical Solution, and thereafter only upon affirmative recommendation of at least 67% of the voting power (determined pursuant to the formula described in Paragraph 3 of Exhibit "H"), but not less than one-third of the members of the Appropriative Pool Committee representatives of parties who produce water within CBMWD or WMWD; after said tenth year the formula set forth in said Paragraph 7(a) and 7(b) of Exhibit "H" for payment of the costs of replenishment water may be changed to 100% gross or net, or any percentage split thereof, but only in response to recommendation to the Court by affirmative vote of at least 67% of said voting power of the Appropriative Pool representatives of parties who produce ground water within CBMWD or WMWD, but not less than one-third of their number. In such event, the Court shall act in conformance with such recommendation unless there are compelling reasons to the contrary; and provided, further, that the fact that the allocation of Safe Yield or Operating Safe Yield shares may be rendered moot by a recommended change in the formula for replenishment assessments shall not be deemed to be such a "compelling reason."

Said continuing jurisdiction is provided for the purpose of enabling the Court, upon application of any party, the Watermaster, the Advisory Committee or any Pool Committee, by motion and, upon

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at least 30 days' notice thereof, and after hearing thereon, to make such further or supplemental orders or directions as may be necessary or appropriate for interpretation, enforcement or carrying out of this Judgment, and to modify, amend or amplify any of the provisions of this Judgment.

V. WATERMASTER

A. APPOINTMENT

16. Watermaster Appointment. CBMWD, acting by and through a majority of its board of directors, is hereby appointed Watermaster, to administer and enforce the provisions of this Judgment and any subsequent instructions or orders of the Court hereunder. The term of appointment of Watermaster shall be for five (5) years. The Court will by subsequent orders provide for successive terms or for a successor Watermaster. Watermaster may be changed at any time by subsequent order of the Court, on its own motion, or on the motion of any party after notice and hearing. Unless there are compelling reasons to the contrary, the Court shall act in conformance with a motion requesting the Watermaster be changed if such motion is supported by a majority of the voting power of the Advisory Committee.

B. POWERS AND DUTIES

17. Powers and Duties. Subject to the continuing supervision and control of the Court, Watermaster shall have and may exercise the express powers, and shall perform the duties, as provided in this Judgment or hereafter ordered or authorized by the Court in the exercise of the Court's continuing jurisdiction.

18. Rules and Regulations. Upon recommendation by the

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Advisory Committee, Watermaster shall make and adopt, after public hearing, appropriate rules and regulations for conduct of Watermaster affairs, including meeting schedules and procedures, and compensation of members of Watermaster at not to exceed $25 per member per meeting, or $300 per member per year, whichever is less, plus reasonable expenses related to activities within the Basin. Thereafter, Watermaster may amend said rules from time to time upon recommendation, or with approval of the Advisory Committee after hearing noticed to all active parties. A copy of said rules and regulations, and of any amendments thereof, shall be mailed to each active party.

19. Acquisition of Facilities. Watermaster may purchase, lease, acquire and hold all necessary facilities and equipment; provided, that it is not the intent of the Court that Watermaster acquire any interest in real property or substantial capital assets.

20. Employment of Experts and Agents. Watermaster may employ or retain such administrative, engineering, geologic, accounting, legal or other specialized personnel and consultants as may be deemed appropriate in the carrying out of its powers and shall require appropriate bonds from all officers and employees handling Watermaster funds. Watermaster shall maintain records for purposes of allocation of costs of such services as well as of all other expenses of Watermaster administration as between the several pools established by the Physical Solution.

21. Measuring Devices. Watermaster shall cause parties, pursuant to uniform rules, to install and maintain in good operating condition, at the cost of each party, such necessary measuring

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devices or meters as Watermaster may deem appropriate. Such measuring devices shall be inspected and tested as deemed necessary by Watermaster, and the cost thereof shall constitute an expense of Watermaster.

22. Assessments. Watermaster is empowered to levy and collect all assessments provided for in the pooling plans and Physical Solution.

23. Investment of Funds. Watermaster may hold and invest any and all Watermaster funds in investments authorized from time to time for public agencies of the State of California.

24. Borrowing. Watermaster may borrow from time to time amounts not exceeding the annual anticipated receipts of Watermaster during such year.

25. Contracts. Watermaster may enter into contracts for the performance of any powers herein granted; provided, however, that Watermaster may not contract with or purchase materials, supplies or services from CBMWD, except upon the prior recommendation and approval of the Advisory Committee and pursuant to written order of the Court.

26. Cooperation With Other Agencies. Subject to prior recommendation or approval of the Advisory Committee, Watermaster may act jointly or cooperate with agencies of the United States and the State of California or any political subdivisions, municipalities or districts or any person to the end that the purpose of the Physical Solution may be fully and economically carried out.

27. Studies. Watermaster may, with concurrence of the Advisory Committee or affected Pool Committee and in accordance with Paragraph 54(b), undertake relevant studies of hydrologic

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conditions, both quantitative and qualitative, and operating aspects of implementation of the management program for Chino Basin.

28. Ground Water Storage Agreements. Watermaster shall adopt, with the approval of the Advisory Committee, uniformly applicable rules and a standard form of agreement for storage of supplemental water, pursuant to criteria therefor set forth in Exhibit "I". Upon appropriate application by any person, Watermaster shall enter into such a storage agreement; provided that all such storage agreements shall first be approved by written order of the Court, and shall by their terms preclude operations which will have a substantial adverse impact on other producers.

29. Accounting for Stored Water. Watermaster shall calculate additions, extractions and losses and maintain an annual account of all Stored Water in Chino Basin, and any losses of water supplies or Safe Yield of Chino Basin resulting from such Stored Water.

30. Annual Administrative Budget. Watermaster shall submit to Advisory Committee an administrative budget and recommendation for each fiscal year on or before March 1. The Advisory Committee shall review and submit said budget and their recommendations to Watermaster on or before April 1, following. Watermaster shall hold a public hearing on said budget at its April quarterly meeting and adopt the annual administrative budget which shall include the administrative items for each pool committee. The administrative budget shall set forth budgeted items in sufficient detail as necessary to make a proper allocation of the expense among the several pools, together with Watermaster's proposed allocation. The budget shall contain such additional comparative information

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or explanation as the Advisory Committee may recommend from time to time. Expenditures within budgeted items may thereafter be made by Watermaster in the exercise of powers herein granted, as a matter of course. Any budget transfer in excess of 20% of a budget category during any budget year or modification of such administrative budget during any year shall be first submitted to the Advisory Committee for review and recommendation.

31. Review Procedures. All actions, decisions or rules of Watermaster shall be subject to review by the Court on its own motion or on timely motion by any party, the Watermaster (in the case of a mandated action), the Advisory Committee, or any Pool Committee, as follows:

(a) Effective Date of Watermaster Action. Any action, decision or rule of Watermaster shall be deemed to have occurred or been enacted on the date on which written notice thereof is mailed. Mailing of copies of approved Watermaster minutes to the active parties shall constitute such notice to all parties.

(b) Noticed Motion. Any party, the Watermaster (as to any mandated action), the Advisory Committee, or any Pool Committee may, by a regularly noticed motion, apply to the Court for review of any Watermaster's action, decision or rule. Notice of such motion shall be served personally or mailed to Watermaster and to all active parties. Unless otherwise ordered by the Court, such motion shall not operate to stay the effect of such Watermaster action, decision or rule.

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(c) Time for Motion. Notice of motion to review any Watermaster action, decision or rule shall be served and filed within ninety (90) days after such Watermaster action, decision or rule, except for budget actions, in which event said notice period shall be sixty (60) days.

(d) De Novo Nature of Proceedings. Upon the filing of any such motion, the Court shall require the moving party to notify the active parties, the Watermaster, the Advisory Committee and each Pool Committee, of a date for taking evidence and argument, and on the date so designated shall review de novo the question at issue. Watermaster's findings or decision, if any, may be received in evidence at said hearing, but shall not constitute presumptive or prima facie proof of any fact in issue.

(e) Decision. The decision of the Court in such proceeding shall be an appealable supplemental order in this case. When the same is final, it shall be binding upon the Watermaster and all parties.

C. ADVISORY AND POOL COMMITTEES

32. Authorization. Watermaster is authorized and directed to cause committees of producer representatives to be organized to act as Pool Committees for each of the several pools created under the Physical Solution. Said Pool Committees shall, in turn, jointly form an Advisory Committee to assist Watermaster in performance of its functions under this judgment. Pool Committees shall be composed as specified in the respective pooling plans, and the Advisory Committee shall be composed of not to exceed ten (10) voting representatives from each pool, as designated by the

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respective Pool Committee. WMWD, PVMWD and SBVMWD shall each be entitled to one non-voting representative on said Advisory Committee.

33. Term and Vacancies. Members of any Pool Committee, shall serve for the term, and vacancies shall be filled, as specified in the respective pooling plan. Members of the Advisory Committee shall serve at the will of their respective Pool Committee.

34. Voting Power. The voting power on each Pool Committee shall be allocated as provided in the respective pooling plan. The voting power on the Advisory Committee shall be one hundred (100) votes allocated among the three pools in proportion to the total assessments paid to Watermaster during the preceding year; provided, that the minimum voting power of each pool shall be

(a) Overlying (Agricultural) Pool 20,

(b) Overlying (Non-agricultural) Pool 5, and

(c) Appropriative Pool 20.

In the event any pool is reduced to its said minimum vote, the remaining votes shall be allocated between the remaining pools on said basis of assessments paid to Watermaster by each such remaining pool during the preceding year. The method of exercise of each pool's voting power on the Advisory Committee shall be as determined by the respective pool committees.

35. Quorum. A majority of the voting power of the Advisory Committee or any Pool Committee shall constitute a quorum for the transaction of affairs of such Advisory or Pool Committee; provided, that at least one representative of each Pool Committee shall be required to constitute a quorum of the Advisory Committee. No Pool Committee representative may purposely absent himself or

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herself, without good cause, from an Advisory Committee meeting to deprive it of a quorum. Action by affirmative vote of a majority of the entire voting power of any Pool Committee or the Advisory Committee shall constitute action by such committee. Any action or recommendation of a Pool Committee or the Advisory Committee shall be transmitted to Watermaster in writing, together with a report of any dissenting vote or opinion.

36. Compensation. Pool or Advisory Committee members may receive compensation, to be established by the respective pooling plan, but not to exceed twenty-five dollars ($25.00) for each meeting of such Pool or Advisory Committee attended, and provided that no member of a Pool or Advisory Committee shall receive compensation of more than three hundred ($300.00) dollars for service on any such committee during any one year. All such compensation shall be a part of Watermaster administrative expense. No member of any Pool or Advisory Committee shall be employed by Watermaster or compensated by Watermaster for professional or other services rendered to such Pool or Advisory Committee or to Watermaster, other than the fee for attendance at meetings herein provided, plus reimbursement of reasonable expenses related to activities within the Basin.

37. Organization.

(a) Organizational Meeting. At its first meeting in each year, each Pool Committee and the Advisory Committee shall elect a chairperson and a vice chairperson from its membership. It shall also select a secretary, a treasurer and such assistant secretaries and treasurers as may be appropriate, any of whom may, but need not, be members of

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such Pool or Advisory Committee.

(b) Regular Meetings. All Pool Committees and the Advisory Committee shall hold regular meetings at a place and time to be specified in the rules to be adopted by each Pool and Advisory Committee. Notice of regular meetings of any Pool or Advisory Committee, and of any change in time or place thereof, shall be mailed to all active parties in said pool or pools.

(c) Special Meetings. Special meetings of any Pool or Advisory Committee may be called at any time by the Chairperson or by any three (3) members of such Pool or Advisory Committee by delivering notice personally or by mail to each member of such Pool or Advisory Committee and to each active party at least 24 hours before the time of each such meeting in the case of personal delivery, and 96 hours in the case of mail. The calling notice shall specify the time and place of the special meeting and the business to be transacted. No other business shall be considered at such meeting.

(d) Minutes. Minutes of all Pool Committee, Advisory Committee and Watermaster meetings shall be kept at Watermaster's offices. Copies thereof shall be mailed or otherwise furnished to all active parties in the pool or pools concerned. Said copies of minutes shall constitute notice of any Pool or Advisory Committee action therein reported, and shall be available for inspection by any party.

(e) Adjournments. Any meeting of any Pool or Advisory Committee may be adjourned to a time and place specified in the order of adjournment. Less than a quorum may so adjourn

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from time to time. A copy of the order or notice of adjournment shall be conspicuously posted forthwith on or near the door of the place where the meeting was held.

38. Powers and Functions. The powers and functions of the respective Pool Committees and the Advisory Committee shall be as follows:

(a) Pool Committees. Each Pool Committee shall have the power and responsibility for developing policy recommendations for administration of its particular pool, as created under the Physical Solution. All actions and recommendations of any Pool Committee which require Watermaster implementation shall first be noticed to the other two pools. If no objection is received in writing within thirty (30) days, such action or recommendation shall be transmitted directly to Watermaster for action. If any such objection is received, such action or recommendation shall be reported to the Advisory Committee before being transmitted to Watermaster.

(b) Advisory Committee. The Advisory Committee shall have the duty to study, and the power to recommend, review and act upon all discretionary determinations made or to be made hereunder by Watermaster.

[1] Committee Initiative. When any recommendation or advice of the Advisory Committee is received by Watermaster, action consistent therewith may be taken by Watermaster; provided, that any recommendation approved by 80 votes or more in the Advisory Committee shall constitute a mandate for action by Watermaster consistent therewith. If Watermaster is unwilling or unable to act

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pursuant to recommendation or advice from the Advisory Committee (other than such mandatory recommendations), Watermaster shall hold a public hearing, which shall be followed by written findings and decision. Thereafter, Watermaster may act in accordance with said decision, whether consistent with or contrary to said Advisory Committee recommendation. Such action shall be subject to review by the Court, as in the case of all other Watermaster determinations.

[2] Committee Review. In the event Watermaster proposes to take any discretionary action, other than approval or disapproval of a Pool Committee action or recommendation properly transmitted, or execute any agreement not theretofore within the scope of an Advisory Committee recommendation, notice of such intended action shall be served on the Advisory Committee and its members at least thirty (30) days before the Watermaster meeting at which such action is finally authorized.

(c) Review of Watermaster Actions. Watermaster (as to mandated action), the Advisory Committee or any Pool Committee shall be entitled to employ counsel and expert assistance in the event Watermaster or such Pool or Advisory Committee seeks Court review of any Watermaster action or failure to act. The cost of such counsel and expert assistance shall be Watermaster expense to be allocated to the affected pool or pools.

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VI. PHYSICAL SOLUTION

A. GENERAL

39. Purpose and Objective. Pursuant to the mandate of Section 2 of Article X of the California Constitution, the Court hereby adopts and orders the parties to comply with a Physical Solution. The purpose of these provisions is to establish a legal and practical means for making the maximum reasonable beneficial use of the waters of Chino Basin by providing the optimum economic, long-term, conjunctive utilization of surface waters, ground waters and supplemental water, to meet the requirements of water users having rights in or dependent upon Chino Basin.

40. Need for Flexibility. It is essential that this Physical Solution provide maximum flexibility and adaptability in order that Watermaster and the Court may be free to use existing and future technological, social, institutional and economic options, in order to maximize beneficial use of the waters of Chino Basin. To that end, the Court's retained jurisdiction will be utilized, where appropriate, to supplement the discretion herein granted to the Wastermaster.

41. Watermaster Control. Watermaster, with the advice of the Advisory and Pool Committees, is granted discretionary powers in order to develop an optimum basin management program for Chino Basin, including both water quantity and quality considerations. Withdrawals and supplemental water replenishment of Basin Water, and the full utilization of the water resources of Chino Basin, must be subject to procedures established by and administered through Watermaster with the advice and assistance of the Advisory and Pool Committees composed of the affected producers. Both the

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quantity and quality of said water resources may thereby be preserved and the beneficial utilization of the Basin maximized.

42. General Pattern of Operations. It is contemplated that the rights herein decreed will be divided into three (3) operating pools for purposes of Watermaster administration. A fundamental premise of the Physical Solution is that all water users dependent upon Chino Basin will be allowed to pump sufficient waters from the Basin to meet their requirements. To the extent that pumping exceeds the share of the Safe Yield assigned to the Overlying Pools, or the Operating Safe Yield in the case of the Appropriative Pool, each pool will provide funds to enable Watermaster to replace such overproduction. The method of assessment in each pool shall be as set forth in the applicable pooling plan.

B. POOLING

43. Multiple Pools Established. There are hereby established three (3) pools for Watermaster administration of, and for the allocation of responsibility for, and payment of, costs of replenishment water and other aspects of this Physical Solution.

(a) Overlying (Agricultural) Pool. The first pool shall consist of the State of California and all overlying producers who produce water for other than industrial or commercial purposes. The initial members of the pool are listed in Exhibit "C".

(b) Overlying (Non-agricultural) Pool. The second pool shall consist of overlying producers who produce water for industrial or commercial purposes. The initial members of this pool are listed in Exhibit "D".

(c) Appropriative Pool. A third and separate pool shall

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consist of owners of appropriative rights. The initial members of the pool are listed in Exhibit "E".

Any party who changes the character of his use may, by subsequent order of the Court, be reassigned to the proper pool; but the allocation of Safe Yield under Paragraph 44 hereof shall not be changed. Any non-party producer or any person who may hereafter commence production of water from Chino Basin, and who may become a party to this physical solution by intervention, shall be assigned to the proper pool by the order of the Court authorizing such intervention.

44. Determination and Allocation of Rights to Safe Yield of Chino Basin. The declared Safe Yield of Chino Basin is hereby allocated as follows:

Pool	Allocation
Overlying (Agricultural) Pool	414,000 acre feet in any five (5) consecutive years.
Overlying (Non-agricultural) Pool.	7,366 acre feet per year.
Appropriative Pool	49,834 acre feet per year.

The foregoing acre foot allocations to the overlying pools are fixed. Any subsequent change in the Safe Yield shall be debited or credited to the Appropriative Pool. Basin Water available to the Appropriative Pool without replenishment obligation may vary from year to year as the Operating Safe Yield is determined by Watermaster pursuant to the criteria set forth in Exhibit "I".

45. Annual Replenishment. Watermaster shall levy and collect assessments in each year, pursuant to the respective pooling plans, in amounts sufficient to purchase replenishment water to replace production by any pool during the preceding year which exceeds that

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pool's allocated share of Safe Yield in the case of the overlying pools, or Operating Safe Yield in the case of the Appropriative Pool. It is anticipated that supplemental water for replenishment of Chino Basin may be available at different rates to the various pools to meet their replenishment obligations. If such is the case, each pool will be assessed only that amount necessary for the cost of replenishment water to that pool, at the rate available to the pool, to meet its replenishment obligation.

46. Initial Pooling Plans. The initial pooling plans, which are hereby adopted, are set forth in Exhibits "F", "G" and "H", respectively. Unless and until modified by amendment of the judgment pursuant to the Court's continuing jurisdiction, each such plan shall control operation of the subject pool.

C. REPORTS AND ACCOUNTING

47. Production Reports. Each party or responsible party shall file periodically with Watermaster, pursuant to Watermaster rules, a report on a form to be prescribed by Watermaster showing the total production of such party during the preceding reportage period, and such additional information as Watermaster may require, including any information specified by the affected Pool Committee.

48. Watermaster Reports and Accounting. Watermaster's annual report, which shall be filed on or before November 15 of each year and shall apply to the preceding year's operation, shall contain details as to operation of each of the pools and a certified audit of all assessments and expenditures pursuant to this Physical Solution and a review of Watermaster activities.

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D. REPLENISHMENT

49. Sources of Supplemental Water. Supplemental water may be obtained by Watermaster from any available source. Watermaster shall seek to obtain the best available quality of supplemental water at the most reasonable cost for recharge in the Basin. To the extent that costs of replenishment water may vary between pools, each pool shall be liable only for the costs attributable to its required replenishment. Available sources may include, but are not limited to:

(a) Reclaimed Water. There exist a series of agreements generally denominated the Regional Waste Water Agreements between CBMWD and owners of the major municipal sewer systems within the basin. Under those agreements, which are recognized hereby but shall be unaffected and unimpaired by this judgment, substantial quantities of reclaimed water may be made available for replenishment purposes. There are additional sources of reclaimed water which are, or may become, available to Watermaster for said purposes. Maximum beneficial use of reclaimed water shall be given high priority by Watermaster.

(b) State Water. State water constitutes a major available supply of supplemental water. In the case of State Water, Watermaster purchases shall comply with the water service provisions of the State's water service contracts. More specifically, Watermaster shall purchase State Water from MWD for replenishment of excess production within CBMWD, WMWD and PVMWD, and from SBVMWD to replenish excess production within SBVMWD's boundaries in Chino Basin, except to the

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extent that MWD and SBVMWD give their consent as required by such State water service contracts.

(c) Local Import. There exist facilities and methods for importation of surface and ground water supplies from adjacent basins and watersheds.

(d) Colorado River Supplies. MWD has water supplies available from its Colorado River Aqueduct.

50. Methods of Replenishment. Watermaster may accomplish replenishment of overproduction from the Basin by any reasonable method, including:

(a) Spreading and percolation or Injection of water in existing or new facilities, subject to the provisions of Paragraphs 19, 25 and 26 hereof.

(b) In Lieu Procedures. Watermaster may make, or cause to be made, deliveries of water for direct surface use, in lieu of ground water production.

E. REVENUES

51. Production Assessment. Production assessments, on whatever basis, may be levied by Watermaster pursuant to the pooling plan adopted for the applicable pool.

52. Minimal Producers. Minimal Producers shall be exempted from payment of production assessments, upon filing of production reports as provided in Paragraph 47 of this Judgment, and payment of an annual five dollar ($5.00) administrative fee as specified by Watermaster rules.

53. Assessment Proceeds -- Purposes. Watermaster shall have the power to levy assessments against the parties (other than minimal pumpers) based upon production during the preceding period

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of assessable production, whether quarterly, semi-annually or annually, as may be determined most practical by Watermaster or the affected Pool Committee.

54. Administrative Expenses. The expenses of administration of this Physical Solution shall be categorized as either (a) general Watermaster administrative expense, or (b) special project expense.

(a) General Watermaster Administrative Expense shall include office rental, general personnel expense, supplies and office equipment, and related incidental expense and general overhead.

(b) Special Project Expense shall consist of special engineering, economic or other studies, litigation expense, meter testing or other major operating expenses. Each such project shall be assigned a Task Order number and shall be separately budgeted and accounted for.

General Watermaster administrative expense shall be allocated and assessed against the respective pools based upon allocations made by the Watermaster, who shall make such allocations based upon generally accepted cost accounting methods. Special Project Expense shall be allocated to a specific pool, or any portion thereof, only upon the basis of prior express assent and finding of benefit by the Pool Committee, or pursuant to written order of the Court.

55. Assessments -- Procedure. Assessments herein provided for shall be levied and collected as follows:

(a) Notice of Assessment. Watermaster shall give written notice of all applicable assessments to each party on

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or before ninety (90) days after the end of the production period to which such assessment is applicable.

(b) Payment. Each assessment shall be payable on or before thirty (30) days after notice, and shall be the obligation of the party or successor owning the water production facility at the time written notice of assessment is given, unless prior arrangement for payment by others has been made in writing and filed with Watermaster.

(c) Delinquency. Any delinquent assessment shall bear interest at 10% per annum (or such greater rate as shall equal the average current cost of borrowed funds to the Watermaster) from the due date thereof. Such delinquent assessment and interest may be collected in a show-cause proceeding herein instituted by the Watermaster, in which case the Court may allow Watermaster its reasonable costs of collection, including attorney's fees.

56. Accumulation of Replenishment Water Assessment Proceeds. In order to minimize fluctuation in assessment and to give Watermaster flexibility in purchase and spreading of replenishment water, Watermaster may make reasonable accumulations of replenishment water assessment proceeds. Interest earned on such retained funds shall be added to the account of the pool from which the funds were collected and shall be applied only to the purchase of replenishment water.

57. Effective Date. The effective date for accounting and operation under this Physical Solution shall be July 1, 1977, and the first production assessments hereunder shall be due after July 1, 1978. Watermaster shall, however, require installation of

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meters or measuring devices and establish operating procedures immediately, and the costs of such Watermaster activity (not including the cost of such meters and measuring devices) may be recovered in the first administrative assessment in 1978.

VII. MISCELLANEOUS PROVISIONS

58. Designation of Address for Notice and Service. Each party shall designate the name and address to be used for purposes of all subsequent notices and service herein, either by its endorsement on the Stipulation for Judgment or by a separate designation to be filed within thirty (30) days after Judgment has been served. Said designation may be changed from time to time by filing a written notice of such change with the Watermaster. Any party desiring to be relieved of receiving notices of Watermaster or committee activity may file a waiver of notice on a form to be provided by Watermaster. Thereafter such party shall be removed from the Active Party list. Watermaster shall maintain at all times a current list of active parties and their addresses for purposes of service. Watermaster shall also maintain a full current list of names and addresses of all parties or their successors, as filed herein. Copies of such lists shall be available, without cost, to any party, the Advisory Committee or any Pool Committee upon written request therefor.

59. Service of Documents. Delivery to or service upon any party or active party by the Watermaster, by any other party, or by the Court, of any item required to be served upon or delivered to such party or active party under or pursuant to the Judgment shall be made personally or by deposit in the United States mail, first

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class, postage prepaid, addressed to the designee and at the address in the latest designation filed by such party or active party.

60. Intervention After Judgment. Any non-party assignee of the adjudicated appropriative rights of any appropriator, or any other person newly proposing to produce water from Chino Basin, may become a party to this judgment upon filing a petition in intervention. Said intervention must be confirmed by order of this Court. Such intervenor shall thereafter be a party bound by this judgment and entitled to the rights and privileges accorded under the Physical Solution herein, through the pool to which the Court shall assign such intervenor.

61. Loss of Rights. Loss, whether by abandonment, forfeiture or otherwise, of any right herein adjudicated shall be accomplished only (1) by a written election by the owner of the right filed with Watermaster, or (2) by order of the Court upon noticed motion and after hearing.

62. Scope of Judgment. Nothing in this Judgment shall be deemed to preclude or limit any party in the assertion against a neighboring party of any cause of action now existing or hereafter arising based upon injury, damage or depletion of water supply available to such party, proximately caused by nearby pumping which constitutes an unreasonable interference with such complaining party's ability to extract ground water.

63. Judgment Binding on Successors. This Judgment and all provisions thereof are applicable to and binding upon not only the parties to this action, but also upon their respective heirs, executors, administrators, successors, assigns, lessees and

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licensees and upon the agents, employees and attorneys in fact of all such persons.

64. Costs. No party shall recover any costs in this proceeding from any other party.

Dated: JAN 27 1978.

Judge

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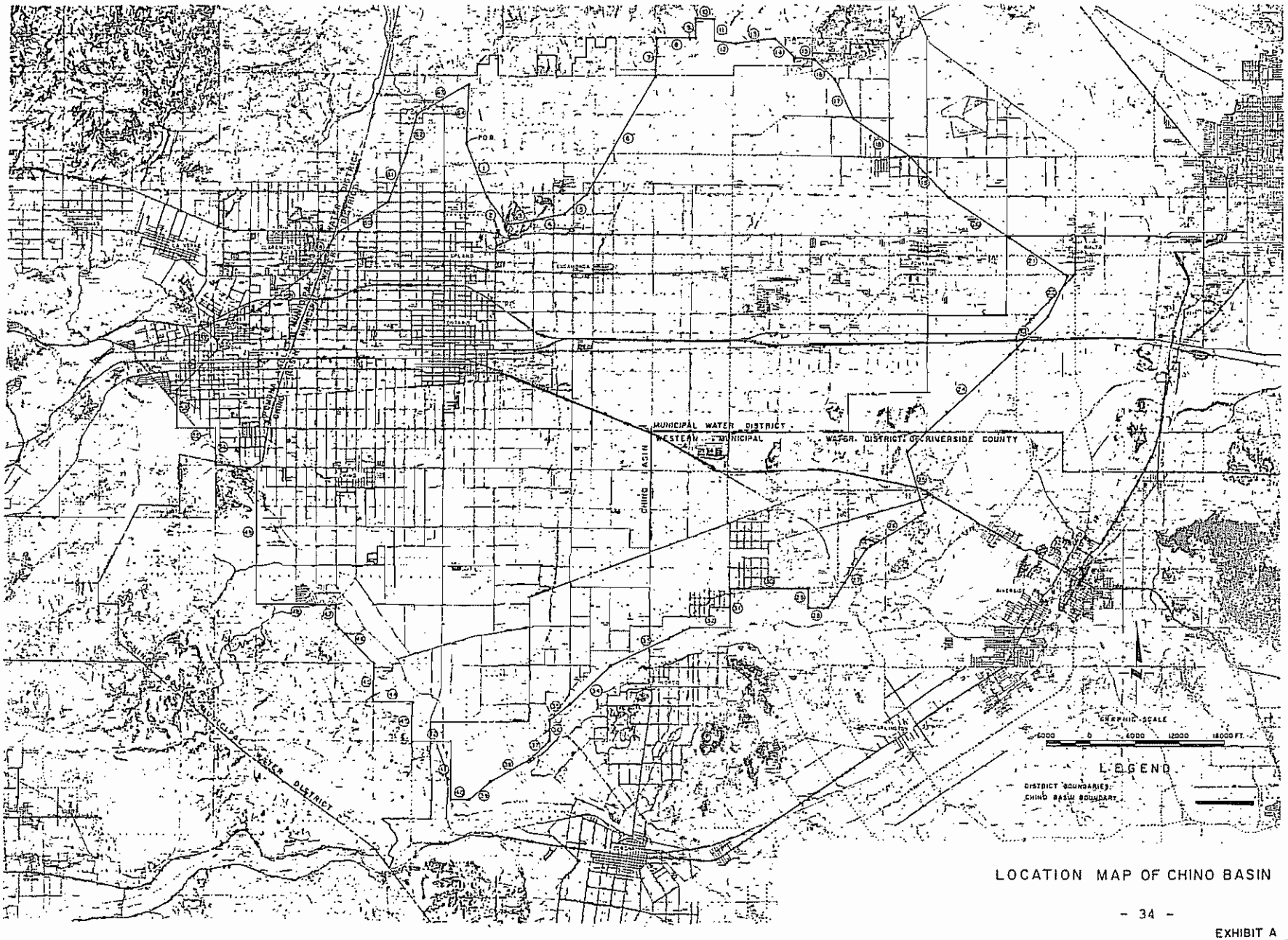
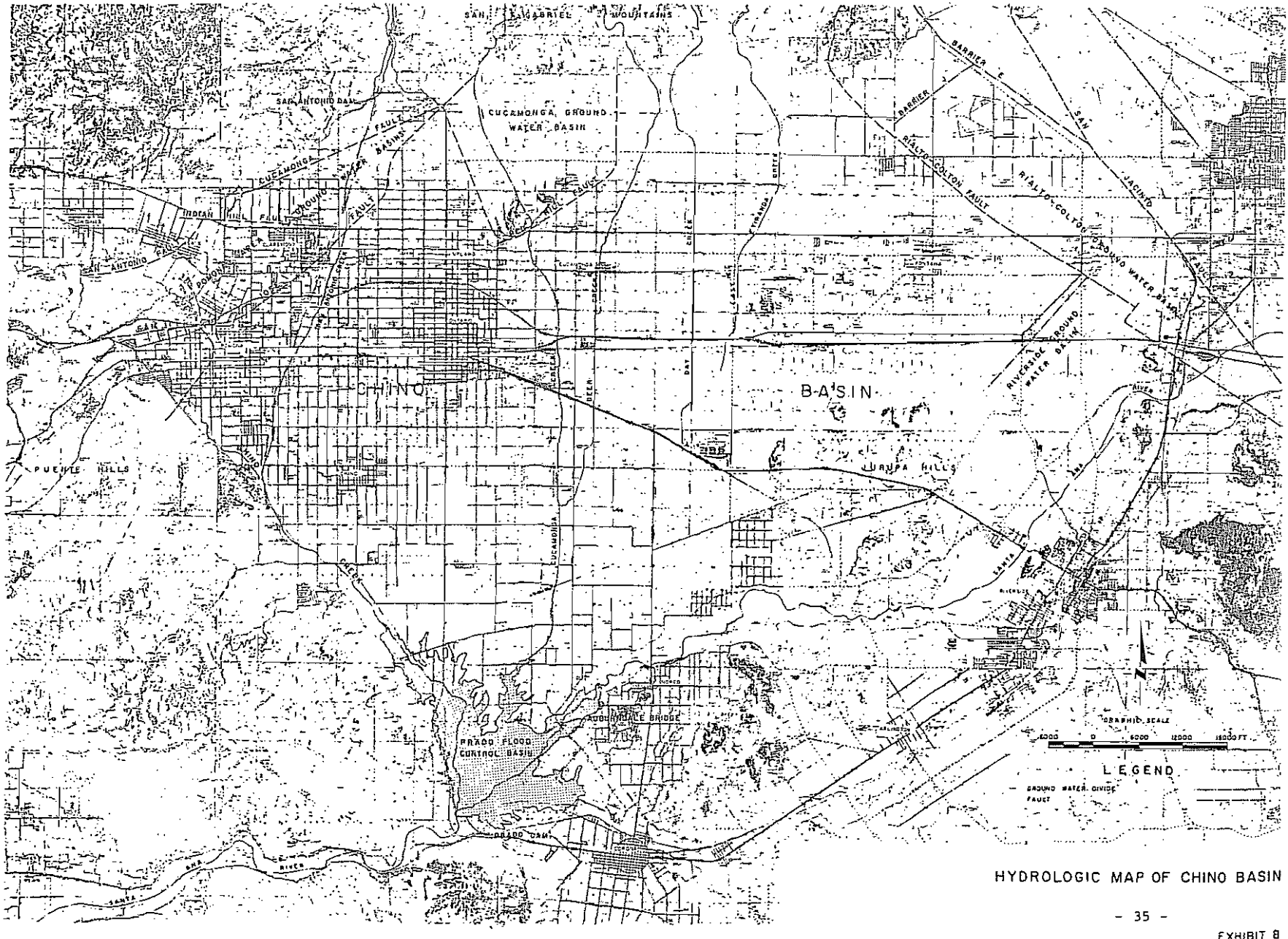


LOCATION MAP OF CHINO BASIN

EXHIBIT A



HYDROLOGIC MAP OF CHINO BASIN

EXHIBIT 8

STIPULATING OVERLYING AGRICULTURAL PRODUCERS

STATE OF CALIFORNIA
COUNTY OF SAN BERNARDINO
Abacherli Dairy, Inc.
Abacherli, Frank
Abacherli, Shirley
Abbona, Anna
Abbona, James
Abbona, Jim
Abbona, Mary
Agliani, Amelia H.
Agman, Inc.
Aguerre, Louis B.
Ahmanson Trust Co.
Akiyama, Shizuye
Akiyama, Tomoo
Akkerman, Dave
Albers, J. N.
Albers, Nellie
Alewyn, Jake J.
Alewyn, Normalee
Alger, Mary D.
Alger, Raymond
Allen, Ben F.
Allen, Jane F.
Alta-Dena Dairy
Anderson Farms
Anguiano, Sarah L. S.
Anker, Gus
Aphessetche, Xavier
Arena Mutual Water Assn.
Armstrong Nurseries, Inc.
Arretche, Frank
Arretche, Jean Pierre
Arvidson, Clarence F.
Arvidson, Florence
Ashley, George W.
Ashley, Pearl E.
Atlas Farms
Atlas Ornamental Iron Works, Inc.
Aukeman, Carol
Aukeman, Lewis
Ayers, Kenneth C., aka Kelley Ayers
Bachoc, Raymond
Baldwin, Edgar A.
Baldwin, Lester
Banbury, Carolyn
Bangma Dairy
Bangma, Arthur
Bangma, Ida
Bangma, Martin
Bangma, Sam
Barba, Anthony B.
Barba, Frank
Barcellos, Joseph
Barnhill, Maurine W.

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Barnhill, Paul	Boersma, Angie
Bartel, Dale	Boersma, Berdina
Bartel, Ursula	Boersma, Frank
Bartel, Willard	Boersma, Harry
Barthelemy, Henry	Boersma, Paul
Barthelemy, Roland	Boersma, Sam
Bassler, Donald V., M.D.	Boersma, William L.
Bates, Lowell R.	Bohlander & Holmes, Inc.
Bates, Mildred L.	Bokma, Peter
Beahm, James W.	Bollema, Jacob
Beahm, Joan M.	Boonstoo, Edward
Bekendam, Hank	Bootsma, Jim
Bekendam, Pete	Borba, Dolene
Bello, Eugene	Borba, Dolores
Bello, Olga	Borba, Emily
Beltman, Evelyn	Borba, George
Beltman, Tony	Borba, John
Bergquist Properties, Inc.	Borba, John & Sons
Bevacqua, Joel A.	Borba, John Jr.
Bevacqua, Marie B.	Borba, Joseph A.
Bidart, Bernard	Borba, Karen E.
Bidart, Michael J.	Borba, Karen M.
Binnell, Wesley	Borba, Pete, Estate of
Black, Patricia E.	Borba, Ricci
Black, Victor	Borba, Steve
Bodger, John & Sons Co.	Borba, Tom
Boer, Adrian	Bordisso, Alleck
Boersma and Wind Dairy	Borges, Angelica M.

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1 Borges, Bernadette
2 Borges, John O.
3 Borges, Linda L.
4 Borges, Manual Jr.
5 Borges, Tony
6 Bos, Aleid
7 Bos, Gerrit
8 Bos, John
9 Bos, John
10 Bos, Margaret
11 Bos, Mary
12 Bos, Mary Beth
13 Bos, Tony
14 Bosch, Henrietta
15 Bosch, Peter T.
16 Boschma, Betty
17 Boschma, Frank
18 Boschma, Greta
19 Boschma, Henry
20 Bosma, Dick
21 Bosma, Florence G.
22 Bosma, Gerrit
23 Bosma, Jacob J.
24 Bosma, Jeanette Thea
25 Bosman, Frank
26 Bosman, Nellie
27 Bosnyak, Goldie M.
28 Bosnyak, Martin

Bothof, Roger W.
Bouma, Cornie
Bouma, Emma
Bouma, Henry P.
Bouma, Martin
Bouma, Peter G. & Sons Dairy
Bouma, Ted
Bouman, Helen
Bouman, Sam
Bower, Mabel E.
Boys Republic
Breedyk, Arie
Breedyk, Jessie
Briano Brothers
Briano, Albert
Briano, Albert Trustee for
Briano, Albert Frank
Briano, Lena
Brink, Russell N.
Brinkerhoff, Margaret
Brinkerhoff, Robert L.
Britschgi, Florence
Britschgi, Magdalena Garetto
Britschgi, Walter P.
Brommer, Marvin
Brookside Enterprizes, dba
Brookside Vineyard Co.
Brothers Three Dairy

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Brown, Eugene
Brun, Martha M.
Brun, Peter Robert
Buma, Duke
Buma, Martha
Bunse, Nancy
Bunse, Ronnie L.
Caballero, Bonnie L.
Caballero, Richard F.
Cable Airport Inc.
Cadlini, Donald
Cadlini, Jesse R.
Cadlini, Marie Edna
Cambio, Anna
Cambio, Charles, Estate of
Cambio, William V.
Cardoza, Florence
Cardoza, Olivi
Cardoza, Tony
Carnesi, Tom
Carver, Robt M., Trustee
Cauffman, John R.
Chacon Bros.
Chacon, Elvera P.
Chacon, Joe M.
Chacon, Robert M.
Chacon, Virginia L.
Chez, Joseph C.
Chino Corona Investment
Chino Water Co.
Christensen, Leslie
Christensen, Richard G.
Christian, Ada R.
Christian, Harold F.
Christy, Ella J.
Christy, Ronald S.
Cihigoyenetche, Jean
Cihigoyenetche, Leona
Cihigoyenetche, Martin
Clarke, Arthur B.
Clarke, Nancy L.
Clarke, Phyllis J.
Coelho, Isabel
Coelho, Joe A. Jr.
Collins, Howard E.
Collins, Judith F.
Collinsworth, Ester L.
Collinsworth, John E.
Collinsworth, Shelby
Cone Estate (05-2-00648/649)
Consolidated Freightways Corp. of Delaware
Corona Farms Co.
Corra, Rose
Costa, Dimas S.
Costa, Laura

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1 Costa, Myrtle
2 Costamagna, Antonio
3 Costamagna, Joseph
4 Cousyn, Claus B.
5 Cramer, Carole F.
6 Cramer, William R.
7 Crossroads Auto Dismantlers, Inc.
8 Crouse, Beatrice I.
9 Crouse, Roger
10 Crowley, Juanita C.
11 Crowley, Ralph
12 Cucamonga Vintners
13 D'Astici, Teresa
14 Da Costa, Cecilia B.
15 Da Costa, Joaquim F.
16 Daloisio, Norman
17 De Berard Bros.
18 De Berard, Arthur, Trustee
19 De Berard, Charles
20 De Berard, Chas., Trustee
21 De Berard, Helan J.
22 De Berard, Robert
23 De Berard, Robert, Trustee
24 De Bie, Adrian
25 De Bie, Henry
26 De Bie, Margaret M.
27 De Bie, Marvin
28 De Boer, Fred

De Boer, L. H.
De Boer, Sidney
De Bos, Andrew
De Graaf, Anna Mae
De Graaf, Gerrit
De Groot, Dick
De Groot, Dorothy
De Groot, Ernest
De Groot, Henrietta
De Groot, Jake
De Groot, Pete Jr.
De Haan, Bernadena
De Haan, Henry
De Hoog, Adriana
De Hoog, Joe
De Hoog, Martin
De Hoog, Martin L.
De Hoog, Mitch
De Hoog, Tryntje
De Jager, Cobi
De Jager, Edward D.
De Jong Brothers Dairy
De Jong, Cornelis
De Jong, Cornelius
De Jong, Grace
De Jong, Jake
De Jong, Lena
De Leeuw, Alice

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1 De Leeuw, Sam
2 De Soete, Agnes
3 De Soete, Andre
4 De Vries, Abraham
5 De Vries, Case
6 De Vries, Dick
7 De Vries, Evelyn
8 De Vries, Henry, Estate of
9 De Vries, Hermina
10 De Vries, Jack H.
11 De Vries, Jane
12 De Vries, Janice
13 De Vries, John
14 De Vries, John J.
15 De Vries, Neil
16 De Vries, Ruth
17 De Vries, Theresa
18 De Wit, Gladys
19 De Wit, Peter S.
20 De Wyn, Evert
21 De Zoete, Hattie V.
22 De Zoete, Leo A.
23 Decker, Hallie
24 Decker, Henry A.
25 Demmer, Ernest
26 Di Carlo, Marie
27 Di Carlo, Victor
28 Di Tommaso, Frank

Dirkse, Catherine
Dirkse, Charles C.
Dixon, Charles E.
Dixon, Geraldine A.
Doesberg, Hendrica
Doesburg, Theodorus P.
Dolan, Marion
Dolan, Michael H.
Dominguez, Helen
Dominguez, Manual
Donkers, Henry A.
Donkers, Nellie G.
Dotta Bros.
Douma Brothers Dairy
Douma, Betty A.
Douma, Fred A.
Douma, Hendrika
Douma, Herman G.
Douma, Narleen J.
Douma, Phillip M.
Dow Chemical Co.
Dragt, Rheta
Dragt, William
Driftwood Dairy Farm
Droogh, Case
Duhalde, Marian
Duhalde, Lauren
Duits, Henrietta

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Duits, John
Dunlap, Edna Kraemer,
Estate of
Durrington, Glen
Durrington, William F.
Dusi, John, Sr.
Dykstra, Dick
Dykstra, John
Dykstra, John & Sons
Dykstra, Wilma
Dyt, Cor
Dyt, Johanna
E and S Grape Growers
Eaton, Thomas, Estate of
Echeverria, Juan
Echeverria, Carlos
Echeverria, Pablo
Eilers, E. Myrle
Eilers, Henry W.
El Prado Golf Course
Ellsworth, Rex C.
Engelsma, Jake
Engelsma, Susan
Escojeda, Henry
Etiwanda Grape Products Co.
Euclid Ave. Investment One
Euclid Ave. Investment Four
Euclid Ave. Three Investment

Excelsior Farms
F.D.I.C.
Fagundes, Frank M.
Fagundes, Mary
Fernandes, Joseph Jr.
Fernandes, Velma C.
Ferraro, Ann
Ferreira, Frank J.
Ferreira, Joe C. Jr.
Ferreira, Narcie
Filippi, J. Vintage Co.
Filippi, Joseph
Filippi, Joseph A.
Filippi, Mary E.
Fitzgerald, John R.
Flameling Dairy Inc.
Flamingo Dairy
Foss, Douglas E.
Foss, Gerald R.
Foss, Russel
Fred & John Troost No. 1 Inc.
Fred & Maynard Troost No. 2 Inc.
Freitas, Beatriz
Freitas, Tony T.
Gakle, Louis L.
Galleano Winery, Inc.
Galleano, Bernard D.
Galleano, D.
Galleano, Mary M.

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1 Garcia, Pete
2 Gardner, Leland V.
3 Gardner, Lola M.
4 Garrett, Leonard E.
5 Garrett, Patricia T.
6 Gastelluberry, Catherine
7 Gastelluberry, Jean
8 Gilstrap, Glen E.
9 Gilstrap, Marjorie J.
10 Godinho, John
11 Godinho, June
12 Gonsalves, Evelyn
13 Gonsalves, John
14 Gorzeman, Geraldine
15 Gorzeman, Henry A.
16 Gorzeman, Joe
17 Govea, Julia
18 Goyenetche, Albert
19 Grace, Caroline E.
20 Grace, David J.
21 Gravatt, Glenn W.
22 Gravatt, Sally Mae
23 Greydanus Dairy, Inc.
24 Greydanus, Rena
25 Griffin Development Co.
26 Haagsma, Dave
27 Haagsma, John
28 Hansen, Mary D.

Hansen, Raymond F.
Hanson, Ardeth W.
Harada, James T.
Harada, Violet A.
Haringa, Earl and Sons
Haringa, Herman
Haringa, Rudy
Haringa, William
Harper, Cecilia de Mille
Harrington, Winona
Harrison, Jacqueline A.
Hatanaka, Kenichi
Heida, Annie
Heida, Don
Heida, Jim
Heida, Sam
Helms, Addison D.
Helms, Irma A.
Hermans, Alma I.
Hermans, Harry
Hettinga, Arthur
Hettinga, Ida
Hettinga, Judy
Hettinga, Mary
Hettinga, Wilbur
Heublein, Inc., Grocery Products Group
Hibma, Catherine M.

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Hibma, Sidney
Hicks, Kenneth I.
Hicks, Minnie M.
Higgins Brick Co.
Highstreet, Alfred V.
Highstreet, Evada V.
Hilarides, Bertha as Trustee
Hilarides, Frank
Hilarides, John as Trustee
Hindelang, Tillie
Hindelang, William
Hobbs, Bonnie C.
Hobbs, Charles W.
Hobbs, Hazel I.
Hobbs, Orlo M.
Hoekstra, Edward
Hoekstra, George
Hoekstra, Grace
Hoekstra, Louie
Hofer, Paul B.
Hofer, Phillip F.
Hofstra, Marie
Hogeboom, Jo Ann M.
Hogeboom, Maurice D.
Hogg, David V.
Hogg, Gene P.
Hogg, Warren G.
Hohberg, Edith J.
Hohberg, Harold C.
Hohberg, Harold W.
Holder, Arthur B.
Holder, Dorothy F.
Holmes, A. Lee
Holmes, Frances P.
Hoogeboom, Gertrude
Hoogeboom, Pete
Hoogendam, John
Hoogendam, Tena
Houssels, J. K. Thoroughbred Farm
Hunt Industries
Idsinga, Ann
Idsinga, William W.
Imbach Ranch, Inc.
Imbach, Kenneth E.
Imbach, Leonard K.
Imbach, Oscar K.
Imbach, Ruth M.
Indaburu, Jean
Indaburu, Marceline
Iseli, Kurt H.
Ito, Kow
J & B Dairy Inc.
Jaques, Johnny C. Jr.
Jaques, Mary
Jaques, Mary Lou

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2 Johnson Bro's Egg Ranches, Inc.
3 Johnston, Ellwood W.
4 Johnston, George F. Co.
5 Johnston, Judith H.
6 Jones, Leonard P.
7 Jongsma & Sons Dairy
8 Jongsma, Diana A.
9 Jongsma, Dorothy
10 Jongsma, George
11 Jongsma, Harold
12 Jongsma, Henry
13 Jongsma, John
14 Jongsma, Nadine
15 Jongsma, Tillie
16 Jordan, Marjorie G.
17 Jordan, Troy O.
18 Jorritsma, Dorothy
19 Juliano, Albert
20 Kamper, Cornelis
21 Kamstra, Wilbert
22 Kaplan, Lawrence J.
23 Kasbergen, Martha
24 Kasbergen, Neil
25 Kazian, Angelen Estate of
26 Kingsway Const. Corp.
27 Klapps Market
28 Kline, James K.

Knevelbaard, John
Knudsen, Ejnar
Knudsen, Karen M.
Knudsen, Kenneth
Knudson, Robert
Knudson, Darlene
Koel, Helen S.
Koetsier, Gerard
Koetsier, Gerrit J.
Koetsier, Jake
Koning, Fred W.
Koning, Gloria
Koning, J. W. Estate
Koning, James A.
Koning, Jane
Koning, Jane C.
Koning, Jennie
Koning, John
Koning, Victor A.
Kooi Holstein Corporation
Koolhaas, Kenneth E.
Koolhaas, Simon
Koolhaas, Sophie Grace
Koopal, Grace
Koopal, Silas
Koopman, Eka
Koopman, Gene T.
Koopman, Henry G.

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1 Koopman, Ted
2 Koopman, Tena
3 Koot, Nick
4 Koster, Aart
5 Koster, Frances
6 Koster, Henry B.
7 Koster, Nellie
8 Kroes, Jake R.
9 Kroeze, Bros
10 Kroeze, Calvin E.
11 Kroeze, John
12 Kroeze, Wesley
13 Kruckenberg, Naomi
14 Kruckenberg, Perry
15 L. D. S. Welfare Ranch
16 Labrucherie, Mary Jane
17 Labrucherie, Raymond F.
18 Lako, Samuel
19 Landman Corp.
20 Lanting, Broer
21 Lanting, Myer
22 Lass, Jack
23 Lass, Sandra L.
24 Lawrence, Cecelia, Estate of
25 Lawrence, Joe H., Estate of
26 Leal, Bradley W.
27 Leal, John C.
28 Leal, John Craig

Leck, Arthur A.
Leck, Evelyn M.
Lee, Harold E.
Lee, Helen J.
Lee, Henrietta C.
Lee, R. T. Construction Co.
Lekkerkerk, Adriana
Lekkerkerk, L. M.
Lekkerkerker, Nellie
Lekkerkerker, Walt
Lewis Homes of California
Livingston, Dorothy M.
Livingston, Rex E.
Lokey, Rosemary Kraemer
Lopes, Candida A.
Lopes, Antonio S.
Lopez, Joe D.
Lourenco, Carlos, Jr.
Lourenco, Carmelina P.
Lourenco, Jack C.
Lourenco, Manual H.
Lourenco, Mary
Lourenco, Mary
Luiten, Jack
Luiz, John M.
Luna, Christine I.
Luna, Ruben T.
Lusk, John D. and Son
a California corporation

EXHIBIT "C"

LAW OFFICES
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Lyon, Gregory E.
Lyon, Paula E.
M & W Co. #2
Madole, Betty M.
Madole, Larry B.
Marquez, Arthur
Marquine, Jean
Martin, Lelon O.
Martin, Leon O.
Martin, Maria D.
Martin, Tony J.
Martins, Frank
Mathias, Antonio
Mc Cune, Robert M.
Mc Masters, Gertrude
Mc Neill, J. A.
Mc Neill, May F.
Mees, Leon
Mello and Silva Dairy
Mello and Sousa Dairy
Mello, Emilia
Mello, Enos C.
Mello, Mercedes
Mendiondo, Catherine
Mendiondo, Dominique
Meth. Hosp. - Sacramento
Metzger, R. S.
Metzger, Winifred
Mickel, Louise
Miersma, Dorothy
Meirsma, Harry C.
Minaberry, Arnaud
Minaberry, Marie
Mistretta, Frank J.
Mocho and Plaa Inc.
Mocho, Jean
Mocho, Noeline
Modica, Josephine
Montes, Elizabeth
Montes, Joe
Moons, Beatrice
Moons, Jack
Moramarco, John A. Enterprises
Moreno, Louis W.
Moss, John R.
Motion Pictures Associates, Inc.
Moynier, Joe
Murphy, Frances V.
Murphy, Myrl L.
Murphy, Naomi
Nanne, Martin Estate of
Nederend, Betty
Nederend, Hans
Norfolk, James
Norfolk, Martha
Notrica, Louis

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1 Nyberg, Lillian M.
2 Nyenhuis, Annie
3 Nyenhuis, Jim
4 Occidental Land Research
5 Okumura, Marion
6 Okumura, Yuiche
7 Oldengarm, Effie
8 Oldengarm, Egbert
9 Oldengarm, Henry
10 Oliviera, Manuel L.
11 Oliviera, Mary M.
12 Olson, Albert
13 Oltmans Construction Co.
14 Omlin, Anton
15 Omlin, Elsie L.
16 Ontario Christian School Assn.
17 Oord, John
18 Oostdam, Jacoba
19 Oostdam, Pete
20 Oosten, Agnes
21 Oosten, Anthonia
22 Oosten, Caroline
23 Oosten, John
24 Oosten, Marinus
25 Oosten, Ralph
26 Orange County Water District
27 Ormonde, Manuel
28 Ormonde, Pete, Jr.

Ormonde, Viva
Ortega, Adeline B.
Ortega, Bernard Dino
Osterkamp, Joseph S.
Osterkamp, Margaret A.
P I E Water Co.
Palmer, Eva E.
Palmer, Walter E.
Parente, Luis S.
Parente, Mary Borba
Parks, Jack B.
Parks, Laura M.
Patterson, Lawrence E. Estate of
Payne, Clyde H.
Payne, Margo
Pearson, Athelia K.
Pearson, William C.
Pearson, William G.
Pene, Robert
Perian, Miller
Perian, Ona E.
Petrissans, Deanna
Petrissans, George
Petrissans, Jean P.
Petrissans, Marie T.
Pickering, Dora M.
(Mrs. A. L. Pickering)
Pierce, John

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1 Pierce, Sadie
2 Pietszak, Sally
3 Pine, Joe
4 Pine, Virginia
5 Pires, Frank
6 Pires, Marie
7 Plaa, Jeanne
8 Plaa, Michel
9 Plantenga, Agnes
10 Plantenga, George
11 Poe, Arlo D.
12 Pomona Cemetery Assn.
13 Porte, Cecelia, Estate of
14 Porte, Garritt, Estate of
15 Portsmouth, Vera McCarty
16 Ramella, Mary M.
17 Ramirez, Concha
18 Rearick, Hildegard H.
19 Rearick, Richard R.
20 Reinalda, Clarence
21 Reitsma, Greta
22 Reitsma, Louis
23 Rice, Bernice
24 Rice, Charlie E.
25 Richards, Karin
26 (Mrs. Ronnie Richards)
27 Richards, Ronald L.
28 Ridder, Jennie Wassenaar

Righetti, A. T.
Riley, George A.
Riley, Helen C.
Robbins, Jack K.
Rocha, John M.
Rocha, Jose C.
Rodrigues, John
Rodrigues, Manuel
Rodrigues, Manuel, Jr.
Rodrigues, Mary L.
Rodriquez, Daniel
Rogers, Jack D.
Rohrer, John A.
Rohrer, Theresa D.
Rohrs, Elizabeth H.
Rossetti, M. S.
Roukema, Angeline
Roukema, Ed.
Roukema, Nancy
Roukema, Siebren
Ruderian, Max J.
Russell, Fred J.
Rusticus, Ann
Rusticus, Charles
Rynsburger, Arie
Rynsburger, Berdena, Trust
Rynsburger, Joan Adele
Rynsburger, Thomas

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1 S. P. Annex, Inc.
2 Salisbury, Elinor J.
3 Sanchez, Edmundo
4 Sanchez, Margarita O.
5 Santana, Joe Sr.
6 Santana, Palmira
7 Satragni, John B. Jr.
8 Scaramella, George P.
9 Schaafsma Bros.
10 Schaafsma, Jennie
11 Schaafsma, Peter
12 Schaafsma, Tom
13 Schaap, Andy
14 Schaap, Ids
15 Schaap, Maria
16 Schacht, Sharon C.
17 Schakel, Audrey
18 Schakel, Fred
19 Schmid, Olga
20 Schmidt, Madeleine
21 Schoneveld, Evert
22 Schoneveld, Henrietta
23 Schoneveld, John
24 Schoneveld, John Allen
25 Schug, Donald E.
26 Schug, Shirley A.
27 Schuh, Bernatta M.
28 Schuh, Harold H.

Scott, Frances M.
Scott, Linda F.
Scott, Stanley A.
Scritsmier, Lester J.
Serl, Charles A.
Serl, Rosalie P.
Shady Grove Dairy, Inc.
Shamel, Burt A.
Shelby, Harold E.
Shelby, John A.
Shelby, Velma M.
Shelton, Alice A.
Sherwood, Robert W.
Sherwood, Sheila J.
Shue, Eva
Shue, Gilbert
Sieperda, Anne
Sieperda, James
Sigrist, Hans
Sigrist, Rita
Silveira, Arline L.
Silveira, Frank
Silveira, Jack
Silveira, Jack P. Jr.
Simas, Dolores
Simas, Joe
Singleton, Dean
Singleton, Elsie R.

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1 Sinnott, Jim
2 Sinnott, Mildred B.
3 Slegers, Dorothy
4 Slegers, Hubert J.
5 Slegers, Jake
6 Slegers, Jim
7 Slegers, Lenwood M.
8 Slegers, Martha
9 Slegers, Tesse J.
10 Smith, Edward S.
11 Smith, Helen D.
12 Smith, James E.
13 Smith, Keith J.
14 Smith, Lester W.
15 Smith, Lois Maxine
16 Smith, Marjorie W.
17 Soares, Eva
18 Sogioka, Mitsuyoshi
19 Sogioka, Yoshimato
20 Sousa, Sam
21 Southern Pacific Land Co.
22 Southfield, Eddie
23 Souza, Frank M.
24 Souza, Mary T.
25 Spickerman, Alberta
26 Spickerman, Florence
27 Spickerman, Rudolph
28 Spyksma, John

Staal, John
Stahl, Zippora P.
Stampfl, Berta
Stampfl, William
Stanley, Robert E.
Stark, Everett
Stellingwerf, Andrew
Stellingwerf, Henry
Stellingwerf, Jenette
Stellingwerf, Shana
Stellingwerf, Stan
Stelzer, Mike C.
Sterk, Henry
Stiefel, Winifred
Stiefel, Jack D.
Stigall, Richard L.
Stigall, Vita
Stockman's Inn
Stouder, Charlotte A.
Stouder, William C.
Struikmans, Barbara
Struikmans, Gertie
Struikmans, Henry Jr.
Struikmans, Henry Sr.
Struikmans, Nellie
Swager, Edward
Swager, Gerben
Swager, Johanna

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1 Swager, Marion
2 Swierstra, Donald
3 Swierstra, Fanny
4 Sybrandy, Ida
5 Sybrandy, Simon
6 Sytsma, Albert
7 Sytsma, Edith
8 Sytsma, Jennie
9 Sytsma, Louie
10 Te Velde, Agnes
11 Te Velde, Bay
12 Te Velde, Bernard A.
13 Te Velde, Bonnie
14 Te Velde, Bonnie G.
15 Te Velde, George
16 Te Velde, George, Jr.
17 Te Velde, Harm
18 Te Velde, Harriet
19 Te Velde, Henry J.
20 Te Velde, Jay
21 Te Velde, Johanna
22 Te Velde, John H.
23 Te Velde, Ralph A.
24 Te Velde, Zwaantina, Trustee
25 Ter Maaten, Case
26 Ter Maaten, Cleone
27 Ter Maaten, Steve
28 Terpstra, Carol

Terpstra, Theodore G.
Teune, Tony
Teunissen, Bernard
Teunissen, Jane
Thomas, Ethel M.
Thommen, Alice
Thommen, Fritz
Tillema, Allie
Tillema, Harold
Tillema, Klaas D.
Timmons, William R.
Tollerup, Barbara
Tollerup, Harold
Trapani, Louis A.
Trimlett, Arlene R.
Trimlett, George E.
Tristant, Pierre
Tuinhout, Ale
Tuinhout, Harry
Tuinhout, Hilda
Tuls, Elizabeth
Tuls, Jack S.
Tuls, Jake
Union Oil Company of California
United Dairyman's Co-op.
Urquhart, James G.
Usle, Cathryn
Usle, Faustino

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1 V & Y Properties
2 Vaile, Beryl M.
3 Valley Hay Co.
4 Van Beek Dairy Inc.
5 Van Canneyt Dairy
6 Van Canneyt, Maurice
7 Van Canneyt, Wilmer
8 Van Dam, Bas
9 Van Dam, Isabelle
10 Van Dam, Nellie
11 Van Den Berg, Gertrude
12 Van Den Berg, Joyce
13 Van Den Berg, Marinus
14 Van Den Berg, Marvin
15 Van Der Linden, Ardith
16 Van Der Linden, John
17 Van Der Linden, Stanley
18 Van Der Veen, Kenneth
19 Van Diest, Anna T.
20 Van Diest, Cornelius
21 Van Diest, Ernest
22 Van Diest, Rena
23 Van Dyk, Bart
24 Van Dyk, Jeanette
25 Van Foeken, Martha
26 Van Foeken, William
27 Van Hofwegan, Steve
28 Van Hofwegen, Adrian A.

Van Hofwegen, Clara
Van Hofwegen, Jessie
Van Klaveren, A.
Van Klaveren, Arie
Van Klaveren, Wilhelmina
Van Klaveren, William
Van Leeuwen, Arie C.
Van Leeuwen, Arie C.
Van Leeuwen, Arlan
Van Leeuwen, Clara G.
Van Leeuwen, Cornelia L.
Van Leeuwen, Harriet
Van Leeuwen, Jack
Van Leeuwen, John
Van Leeuwen, Letie
Van Leeuwen, Margie
Van Leeuwen, Paul
Van Leeuwen, William A.
Van Ravenswaay, Donald
Van Ryn Dairy
Van Ryn, Dick
Van Surksum, Anthonetta
Van Surksum, John
Van Veen, John
Van Vliet, Effie
Van Vliet, Hendrika
Van Vliet, Hugo
Van Vliet, Klaas

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Vande Witte, George
Vanden Berge, Gertie
Vanden Berge, Gertie
Vanden Berge, Jack
Vanden Berge, Jake
Vanden Brink, Stanley
Vander Dussen, Agnes
Vander Dussen, Cor
Vander Dussen, Cornelius
Vander Dussen, Edward
Vander Dussen, Geraldine Marie
Vander Dussen, James
Vander Dussen, John
Vander Dussen, Nelvina
Vander Dussen, Rene
Vander Dussen, Sybrand Jr.
Vander Dussen, Sybrand Sr.
Vander Dussen Trustees
Vander Eyk, Case Jr.
Vander Eyk, Case Sr.
Vander Feer, Peter
Vander Feer, Rieka
Vander Laan, Ann
Vander Laan, Ben
Vander Laan, Bill
Vander Laan, Corrie
Vander Laan, Henry
Vander Laan, James
Vander Laan, Katie
Vander Laan, Martin Jr.
Vander Laan, Tillie
Vander Leest, Anna
Vander Leest, Ann
Vander Meer, Alice
Vander Meer, Dick
Vander Poel, Hank
Vander Poel, Pete
Vander Pol, Irene
Vander Pol, Margie
Vander Pol, Marines
Vander Pol, William P.
Vander Schaaf, Earl
Vander Schaaf, Elizabeth
Vander Schaaf, Henrietta
Vander Schaaf, John
Vander Schaaf, Ted
Vander Stelt, Catherine
Vander Stelt, Clarence
Vander Tuig, Arlene
Vander Tuig, Sylvester
Vander Veen, Joe A.
Vandervlag, Robert
Vander Zwan, Peter
Vanderford, Betty W.
Vanderford, Claud R.
Vanderham, Adrian

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1 Vanderham, Cornelius
2 Vanderham, Cornelius P.
3 Vanderham, Cory
4 Vanderham, E. Jane
5 Vanderham, Marian
6 Vanderham, Martin
7 Vanderham, Pete C.
8 Vanderham, Wilma
9 Vasquez, Eleanor
10 Veenendaal, Evert
11 Veenendaal, John H.
12 Veiga, Dominick Sr.
13 Verbree, Jack
14 Verbree, Tillie
15 Verger, Bert
16 Verger, Betty
17 Verhoeven, Leona
18 Verhoeven, Martin
19 Verhoeven, Wesley
20 Vermeer, Dick
21 Vermeer, Jantina
22 Vernola Ranch
23 Vernola, Anthonietta
24 Vernola, Anthony
25 Vernola, Frank
26 Vernola, Mary Ann
27 Vernola, Pat F.
28 Vestal, Frances Lorraine

Vestal, J. Howard
Visser, Gerrit
Visser, Grace
Visser, Henry
Visser, Jess
Visser, Louie
Visser, Neil
Visser, Sam
Visser, Stanley
Visser, Tony D.
Visser, Walter G.
Von Der Ahe, Fredric T.
Von Euw, George
Von Euw, Marjorie
Von Lusk, a limited partnership
Voortman, Anna Marie
Voortman, Edward
Voortman, Edwin J.
Voortman, Gertrude Dena
Wagner, Richard H.
Walker, Carole R.
Walker, Donald E.
Walker, Wallace W.
Wardle, Donald M.
Warner, Dillon B.
Warner, Minnie
Wassenaar, Peter W.
Waters, Michael

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Weeda, Adriana
Weeda, Daniel
Weeks, O. L.
Weeks, Verona E.
Weidman, Maurice
Weidman, Virginia
Weiland, Adaline I.
Weiland, Peter J.
Wesselink, Jules
West, Katharine R.
West, Russel
West, Sharon Ann
Western Horse Property
Westra, Alice
Westra, Henry
Westra, Hilda
Westra, Jake J.
Weststeyn, Freida
Weststeyn, Pete
Whitehurst, Louis G.
Whitehurst, Pearl L.
Whitmore, David L.
Whitmore, Mary A.
Whitney, Adolph M.
Wiersema, Harm
Wiersema, Harry
Wiersma, Ellen H.
Wiersma, Gladys J.
Wiersma, Jake
Wiersma, Otto
Wiersma, Pete
Winchell, Verne H., Trustee
Wind, Frank
Wind, Fred
Wind, Hilda
Wind, Johanna
Woo, Frank
Woo, Sem Gee
Wybenga, Clarence
Wybenga, Gus
Wybenga, Gus K.
Wybenga, Sylvia
Wynja, Andy
Wynja, Iona F.
Yellis, Mildred
Yellis, Thomas E.
Ykema-Harmsen Dairy
Ykema, Floris
Ykema, Harriet
Yokley, Betty Jo
Yokley, Darrell A.
Zak, Zan
Zivelonghi, George
Zivelonghi, Margaret
Zwaagstra, Jake
Zwaagstra, Jessie M.
Zwart, Case

EXHIBIT "C"

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NON-PRODUCER WATER DISTRICTS

Chino Basin Municipal Water District

Chino Basin Water Conservation District

Pomona Valley Municipal Water District

Western Municipal Water District of Riverside County

EXHIBIT "C"

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DEFAULTING OVERLYING AGRICULTURAL PRODUCERS

Cheryl L. Bain
Warren Bain
John M. Barcelona
Letty Bassler
John Brazil
John S. Briano
Lupe Briano
Paul A. Briano
Tillie Briano
Arnie B. Carlson
John Henry Fikse
Phyllis S. Fikse
Lewellyn Flory
Mary I. Flory
L. H. Glazer
Dorothy Goodman
Sidney D. Goodman
Frank Grossi
Harada Brothers
Ellen Hettinga
Hein Hettinga
Dick Hofstra, Jr.
Benjamin M. Hughey
Frieda L. Hughey
Guillaume Indart
Ellwood B. Johnston, Trustee
Perry Kruckenberg, Jr.
Roy W. Lantis
Sharon I. Lantis
Frank Lorenz
Dagney H. MacDonald
Frank E. Martin
Ruth C. Martin
Connie S. Mello
Naldiro J. Mello
Felice Miller
Ted Miller
Masao Nerio
Tom K. Nerio
Toyo Nerio
Yuriko Nerio
Harold L. Rees
Alden G. Rose
Claude Rouleau, Jr.
Patricia M. Rouleau
Schultz Enterprises
Albert Shaw
Lila Shaw
Cathy M. Stewart
Marvin C. Stewart
Betty Ann Stone
John B. Stone
Vantoll Cattle Co., Inc.
Catherene Verburg

Martin Verburg

Donna Vincent

Larry Vincent

Cliff Wolfe & Associates

Ada M. Woll

Zarubica Co.

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EXHIBIT "D"

OVERLYING NON-AGRICULTURAL RIGHTS

Party	Total Overlying Non-Agricultural Rights (Acre Feet)	Share of Safe Yield (Acre Feet)
Ameron Steel Producers, Inc.	125	97.858
County of San Bernardino	171	133.870
Conrock Company	406	317.844
Kaiser Steel Corporation	3,743	2,930.274
Red Star Fertilizer	20	15.657
Southern California Edison Co.	1,255	982.499
Space Center, Mira Loma	133	104.121
Southern Service Co., dba Blue Seal Linen	24	18.789
Sunkist, Orange Products Division	2,393	1,873.402
Carlsberg Mobile Home Properties, Ltd. '73	593	464.240
Union Carbide Corporation	546	427.446
Quaker Chemical Co.	0	0
Totals	9,409	7,366.000

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EXHIBIT "E"
APPROPRIATIVE RIGHTS

Party	Appropriative Right (Acre Feet)	Share of Initial Operating Safe Yield (Acre Feet)	Share of Operating Safe Yield (Percent)
City of Chino	5,271.7	3,670.067	6.693
City of Norco	289.5	201.545	0.368
City of Ontario	16,337.4	11,373.816	20.742
City of Pomona	16,110.5	11,215.852	20.454
City of Upland	4,097.2	2,852.401	5.202
Cucamonga County Water District	4,431.0	3,084.786	5.626
Jurupa Community Services District	1,104.1	768.655	1.402
Monte Vista County Water District	5,958.7	4,148.344	7.565
West San Bernardino County Water District	925.5	644.317	1.175
Etiwanda Water Company	768.0	534.668	0.975
Felspar Gardens Mutual Water Company	68.3	47.549	0.087
Fontana Union Water Co.	9,188.3	6,396.736	11.666
Marygold Mutual Water Co.	941.3	655.317	1.195
Mira Loma Water Co.	1,116.0	776.940	1.417
Monta Vista Irr. Co.	972.1	676.759	1.234
Mutual Water Company of Glen Avon Heights	672.2	467.974	0.853
Park Water Company	236.1	164.369	0.300
Pomona Valley Water Co.	3,106.3	2,162.553	3.944
San Antonio Water Co.	2,164.5	1,506.888	2.748
Santa Ana River Water Company	1,869.3	1,301.374	2.373
Southern California Water Company	1,774.5	1,235.376	2.253
West End Consolidated Water Company	1,361.3	947.714	1.728
TOTAL	78,763.8	54,834.000	100.000

EXHIBIT "F"
OVERLYING (AGRICULTURAL) POOL
POOLING PLAN

1. Membership in Pool. The State of California and all producers listed in Exhibit "C" shall be the initial members of this pool, which shall include all producers of water for overlying uses other than industrial or commercial purposes.

2. Pool Meetings. The members of the pool shall meet annually, in person or by proxy, at a place and time to be designated by Watermaster for purposes of electing members of the Pool Committee and conducting any other business of the pool. Special meetings of the membership of the pool may be called and held as provided in the rules of the pool.

3. Voting. All voting at meetings of pool members shall be on the basis of one vote for each 100 acre feet or any portion thereof of production from Chino Basin during the preceding year, as shown by the records of Watermaster.

4. Pool Committee. The Pool Committee for this pool shall consist of not less than nine (9) representatives selected at large by members of the pool. The exact number of members of the Pool Committee in any year shall be as determined by majority vote of the voting power of members of the pool in attendance at the annual pool meeting. Each member of the Pool Committee shall have one vote and shall serve for a two-year term. The members first elected shall classify themselves by lot so that approximately one-half serve an initial one-year term. Vacancies during any term shall be filled by a majority of the remaining members of the Pool Committee.

5. Advisory Committee Representatives. The number of

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representatives of the Pool Committee on the Advisory Committee shall be as provided in the rules of the pool from time to time but not exceeding ten (10). The voting power of the pool on the Advisory Committee shall be apportioned and exercised as determined from time to time by the Pool Committee.

6. Replenishment Obligation. The pool shall provide funds for replenishment of any production by persons other than members of the Overlying (Non-agricultural) Pool or Appropriator Pool, in excess of the pool's share of Safe Yield. During the first five (5) years of operations of the Physical Solution, reasonable efforts shall be made by the Pool Committee to equalize annual assessments.

7. Assessments. All assessments in this pool (whether for replenishment water cost or for pool administration or the allocated share of Watermaster administration) shall be in an amount uniformly applicable to all production in the pool during the preceding year or calendar quarter. Provided, however, that the Agricultural Pool Committee, may recommend to the Court modification of the method of assessing pool members, inter se, if the same is necessary to attain legitimate basin management objectives, including water conservation and avoidance of undesirable socio-economic consequences. Any such modification shall be initiated and ratified by one of the following methods:

(a) Excess Production. In the event total pool production exceeds 100,000 acre feet in any year, the Pool Committee shall call and hold a meeting, after notice to all pool members, to consider remedial modification of the assessment formula.

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(b) Producer Petition. At any time after the fifth full year of operation under the Physical Solution, a petition by ten percent (10%) of the voting power or membership of the Pool shall compel the holding of a noticed meeting to consider revision of said formula of assessment for replenishment water.

In either event, a majority action of the voting power in attendance at such pool members' meeting shall be binding on the Pool Committee.

8. Rules. The Pool Committee shall adopt rules for conducting meetings and affairs of the committee and for administering its program and in amplification of the provisions, but not inconsistent with, this pooling plan.

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EXHIBIT "G"
OVERLYING (NON-AGRICULTURAL) POOL
POOLING PLAN

1. Membership in Pool. The initial members of the pool, together with the decreed share of the Safe Yield of each, are listed in Exhibit "D". Said pool includes producers of water for overlying industrial or commercial (non-agricultural) purposes, or such producers within the Pool who may hereafter take water pursuant to Paragraph 8 hereof.

2. Pool Committee. The Pool Committee for this pool shall consist of one representative designated by each member of the pool. Voting on the committee shall be on the basis of one vote for each member, unless a volume vote is demanded, in which case votes shall be allocated as follows:

> The volume voting power on the Pool Committee shall be 1,484 votes. Of these, 742 votes shall be allocated on the basis of one vote for each ten (10) acre feet or fraction thereof of decreed shares in Safe Yield. (See Exhibit "D".) The remaining 742 votes shall be allocated proportionally on the basis of assessments paid to Watermaster during the preceding year.*

3. Advisory Committee Representatives. At least three (3) members of the Pool Committee shall be designated by said committee to serve on the Advisory Committee. The exact number of such representatives at any time shall be as determined by the Pool Committee. The voting power of the pool shall be exercised in the

*Or production assessments paid under Water Code Section 72140 et seq., as to years prior to the second year of operation under the Physical Solution hereunder.

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Advisory Committee as a unit, based upon the vote of a majority of said representatives.

4. Replenishment Obligation. The pool shall provide funds for replenishment of any production in excess of the pool's share of Safe Yield in the preceding year.

5. Assessment. Each member of this pool shall pay an assessment equal to the cost of replenishment water times the number of acre feet of production by such producer during the preceding year in excess of (a) his decreed share of the Safe Yield, plus (b) any carry-over credit under Paragraph 7 hereof. In addition, the cost of the allocated share of Watermaster administration expense shall be recovered on an equal assessment against each acre foot of production in the pool during such preceding fiscal year or calendar quarter; and in the case of Pool members who take substitute ground water as set forth in Paragraph 8 hereof, such producer shall be liable for its share of administration assessment, as if the water so taken were produced, up to the limit of its decreed share of Safe Yield.

6. Assignment. Rights herein decreed are appurtenant to the land and are only assignable with the land for overlying use thereon; provided, however, that any appropriator who may, directly or indirectly, undertake to provide water service to such overlying lands may, by an appropriate agency agreement on a form approved by Watermaster, exercise said overlying right to the extent, but only to the extent necessary to provide water service to said overlying lands.

7. Carry-over. Any member of the pool who produces less than its assigned water share of Safe Yield may carry such unexercised

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right forward for exercise in subsequent years. The first water produced during any such subsequent year shall be deemed to be an exercise of such carry-over right. In the event the aggregate carry-over by any pool member exceeds its share of Safe Yield, such member shall, as a condition of preserving such surplus carry-over, execute a storage agreement with Watermaster.

8. Substitute Supplies. To the extent that any Pool member, at the request of Watermaster and with the consent of the Advisory Committee, takes substitute surface water in lieu of producing ground water otherwise subject to production as an allocated share of Safe Yield, said party shall nonetheless remain a member of this Pool.

9. Rules. The Pool Committee shall adopt rules for administering its program and in amplification of the provisions, but not inconsistent with, this pooling plan.

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EXHIBIT "H"
APPROPRIATIVE POOL
POOLING PLAN

1. Qualification for Pool. Any city, district or other public entity and public utility -- either regulated under Public Utilities Commission jurisdiction, or exempt therefrom as a non-profit mutual water company (other than those assigned to the Overlying [Agricultural] Pool) -- shall be a member of this pool. All initial members of the pool are listed in Exhibit "E", together with their respective appropriative rights and acre foot allocation and percentage shares of the initial and subsequent Operating Safe Yield.

2. Pool Committee. The Pool Committee shall consist of one (1) representative appointed by each member of the Pool.

3. Voting. The total voting power on the Pool Committee shall be 1,000 votes. Of these, 500 votes shall be allocated in proportion to decreed percentage shares in Operating Safe Yield. The remaining 500 votes shall be allocated proportionally on the basis of assessments paid to Watermaster during the preceding year.* Routine business of the Pool Committee may be conducted on the basis of one vote per member, but upon demand of any member a weighted vote shall be taken. Affirmative action of the Committee shall require a majority of the voting power of members in attendance, provided that it includes concurrence by at least one-third of its total members.

4. Advisory Committee Representatives. Ten (10) members of

*Or production assessments paid under Water Code Section 72140 et seq., as to years prior to the second year of operation under the Physical Solution hereunder.

the Pool Committee shall be designated to represent this pool on the Advisory Committee. Each major appropriator, i.e., the owner of an adjudicated appropriative right in excess of 3,000 acre feet, shall be entitled to one representative. The remaining members representing the Appropriative Pool on the Advisory Committee shall be elected at large by the remaining members of the pool. The voting power of the Appropriative Pool on the Advisory Committee shall be apportioned between the major appropriator representatives in proportion to their respective voting power in the Pool Committee. The remaining two representatives shall exercise equally the voting power proportional to the Pool Committee voting power of all remaining appropriators; provided, however, that if any representative fails to attend an Advisory Committee meeting, the voting power of that representative shall be allocated among the representatives of the Appropriator Pool in attendance in the same proportion as their own respective voting powers.

5. Replenishment Obligation. The pool shall provide funds for purchase of replenishment water to replace any production by the pool in excess of Operating Safe Yield during the preceding year.

6. Administrative Assessment. Costs of administration of this pool and its share of general Watermaster expense shall be recovered by a uniform assessment applicable to all production during the preceding year.

7. Replenishment Assessment. The cost of replenishment water required to replace production from Chino Basin in excess of Operating Safe Yield in the preceding year shall be allocated and recovered as follows:

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(a) For production, other than for increased export, within CBMWD or WMWD:

(1) Gross Assessment. 15% of such replenishment water costs shall be recovered by a uniform assessment against all production of each appropriator producing in said area during the preceding year.

(2) Net Assessment. The remaining 85% of said costs shall be recovered by a uniform assessment on each acre foot of production from said area by each such appropriator in excess of his allocated share of Operating Safe Yield during said preceding year.

(b) For production which is exported for use outside Chino Basin in excess of maximum export in any year through 1976, such increased export production shall be assessed against the exporting appropriator in an amount sufficient to purchase replenishment water from CBMWD or WMWD in the amount of such excess.

(c) For production within SBVMWD or PVMWD:

By an assessment on all production in excess of an appropriator's share of Operating Safe Yield in an amount sufficient to purchase replenishment water through SBVMWD or MWD in the amount of such excess.

8. Socio-Economic Impact Review. The parties have conducted certain preliminary socio-economic impact studies. Further and more detailed socio-economic impact studies of the assessment formula and its possible modification shall be undertaken for the Appropriator Pool by Watermaster no later than ten (10) years from the effective date of this Physical Solution, or whenever total

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production by this pool has increased by 30% or more over the decreed appropriative rights, whichever is first.

9. Facilities Equity Assessment. Watermaster may, upon recommendation of the Pool Committee, institute proceedings for levy and collection of a Facilities Equity Assessment for the purposes and in accordance with the procedures which follow:

(a) Implementing Circumstances. There exist several sources of supplemental water available to Chino Basin, each of which has a differential cost and quantity available. The optimum management of the entire Chino Basin water resource favors the maximum use of the lowest cost supplemental water to balance the supplies of the Basin, in accordance with the Physical Solution. The varying sources of supplemental water include importations from MWD and SBVMWD, importation of surface and ground water supplies from other basins in the immediate vicinity of Chino Basin, and utilization of reclaimed water. In order to fully utilize any of such alternate sources of supply, it will be essential for particular appropriators having access to one or more of such supplies to have invested, or in the future to invest, directly or indirectly, substantial funds in facilities to obtain and deliver such water to an appropriate point of use. To the extent that the use of less expensive alternate sources of supplemental water can be maximized by the inducement of a Facilities Equity Assessment, as herein provided, it is to the long-term benefit of the entire basin that such assessment be authorized and levied by Watermaster.

(b) Study and Report. At the request of the Pool

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Committee, Watermaster shall undertake a survey study of the utilization of alternate supplemental supplies by members of the Appropriative Pool which would not otherwise be utilized and shall prepare a report setting forth the amount of such alternative supplies being currently utilized, the amount of such supplies which could be generated by activity within the pool, and the level of cost required to increase such uses and to optimize the total supplies available to the basin. Said report shall contain an analysis and recommendation for the levy of a necessary Facilities Equity Assessment to accomplish said purpose.

(c) Hearing. If the said report by Watermaster contains a recommendation for imposition of a Facilities Equity Assessment, and the Pool Committee so requests, Watermaster shall notice and hold a hearing not less than 60 days after distribution of a copy of said report to each member of the pool, together with a notice of the hearing date. At such hearing, evidence shall be taken with regard to the necessity and propriety of the levy of a Facilities Equity Assessment and full findings and decision shall be issued by Watermaster.

(d) Operation of Assessment. If Watermaster determines that it is appropriate that a Facilities Equity Assessment be levied in a particular year, the amount of additional supplemental supplies which should be generated by such assessment shall be estimated. The cost of obtaining such supplies, taking into consideration the investment in necessary facilities shall then be determined and spread equitably among the producers within the pool in a manner so that those

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producers not providing such additional lower cost supplemental water, and to whom a financial benefit will result, may bear a proportionate share of said costs, not exceeding said benefit; provided that any producer furnishing such supplemental water shall not thereby have its average cost of water in such year reduced below such producer's average cost of pumping from the Basin. In so doing, Watermaster shall establish a percentage of the total production by each party which may be produced without imposition of a Facilities Equity Assessment. Any member of the pool producing more water than said percentage shall pay such Facilities Equity Assessment on any such excess production. Watermaster is authorized to transmit and pay the proceeds of such Facilities Equity Assessment to those producers who take less than their share of Basin water by reason of furnishing a higher percentage of their requirements through use of supplemental water.

10. Unallocated Safe Yield Water. To the extent that, in any five years, any portion of the share of Safe Yield allocated to the Overlying (Agricultural) Pool is not produced, such water shall be available for reallocation to members of the Appropriative Pool, as follows:

(a) Priorities. Such allocation shall be made in the following sequence:

(1) to supplement, in the particular year, water available from Operating Safe Yield to compensate for any reduction in the Safe Yield by reason of recalculation thereof after the tenth year of operation hereunder.

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(2) pursuant to conversion claims as defined in Subparagraph (b) hereof.

(3) as a supplement to Operating Safe Yield, without regard to reductions in Safe Yield.

(b) Conversion Claims. The following procedures may be utilized by any appropriator:

(1) Record of Land Use Conversion. Any appropriator who undertakes, directly or indirectly, during any year, to permanently provide water service to lands which during the immediate preceding five (5) consecutive years was devoted to irrigated agriculture may report such change in land use or water service to Watermaster. Watermaster shall thereupon verify such change in water service and shall maintain a record and account for each appropriator of the total acreage involved and the average annual water use during said five-year period.

(2) Establishment of Allocation Percentage. In any year in which unallocated Safe Yield water from the Overlying (Agricultural) Pool is available for such conversion claims, Watermaster shall establish allocable percentages for each appropriator based upon the total of such converted acreage recorded to each such appropriator's account.

(3) Allocation and Notice. Watermaster shall thereafter apply the allocated percentage to the total unallocated Safe Yield water available for special allocation to derive the amount thereof allocable to

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each appropriator; provided that in no event shall the allocation to any appropriator as a result of such conversion claim exceed 50% of the average annual amount of water actually applied to the areas converted by such appropriator prior to such conversion. Any excess water by reason of such limitation on any appropriator's right shall be added to Operating Safe Yield. Notice of such special allocation shall be given to each appropriator and shall be treated for purposes of this Physical Solution as an addition to such appropriator's share of the Operating Safe Yield for the particular year only.

(4) Administrative Costs. Any costs of Watermaster attributable to administration of such special allocations and conversion claims shall be assessed against appropriators participating in such reporting.

11. In Lieu Procedures. There are, or may develop, certain areas within Chino Basin where good management practices dictate that recharge of the basin be accomplished, to the extent practical, by taking surface supplies of supplemental water in lieu of ground water otherwise subject to production as an allocated share of Operating Safe Yield.

(a) Method of Operation. Any appropriator producing water within such designated in lieu area who is willing to abstain for any reason from producing any portion of such producer's share of Operating Safe Yield in any year may offer such unpumped water to Watermaster. In such event, Watermaster shall purchase said water in place, in lieu of spreading replenishment water, which is otherwise required to

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make up for over production. The purchase price for in lieu water shall be the lesser of:

(1) Watermaster's current cost of replenishment water, whether or not replenishment water is currently then obtainable, plus the cost of spreading; or

(2) The cost of supplemental surface supplies to the appropriator, less

a. said appropriator's average cost of ground water production, and

b. the applicable production assessment were the water produced.

Where supplemental surface supplies consist of MWD or SBVMWD supplies, the cost of treated, filtered State water from such source shall be deemed the cost of supplemental surface supplies to the appropriator for purposes of such calculation.

In any given year in which payments may be made pursuant to a Facilities Equity Assessment, as to any given quantity of water the party will be entitled to payment under this section or pursuant to the Facilities Equity Assessment, as the party elects, but not under both.

(b) Designation of In Lieu Areas. The first in lieu area is designated as the "In Lieu Area No. 1" and consists of an area wherein nitrate levels in the ground water generally exceed 45 mg/l, and is shown on Exhibit "J" hereto. Other in lieu areas may be designated by subsequent order of Watermaster upon recommendation or approval by Advisory Committee. Said in lieu areas may be enlarged, reduced or

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eliminated by subsequent orders; provided, however, that designation of In Lieu Areas shall be for a minimum fixed term sufficient to justify necessary capital investment. In Lieu Area No. 1 may be enlarged, reduced or eliminated in the same manner, except that any reduction of its original size or elimination thereof shall require the prior order of Court.

12. Carry-over. Any appropriator who produces less than his assigned share of Operating Safe Yield may carry such unexercised right forward for exercise in subsequent years. The first water produced during any such subsequent year shall be deemed to be an exercise of such carry-over right. In the event the aggregate carry-over by any appropriator exceeds its share of Operating Safe Yield, such appropriator shall, as a condition of preserving such surplus carry-over, execute a storage agreement with Watermaster. Such appropriator shall have the option to pay the gross assessment applicable to such carry-over in the year in which it accrued.

13. Assignment, Transfer and Lease. Appropriative rights, and corresponding shares of Operating Safe Yield, may be assigned or may be leased or licensed to another appropriator for exercise in a given year. Any transfer, lease or license shall be ineffective until written notice thereof is furnished to and approved as to form by Watermaster, in compliance with applicable Watermaster rules. Watermaster shall not approve transfer, lease or license of a right for exercise in an area or under conditions where such production would be contrary to sound basin management or detrimental to the rights or operations of other producers.

14. Rules. The Pool Committee shall adopt rules for

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administering its program and in amplification of the provisions, but not inconsistent with, this pooling plan.

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EXHIBIT "I"

ENGINEERING APPENDIX

1. Basin Management Parameters. In the process of implementing the physical solution for Chino Basin, Watermaster shall consider the following parameters:

(a) Pumping Patterns. Chino Basin is a common supply for all persons and agencies utilizing its waters. It is an objective in management of the Basin's waters that no producer be deprived of access to said waters by reason of unreasonable pumping patterns, nor by regional or localized recharge of replenishment water, insofar as such result may be practically avoided.

(b) Water Quality. Maintenance and improvement of water quality is a prime consideration and function of management decisions by Watermaster.

(c) Economic Considerations. Financial feasibility, ecnomic impact and the cost and optimum utilization of the Basin's resources and the physical facilities of the parties are objectives and concerns equal in importance to water quantity and quality parameters.

2. Operating Safe Yield. Operating Safe Yield in any year shall consist of the Appropriative Pool's share of Safe Yield of the Basin, plus any controlled overdraft of the Basin which Watermaster may authorize. In adopting the Operating Safe Yield for any year, Watermaster shall be limited as follows:

(a) Accumulated Overdraft. During the operation of this Judgment and Physical Solution, the overdraft accumulated from and after the effective date of the Physical

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Solution and resulting from an excess of Operating Safe Yield over Safe Yield shall not exceed 200,000 acre feet.

(b) Quantitative Limits. In no event shall Operating Safe Yield in any year be less than the Appropriative Pool's share of Safe Yield, nor shall it exceed such share of Safe Yield by more than 10,000 acre feet. The initial Operating Safe Yield is hereby set at 54,834 acre feet per year. Operating Safe Yield shall not be changed upon less than five (5) years' notice by Watermaster.

Nothing contained in this paragraph shall be deemed to authorize, directly or indirectly, any modification of the allocation of shares in Safe Yield to the overlying pools, as set forth in Paragraph 44 of the Judgment.

3. Ground Water Storage Agreements. Any agreements authorized by Watermaster for storage of supplemental water in the available ground water storage capacity of Chino Basin shall include, but not be limited to:

(a) The quantities and term of the storage right.

(b) A statement of the priority or relation of said right, as against overlying or Safe Yield uses, and other storage rights.

(c) The procedure for establishing delivery rates, schedules and procedures which may include

[1] spreading or injection, or

[2] in lieu deliveries of supplemental water for direct use.

(d) The procedures for calculation of losses and annual accounting for water in storage by Watermaster.

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(e) The procedures for establishment and administration of withdrawal schedules, locations and methods.

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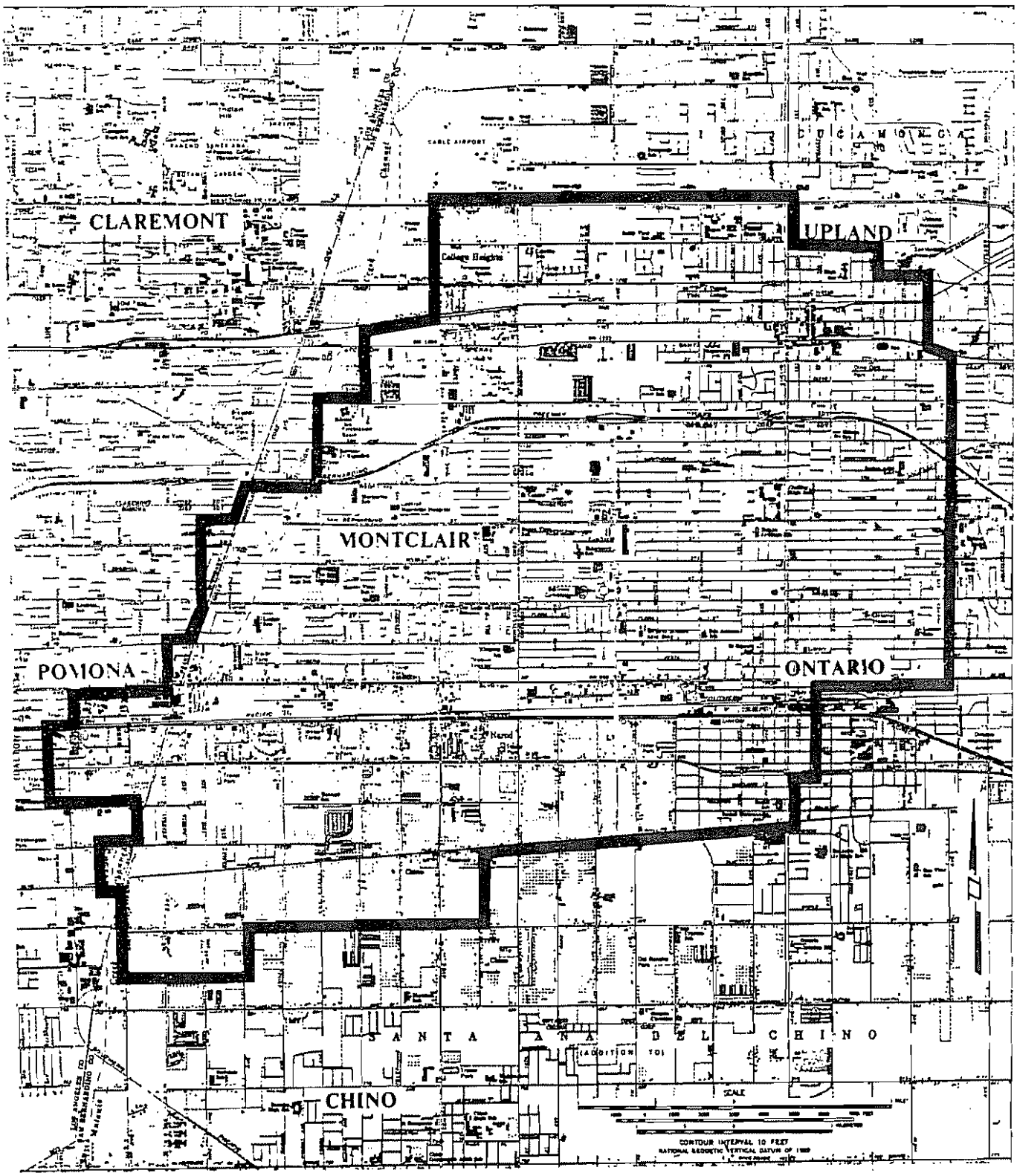


CHINO BASIN

IN LIEU AREA NO. 1

EXHIBIT "J"

LEGAL DESCRIPTION

OF CHINO BASIN

Preamble

All of the townships and ranges referred to in the following legal description are the San Bernardino Base and Meridian. Certain designated sections are implied as the System of Government Surveys may be extended where not established. Said sections are identified as follows:

Section 20, T1N, R8W is extended across Rancho Cucamonga;

Section 36, T1N, R8W is extended across the City of Upland;

Sections 2, 3, and 4, T1S, R7W are extended across Rancho Cucamonga;

Section 10, T1S, R8W is extended across the City of Claremont;

Sections 19, 20, 21, 30, 31 and 32, T1S, R8W are extended across the City of Pomona;

Sections 4, 5, and 28, T2S, R8W are extended across Rancho Santa Ana Del Chino;

Sections 15 and 16, T3S, R7W are extended across Rancho La Sierra; and

Sections 17 and 20, T3S, R7W are extended across Rancho El Rincon.

Description

Chino Basin is included within portions of the Counties of San Bernardino, Riverside and Los Angeles, State of California, bounded by a continuous line described as follows:

BEGINNING at the Southwest corner of Lot 241 as shown on Map of Ontario Colony Lands, recorded in Map Book 11, page 6, Office of the County Recorder of San Bernardino County, said corner being the Point of Beginning;

1. Thence Southeasterly to the Southeast corner

of Lot 419 of said Ontario Colony Lands;

2. Thence Southeasterly to a point 1300 feet North of the South line and 1300 feet East of the West line of Section 4, T1S, R7W;

3. Thence Easterly to a point on the East line of Section 4, 1800 feet North of the Southeast corner of said Section 4;

4. Thence Easterly to the Southeast corner of the Southwest quarter of the Northeast quarter of Section 3, T1S, R7W;

5. Thence Northeasterly to a point on the North line of Section 2, T1S, R7W, 1400 feet East of the West line of said Section 2;

6. Thence Northeasterly to the Southwest corner of Section 18, T1N, R6W;

7. Thence Northerly to the Northwest corner of said Section 18;

8. Thence Easterly to the Northeast corner of said Section 18;

9. Thence Northerly to the Northwest corner of the Southwest quarter of Section 8, T1N, R6W;

10. Thence Easterly to the Northeast corner of said Southwest quarter of said Section 8;

11. Thence Southerly to the Southeast corner of said Southwest quarter of said Section 8;

12. Thence Easterly to the Northeast corner of Section 17, T1N, R6W;

13. Thence Easterly to the Northeast corner of Section 16, T1N, R6W;

14. Thence Southeasterly to the Northwest corner of the Southeast quarter of Section 15, T1N, R6W;

15. Thence Easterly to the Northeast corner of said Southeast quarter of said Section 15;

16. Thence Southeasterly to the Northwest corner of the Northeast quarter of Section 23, T1N, R6W;

17. Thence Southeasterly to the Northwest corner

of Section 25, T1N, R6W;

18. Thence Southeasterly to the Northwest corner of the Northeast quarter of Section 31, T1N, R5W;

19. Thence Southeasterly to the Northeast corner of the Northwest quarter of Section 5, T1S, R5W;

20. Thence Southeasterly to the Southeast corner of Section 4, T1S, R5W;

21. Thence Southeasterly to the Southeast corner of the Southwest quarter of Section 11, T1S, R5W;

22. Thence Southwesterly to the Southwest corner of Section 14, T1S, R5W;

23. Thence Southwest to the Southwest corner of Section 22, T1S, R5W;

24. Thence Southwesterly to the Southwest corner of the Northeast quarter of Section 6, T2S, R5W;

25. Thence Southeasterly to the Northeast corner of Section 18 T2S, R5W;

26. Thence Southwesterly to the Southwest corner of the Southeast quarter of Section 13, T2S, R6W;

27. Thence Southwesterly to the Southwest corner of the Northeast quarter of Section 26, T2S, R6W;

28. Thence Westerly to the Southwest corner of the Northwest quarter of said Section 26;

29. Thence Northerly to the Northwest corner of said Section 26;

30. Thence Westerly to the Southwest corner of Section 21, T2S, R6w:

31. Thence Southerly to the Southeast corner of Section 29, T2S, R6W;

32. Thence Westerly to the Southeast corner of Section 30, T2S, R6W;

33. Thence Southwesterly to the Southwest corner of Section 36, T 2 S, R 7 W;

34. Thence Southwesterly to the Southeast corner

of Section 3, T3S, R7W;

35. Thence Southwesterly to the Southwest corner of the Northeast quarter of Section 10, T3S, R7W;

36. Thence Southerly to the Northeast corner of the Northwest quarter of Section 15, T3S, R7W;

37. Thence Southwesterly to the Southeast corner of the Northeast quarter of Section 16, T3S, R7W;

38. Thence Southwesterly to the Southwest corner of said Section 16;

39. Thence Southwesterly to the Southwest corner of the Northeast quarter of Section 20, T3S, R7W;

40. Thence Westerly to the Southwest corner of the Northwest quarter of said Section 20;

41. Thence Northerly to the Northwest corner of Section 17, T3S, R7W;

42. Thence Westerly to the Southwest corner of Section 7, T3S, R7W;

43. Thence Northerly to the Southwest corner of Section 6, T3S, R7W;

44. Thence Westerly to the Southwest corner of Section 1, T3S, R8W;

45. Thence Northerly to the Southeast corner of Section 35, T2S, R8W;

46. Thence Northwesterly to the Northwest corner of said Section 35;

47. Thence Northerly to the Southeast corner of Lot 33, as shown on Map of Tract 3193, recorded in Map Book 43, pages 46 and 47, Office of the County Recorder of San Bernardino County;

48. Thence Westerly to the Northwest corner of the Southwest quarter of Section 28, T2S, R8W;

49. Thence Northerly to the Southwest corner of Section 4, T2S, R8W;

50. Thence Westerly to the Southwest corner of Section 5, T2S, R8W;

51. Thence Northerly to the Southwest corner of Section 32, T1S, R8W;

52. Thence Westerly to the Southwest corner of Section 31, T1S, R8W;

53. Thence Northerly to the Southwest corner of Section 30, T1S, R8W;

54. Thence Northeasterly to the Southwest corner of Section 20, T1S, R8W;

55. Thence Northerly to the Northwest corner of the Southwest quarter of the Southwest quarter of said Section 20;

56. Thence Northwesterly to the Northeast corner of the Southeast quarter of the Southeast quarter of the Northwest quarter of Section 19, T1S, R8W;

57. Thence Easterly to the Northwest corner of Section 21, T1S, R8W;

58. Thence Northeasterly to the Southeast corner of the Southwest quarter of the Southwest quarter of Section 10, T1S, R8W;

59. Thence Northeasterly to the Southwest corner of Section 2, T1S, R8W;

60. Thence Northeasterly to the Southeast corner of the Northwest quarter of the Northwest quarter of Section 1, T1S, R8W;

61. Thence Northerly to the Northeast corner of the Northwest quarter of the Northeast quarter of Section 36, T1N, R8W;

62. Thence Northerly to the Southeast corner of Section 24, T1N, R8W;

63. Thence Northeasterly to the Southeast corner of the Northwest quarter of the Northwest quarter of Section 20, T1N, R7W; and

64. Thence Southerly to the Point of Beginning.

Sections Included

Said perimeter description includes all or portions of the following Townships, Ranges and Sections of San Bernardino Base and Meridian:

T1N, R5W - Sections:	30, 31 and 32
T1N, R6W - Sections:	8, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35 and 36
T1N, R7W - Sections:	19, 20, 24, 25, 26, 29, 30, 31, 32, 35 and 36
T1N, R8W - Sections:	25 and 36
T1S, R5W - Sections:	4, 5, 6, 7, 8, 9, 10, 11, 14, 15, 16, 17, 18, 19, 20, 21, 22, 28, 29, 30, 31 and 32.
T1S, R6W - Sections:	1 through 36, inclusive
T1S, R7W - Sections:	1 through 36, inclusive
T1S, R8W - Sections:	1, 2, 10, 11, 12, 13, 14, 15, 16, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35 and 36
T2S, R5W - Sections:	6, 7 and 18
T2S, R6W - Sections:	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 26, 29, 30 and 31
T2S, R7W - Sections:	1 through 36, inclusive
T2S, R8W - Sections:	1, 2, 3, 4, 5, 9, 10, 11, 12, 13, 14, 15, 16, 21, 22, 23, 24, 25, 26, 27, 28, 35 and 36
T3S, R7W - Sections:	2, 3, 4, 5, 6, 7, 8, 9, 10, 15, 16, 17 and 20
T3S, R8W - Section:	1.

THE DOCUMENT TO WHICH THIS CERTIFICATION IS ATTACHED IS A FULL, TRUE AND CORRECT COPY OF THE ORIGINAL ON FILE AND OF RECORD IN MY OFFICE.

ATTEST DCT 2 9 2002

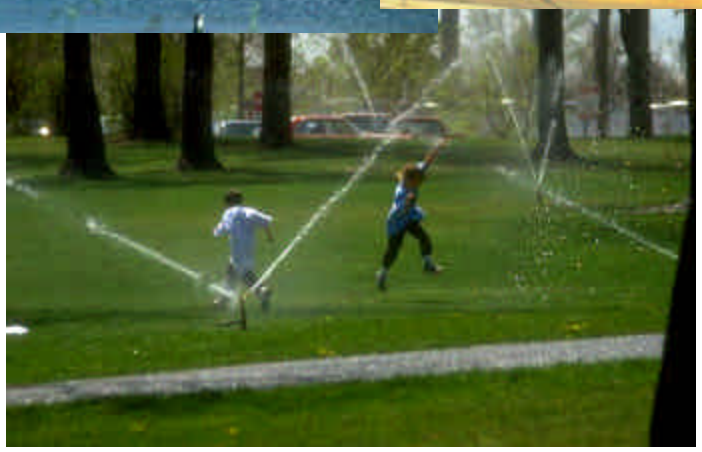
Clerk of the Superior Court of the State of California, in and for the County of San Bernardino

By _____ Deputy

Terry Wittenborn

92 pages

Optimum Basin Management Program



Draft Phase I Report

Prepared for

Chino Basin Watermaster

August 19, 1999

WE Wildermuth Environmental, Inc.

Optimum Basin Management Program

Phase I Report

Prepared for the

Chino Basin Watermaster

August 19, 1999

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SECTION 1
INTRODUCTION

An Optimum Basin Management Program (OBMP) for the Chino Basin (Figure 1-1) is being developed pursuant to a Judgment entered in the Superior Court of the State of California for the County of San Bernardino and a February 19, 1998 ruling as described below. Pursuant to the Judgment, the Chino Basin Watermaster (Watermaster) files an annual report of Watermaster activities with the Court each year. The information presented below regarding the Judgment, Watermaster, and the events leading up to the February 19, 1998 ruling was obtained from these annual reports.

THE CHINO BASIN JUDGMENT AND WATERMASTER

The Chino Basin Watermaster was established under a Judgment entered in the Superior Court of the State of California for the County of San Bernardino, entitled "Chino Basin Municipal Water District v. City of Chino *et al*," (originally Case No. SCV 164327, file transferred August 1989, by order of the Court and assigned new Case No. RCV 51010). The Honorable Judge Howard B. Wiener signed the Judgment on January 27, 1978. The effective date of this Judgment for accounting and operations was July 1, 1977.

The Judgment resulted from studies and discussions that began in the early 1970's and continued for several years. The initial action to formalize the producers' intentions was the passage in 1974 of a "Memorandum of Agreement on the Chino Basin Plan." In January 1975, Senator Ruben S. Ayala introduced Senate Bill 222 (S.B. 222) in the California Legislature. This bill authorized a production assessment levy of $2.00 per acre-foot per year for a period of three years. The funds were utilized to finance the essential studies and negotiations to implement a water management program for the Chino Groundwater Basin.

S.B. 222 was subsequently renumbered as a part of the Municipal Water District Law at Section 74120 of the Water Code. It was approved by Governor Ronald Reagan and filed with the Secretary of State on June 28, 1975. Three major groups that represented the majority of the producer's interests became active in the early negotiations under S.B. 222. The groups formalized into committees and eventually became known as the: Overlying (Agricultural) Pool, including the State of California and minimal producers; Overlying (Non-Agricultural) Pool representing industries; and Appropriative Pool, representing cities, water districts and water companies. Engineering, legal and other working sub-committees were formed to analyze and define specific problem areas. Representatives of the three pools, when acting together, were called the "Watermaster Advisory Committee." The Watermaster Advisory Committee forwarded recommendations for formal action to the Chino Basin Municipal Water District (CBMWD), which was assigned the responsibility of administering S.B. 222. Socio-economic, safe yield and other studies were conducted to provide the information necessary to reach an agreement regarding the allocation of rights between and within the pool committees.

The Watermaster Advisory Committee was established as the policy setting body and charged with oversight of Watermaster's discretionary activities. Members of each of the three pool committees met regularly to transact the business concerns of its respective producers. Decisions affecting more than one pool committee were forwarded to the Watermaster Advisory Committee. The Judgment provided a method to determine the voting power of the producers on the committees, through a formula based on assessments paid in the prior year and allocated safe yield.

The Judgment declares that the safe yield of the Chino Basin is 140,000 acre-ft/yr, which is allocated among the three pools as follows:

Overlying agricultural pool	82,800 acre-ft/yr
Overlying non-agricultural pool	7,366 acre-ft/yr
Appropriative pool	49,834 acre-ft/yr

A fundamental premise of the Judgment (aka the physical solution) is that all Chino Basin water users will be allowed to pump sufficient water from the Basin to meet their requirements. To the extent that pumping exceeds the share of the safe yield, assessments are levied by the Watermaster to replace the overproduction. The Judgment recognizes that there exists a substantial amount of available groundwater storage capacity in the Chino Basin that can be utilized for storage and conjunctive use of supplemental water and basin waters; makes utilization of this storage subject to Watermaster control and regulation; and provides that any person or public entity, whether or not a party to the Judgment, may make reasonable beneficial use of the available storage, provided that no such use shall be made except pursuant to a written storage agreement with the Watermaster.

EVENTS LEADING UP TO THE FEBRUARY 19, 1998 RULING

During fiscal year 1995-96, it was determined that the reappointment of the CBMWD board as Watermaster had not been submitted to the Court for approval in 1993. In January 1996, a motion was made and supported by a majority of the Advisory Committee to appoint the Advisory Committee to serve as Watermaster. Initially, this motion was supported by 71.64% of the Advisory Committee and as provided in Paragraph 16 of the Judgment, Watermaster Counsel was directed by the Advisory Committee to file the motion with the Court. A Watermaster Ad Hoc Transition Committee of pool members and interested parties was formed to work out the logistics involved with changing the Watermaster. Shortly after the motion was filed, the case was assigned to the Honorable Judge J. Michael Gunn. Fifteen committee members attended the first Ad Hoc Transition Committee meeting on January 31, 1996, and agreed unanimously to propose that an arbitrator or an arbitration process be put in place to address initial concerns raised by some parties to the Judgment regarding the Advisory Committee serving as Watermaster.

By early March, the Overlying (Agricultural) Pool and a few appropriators had reconsidered their positions and were opposed to the motion to appoint the Advisory Committee as Watermaster, even with an arbitration process. As a result, the motion was taken off calendar and additional Ad Hoc Transition Committee meetings were held. These meetings resulted in the development of a proposal for a nine-member board, which was approved by the Advisory Committee in April 1996. Watermaster Counsel was directed to file a motion to appoint the nine-member board, which was set for hearing on June 18, 1996.

On June 3, 1996, CBMWD filed an ex-parte motion to shorten the time on a motion to appoint itself as Interim Watermaster, to appoint itself "*nunc pro tunc*" Watermaster and to disqualify Watermaster Counsel based on the allegation that Counsel had a conflict of interest in serving both Watermaster and the Advisory Committee. The motion to shorten time was granted and the hearing was set for June 18, 1996. At the June 18, 1996 hearing, the Honorable Judge J. Michael Gunn granted the motions to appoint CBMWD nunc pro tunc and Interim Watermaster, and denied the motion to disqualify Watermaster Counsel. The Judge also ordered the parties to meet and confer regarding the nine-member board

proposal, which continued the matter to a *meet and confer* among all the interested parties, held July 29, 1996.

July 29, 1996, was the first of two *meet and confers*, held at the City of Chino Council Chambers. Although there was much discussion on that date, the only substantive decision made was to hold an additional *meet and confer* on August 28, 1996.

As a result of the second *meet and confer*, a three-member Watermaster Board proposal was submitted to the Court for hearing on September 18, 1996. As of the Court hearing date, only two of the three municipal water districts invited to participate on the proposed three-member Watermaster Board had responded affirmatively. CBMWD was expected to agree to participate after consideration at their October board meeting and the Court continued the motion until November 20, 1996. CBMWD did not take action to participate on the three-member Watermaster Board as anticipated and the motion was taken off calendar in November of 1996. Four additional workshops were held during late 1996 and into the early months of 1997. As a result, the original nine-member Watermaster Board proposal was modified and approved by the Watermaster Advisory Committee on January 30, 1997, by a majority vote of 67.99 percent.

On March 11, 1997, a new motion to appoint a nine-member Watermaster Board was heard by the Honorable Judge J. Michael Gunn. On April 29, 1997, Judge Gunn issued a ruling which:

- Appointed Anne J. Schneider, Esq. as Special Referee to make a recommendation to the Court regarding the issues raised by the motions.
- Ordered CBMWD, the Advisory Committee, and the DWR (Department of Water Resources) to negotiate terms for the DWR to serve as Interim Watermaster.
- Granted a motion submitted on March 6, 1997, by the law firm of Cihigoyenetche, Grossberg & Clouse, general counsel for CBMWD, to disqualify Watermaster Counsel.

Negotiations began regarding the DWR serving as interim Watermaster through Special Counsel to the Watermaster Advisory Committee, James L. Markman, CBMWD Counsel, Jean Cihigoyenetche, and the attorneys for the DWR.

Anne Schneider accepted the Court's appointment to become a Special Referee and began the process necessary to make a recommendation to the Court. No substantial decisions were reached by fiscal year end and the matter continued into fiscal year 1997-98.

The Special Referee held a special hearing on October 21, 1997, at the Watermaster offices. By mid December 1997, the Special Referee filed her written *Report and Recommendation* with the Court. Based on the *Report and Recommendation*, the Honorable J. Michael Gunn entered a ruling on February 19, 1998 which:

- Appointed the Nine-Member Board as Interim Watermaster.
- Directed that an Optimum Basin Management Program be developed.
- Directed negotiation with DWR be resumed.
- Set hearing dates regarding:
  - The Optimum Basin Management Program (October 28, 1999).
  - Continuance of the Nine-Member Board (October 28, 1999).

- Status of negotiations with DWR to serve as Watermaster and to carry out Watermaster operations (September 30, 1999).

This report documents the development of the OBMP for the Chino Basin pursuant to the Honorable J. Michael Gunn's February 19,1998 ruling.

PROCESS TO DEVELOP THE OBMP

Since the ruling, the Watermaster, the producers, and other interested parties have met twice a month and held special workshops to develop the scope of work to prepare an OBMP and to cooperatively develop the OBMP. The Court officially accepted the scope of work to develop the OBMP on November 5, 1998.

Development of the OBMP required three parallel processes: institutional, engineering, and financial. The institutional process defined the management agenda, directed the engineering and financial processes, and built an institutional support for OBMP implementation. The engineering process developed planning data and management elements, and evaluated the technical and economic performance of the management elements. The financial process was supposed to develop alternative financing plans for the OBMP through its evolution. However because of institutional complexity involved in developing regional water supply facilities and their related financing, most of the financial process will occur in the latter half of 1999 and into the year 2000 – after this document is submitted to the Court in October 1999.

Institutional Process

The institutional process consisted of the following tasks:

Task 1 Identify needs and interests of interested parties.

Task 2 Establish a meeting schedule necessary to complete the OBMP within the time frame allocated.

Task 3 Develop and refine the scope of work based on identified needs.

Task 4 Identify early implementation actions and develop a list of potential program (management) elements of the OBMP to balance needs and interests.

Task 5 Evaluate program elements and develop recommended management and implementation plan.

The first three tasks were completed with the submission of the recommended scope of work to the Special Referee and the Court. Task 4 work was begun in June 1998 with several early implementation action items having already been approved and with initial management concepts submitted to begin the list of potential program elements of the OBMP. The management concepts that were submitted represented concepts or implementation plans that described the party's vision of the OBMP. Submission of management concepts continued into July and August of 1998 and reflected the needs and interests that were previously identified for the OBMP. All proposals submitted were discussed and listed.

As part of Task 5, those proposals that appeared the most promising were forwarded to the engineering and financial consultants for reconnaissance-level, technical, economic and financial analyses. The results of the engineering and financial analyses were submitted to the producers and Watermaster for

review. Working together, the producers and the Watermaster Board have developed an Optimum Basin Management Program for the Chino Basin.

Engineering Process

The engineering process consisted of the following tasks:

Task 1 Develop Optimum Basin Management Program Criteria

Task 2 Assess Current State of the Basin

Task 3 Prepare Sections 1, 2, and 3 of the Optimum Basin Management Program document

Task 4 Develop the Components of the Optimum Basin Management Program

Task 5 Develop Implementation Plan

Task 6 Finalize Optimum Basin Management Program document

Tasks 1 and 2 define the basin problems, planning environment, and the needs and interests of the basin producers. Tasks 1, 2, and 3 were completed in December 1998 and draft Sections 1, 2, and 3 of the OBMP were provided to all interested parties for review. A matrix was developed that contains the goals, impediments to the goal, action items to achieve the goals and the implications of the action items. This matrix was used to define the program elements of the OBMP. Tasks 4 and 5 were engineering efforts to develop these elements and to describe the implementation process.

Over time, the institutional process Tasks 4 and 5, and engineering process Tasks 4 and 5 merged and became one seamless process. Completion of engineering process Task 6 will be completed when the financial process is completed sometime in the year 2000.

ORGANIZATION OF THE OPTIMUM BASIN MANAGEMENT PROGRAM REPORT

The OBMP report is being presented in two phases. This document is the Phase I report and contains a description of the OBMP and the following additional sections:

Section 2 – Current Physical State of the Basin – This section describes the state of the Basin in terms of historical groundwater levels, storage, production, water quality, and safe yield. Current and projected water demands and water supply plans are described. Problems in these areas are identified and potential solutions or solution processes are described.

Section 3 – Goals of the Optimum Basin Management Program – This section describes the major issues defined by stakeholders in the OBMP process, the mission statement for the OBMP process and the goals for the OBMP process.

Section 4 – Management Plan – This section describes program elements to achieve the goals of the OBMP, a management plan, and a process to periodically review and update the OBMP.

Appendix A – Public Comments. This appendix contains written correspondence and a transcript of public comments on the OBMP from a Watermaster hearing held on September 15, 1999 (bound separately).

The technical memoranda produced to support the program elements and implementation process described in Section 4 are on file at the Watermaster offices. Copies are available upon request.

The Phase II report consists of more detailed descriptions of capital-intensive and institutionally complex features of the OBMP. The Phase 2 report will be bound separately.

SECTION 2
STATE OF THE BASIN

This section has been prepared for the OBMP stakeholders so that they will have a common starting point or frame of reference from which to develop the OBMP. The stakeholders developed the outline of this section with input from the Special Referee.

This section of the OBMP report describes the Basin, its physical state, future water demands in the Chino Basin area, and concludes with a summary of problems within the Basin. The physical state of the Basin includes a description of groundwater levels, groundwater storage, production patterns, groundwater quality, and safe yield. These characteristics of the Basin are intimately related, as are the solutions to the problems associated with these characteristics. Water demands in the Chino Basin area include an estimate of current water usage and future water demand projections for groundwater and other sources, an assessment of water quality conditions, and future projections of wastewater generation – including the relationship of source water quality and wastewater quality.

DESCRIPTION OF THE BASIN

The Chino Basin consists of about 235 square miles of the upper Santa Ana River watershed. Figure 1-1 illustrates the boundary of the Chino Basin as it is legally defined in the stipulated Judgment in the case of Chino Basin Municipal Water District vs. the City of Chino *et al.* Figure 1-1 also shows the hydrologic boundary of the Basin, which is slightly different from the adjudicated boundary. Chino Basin is an alluvial valley that is relatively flat from east to west and slopes from the north to the south at a one to two percent grade. Valley elevation ranges from about 2,000 feet in the foothills to about 500 feet near Prado Dam. Chino Basin is bounded:

- on the north by the San Gabriel Mountains and the Cucamonga Basin;
- on the east by the Rialto-Colton Basin, Jurupa Hills, and the Pedley Hills;
- on the south by the La Sierra area and the Temescal basin; and
- on the west by the Chino Hills, Puente Hills, and the Pomona and Claremont Basins.

The Chino Basin is one of the largest groundwater basins in southern California with about 5,000,000 acre-ft of water in the Basin and an unused storage capacity of about 1,000,000 acre-ft. Cities and other water supply entities produce groundwater for all or part of their municipal and industrial supplies; and about 300 to 400 agricultural users produce groundwater from the Basin. The Chino Basin is an integral part of the regional and statewide water supply system. Prior to 1978, the Basin was in overdraft. After 1978, the Basin has been operated as described in the 1978 Judgment in Chino Basin Municipal Water District vs. City of Chino *et al*. (Chino Judgment or Judgment).

SURFACE WATER RESOURCES

The principal drainage course of the Chino Basin is the Santa Ana River. It flows 69 miles across the Santa Ana Watershed from its origin in the San Bernardino Mountains to the Pacific Ocean. The Santa Ana River enters the Basin at the Riverside Narrows and flows along the southern boundary to the Prado Flood Control Reservoir where it is eventually discharged through the outlet at Prado Dam. Chino Basin is traversed by a series of ephemeral and perennial streams that include: Chino Creek, San Antonio Creek, Cucamonga Creek, Deer Creek, Day Creek, Etiwanda Creek and San Sevaine Creek. Figure 2-1

illustrates the stream system in the Chino Basin. San Antonio Creek joins Chino Creek and along with Cucamonga Creek, discharges directly into the Prado Reservoir. Cucamonga Creek changes its name to Mill Creek just north of the Prado Reservoir. Deer Creek was realigned and now discharges into Cucamonga Creek. Currently, Etiwanda Creek discharges into Day Creek at Wineville Basin. In the near future, Etiwanda Creek will be joined with San Sevaine Creek. Day Creek and San Sevaine Creek flow south and enter the Santa Ana River upstream of the Prado Reservoir.

These creeks carry significant flows only during, and for a short time after, intermittent storms that typically occur from November through March. Year-round flow occurs along the entire reach of the Santa Ana River due to year round surface inflows at Riverside Narrows, discharges from municipal water recycling plants that discharge in the River between the narrows and Prado Dam, and rising groundwater. Rising groundwater occurs in Chino Creek, in the Santa Ana River at Prado Dam, and potentially other locations on the Santa Ana River depending on climate and season. The rising groundwater in Chino Creek and the Santa Ana River contains high concentrations of total dissolved solids (TDS). Year-round discharges are sustained:

- in Chino Creek from the Inland Empire Utilities Agency (IEUA) Regional Plant No. 2 (RP2) to the Prado Reservoir, the source of which is from recycled water discharges from RP2; and
- in Cucamonga Creek from IEUA Regional Plant No. 1 (RP1) to the Prado Reservoir, the source of which is from recycled water discharges from RP1.

Significant nuisance flows have developed in Cucamonga Creek above RP1, the source of which is excess landscape irrigation and other outside urban uses. Some of the storm water runoff from the San Gabriel Mountains and urban areas is diverted for recharge in flood retention and spreading basins. These basins are shown in Figure 2-1.

Geology

Chino Basin was formed when eroded sediments from the San Gabriel Mountains, the Chino Hills, Puente Hills, and the San Bernardino Mountains filled a structural depression. The formation of the Basin is described in detail in the *Final* Task 2.2 and 2.3 Report, Describe Watershed Hydrology and Identify Current TDS and TIN Inflows in the Watershed (Wildermuth, 1997). The bottom of the Basin – the effective base of the freshwater aquifer – consists of impermeable sedimentary and igneous rocks. The base of the aquifer is overlain by older alluvium of the Pleistocene period followed by younger alluvium of the Holocene period.

The younger alluvium varies in thickness from over 100 feet near the mountains to a just few feet, south of Interstate 10 and generally covers most of the north half of the Basin in undisturbed areas. The younger alluvium is not saturated and thus does not yield water directly to wells. Water percolates readily in the younger alluvium and most of the large spreading basins are located in the younger alluvium.

The older alluvium varies in thickness from about 200 feet thick near the southwestern end of the Basin to over 1,100 feet thick southwest of Fontana, and averages about 500 feet throughout the Basin. Well capacities range between 500 and 1,500 gallons per minute (gpm). Well capacities exceeding 1,000 gpm are common, with some modern production wells test-pumped at over 4,000 gpm (e.g., Ontario Wells 30 and 31 in southeastern Ontario). In the southern part of the Basin where sediments tend to be more clayey, wells generally yield 100 to 1,000 gpm. Three main water-bearing (hydrostratigraphic) units were identified by Montgomery Watson (1992) during the development of a three-dimensional groundwater model of the Basin. Figure 2-2 shows the locations of two (of seven) generalized cross-sections through

the Chino Basin. These generalized cross-sections illustrate these main aquifer units and are shown in Figures 2-3 and 2-4.

Faults are one of the principal agents in the development of the landscape and restriction of groundwater flow in the Chino Basin. The basin is bounded by major fault systems along which the mountains and hills have been uplifted. The location of fault and groundwater barriers, and displacements in the effective base of the aquifer at faults are shown in Figure 2-2. The faults and groundwater barriers are significant in that they define the external boundaries of the Basin and influence the magnitude and direction of groundwater flow near the boundaries.

MAJOR FLOW SYSTEMS

While considered one basin from geologic and legal perspectives, the Chino Basin can be hydrologically subdivided into at least five flow systems that act as separate and distinct basins. Figure 2-5 is a groundwater elevation contour map for fall of 1997. Figure 2-5 also shows the location of five groundwater flow systems developed during the *TDS and Nitrogen Study* (Wildermuth, 1999) of which the Watermaster, the Chino Basin Water Conservation District (CBWCD), and the IEUA are study participants. Each flow system has a unique hydrology, and water resource management activities that occur in each flow system have little or no impact on the other systems. Each flow system can be considered a management zone. These management zones can be subdivided further if necessary to define and manage flow systems at a finer scale. These management zones are used to characterize the groundwater level, storage, production, and water quality conditions. Figure 2-6 shows these management zones relative to the subbasins used in the 1995 Regional Water Quality Control Plan (Basin Plan) for the Santa Ana Watershed. The Regional Water Quality Control Board, Santa Ana Region (Regional Board) has established water quality objectives for these subbasins and writes waste discharge requirements for waste dischargers based in part on these objectives. Presently, the Basin Plan subbasin boundaries and objectives are being rigorously reviewed. New boundaries similar to the management zone boundaries have been proposed. Revised boundaries and water quality objectives should be adopted sometime in the year 2000.

Management Zone 1. Management Zone 1 is bounded:

- on the southwest by the Chino and Puente Hills,
- on the northwest by the San Jose fault that separates Chino Basin from the Pomona and Claremont Heights Basins,
- on the north by an unnamed non-echelon fault system associated with the Cucamonga and Red Hill faults and separates the Chino Basin from the Cucamonga Basin,
- and on the east by a line that stretches from the southern most edge of the Red Hill fault to Prado Dam.

Groundwater in Management Zone 1 flows generally south with some localized flows to the west in response to groundwater production. Sources of water to Management Zone 1 include direct percolation of precipitation, returns from irrigation, recharge of storm flows and imported water in spreading basins, and subsurface inflow from the Pomona, Claremont Heights, and Cucamonga Basins. Discharge is through groundwater production and as rising groundwater in Chino Creek and the Santa Ana River.

Management Zone 2. Management Zone 2 is bounded:

- on the west by Management Zone 1,
- on the north by the Red Hill fault that separates the Chino Basin from the Cucamonga Basin,
- on the northeast by a segment of the Rialto-Colton fault,
- and on the east by a segment of Barrier J and a line extending from Barrier J in a southwesterly direction to a point of convergence with other management zone boundaries near Prado Dam.

Groundwater in Management Zone 2 flows generally in a southwesterly direction in the northern half of the management zone and then due south in the southern half of the zone. Sources of water to Management Zone 2 include direct percolation of precipitation, returns from irrigation, recharge of storm flows and imported water in spreading basins and subsurface inflow from the part of the Rialto Basin northwest of Barrier J and the Cucamonga Basin. Discharge is mainly through groundwater production and potentially small amounts of rising groundwater in the Prado Reservoir area.

Management Zone 3. Management Zone 3 is bounded:

- on the west by Management Zone 2,
- on the northeast by the Rialto-Colton fault that separates the Chino Basin from the Rialto Basin,
- on the southeast by the Bloomington divide, Jurupa Hills and line projecting from the most western extension of the Jurupa Hills to a point of convergence with other management zone boundaries near Prado Dam.

Groundwater in Management Zone 3 flows generally in a southwesterly direction. Sources of water to Management Zone 3 include direct percolation of precipitation, returns from irrigation, and subsurface inflow from the part of the Rialto Basin southeast of Barrier J. Discharge is mainly through groundwater production and potentially small amounts of rising groundwater in the Prado Reservoir area.

Management Zone 4. Management Zone 4 is bounded

- on the west by Management Zone 3,
- on the north by the Jurupa Hills,
- on the southeast by the Pedley Hills, and
- on the south by Management Zone 5.

Groundwater in Management Zone 4 flows west. Sources of water to Management Zone 4 include direct percolation of precipitation, and returns from irrigation. Discharge is through groundwater production.

Management Zone 5. Management Zone 5 is bounded:

- on the north and west by the Management Zones 3 and 4, Prado Dam,
- on the east by the Riverside Narrows, and
- on the south by the La Sierra area and Temescal Basin.

Sources of water to Management Zone 5 include streambed percolation in the Santa Ana River, direct percolation of precipitation, returns from irrigation and subsurface inflow from the Temescal Basin. Discharge is through groundwater production, consumptive use by phreatophytes, and rising groundwater

in the Prado Reservoir area, and potentially other locations on the Santa Ana depending on climate and season.

GROUNDWATER LEVELS AND STORAGE

Historical Groundwater Level Monitoring

Various entities have collected groundwater-level data in the past. Municipal and agricultural water supply entities have historically collected groundwater-level data in programs that range from irregular, study-oriented measurements to long-term periodic measurements. Groundwater-level measurements were made for specific investigations such as various California Department of Water Resources (DWR) studies, the 1969 Judgment on the Santa Ana River (Orange County Water District *vs.* City of Chino *et al.*), and the Chino Basin Judgment (Chino Basin Municipal Water District vs. City of Chino *et al.*). The spatial extent and temporal history of groundwater-level measurements south of State Route 60 have always been less than north of State Route 60. The DWR and the San Bernardino County Flood Control District (SBCFCD) were very active in collecting groundwater-level measurements in the Chino Basin prior to the settlement of the Chino Basin adjudication. After the Judgment was entered in 1978, the water level monitoring south of State Route 60 stopped almost completely except for the cities of Chino, Chino Hills, and the Jurupa Community Services District (JCSD). Most of the pre-1978 measurements were digitized by the DWR.

Watermaster conducted its first mass groundwater-level monitoring program for the Chino Basin in the spring of 1986. In 1989, Watermaster initiated a more regular monitoring program for the Basin with groundwater-level measurements obtained in 1990, and periodically thereafter through 1997. Watermaster's program relies on municipal producers and other government agencies supplying their groundwater-level measurements on a cooperative basis. Watermaster staff supplements these data with groundwater-level measurements collected by staff, primarily south of State Route 60. In addition to Watermaster staff efforts, private contractors conducting well efficiency tests collect groundwater-level measurements and submit these measurements to Watermaster. Watermaster has digitized all of these recent measurements. Watermaster has combined digitized groundwater-level measurements from all known sources into a database structure that is maintained at Watermaster's office.

Watermaster began a process to develop a comprehensive groundwater-level monitoring program in the spring of 1998. The process consists of collecting groundwater-level data at all wells in the Basin from which groundwater-level measurements can be obtained for fall 1999, spring 2000, fall 2000, and spring 2001. These data will be mapped and reviewed. Based on this review and Watermaster management needs, a long-term water-level monitoring program will be developed and implemented in the fall of 2001.

Historical Groundwater Levels

This section describes the groundwater-level time histories in the Chino Basin by management zone and characterizes the differences between management zones. Figure 2-7 illustrates the location of wells whose groundwater-level time histories are discussed herein and the management zone boundaries described in Section 1. The wells were selected based on length of record, completeness of record, and geographical distribution. Wells discussed herein are identified by their state well number. The behavior of groundwater-levels at specific wells is compared to climate, to pre- and post-Judgment periods, and to other factors as appropriate.

Management Zone 1. Wells 01S07W08N01 (Figure 2-8) and 01S08W11R01 and 01S08W14A03 (Figure 2-9) illustrate typical groundwater-level time histories in the northern end of Management Zone 1. The accumulated departure from mean precipitation (ADFM) curve is plotted on Figures 2-8 and 2-9 to illustrate climatic conditions. Positive sloping lines on the ADFM curve imply wet years or wet periods. Negatively sloping lines imply dry years or dry periods. For example, the period between 1937 to 1944 and 1978 to 1983 are extremely wet periods, and are represented as positively sloping lines. The period 1945 through 1977 is a drought period and is represented as a negatively sloping line, punctuated with a few wet years (positively sloped in 1952, 1958 and 1969). Short-term groundwater-level fluctuations shown in these figures are caused by including static and dynamic observations in the groundwater-level time histories. These time histories follow the climatic trends very closely with the 01S08W11R01 and 0S08W14A03 (westernmost wells) being slightly more sensitive to high rainfall years than 01S7W08N01 (eastern well). The groundwater-level response in well 01S7W08N01 lags the 1937 to 1944 and the 1978 to 1983 wet periods by about three to four years. By comparison, wells 01S08W11R01 and 0S08W14A03 responded to the 1978 to 1983 wet period within a year. The difference in response time is due to proximity of recharge to the area near the wells. Wells 01S08W11R01 and 0S08W14A03 are relatively close the Upland and Montclair Basins. Well 01S7W08N01 is two miles east of wells 01S08W11R01 and 0S08W14A03 with no significant recharge facilities nearby. In addition, the Metropolitan Water District of Southern California (MWDSC) recharged large quantities of State Water Project (SWP) water in the Montclair Basins during the period 1978 to 1983. The depth to water in the vicinity of these wells ranged from about 460 feet in the late 1920s to about 600 feet in 1996.

Wells 01S08W28E01 (Figure 2-10) and 01S08W31J01 and 01S08W33D01 (Figure 2-11) are about three miles south of wells 01S08W11R01 and 01S08W14A03 (Figure 2-9). These wells follow the general climatic trend, but show essentially no response to intermittent wet years in 1952, 1958, and 1969. The post-1977 groundwater-level increase is due to the 1978 to 1983 wet period, the reduction in overdraft following the implementation of the Chino Basin Judgment, the initiation of groundwater replenishment with imported water, and the reduction in pumping due to increased use of imported surface water. The groundwater-level response in these wells responded to the 1978 to 1983 wet period within a year. The depth to water in the vicinity of these wells ranged from about 130 to 160 feet in the late 1920s to about 150 to 280 feet in 1996 with well 01S08W28E01 showing the greatest depth to water. Well 01S08W28E01 is a municipal production well owned by the City of Pomona and is located in an area of regionally depressed groundwater levels.

Wells 02S08W04P01 and 02S08W12F01 (Figure 2-12) are located about two to three miles south of well 01S08W28E01 (Figure 2-10) and wells 01S08W31J01 and 01S08W33D01 (Figure 2-11). These wells follow the general climatic trend, but show essentially no response to intermittent wet years in 1952, 1958 and 1969. The groundwater-level responses in these wells lag the 1937 to 1944 and the 1978 to 1983 wet periods by about two to three years. The response to the 1937 to 1944 wet period is surprisingly subtle compared to most other wells with contemporaneous time histories in Management Zone 1. This suggests that recharge in the area is low and that production is high. The post-1977 groundwater level increase for 02S08W04P01 is due to the 1978 to 1983 wet period, the reduction in overdraft following the implementation of the Chino Basin Judgment, the initiation of groundwater replenishment with imported water, and the reduction in pumping due to increased use of imported surface water. The depth to water in the vicinity of these wells ranged from about 20 to 40 feet in the late 1920s to about 200 feet in 1982.

From north to the south, the following observations can be made regarding time histories of groundwater levels in Management Zone 1:

- groundwater levels are down from observed period of record highs in the late 1920s;
- the lowest groundwater levels were observed around 1977;

- groundwater levels have recovered slightly since 1977 due in part to the wet period of 1978 to 1983, reduction in overdraft after 1977, the initiation of groundwater replenishment with imported water, and the reduction in pumping due to increased use of imported surface water;
- a condition of long-term overdraft has occurred in this management zone with groundwater levels dropping by about 100 to 140 feet between the late 1920s to the present with most of the decline prior to 1977 and the Chino Basin Judgment (1978).

Management Zone 2. Figure 2-13 contains groundwater-level time histories for 01S07W14G01, 01S07W27D01, and 02S07W09M01. These wells are aligned north to south, approximately along a flow line. The groundwater-level time histories in Figure 2-13 show a general decline since before the 1937 to 1944 wet period, with little or no response to wet years until 1978. The post-1977 increase is probably due to the combination of 1978 to 1983 wet period, reduction in overdraft following the implementation of the Chino Basin Judgment, the start of artificial replenishment with imported water in the San Sevaine and Etiwanda flood control basins, and the increased use of imported surface water. The depth to water for 01S07W27D01 ranged from about 200 feet in the late 1920s to about 380 feet in 1974, a decline in groundwater levels of about 180 feet.

Management Zone 3. Figure 2-14 contains time histories for wells 01S06W11B01 and 01S05W16C01 that are located in the most upgradient part of Management Zone 3. The groundwater-level observations in these wells follow the general climatic trend. The groundwater-level time history for well 01S06W16C01 shows a general decline since the 1920s and a general non-responsiveness to significant wet years or periods. For example, there is a slight response to the 1937 to 1944 and 1978 to 1983 wet periods and no response to wet years in 1952, 1958, and 1969. Well 01S06W11B01 behaves in a similar manner with slightly less responsiveness. The lack of responsiveness is due to the lack of significant sources of recharge. There are no major streams or recharge basins in the upper part of Management Zone 3. The peak groundwater levels for both of these wells are lagged about three years behind the peaks in the ADFM curve for the 1937 to 1944 and 1978 to 1983 wet periods. The depth to water ranges from about 360 to 430 feet in the late 1920s to about 430 to 540 in 1978 for wells 01S05W16C01 and 01S06W11B01, respectively. The groundwater decline from the 1920s to the early 1990s is about 20 feet and 60 feet for wells 01S05W16C01 and 01S06W11B01, respectively. Figure 2-15 is a similar plot for wells 01S05W30L01 and 01S06W23D01. These wells have similar response characteristics as 01S06W11B01 and 01S05W16C01 with about 60 to 70 feet of groundwater decline over the period from the late 1920s to the early 1990s.

The relative amount of decline from 1920s to 1977 is less in Management Zone 3 than in Management Zone 1. This is due to greater production in Management Zone 1 than in Management Zone 3 and because of the specific yield (fraction of usable groundwater per unit volume), which is greater in the eastern portion of Chino Basin than in the western portion. The alluvium in the eastern part of the Chino Basin is derived from granitic rocks of the San Gabriel Mountains. The alluvium on the west side of Chino Basin is derived in part from the San Gabriel Mountains and marine sedimentary rocks of the Chino and Puente Hills. The latter produce finer-grained alluvium with more clay and poorer storage properties.

Figure 2-16 contains time histories for wells 02S06W05B01 and 02S07W34H01. These wells are aligned northeast to southwest, approximately along a flow line. The groundwater-level time histories end in the late 1970s or early 1980s, as is typical for agricultural wells in the southern half of the Basin. These time histories follow the general climatic trend, however, there is trend among the wells of a decreasing climatic influence from northeast to southwest. The depth to water for 02S06W05B01 ranged from 130 feet in the late 1920s, to about 200 feet in 1978, a decline in groundwater levels of about 70 feet.

Management Zone 4. Management Zone 4 is bounded on the north by the Jurupa Hills, on the east by the Pedley Hills, on the south by Management Zone 5 and on the west by Management Zone 3. The only outflow from Management Zone 4 is by production. Figure 2-17 contains groundwater-level time histories for wells 02S06W16B02 and 02S06W14C02. These wells generally follow the climatic trend. The depth to water for 02S06W14C02 ranged from about 7 feet in 1945 to about 17 feet in 1993, corresponding to an overall decline in groundwater levels of about 10 feet for this period.

Management Zone 5. Management Zone 5 is bounded on the north and west by the Management Zones 3 and 4, on the east by the Riverside Narrows and on the south by various unnamed hills. Figure 2-18 contains time histories for wells 02S07W36H02, 02S06W26D02, and 03S07W03N01. Groundwater levels in these wells follow the general climatic trend. However, wells 2S07W36H02 and 03S07W03N01 are much less responsive than well 02S07W26D02 due to the stabilizing effects of being adjacent to the Santa Ana River. The depth to water for 02S07W26D02 ranged from about 24 feet in 1939 to about 28 feet in 1992, corresponding to an overall decline in groundwater levels of about 4 feet for this period.

For the most part, the response of groundwater levels in the Chino Basin to significant storms and wet climatic periods is small. There are two reasons for this. First, the mountain drainage areas tributary to the Chino Basin are relatively small compared to the size of Chino Basin (235 square miles) and the amount of water in storage (~5,000,000 acre-ft). The mountain drainage areas tributary to the Chino Basin areas are:

San Antonio Creek	17.7	sq mi
Cucamonga Creek	13.6	
Deer Creek	6.4	
Day Creek	7.7	
Etiwanda Creek	6.7	
San Sevaine Creek	9.7	
Total	61.7	sq mi

San Antonio Creek is mostly diverted for direct use and recharge in the Claremont Heights and Cucamonga Basins. Cucamonga, Deer, and Day Creeks are diverted for direct use and recharge in the Cucamonga Basin. Large storm flows from these creeks can make it into the Chino Basin, however these channels are concrete-lined and consequently large amounts of storm flow are not recharged. In contrast, San Bernardino area groundwater basins (Bunker Hill and Lytle Basins) – located just to the east of the Chino Basin – consist of about 120 square miles of aquifer and with about 466 square miles of tributary areas in the San Gabriel and San Bernardino mountains. The groundwater level response in the Chino Basin due to wet years is small, on the order of a few feet to tens of feet. In contrast, the San Bernardino area groundwater-level response to significant wet years and climatic periods could range from 100 to 300 feet.

Regional Groundwater Level Changes

Figures 2-19 and 2-20 are groundwater elevation contour maps for the Chino Basin for 1997 and 1933, respectively. The 1997 map is based on data collected in Watermaster's ongoing monitoring programs and is representative of current conditions. The 1933 map is based on groundwater-level data compiled and mapped by the DWR. Figure 2-21 shows the change in groundwater level from 1933 to 1997 based on the groundwater elevation maps for 1933 and 1997. The regional groundwater decline by management zone is:

Management Zone	Range
1	50 to 150 feet
2	50 to 100 feet
3	50 to 100 feet
4	less than 50 feet
5	less than 50 feet

Figure 2-22 is a map similar to Figure 2-21 with the water service area boundaries shown in place of management zone boundaries. The areas of greatest regional groundwater decline underlie the city of Pomona, the Monte Vista Water District, the City of Chino, and the western half of the City of Ontario.

Figure 2-23 shows the depth to water for fall 1997. Mendenhall surveyed the Basin in 1902 and found parts of the Chino Basin to be artesian as evidenced by springs and marshy areas (Mendenhall, 1904). This artesian area is also shown on Figure 2-23. In the artesian areas, the historical groundwater level or piezometric surface was at or exceeded the ground surface. Figure 2-23 suggests that the regional groundwater decline in the western Chino Basin is up to 200 feet since 1902. Groundwater levels appear to have stabilized since the Chino Basin Judgment was implemented and groundwater production has been managed within the Basin's safe yield. However, there may still be areas experiencing localized overdraft including the area overlain by the Cities of Chino, Chino Hills, Pomona, the western portion of the City of Ontario, and the Monte Vista Water District. Todd defines the *safe yield* of a groundwater basin as the amount of water that can be withdrawn annually without producing an undesirable result. Withdrawal or production is excess of safe yield is an *overdraft*. Domenico (1972) defines undesirable results to include not only the depletion of groundwater in storage but also intrusion of water of undesirable quality, contravention of existing water rights, and the deterioration of the economic advantages of pumping. Cherry (1979) includes subsidence in the list of undesirable results.

The significant issues related to large-scale regional groundwater declines in the Chino Basin include: decline in storage, higher pumping costs, loss of production capacity, water quality degradation, and subsidence.

In the mid-1970s, ground fissuring was identified in the southwestern portion of Chino Basin. Ground fissuring in this area has continued to the present, and subsidence has been documented and identified as the cause of ground fissuring (Kleinfelder, 1993; 1996). Kleinfelder documented regional subsidence through an analysis of topographic benchmarks from 1987 to 1993, 1993 to 1995, and from 1995 to 1999. The resulting contour maps of equal differences in elevation revealed a north-south trending, elongated area of subsidence underlying the City of Chino and California Institute of Men (CIM) (see Figures 2-23 and 2-24). Maximum subsidence over the period 1987-1995 was reported to be about 2 feet located along Central Avenue between Schaefer and Eucalyptus Avenues. However, about one foot (or 50 percent) of this subsidence occurred over the period from 1993-1995 – indicating that the rate of subsidence has increased. This was confirmed independently by scientists at the Jet Propulsion Laboratories using remote sensing (see www-radar.jpl.nasa.gov/sect323/InSar4crust/LosAngeles.html). Kleinfelder (1993; 1996) concluded that regional subsidence was caused by localized groundwater overdraft and declining groundwater levels. The reasoning to support this conclusion is four-fold:

- As shown in Figure 2-23, the area of regional subsidence and ground fissuring geographically coincides with the late 1800s artesian area mapped by Mendenhall (1904, 1908) – an area that has experienced extreme declines in groundwater levels.

- Subsidence is well documented in areas where underlying soils have experienced extensive fluid withdrawal. In saturated soils, buoyant conditions exist, where stresses between soil particles are low. But as the water level drops, the stresses between soil particles increase and overburden pressure causes soil consolidation.
- The initiation of ground fissuring temporally coincides with new groundwater production by the city of Chino Hills in the area of maximum subsidence. By 1975, groundwater levels had declined by a maximum of 200 feet in the former artesian area.
- Regional subsidence and ground fissuring is not attributable to other potential causes of subsidence. The area does not coincide with known faults or groundwater barriers and the area has not experienced significant petroleum extractions.

Methodology for Estimating Groundwater Storage

Estimating groundwater storage within the Chino Basin is a critical exercise because of the direct influence of storage upon the safe yield and reliability of the aquifer. The safe yield of a groundwater basin approximates the average annual recharge in a basin if the storage in the basin is large. The larger the storage, the more reliable the basin will be in dry period. The amount of water in storage in the Chino Basin is directly proportional to groundwater level.

The methodology for computing the volume of groundwater in storage consists of the following steps:

1. develop groundwater elevation maps for the basin;
2. obtain and map aquifer storage properties;
3. obtain and map the effective base of the freshwater aquifer;
4. divide the basin into a regular grid – with each grid cell assigned a:
   - groundwater elevation,
   - tops and bottom elevations of each aquifer
   - elevation of the effective base of the bottommost aquifer (*e.g.*, bedrock elevation), and
   - storage properties;
5. compute the volume of groundwater in storage for each grid cell, and sum the storage values of all grid cells.

In most parts of the Chino Basin, unconfined aquifers overlie confined aquifers. Thus, the storage in some grid cells consists of the sum of water in storage in confined and unconfined aquifers. The volume of groundwater in storage in each grid cell is estimated from the following equations:

volume in an unconfined aquifer in a grid cell is given by:

$$V_{i,l} = (GWE_{i,l} - B_{i,l}) * A_i * P_{i,l} \qquad \text{(Equation 1)}$$

volume in a confined aquifer in a grid cell is given by:

$$V_{i,l} = [(GWE_{i,l} - T_{i,l}) * SC_{i,l} + (T_{i,l} - B_{i,l}) * P_{i,l}] * A_I \qquad \text{(Equation 2)}$$

where:

$GWE_{i,l}$ is the groundwater/piezometric elevation for grid cell *i* and aquifer *l*
$T_{i,l}$ is the effective top elevation of a grid cell *i* and aquifer *l*
$B_{i,l}$ is the effective bottom elevation of grid cell *i* and aquifer *l*
A_i is the surface area of grid cell *i*
$P_{i,l}$ is the effective porosity of grid cell *i* and aquifer *l*
$SC_{i,l}$ is the storage coefficient of a grid cell *i* and aquifer *l*

Not all the water in storage is available for production. A minimum volume of groundwater must be maintained in storage to ensure that groundwater can flow to wells. This minimum storage is included in the volume computations described above.

A maximum storage could also be defined, although it is more difficult to do so. The difficulties associated with maximum storage relate to defining which high groundwater-level impacts are acceptable and to whom. An across-the-basin increase of 50 feet would probably impact only those lands near the Santa Ana River with unknown water quality impacts everywhere.

Time History of Groundwater Storage for the Basin

Groundwater-level maps were prepared using all available data for 1933, 1965, 1969, 1974, 1977, 1983, 1991, and 1997. Aquifer geometry and storage properties were developed from the Chino Basin Water Resources Management Study (CBWRMS) (Montgomery Watson, 1995). Equations 1 and 2 were used to estimate the groundwater in storage for these years. Figures 2-19 and 2-20 illustrate the spatial distribution of groundwater elevations within the Chino Basin for the fall 1997 and 1933, respectively. The estimated volume of groundwater in storage in the Chino Basin using this methodology and information was:

Year	Volume (acre-ft)
1933	6,300,000
1997	5,300,000

Groundwater storage decreased by about 1,000,000 acre-ft during the 64-year period of 1933 to 1997. Table 2-1 lists the estimated storage in each of the management zones shown in Figure 2-5 and aggregations of the management zones into the Lower Chino Basin (south of State Route 60), the Upper Chino Basin (north of State Route 60) and the Total Chino Basin. The storage estimates in Table 2-1 are shown graphically in Figures 2-25 and 2-26. The lowest level of groundwater storage during the period 1960 to the present occurred in 1977 at the end of a 33-year drought. Prior to 1977, groundwater storage was falling at a rate of about 25,500 acre-ft/yr. The decline in storage was due to drought and groundwater production in excess of sustainable yield. The period of 1978 though 1983 was an extremely wet period. The physical solution with the Chino Basin Judgment was implemented in 1978. The end of the drought and the elimination of basin-wide overdraft caused an increase in storage. Table 2-1 shows the change in storage relative to 1977 (the lowest level of storage) for the period 1965 to 1997. The losses in storage that occurred during the period 1965 to 1977 have been partially offset by gains in storage that occurred after 1977.

Figure 2-27 shows the time history of storage in the upper and lower parts of the Chino Basin. There was a decline in storage prior to 1977. After 1977, storage in the upper basin increases, however the rate of increase declines over time. This continued increase in storage after 1983 probably is due to:

- accumulation of unproduced safe yield rights in local storage accounts;
- lagged inflows from the deep unsaturated zone in the northern half of the Basin; and
- lagged subsurface inflows from the Lytle Basin north of Barrier J and the Riverside Basin through the Bloomington divide.

After 1977, storage in the lower part of the Basin appears to have stabilized and follows the general climatic pattern.

Table 2-2 and Figure 2-28 show a comparison of the time history of total Chino Basin storage to groundwater production, volume of water stored in cyclic and local storage accounts, and climate. As of fall 1997, the combined volume of water in cyclic and local storage accounts was about 274,000 acre-ft and is greater than the increase in total storage that occurred between 1977 (pre-Judgment) and the present. The increase in storage since 1977 is about 174,000 acre-ft. This is counter intuitive, that is, the change in total storage since 1977 should be greater than the volume of water in cyclic and local storage accounts – especially given that the Basin has experienced a wetter than average period since 1977. The discrepancy may be due in part to under reporting of production in the agricultural pool, storage losses to the Santa Ana River, and inaccuracies in the methods used to compute storage herein.

Losses From Storage

The surface water discharge in the Santa Ana River consists of storm flow and baseflow. Baseflow is divided into two components: wastewater discharged from publicly-owned treatment plants (POTWs) and rising groundwater. The rising groundwater component in the Santa Ana River can be divided into two components: short-term storage water from seasonal recharge along the river, and persistent rising water caused by the regional groundwater gradient towards the river. The short-term storage component of rising water will decrease when total groundwater storage is increased either naturally (wet years) or artificially. If total groundwater storage is maintained at higher levels, recharge of surface water from the Santa Ana River will decrease.

Because of the spatial distribution of storage, the rising groundwater response to increases in groundwater storage is often lagged and variable in time. For example, the baseflow at Riverside Narrows (the location where the Santa Ana River enters the Chino Basin) peaks about five to seven years after heavy recharge years in the upstream groundwater basins. Chino Basin groundwater discharge to the river also exhibits a slight lag time. The time history of baseflow at Prado consists of a complicated mix of rising water responses from the Bunker Hill, Riverside, Chino and Temescal Basins. Analysis of the increase in rising water in the Chino Basin caused by an increase in groundwater storage requires the filtering out of these other sources of surface discharge from historical records and modeling results.

The accumulation of groundwater in storage will cause an increase in groundwater discharge in the Santa Ana River and its tributaries Chino Creek and Mill Creek – losses from storage that are not recoverable. The physics of the groundwater storage-baseflow relationship can be represented by linear reservoir theory where outflow is directly proportional to storage:

$$O = K * S \qquad \text{(Equation 3)}$$

where:

O is the outflow from storage (L^3/T)

S is volume of water in storage (L^3)
K is the linear reservoir coefficient (T^{-1})
L denotes units of length and
T denotes unites of time.

This formula can be calibrated to a specific range of storage and groundwater management conditions. The flow in the Santa Ana River in the Chino Basin was decomposed into rising water from the Chino Basin and other components. The rising water component was subdivided into short-term storage water from seasonal recharge along the river in Management Zone 5, and persistent rising water caused by the regional groundwater gradient towards the River from all management zones. This decomposition was done using simulation model results from the **C**hino Basin **I**ntegrated **G**roundwater and **S**urface Water **M**odel (CIGSM) developed for the Chino Basin Water Resources Management Task Force (Montgomery Watson, 1995, and unpublished modeling results for calibration and planning simulations).

Historical Storage Losses to the Santa Ana River. Rising groundwater estimates were made for the period of model calibration 1960 to 1989, and the forecasting period of 1990 to 2040. Certain historical periods were studied to isolate the spatial effects of groundwater production patterns and hydrology on rising groundwater. For example, the period 1960 to 1977 represents the pre-Judgment period that has higher groundwater production than the period after 1978 that represents the period when the Basin was managed by Watermaster without basin-wide overdraft. Linear reservoir theory was used to develop a simple relationship of change in groundwater discharge to the Santa Ana River to incremental change in groundwater storage.

Hydrograph decomposition for the historical period was done using water balance tables from CIGSM for reaches of the Santa Ana River and its tributaries. Analysis of the hydrology of the period suggest that two periods could be used to develop a linear reservoir relationship:

- 1970 to 1977 representing a pre-Judgment period; and
- 1984 to 1989 representing a post-Judgment period.

The period 1970 to 1977 was a dry period following significant recharge along the river from the 1969 storms. The 1984 to 1989 period was also a dry period following the wet period from 1978 to 1983. Both of these periods exhibit recession flows typical of streams fed by groundwater systems. CIGSM model-estimated rising water was plotted against the model-estimated storage in the Chino Basin. The annual rising water estimates and respective storage estimates are shown graphically in Figures 2-34 and 2-35. Simple linear regressions were done for the 1974 to 1977 period and 1987 to 1989 period to estimate the linear reservoir coefficient (K) for the linear reservoir equation (Equation 3). The linear reservoir coefficient is the slope of the best-fit lines in Figures 2-34 and 2-35. The resulting linear reservoir coefficients are 0.0254 for the 1970 to 1977 period, and 0.0203 for the 1987 to 1989 period. Physically, the linear reservoir coefficient represents the fraction of the storage that annually becomes rising water. Thus, an increase in storage of 100,000 acre-ft in the 1987 will cause about 2,000 acre-ft of new rising water in the first year. Groundwater storage after the first year would be reduced to 98,000 acre-ft. In the second year, the storage would be reduced another 2.03 percent, or 1,970 acre-ft, and so on. The 0.0051 difference in linear reservoir coefficients for the pre- and post-Judgment periods is due in part to changes in groundwater production patterns, hydrology, and CIGSM modeling artifacts.

Future Storage Losses to the Santa Ana River. An estimate of the linear reservoir coefficient for the period 1990 through 2040 was estimated by comparing the total Santa Ana River flow at Prado Dam and groundwater storage for Alternatives 3 and 4 of the CBWRMS. Alternative 3 represents a specific groundwater management strategy that could be implemented. Alternative 4 is identical to Alternative 3 with the addition of a conjunctive use program and an increase in limits for local storage accounts. The

conjunctive use program has three cycles of build up in storage to approximately 300,000 acre-ft and subsequent pump-out periods. The increase in storage in local storage accounts is gradual and incremental throughout the period. The rising water losses from the conjunctive use storage and the increase in local storage accounts are simply the difference in Santa Ana River flow between these alternatives. Table 2-3 lists the differences in groundwater storage and Santa Ana River flow. The linear reservoir coefficient for future conditions is estimated to be about 0.0408, or 4.1 percent of storage – about double that of the 1984 to 1989 period. The increase in the linear reservoir coefficient was caused by changes in groundwater production patterns, hydrology, and CIGSM modeling artifacts.

Computation of Storage Losses to Santa Ana River. The linear reservoir equation can be used to estimate losses from groundwater storage accounts to the Santa Ana River:

$$q_t = K * (S_t + 0.5 * T *(I_t - Q_t)) \qquad \text{(Equation 4)}$$

where:

q_t	is the annual loss from a storage account in period *t* to *t+1* (acre-ft/yr)
K	is the linear reservoir coefficient
S_t	is water in a storage account at the end of period *t* (acre-ft)
I_t	is the water put into a storage account in period *t* to *t+1* (acre-ft/yr)
Q_t	is the water taken from the storage account for use in period *t* to *t+1* (acre-ft/yr)
T	duration of time between *t* to *t+1*, assumed to be one year

The volume of water in storage accounts at the end of a period is equal to:

$$S_{t+1} = S_t + T * (I_t - Q_t - q_t) \qquad \text{(Equation 5)}$$

Using a linear reservoir coefficient of 0.0201 and Equation 4, the total water lost from local storage accounts and cyclic storage since the Judgment became active in 1978 is estimated to be about 50,000 acre-ft or about 18 percent of the volume that Watermaster currently assumed was in storage. The time history of accumulating storage accounts and estimated losses to baseflow are listed in Table 2-4. Watermaster does not currently compute losses from storage accounts. This means that when water in storage accounts is produced, additional overdraft of the Basin will occur. Losses from conjunctive use projects could be very large. In the example in Table 2-3, three filling and withdrawal cycles were done over a 40-year period with each reaching a fill capacity of 300,000 acre-ft. The model estimated losses of over 300,000 acre-ft over three fill and extraction cycles – a loss of over one-third of the water stored. If these losses were not accounted for, the Basin would be overdrafted by 300,000 acre-ft over the 40-year period.

The losses described above were developed from modeling studies. Monitoring to verify these losses has not been done in the past nor is it practical in the future. The measuring errors associated with such a program would be larger than the probable losses from storage. The only practical ways to estimate such losses are to:

- Use a linear reservoir model as described above, or
- Calibrate a groundwater flow model over the period that water is held in cyclic, local, and conjunctive use storage and compare it to a simulation run with the same hydrology that did not have water in these storage accounts. The difference in groundwater discharge to the river would be the losses due to cyclic, local, and conjunctive use storage. Adjustments to storage accounts could be made retroactively or a new loss factor established for the next period.

GROUNDWATER PRODUCTION

Historical Groundwater Production Monitoring

Prior to 1975, groundwater production monitoring was not formally done by a single entity for the benefit of the Basin. Municipal and some industrial producers kept production records with some submitting annual production reports to the State Water Resources Control Board (SWRCB). Very few agricultural wells had meters and fewer kept records of production. During the period 1975 to 1978, production monitoring at agricultural wells improved slightly. Most of the agricultural production volumes for the period preceding 1978 are comprised of estimates provided by producers and are not based on direct measurements from in-line flow meters.

Since 1978, Watermaster has collected information to develop production estimates. Production estimates in the appropriative pool and overlying non-agricultural pool are based on totalizing in-line flow meter data provided to Watermaster on a quarterly basis by these producers. Watermaster aggregates these quarterly values to obtain annual production for these pools. Production estimates for the agricultural pool are based in part on totalizing in-line flow meter data, water duty methods, and hour-meter data combined with well efficiency tests. As with the other pools, reporting is done by the producers. However, not all agricultural pool producers provide Watermaster with estimates of their production. About one third of agricultural pool producers either did not file production reports or filed incomplete reports in fiscal year 1997/98 (telephone discussion with Jim Theirl, 1998).

Historical Groundwater Production

Table 2-4 contains estimates of annual groundwater production in the Chino Basin from three different sources: summaries of SWRCB filings and interviews with some producers; Watermaster estimates, and production estimates developed for calibration of CIGSM developed for the CBWRMS. The second column in Table 2-5 contains annual production estimates that were used to develop the safe yield in the Judgment. The third column contains Watermaster estimates of annual production that are based on production reports submitted to Watermaster by the producers. The fourth column contains annual production estimates that are based on SWRCB filings, production reports from producers, and water duty methods. In the latter case, water duty methods were used as a check on reported production and supplemented reported production data when production data was missing or under-reported at wells.

The safe yield of the Chino Basin was based on the hydrology of the period 1965 to 1974. The average annual groundwater production for that period from SWRCB filings and interviews was estimated at 152,100 acre-ft/yr. The engineer working on the historical production data knew there was *unaccounted for* production and assumed that actual production was 20 percent more than the estimate from SWRCB filings and interviews, or about 180,000 acre-ft/yr (Carroll, 1977). This estimate is close to the 189,400 acre-ft/yr average for the same period from the CBWRMS.

In Table 2-5, the period of Watermaster groundwater production estimates overlaps the period of CBWRMS production estimates. For their common period of record (1975 through 1989), the CBWRMS estimates are consistently higher. This occurs in part because some of the agricultural producers fail to report production or fail to provide production information to Watermaster. For the CBWRMS, water demands based on land use were compared to reported production. If the water demand for the land uses in a given area was greater than reported production, then reported production was increased to meet the demands based on land use. This method was validated in the CIGSM model calibration process (Montgomery Watson, 1993). In the latter years, the CBWRMS production estimates increasingly diverge from Watermaster estimates. For their common period of record, the average annual groundwater production was estimated at 147,900 acre-ft/yr by Watermaster and 174,000 acre-ft/yr by the CBWRMS – a difference of about 26,000 acre-ft/yr. Actual production is probably somewhere in between Watermaster and CBWRMS estimates.

Spatial and Temporal Changes in Groundwater Production

Table 2-6 lists Watermaster's estimates of Chino Basin production by pool for the period of fiscal year 1974/75 to 1997/98, and the relative amount of production by pool. Over this period, groundwater production has ranged from a high of 181,000 acre-ft/yr (1975/76) to a low of about 122,600 acre-ft/yr (1982/83), and has averaged about 147,100 acre-ft/yr. The distribution of production by pool has shifted since 1975 with the agricultural pool production dropping from about 55 percent in 1974/75 to 28 percent in 1996/97. During the same period, appropriative pool production increased from about 40 percent in 1974/75 to 68 percent in 1996/97. The increases in appropriative pool production have kept pace with decline in agricultural production. Production in the overlying non-agricultural pool declined from about 5 percent in 1974/74 to about 2 percent in the mid-1980s, rose to about 4 percent by 1990/91 and has remained at about 4 percent of total production thereafter.

Figure 2-29 is a plot that compares the change in total groundwater production in the Chino Basin to the change in urban and agricultural/other non-urban land uses. Prior to 1980, the decline in groundwater production appears proportional to the decline in agricultural and other non-urban land uses. After 1980, groundwater production appears to be relatively stable even though the decline in agricultural and other non-urban land uses is accelerating.

Figures 2-30 and 2-31 are similar to Figure 2-29 except they represent the Basin north of State Route 60 and south of State Route 60, respectively. North of State Route 60, the pattern of land use change is similar to the entire basin, but the groundwater production that was declining from 1960 to 1980 rose sharply after 1980. South of State Route 60, groundwater production was generally declining throughout the period of 1960 to 1990. The rate of decline in production in the southern half of the Basin after 1980 matches the rate of increase in production north of State Route 60, such that the total annual production in the Basin after 1980 is relatively constant (see Figure 2-29).

Figures 2-32 through 2-36 illustrate the location and magnitude of groundwater production at wells in the Chino Basin for years 1960, 1970, 1980, 1989 and 1997. These maps are based on production estimates developed in the *Chino Basin Water Resources Management Study* (Montgomery Watson, 1995) and by Watermaster. Two trends are evident in the period 1960 through 1998:

- In the southern half of the Basin there is an increase in the number of active wells and a decrease in the per well production. This is due to the land use transition from predominately irrigated agriculture uses to predominately dairy uses and due to a recent well inspection program, resulting in more wells of record.

- In the northern half of the Basin there is an increase in the number of wells producing over 2,000 acre-ft/yr. This is consistent with the land use transition from agricultural uses to urban uses and with the trend for increasing imported water costs.

Groundwater Production and Safe Yield

Recent and past studies have provided some insight into the influence of groundwater production in the southern end of the Chino Basin on the safe yield of the Basin. Three studies were done that quantified the impacts of proposed desalters in the lower Chino Basin on groundwater discharge to the Santa Ana River. The proposed desalters were first described in *Nitrogen and TDS Studies, Upper Santa Ana Watershed* (James M. Montgomery, Consulting Engineers, Inc., 1991). This study matched desalter production to meet future potable demands in the lower Chino Basin through the year 2015. The well fields were sited to maximize the interception of rising water and to induce streambed percolation in the Santa Ana River. The decrease in rising water and the increase in streambed percolation were projected to range from 45 to 65 percent of total desalter production.

Well field design studies for the SAWPA desalter provided estimates of the volume of rising water intercepted by the currently proposed desalter – scheduled for completion in March 2000 (Wildermuth, 1993). These studies used a very detailed model of the lower Chino Basin (rectangular 400-foot by 400-foot grid covering the lower Chino Basin) to evaluate the hydraulic impacts on rising water and groundwater levels at nearby wells. These studies showed the relationship of interception of rising water to well field location and well field capacity. The fraction of the desalter production composed of decreased rising water and the increased stream bed percolation water was estimated to range from 40 to 50 percent.

No formal studies and estimates of desalter well field interception of rising water were made during the *Chino Basin Water Resources Management Study* (Montgomery Watson, 1995). An informal estimate of the interception of rising water was made by Wildermuth (letter to Neil Cline, dated August 9, 1993). Wildermuth used the groundwater model developed in *Chino Basin Water Resources Management Study* for a well field similar to the SAWPA desalter well field and used the model calibration period of 1960 to 1989. This study estimated the interception of rising groundwater at about 80 percent of desalter production capacity.

These three studies suggest that the yield of the Basin could be increased by simply increasing the production near the river, and that for every two acre-ft of new, near-river production the safe yield could be increased by one acre-ft, that is the marginal change in safe yield with increased near-river production is about 0.5 acre-ft/yr per acre-ft/yr of production. The opposite is also true. That is, if production were to decrease in the southern half of the Basin, the safe yield will also decrease. Agricultural production is projected to decrease about 40,000 acre-ft/yr when current agricultural land use transitions to urban use. If the magnitude and spatial distribution of current agricultural production is not replaced with new production then the yield of the Chino basin will decrease by a comparable amount.

HISTORICAL AND CURRENT GROUNDWATER QUALITY

Historical Groundwater Quality Monitoring

Various entities have collected groundwater quality data in the past. Municipal and agricultural water supply entities have collected groundwater quality data to comply with Department of Health Services requirements under Title 22 or for programs that range from irregular study-oriented measurements to long-term periodic measurements. Groundwater quality observations have been made by the DWR, by

participants in the 1969 Judgment on the Santa Ana River (Orange County Water District *vs.* City of Chino *et al.*), by dischargers under order from the Regional Board, and by the County of San Bernardino. The DWR and the SBCFCD were very active in collecting groundwater quality data in the Chino Basin prior to the settlement of the Chino Basin adjudication. After the Judgment was entered in 1978, monitoring south of State Route 60 stopped almost completely except for the cities of Chino, Chino Hills, and Norco, and the Jurupa Community Services District (JCSD). Most of the pre-1978 measurements were digitized by the DWR. In 1986, Metropolitan Water District of Southern California (Metropolitan) conducted the first comprehensive survey of groundwater quality covering all constituents regulated in California Code of Regulations Title 22.

In 1989, Watermaster initiated a regular monitoring program for the Basin with groundwater quality data obtained in 1990 and periodically thereafter to the present. Watermaster's program relies on municipal producers and other government agencies supplying their groundwater quality data on a cooperative basis. Watermaster staff supplements this data with data obtained through a Watermaster sampling and analysis program in the area south of State Route 60. Water quality data are also obtained from special studies and monitoring that takes place under orders of the Regional Board. Watermaster has combined previously digitized groundwater quality data from all known sources into a database structure that is maintained at Watermaster's office.

Watermaster plans to begin the development of a new, more comprehensive water quality monitoring program to support the OBMP starting in July 1999. The program consists of two phases. The initial phase consists of collecting and analyzing groundwater quality samples at all producing wells in the over a three year period starting in July 1999. These data will be mapped and reviewed. Based on this review and Watermaster management goals in the OBMP, a long-term monitoring program will be developed The second phase consists of implementing the long term monitoring program and will start in July 2002.

Water Quality Conditions

Sources of water quality degradation can be classified into point and non-point sources. Point sources are confined to point discharges to the soil, groundwater, or stream systems. Examples include conventional wastewater and industrial discharges to streams or ponds, and leaky underground storage tanks. Non-point sources are areal discharges to soil, groundwater and surface waters, such as land application of waste and fertilizers and atmospheric deposition of contaminants to the soil and water bodies. The discussion below describes the water quality state of the Basin as it exists today for specific constituents of concern. The constituents described below are regulated for drinking water purposes in *California Code of Regulations, Title 22* or are regulated in the *1995 Water Quality Control Plan for the Santa Ana River Basin* (Basin Plan).

Figures 2-37a-h illustrate land uses in the Chino Basin in 1933, 1949, 1957, 1963, 1975, 1984, 1990 and 1993. These land use maps were developed from DWR land use surveys for 1933 through 1984, and from Southern California Association of Governments surveys for 1990 and 1993. The maps show a steady, dramatic change over time from agricultural to urban land uses. An exception to this occurs in the southern Chino Basin where dairies have moved in to replace irrigated and non-irrigated agriculture. These maps are useful in characterizing water quality degradation associated with non-point source loading from agriculture. The land uses shown in these maps are quantified in Table 2-7.

Total Dissolved Solids (TDS). TDS is regulated as a secondary contaminant in Title 22. The recommended drinking water maximum contaminant level (MCL) for TDS is 500 mg/L, however the upper limit is 1,000 mg/L. For irrigation uses, TDS should generally be less than 700 mg/L. The Regional Board has established TDS limitations for all municipal wastewater plants that discharge

recycled water to the Santa Ana River. A problem arises in that TDS concentrations increase through municipal use -- typically by about 150 to 250 mg/L. The TDS limitations for water recycling plants that discharge to the Santa Ana River in the Chino Basin are listed below:

Plant	TDS Limit (mg/L)
IEUA RP1	540
IEUA RP2	610
IEUA Carbon Canyon	555
IEUA RP4	505
Western Riverside Regional	625
City of Riverside	650
Jurupa Indian Hills	650

The TDS in source (drinking) water generally must be kept well below 500 mg/L (preferably less than 300 mg/L) to ensure that recycled water discharged to the Santa Ana River and its tributaries meets Regional Board limitations. The treatment cost to remove TDS from water is very expensive – about $500 to $700 per ton.

Table 2-9 provides the average TDS concentrations by well for five-year periods from 1961 to 1995. These wells are grouped by management zones. Figures 2-38, 2-39, and 2-40 show average TDS concentrations in groundwater measured at wells for the periods 1961 to 1965, 1971 to 1975, and 1991 to 1995. Historically, TDS has not been measured at wells on an annual basis. The choice of one year, say 1963 for example, might have only one-third as many TDS measurements at wells compared to a five-year period. Thus, averaging TDS over a five-year period was necessary to get adequate spatial coverage of measurements.

TDS concentrations in the northeast part of the Basin range from about 170 to about 300 mg/L for the period 1960 through 1990, with typical concentrations in the mid- to low-200s. TDS concentrations in excess of 200 mg/L indicate degradation from overlying land use. With few exceptions, areas with significant irrigated land use or dairy waste disposal histories overlie groundwater with elevated TDS concentrations. The exceptions are areas where point sources have contributed to TDS degradation, such as the former Kaiser Steel site in Fontana and the former wastewater disposal ponds near IEUA Regional Plant No. 1 (RP1) in South Ontario. The TDS anomaly from Kaiser is not shown on Figures 2-38, 2-39 and 2-40. A TDS anomaly from former municipal wastewater ponds can be seen in the east central part of Management Zone 2.

The impacts of agriculture on TDS in groundwater primarily are caused by fertilizer use on crops, consumptive use, and dairy waste disposal. The TDS impacts from the dairies located in the southern half of the Basin is reflected at least partially in Figures 2-39 and 2-40. The intensity of the TDS loading from dairy waste to the Basin is illustrated in Table 2-8 (Table 2-1 from *Final Task 6 Memorandum, Development of a Three-Dimensional Groundwater Model*, Montgomery Watson, 1994). This table shows the steady buildup of the dairy cattle population in the southern Chino Basin between 1949 and 1989. The total amount of TDS from manure discharged to the southern half of the Basin that will reach groundwater is estimated to be about 1,200,000 tons through 1989 and averages about 29,000 tons per year. The dairy loading numbers in Table 2-8 assume that half of the manure was hauled out of the Basin after 1973, which was a requirement of the Santa Ana watershed Water Quality Control Plan enacted in

1973. The amount of manure exported out of the Basin was never verified until the late 1990's. The TDS loading to groundwater from dairy waste disposal activities could be far greater than estimated in Table 2-8.

As irrigation efficiency increases, the impact of consumptive use on TDS in groundwater also increases. For example, if source water has a TDS concentration of 250 mg/L, and the irrigation efficiency is about 50 percent (flood irrigation), the resulting TDS concentration in the returns to groundwater will be 500 mg/L, exclusive of the mineral increments from fertilizer. If the irrigation efficiency were increased to 75 percent, the resulting TDS concentration in the returns to groundwater will be 1,000 mg/L, exclusive of the mineral increments from fertilizer. For modern irrigated agriculture, the TDS impacts of consumptive use are more significant than mineral increments from fertilizers.

TDS concentrations in groundwater have increased slightly or remained relatively constant in the northern parts of Management Zones 1, 2, and 3. TDS concentrations are significantly higher in the southern parts of Management Zones 1, 2, and 3, and all of Management Zone 5 where they typically exceed the 500 mg/L recommended MCL and frequently exceed the upper limit of 1,000 mg/L.

Nitrate. Nitrate is regulated in drinking water in Title 22 with an MCL of 10 mg/L (as nitrogen). Table 2-10 provides the average nitrate concentrations by well for 5-year periods from 1961 to 1995. These wells are grouped by management zones. Figures 2-41, 2-42, and 2-43 show the average nitrate concentrations in groundwater measured at wells for the periods 1961 to 1965, 1971 to 1975, and 1991 to 1995. Nitrate measurements in the surface water flows in the San Gabriel Mountains and in groundwater near the foot of these mountains are generally less than 0.5 mg/L (Montgomery Watson, 1993). Nitrate concentrations in excess of 0.5 mg/L indicate degradation from overlying land use. Similar to TDS, areas with significant irrigated land use or dairy waste disposal histories overlie groundwater with elevated nitrate concentrations. The primary areas of nitrate degradation are the areas formerly or currently overlain by:

- Citrus in the northern parts of Management Zones 1, 2 and 3; and
- Dairy areas in the southern parts of Management Zones 1, 2 and 3 and all of Management Zone 5.

Nitrate concentrations in groundwater have increased slightly or remained relatively constant in northern parts of Management Zones 1, 2 and 3 over the period 1960 to the present. These are areas formerly occupied by citrus and vineyard land uses (see Figures 2-37a-d), and nitrate concentrations underlying these areas rarely exceed 20 mg/L (as nitrogen). Over the same period, nitrate concentrations have increased significantly in the southern parts of Management Zones 1, 2 and 3, and all of Management Zone 5. These are areas where land use has progressively converted from irrigated/non-irrigated agriculture to dairy uses (see Figures 2-37e-h), and nitrate concentrations typically exceed the 10 mg/L MCL and frequently exceed 20 mg/L by 1991-1995.

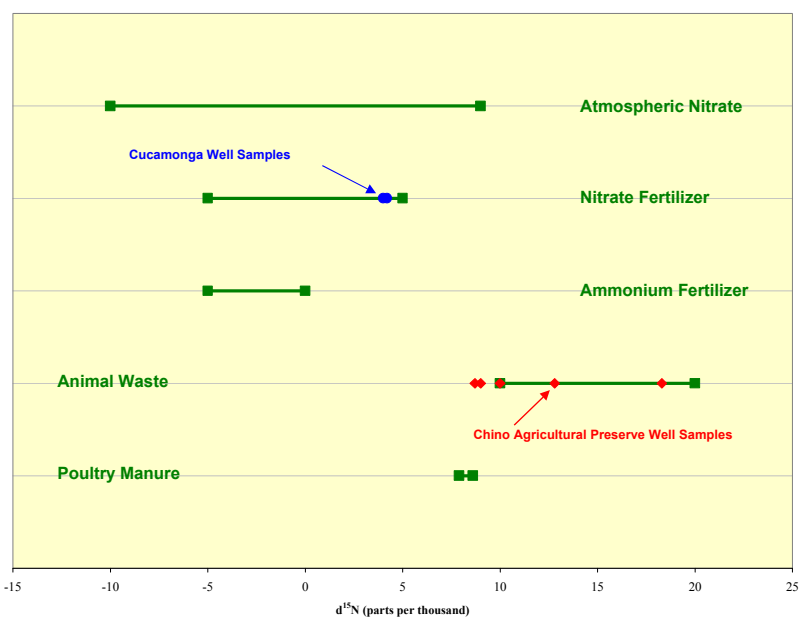
There are two stable isotopes of nitrogen: ^{14}N and ^{15}N. Within the nitrogen cycle, thermodynamic and kinetic processes occur which fractionate these isotopes in various nitrogen-bearing compounds. Most biologically-mediated reactions (*e.g.*, assimilation, nitrification, and denitrification) result in ^{15}N enrichment of the substrate and depletion of the product. Nitrogen isotope chemistry is a technique to help distinguish potential sources of nitrogen in the environment (Clark and Fritz, 1997). The enrichment of ^{15}N relative to atmospheric nitrogen is expressed as $\delta^{15}N$ and has units of parts per thousand (permil). The following table shows the ranges of nitrogen isotopes of potential sources of nitrate (Battaglin *et al.*, 1997):

Source of Nitrate	$d^{15}N$ of Nitrate (permil)
Atmospheric Nitrate	-10 to 9
Nitrate Fertilizer	-5 to 5
Ammonium Fertilizer	-5 to 0
Animal Waste	10 to 20
Poultry Manure	7.9 to 8.6

As part of the 1997 groundwater-monitoring program, samples were collected from six wells for nitrogen isotope analysis:

State Well Number	Region	Nitrate-N (mg/L)	$d^{15}N$ (permil)
01S07W14D01	Cucamonga – Former Citrus	3.2	4.0
01S07W14D02	Cucamonga – Former Citrus	4.0	4.2
02S07W34D	Chino Agricultural Preserve	106.0	12.8
03S07W05G	Chino Agricultural Preserve	77.3	18.3
02S07W20A	Chino Agricultural Preserve	64.5	10.0
02S07W16D	Chino Agricultural Preserve	63.6	8.7
02S07W16D - Duplicate		63.6	9.0

The samples from the wells in areas where the antecedent land use was predominantly citrus had nitrate values that were significantly below the maximum contaminant level (MCL) of 10 mg/L. Nitrate values in samples from the Chino Agricultural Preserve all exceeded the MCL by at least a factor of six. In addition, the $\delta^{15}N$ values for the Cucamonga wells were about 4 permil, while the $\delta^{15}N$ values for the Chino Agricultural Preserve wells ranged from 8.7 to 18.3 permil. The nitrogen isotope results are compared graphically with ranges from known sources in the figure below.



The high nitrate concentrations shown in Figure 2-43 probably depict the nitrate impacts from the agricultural waste disposal areas located in the southern half of the Basin.

Other Constituents of Potential Concern. Tables 2-11a through 2-11c summarize inorganic and organic constituents that have been analyzed for and detected in groundwater samples from wells in the Chino Basin through July 1998. Table 2-12 summarizes the information in Tables 2-11a through 2-11c for the constituents detected at or above their MCLs. This is a synoptic analysis and includes all available data, including data from several monitoring programs and studies. The water quality data reviewed in this synoptic analysis are derived from production wells and monitoring wells. Hence, the data do not represent a programmatic investigation of potential sources nor do they represent a randomized study designed to ascertain the water quality status of the Chino Basin. The data do represent the most comprehensive information available to date.

A large subset of this data was extracted from the California Department of Health Services (DHS) database (current through July 1998). For each constituent, the tables lists:

- the number of measurements at or above one-half the applicable MCL;
- the number of wells with measurements at or above one-half the applicable MCL;
- the number of measurements at or above the applicable MCL;
- the number of wells with measurements at or above the applicable MCL; and
- the applicable MCL.

The tables are organized as follows:

- Table 11a: Inorganic constituents, total trihalomethanes (THMs) and radioactivity with primary MCLs;
- Table 11b: Organic chemicals with primary MCLs;
- Table 11c: Inorganic constituents and organic chemicals with secondary MCLs, lead and copper rule, and California DHS Action Levels.

Table 12 summarizes the constituents that were detected at concentrations greater than one-half their MCL, and are grouped by chemical type. These values represent a mixture of data from monitoring and production well samples. Monitoring wells targeted at a potential source will likely have a greater concentration than a municipal or agricultural production well. Wells with constituent concentrations greater than one-half the MCL represent areas that warrant concern and inclusion in a long-term monitoring program. Groundwater in the vicinity of wells with samples greater than the MCL may be impaired from a beneficial use standpoint.

Inorganic Constituents. Five inorganic constituents were detected at or above their MCL in more than 20 wells:

- TDS;
- nitrate;
- fluoride;
- iron; and
- manganese.

TDS and nitrate have been discussed in previous subsections. Fluoride, iron, and manganese naturally exist in groundwater. Their concentrations depend on mineral solubility, ion exchange reactions, surface

complexations, and soluble ligands. These speciation and mineralization reactions, in turn, depend on pH, oxidation-reduction potential, and temperature. Fluoride occurs naturally in groundwater in concentrations ranging from less than 0.1 mg/L to 10-20 mg/L (Freeze and Cherry, 1979). Based on the available data, none of these constituents shows a spatial pattern throughout Chino Basin (see Figures 2-44, 2-45 and 2-46). However, site-specific monitoring wells may reveal point sources (*e.g.*, wells near landfills have shown relatively high concentrations of manganese).

In addition, perchlorate has recently been detected in several wells in the Chino Basin (Figure 2-47), in other basins in California and other states in the West. The probable reason that perchlorate was not detected in groundwater until recently is that analytical methodologies did not previously exist that could attain a low enough detection limit. Prior to 1996, the method detection limit for perchlorate was 400 µg/L. By March 1997, an ion chromatographic method was developed with a detection limit of 1 µg/L and a reporting limit of 4 µg/L.

Perchlorate (ClO_4^-) originates as a contaminant in the environment from the solid salts of ammonium perchlorate (NH_4ClO_4), potassium perchlorate ($KClO_4$), or sodium perchlorate ($NaClO_4$). The perchlorate salts are quite soluble in water. The perchlorate anion (ClO_4^-) is exceedingly mobile in soil and groundwater environments. It can persist for many decades under typical groundwater and surface water conditions, because of its resistance to react with other available constituents. Perchlorate is a kinetically stable ion, which means that reduction of the chlorine atom from a +7 oxidation state in perchlorate to a -1 oxidation state as a chloride ion requires activation energy or the presence of a catalyst to facilitate the reaction. Since perchlorate is chemically stable in the environment, natural chemical reduction in the environment is not expected to be significant.

At very high levels, perchlorate interferes with the function of the thyroid gland and the production of hormones necessary for normal human development. In the extreme cases, it can cause brain damage in fetuses and a potentially fatal form of anemia in adults. However, effects of chronic exposures to lower levels currently detected in groundwater are not known.

Ammonium perchlorate is manufactured for use as an oxygenating component in solid propellant for rockets, missiles, and fireworks. Because of its limited shelf life, inventories of ammonium perchlorate must be periodically replaced with a fresh supply. Thus, large volumes of the compound have been disposed of since the 1950s in Nevada, California, Utah, and likely other states. While ammonium perchlorate is also used in certain munitions, fireworks, the manufacture of matches, and in analytical chemistry, perchlorate manufacturers estimate that about 90 percent of the substance is used for solid rocket fuel

Perchlorate is of concern because of the existing uncertainties in:

- the toxicological database documenting its health effects at low levels in drinking water;
- the actual extent of the occurrence of perchlorate in ground and surface waters, which is compounded by some uncertainty in the validation of the analytical detection method;
- the efficacy of different treatment technologies for various water uses such as drinking water or agricultural application; and
- the extent and nature of ecological impact or transport and transformation phenomena in various environmental media.

The requisite toxicology data available to evaluate the potential health effects of perchlorate are extremely limited. The US Environmental Protection Agency (EPA) Superfund Technical Support Center issued a provisional reference dose (RfD) in 1992 and a revised provisional RfD in 1995. Standard assumptions for ingestion rate and body weight were then applied to the RfD to calculate the reported range in the groundwater cleanup guidance levels of 4 to 18 (µg/L). In 1997, the DHS and California EPA's Office of Environmental Health Hazard Assessment reviewed the EPA risk assessment reports for perchlorate. Consequently, California established its provisional action level of 18 µg/L. On August 1, 1997, DHS informed drinking water utilities of its intention to develop a regulation to require monitoring for perchlorate as an unregulated chemical. Legislative action to establish a state drinking water standard for perchlorate has been introduced but has not been brought to a vote (CA Senate Bill 1033).

Volatile Organic Chemicals. Six volatile organic chemicals (VOCs) were detected at or above their MCL in more than 10 wells:

- 1,1-dichloroethene;
- 1,2-dichloroethane;
- benzene;
- tetrachloroethene (PCE);
- trichloroethene (TCE); and
- vinyl chloride.

TCE and PCE were/are widely used industrial solvents. TCE was commonly used for metal degreasing and was also used as a food extractant. PCE is commonly used in the dry-cleaning industry. About 80 percent of all dry cleaners used PCE as their primary cleaning agent (Oak Ridge National Laboratory, 1989). The areal distributions of PCE and TCE are shown in Figures 2-48 and 2-49. 1,1-Dichloroethane, 1,1-Dichloroethene, *cis*-1, 2-dichloroethene, 1,2-dichloroethane, and vinyl chloride are degradation by-products of PCE and TCE and their areal distributions are shown in Figures 2-50 though 2-54.

The spatial distributions of TCE and PCE appear to be correlatable to identified point sources in the Chino Basin (see the following subsection and Figure 2-58.) The areal distributions of 1,2-dichloroethane and vinyl chloride appear to be more extensive. 1,2-Dichloroethane is used as a lead-scavenging agent in gasoline (Oak Ridge National Laboratories, 1989) and the greater areal distribution of 1,2-dichloroethane and vinyl chloride may reflect numerous minor releases from gasoline stations, automobile service stations, *et cetera*. This hypothesis appears to be corroborated, in part, by the distribution of benzene, which is a minor contaminant in gasoline (see Figure 2-55). Gasoline used in the United States contains between 0.8 and 2 percent benzene (Oak Ridge National Laboratories, 1989).

Pesticides/herbicides. Two were detected at or above their MCL in more than 10 wells:

- dibromochloropropane (DBCP); and
- lindane.

DBCP was used as a fumigant for citrus, other orchards and some field crops prior to being banned in 1987. The areal distribution of DBCP appears to be related to historical citrus crop production in Chino Basin (see Figures 2-37a-d and 2-56). Lindane is used as an insecticide on foliar plants and fruit and vegetable crops; its areal distribution is shown in Figure 2-57.

Point Sources of Concern

The previous water quality discussion described water quality conditions broadly across the entire basin. The discussion presented below describes the water quality anomalies associated with known point source discharges to groundwater. Figure 2-58 shows the location of various point sources and areas of water quality degradation associated with these sources.

Chino Airport. The Chino Airport is located approximately four miles east of the City of Chino and six miles south of Ontario International Airport, and occupies an area of about 895 acres. From the early 1940s until 1948, the airport was owned by the federal government and used for flight training and aircraft storage. The County of San Bernardino acquired the airport in 1948 and has operated and/or leased portions of the facility ever since. Since 1948, past and present businesses and activities at the airport include modification of military aircraft, crop dusting, aircraft-engine repair, aircraft painting, stripping and washing, dispensing of fire-retardant chemicals to fight forest fires, and general aircraft maintenance. The use of organic solvents for various manufacturing and industrial purposes has been widespread throughout the airport's history (Regional Board, 1990). From 1986 to 1988, a number of groundwater quality investigations were performed in the vicinity of Chino Airport. Analytical results from groundwater sampling revealed the presence of VOCs above MCLs in six wells downgradient of Chino Airport. The most common VOC detected above its MCL is TCE. TCE concentrations in the contaminated wells ranged from 6.0 to 75.0 µg/L. Figure 2-58 shows the approximate areal extent of TCE in groundwater in the vicinity of Chino Airport at concentrations exceeding its MCL as of 1990. The plume is elongate in shape, about 2,200 feet wide and extends approximately 8,000 feet from the airport's northern boundary in a south to southwestern direction.

California Institute for Men. The California Institute for Men (CIM) located in Chino is bounded on the north by Edison Avenue, on the east by Euclid Avenue, on the south by Kimball Avenue and on the west by Central Avenue. CIM is a state correctional facility and has been in existence since 1939. It occupies approximately 2,600 acres – about 2,000 acres are used for dairy and agricultural uses and about 600 acres are used for housing inmates and related support activities (Geomatrix Consultants, 1996). In 1990, PCE was detected at a concentration of 26 µg/L in a sample of water collected from a CIM drinking water supply well. Analytical results from groundwater sampling indicate that the most common VOCs detected in groundwater underlying CIM are PCE and TCE. Other VOCs detected include carbon tetrachloride, chloroform, 1,2-dichloroethene, bromodichloromethane, 1,1,1-trichloroethane, and toluene. The maximum PCE concentration in groundwater detected at an individual monitoring well (GWS-12) was 290 µg/L. The maximum TCE concentration in groundwater detected at an individual monitoring well (MW-6) was 160 µg/L (Geomatrix Consultants, 1996). Figure 2-58 shows the approximate areal extent of VOCs in groundwater at concentrations exceeding MCLs as of May 1996. The plume is approximately 1,000 feet wide and extends about 3,600 feet southwest.

General Electric Flatiron Facility. The General Electric Flatiron Facility (Flatiron Facility) occupied the site at 234 East Main Street, Ontario, California from the early 1900s to 1982. Its operations consisted primarily of the manufacturing of clothes irons. Currently, the site is occupied by an industrial park. The Regional Board issued an investigative order to General Electric in 1987 after an inactive well in the City of Ontario was found to contain TCE and chromium above drinking water standards. Analytical results from groundwater sampling indicated that VOCs and total dissolved chromium were the major groundwater contaminants. The most common VOC detected at levels significantly above its MCL is TCE, which reached a measured maximum concentration of 3,700 µg/L. Other VOCs periodically detected, but commonly below MCLs, include PCE, toluene, and total xylenes, (Geomatrix Consultants, 1997). Figure 2-58 shows the approximate areal extent of TCE in groundwater at concentrations exceeding MCLs, as of November 1997. The plume is approximately 3,000 feet wide and

extends about 8,400 feet south-southwest (hydraulically downgradient) from the southern border of the site.

General Electric Test Cell Facility. The General Electric Company's Engine Maintenance Center Test Cell Facility (Test Cell Facility) is located at 1923 East Avion, Ontario, California. Primary operations at the Test Cell Facility include the testing and maintenance of aircraft engines. A soil and groundwater investigation, followed by a subsequent quarterly groundwater-monitoring program, began in 1991 (Dames & Moore, 1996). The results of these investigations showed that VOCs exist in the soil and groundwater beneath the Test Cell Facility and that the released VOCs have migrated off site. Analytical results from subsequent investigations indicate that the most common and abundant VOC detected in groundwater is TCE. Other VOCs detected include PCE, *cis*-1,2-dichloroethene, 1,2-dicholoropropane, 1,1-dichloroethene, 1,1-dichloroethane, benzene, toluene and xylenes, among others. The historical maximum TCE concentration measured at an on-site monitoring well (directly beneath the Test Cell Facility) is 1,240 µg/L. The historical maximum TCE concentration measured at an off-site monitoring well (downgradient) is 190 µg/L (BDM International, 1997). Figure 2-58 shows the areal extent of VOC contamination exceeding federal MCLs as of March 1997. The plume is elongate in shape, about 1,000 to 1,200 feet wide and extends approximately 8,000 feet from the Test Cell Facility in a southwesterly direction.

Kaiser Steel Fontana Steel Site. Between 1943 and 1983, Kaiser Steel Corporation (Kaiser), operated an integrated steel manufacturing facility in Fontana. During the first 30 years of the facility's operation (1945-1974), a portion of the Kaiser brine wastewater was discharged to surface impoundments and allowed to percolate into the soil. In the early 1970s, the surface impoundments were lined to eliminate percolation to groundwater (Wildermuth, 1991). In July of 1983, Kaiser initiated a groundwater investigation that revealed the presence of a plume of degraded groundwater under the facility. In August of 1987, the Regional Board issued Cleanup and Abatement Order Number 87-121, which required additional groundwater investigation and remediation activities. The results of these investigations showed that the major constituents of the release to groundwater were inorganic dissolved solids and low molecular weight organic compounds. Wells sampled during the groundwater investigations measured concentrations of total dissolved solids (TDS) ranging from 500-1,200 mg/L and concentrations of total organic carbon (TOC) ranging from 1 to 70 mg/L. Figure 2-58 shows the approximate areal extent of the TDS/TOC groundwater plume as of November 1991. The plume is approximately 3,000 feet wide and extends about 17,000 feet southwest. As of November 1991, the plume had migrated almost entirely off the Kaiser site.

Milliken Sanitary Landfill. The Milliken Sanitary Landfill (MSL) is a Class III Municipal Solid Waste Management Unit located near the intersections of Milliken Avenue and Mission Boulevard in the City of Ontario. The facility is owned by the County of San Bernardino and managed by the County's Waste System Division. The facility was opened in 1958 and continues to accept waste within an approximate 140-acre portion of the 196-acre permitted area (GeoLogic Associates, 1998). Groundwater monitoring at the MSL began in 1987 with five monitoring wells as part of a Solid Waste Assessment Test investigation (IT, 1989). The results of this investigation indicated that the MSL has released organic and inorganic compounds to the underlying groundwater. At the completion of an Evaluation Monitoring Program (EMP) investigation (GeoLogic Associates, 1998), a total of 29 monitoring wells were drilled to evaluate the nature and extent of groundwater impacts identified in the vicinity of the MSL. Analytical results from groundwater sampling indicate that VOCs are the major constituents of the release. The most common VOCs detected are TCE, PCE, and dichlorodifluoromethane. Other VOCs detected above MCLs include vinyl chloride, benzene, 1,1-dichloroethane, and 1,2-dichloropropane. The historical maximum total VOC concentration in an individual monitoring well is 159.6 µg/L (GeoLogic Associates, 1998). Figure 2-58 shows the approximate areal extent of VOCs in groundwater at concentrations

exceeding MCLs as of April 1998. The plume is approximately 1,900 feet wide and extends about 2,000 feet south of the MSL's southern border (GeoLogic Associates, 1998).

Municipal Wastewater Disposal Ponds. Treated municipal wastewater has been disposed into ponds located near the current IEUA Regional Plant 1 (RP1) located in south Ontario and the former Regional Plant 3 (RP3) located in south Fontana. The ponds located just east of RP1, commonly called the Cucamonga ponds, were used to dispose of untreated effluent collected by the Cucamonga County Water District (CCWD) and IEUA. RP3 and its disposal ponds are located on the southwest corner of Beech and Jurupa Avenues in the City of Fontana. Discharge to the Cucamonga ponds and the ponds of RP3 ceased between the early 1970s and the mid-1980s. The areas downgradient of these recharge ponds typically have elevated TDS and nitrate concentrations. The locations of these ponds are shown in Figure 2-58. Contaminant plumes emanating from these ponds have never been fully characterized.

Upland Sanitary Landfill. The closed and inactive Upland Sanitary Landfill (USL) is located on the site of a former gravel quarry at the southeastern corner of 15th Street and Campus Avenue in the City of Upland. The facility operated from 1950 to 1979 as an unlined Class II and Class III municipal solid waste disposal site. In 1982, USL was covered with a 10-inch thick, low permeability layer of sandy silt over the entire disposal site (GeoLogic Associates, 1997). Groundwater monitoring at the USL began in 1988 and now includes three on-site monitoring wells (an upgradient well, a cross-gradient well, and a downgradient well) (City of Upland, 1998). The results of groundwater monitoring indicate that USL has released organic and inorganic compounds to underlying groundwater (GeoLogic Associates, 1997). Groundwater samples from the downgradient monitoring well consistently contain higher concentrations of organic and inorganic compounds than samples from the upgradient and cross-gradient monitoring wells. Analytical results from groundwater sampling indicate that VOCs are the major constituents of the organic release. All three monitoring wells have shown detectable levels of VOCs. The most common VOCs detected above MCLs are dichlorodifluoromethane, PCE, TCE, and vinyl chloride. Other VOCs that have been periodically detected above MCLs include methylene chloride, *cis*-1,2 dichloroethene, 1,1-dichloroethane, and benzene. The 1990-95 average total VOC concentration in the downgradient monitoring well is 125 µg/L (GeoLogic Associates, 1997). Figure 2-58 shows the approximate areal extent of VOCs in groundwater at concentrations exceeding MCLs as of April 1998. However, the plume is defined only by the three on-site monitoring wells. The plume extent may be greater than is depicted on Figure 2-58.

National Priorities List Sites. Three facilities in, or directly tributary to, the Chino Basin are on the current National Priorities List (NPL) of Superfund sites:

- Stringfellow;
- Dodson Brothers; and
- Pacific Polishing (Figure 2-58).

Elevated levels of TCE and its degradation by-products have been detected in groundwater in the vicinity of the Dodson Brothers Superfund site (*cf.* Tables 2-44 and 2-53).

TCE/PCE Anomaly – South of the Ontario Airport. A plume containing TCE and PCE exists south of the Ontario Airport. The plume extends from approximately State Route 60 on the north, Turner Avenue on the east to Schaeffer Avenue on the south and Vineyard Avenue on the west. Figure 2-58 shows the approximate areal extent of the plume. The plume appears to be approximately 6,000 feet wide and 9,000 feet long. The maximum reported TCE and PCE concentrations are 142 µg/L and 2 µg/L, respectively.

Role of the Vadose Zone in Future Water Quality

The vadose zone is the unsaturated part of the aquifer that lies between the water table surface and the land surface. The vadose zone has become larger and thicker over time as the groundwater levels in the Basin have declined due to overdraft. Some of the contaminants discharged to the land surface or into ponds remain in the vadose zone. The mechanisms for retention of contaminants within the vadose zone are complex, but are generally caused by sorption and precipitation. Some contaminants move down towards the saturated zone at much lower rates (a few feet per year) than they can move once they get to the saturated zone (a few feet per day). MWDSC completed a study of the TDS and nitrate impacts in the Chino Basin from a proposed 700,000 acre-ft storage program California (MWDSC, 1988). The outcome of this study suggested that the raising of groundwater levels associated with the increase in storage would mobilize TDS and nitrates in the vadose zone and cause serious water quality problems throughout the Basin. The proposed storage program did not add contaminants – it flushed contaminants already in the vadose zone into the saturated zone. This potential effect could not be verified with more advanced modeling in the CBWRMS due to problems with the model. Real-world experiments to verify the TDS and nitrate contamination are not practical for a basin as large as the Chino Basin.

As the agricultural land uses in the Chino Basin convert, the loading of contaminants to the vadose zone will be significantly reduced, as will percolation at the land surface that drives the contaminants down towards the saturated zone. This will have the effect of reducing the rate of vadose zone loading to the saturated zone.

SAFE YIELD

The safe yield of the Chino Basin was established in the 1978 Judgment to be 140,000 acre-ft/yr. The basis for this estimate is described by William J. Carroll in his testimony on December 19 and 20, 1977, during the adjudication process. Table 2-13 lists the hydrologic components developed by Carroll to estimate the safe yield of the Chino Basin. These components were developed for the period 1965 to 1974, a period that Carroll referred to as the *base period*. The hydrologic components listed in Table 2-13 are described below.

Deep Percolation of Precipitation and Surface Inflow – consists of the deep percolation of precipitation and streamflow. Carroll developed the estimate of 47,500 acre-ft/yr based on an extrapolation of the early Chino Basin modeling results from the DWR.

Deep Percolation of Artificial Recharge – consists of the percolation of local runoff in spreading basins. Carroll estimated that the local runoff recharged in SBCFCD-controlled facilities to be about 2,800 acre-ft/yr during the base period. The Etiwanda Water Company also recharged about 1,000 acre-ft/yr of Deer and Day Creek water in the Chino Basin during the base period.

Deep Percolation of Chino Basin Groundwater Used for Irrigation (domestic and agricultural) – defined as the fraction of water applied for irrigation that percolates through the soil and recharges underlying groundwater. Carroll estimated that about 15 percent of the water used for domestic irrigation would percolate to groundwater; and that 45 percent of the water used for agricultural irrigation would percolate to groundwater. The volume of percolation of Chino Basin groundwater used for irrigation over the base period was estimated by Carroll to be about 61,700 acre-ft/yr.

Deep Percolation of Imported Water Used for Irrigation (domestic and agricultural) – same as deep percolation of Chino Basin groundwater except that the water used for irrigation is imported to and used

over the Chino Basin. The volume of percolation of imported water used for irrigation over the base period was estimated by Carroll to be about 7,000 acre-ft/yr.

Recharge of Sewage – defined to be the percolation in ponds of wastewater discharged by municipal wastewater treatment plants. This component almost completely ceased during the base period and was known to be eliminated as a recharge source when the safe yield was estimated. The volume of sewage recharge over the base period was about 18,200 acre-ft/yr. The inclusion of recharge of sewage as a component of safe yield in the stipulated Judgment was therefore not hydrologically consistent with how the Basin was to be operated post-Judgment.

Subsurface Inflow – defined to be the groundwater inflow to the Chino Basin from adjacent groundwater basins and mountain fronts including:

Bloomington Divide (Riverside Basin)	3,500 acre-ft/yr
San Gabriel Mountain front	2,500 acre-ft/yr
Colton Rialto Basin	500 acre-ft/yr
Cucamonga Basin	100 acre-ft/yr
Claremont and Pomona Basins	100 acre-ft/yr
Jurupa Hills	500 acre-ft/yr
Total	**7,200 acre-ft/yr**
	say 7,000

Subsurface Outflow – defined as groundwater that rises to the ground surface in Prado Basin to become Santa Ana River flow. Estimates of subsurface outflow were based on studies by DWR, United States Geological Survey (USGS), and Carroll. Carroll estimated the subsurface outflow to average about 6,800 acre-ft/yr over the base period.

Extractions – consists of groundwater extractions from the Chino Basin. Carroll estimated the groundwater extractions to average about 180,000 acre-ft/yr during the base period.

In addition to these components, Carroll estimated the change in storage over the base period to be about 40,000 acre-ft/yr; that is, the groundwater in storage declined by about 400,000 acre-ft between 1965 and 1974. Carroll estimated the safe yield to be the equal to the average extraction over the base period minus the average annual overdraft during the base period:

safe yield = extraction - overdraft
= 180,000 - 40,000
= 140,000 acre-ft/yr

A more recent estimate the safe yield can be abstracted from the groundwater modeling work done for the *Chino Basin Water Resources Management Study -- Task 6 Memorandum Develop Three Dimensional Groundwater Model* (Montgomery Watson, 1994). The hydrologic components derived from the modeling results for a 30-year period -- October 1960 to September 1989 (water years 1961 to 1989) - are listed in Table 2-14. The safe yield based on the CBWRMS results (1961 to 1989) computed in a manner similar to Carroll is:

safe yield = extraction - overdraft
= 183,000 - 17,000

= 166,000 acre-ft/yr

The safe yield based on CBWRMS modeling results for the base period (1965 to 1974) used by Carroll would be:

safe yield = extraction - overdraft
= 189,000 - 20,000
= 169,000 acre-ft/yr

A more conceptually correct estimate of the safe yield would include a reduction for artificial recharge of imported water and other waters that are currently not part of the yield, such as recharge of reclaimed water. The adjusted estimates would then be:

Carroll's estimate 1965 to 1974	118,000 acre-ft/yr
CBWRMS estimate 1961 to 1989	151,000 acre-ft/yr
CBWRMS estimate 1965 to 1974	156,000 acre-ft/yr

Watermaster may decide to change the safe yield of the Basin based on new information such as that developed from the CBWRMS and subsequent studies. Safe yield is used to determine the need for replenishment obligation for individual parties to the judgment. New water from the capture and recharge of storm water, from induced recharge caused by increased southern basin production (or, conversely, the reduction of yield from reduced production in the southern Chino Basin), or from other sources will enhance the yield of the Basin and thereby reduce the cost of purchasing imported water for replenishment.

At the time the Chino Judgment was implemented (1978), about 41 percent of the safe yield was estimated to come from irrigation returns. Since that time, irrigated agriculture has declined and is projected to be almost completely gone by 2020. This will result in a decline in irrigation returns to groundwater and a potential decrease in the safe yield. In addition, San Bernardino County, Riverside County, and the US Army Corps of Engineers (USACE) have constructed flood control projects that capture and convey runoff to the Santa Ana River - effectively eliminating the groundwater recharge that formerly took place in the stream channels and flood plains in the Chino Basin. This also may have resulted in a decrease in the safe yield of the Chino Basin.

Water harvesting opportunities exist that can be used to offset the yield lost to urbanization and flood control improvements. Water harvesting consists of capturing and recharging runoff caused by urbanization. Most of the precipitation falling on undeveloped land or land in agricultural uses is lost to evapotranspiration. Runoff increases dramatically with urbanization due to drainage improvements, increased impervious land cover, and decreased evapotranspiration of rainfall. The potential yield from this additional runoff is numerically equal to the increase in runoff that occurs when the land is converted to urban uses. The actual yield is equal to the additional runoff that is captured and put to beneficial use. In the Chino Basin, the best and least expensive way to put this yield to beneficial use is groundwater recharge.

Urbanization also creates reclaimed water. Presently, most of this water is discharged to the Santa Ana River. IEUA currently plans to use some of their reclaimed water for direct uses, including non-potable industrial uses, irrigation, and groundwater recharge. Increasing the yield of the Chino Basin by increased capture of local runoff will improve the dilution of reclaimed water used for groundwater recharge and reduce the cost of mitigation requirements for such reclamation.

WATER DEMANDS AND WATER SUPPLY PLANS

Current and Future Water Demands

The purpose of this subsection is to describe the current and projected water demands and supplies for agencies that produce groundwater from the Chino Basin. This information will serve as the basis for identifying future water resources issues in the Chino Basin area. Updated forecasts of water demands and supplies were requested from each Chino Basin water agency and industrial producer. Requested data included demands, water supply plans by individual well or source, well construction and operating data, and water production and treatment costs. Many agencies provided updated information. Where responses were incomplete, previous information developed as part of the 1995 Chino Basin Water Resources Management Study (CBWRMS) was used. The planning period for this evaluation is 2000 to 2020.

Growth Projections. There are several indicators of potential growth within the Chino Basin study area. These include population, housing, employment, and land use. The Southern California Association of Governments (SCAG) periodically develops population, housing, and employment projections. SCAG prepares growth projections as part of its regional transportation planning for Imperial, Los Angeles, Orange, Riverside, San Bernardino, and Ventura counties. The most recent SCAG projection is SCAG-98, which was adopted in April 1998.

The SCAG-98 projection indicates the six-county region will grow from 15.6 million people in 1994 to 22.4 million in 2015. This represents an increase 6.7 million people between 1994 and 2015 and a growth rate of 43 percent. San Bernardino and Riverside counties are projected to grow at a rate that is more than double the regional average. San Bernardino County is projected to grow from 1,558,000 people in 1994 to 2,830,000 in 2020. Riverside County is projected to increase from 1,377,000 people in 1994 to 2,816,000 in 2020.

Population. Table 2-15 summarizes the population projections for the Chino Basin area by water purveyor. The SCAG projections were desegregated by city and census tract and combined by water purveyor service area. These projections indicate population will increase from 971,000 in 1994 to 1,631,000 in 2020. This is a growth rate of 68 percent or 2.6 percent per year. The population in some water service areas in the San Bernardino County portion of the Basin are projected to increase by as much as 125 percent.

Housing. Total housing is projected to increase from 284,000 units in 1994 to 496,000 in 2020, a growth rate of 75 percent. By comparing population and housing, the average occupancy is projected to decrease slightly from 3.4 to 3.3 persons per dwelling unit.

Employment. Employment is projected to increase from 316,000 jobs in 1994 to 702,000 jobs in 2020, a growth rate of 122 percent.

Water Demand Projections. Current water demands and supply projections form the basis for evaluating future water management programs in the Chino Basin area. Water demands are developed based on the water service areas shown in Table 2-16.

Water demand projections can be developed by several different methods. These include per capita, water duty and units of use approaches. The most frequently used methods are the per capita consumption method and the water duty method.

For this assessment, all water demands are based on information provided by the water agencies. In the absence of agency data, the assumptions in the CBWRMS have been used. These projections have been compared with the current SCAG projections. However, no adjustments to he demands have been made.

Projected water demands for the Chino Basin are presented in Table 2-16. This table indicates that Chino Basin area water demands will reach 348,000 acre-ft/yr in 2000 to 418,000 acre-ft/yr in 2020. Significant municipal water demand growth is expected to occur in the agricultural preserve area. This will result in increased demands for the Cities of Chino, Chino Hills and Ontario, and Jurupa Community Services District. Agricultural water demands are expected to decrease during the planning period as land is converted to urban uses.

Water Supply Plans

The principal water supplies in the Chino Basin area are groundwater pumped from the Chino Basin, other local groundwater and surface water, imported water purchased from Metropolitan and recycled water. The amounts of water utilized from each source are based on data provided by each water purveyor. If data was not provided, the supplies area based on projections developed for the Chino Basin Water Resources Management Study (1995). Each of these sources is discussed below. Table 2-17 presents projected water supply plans for appropriators in the Chino Basin area. Table 2-18 summarizes the water demands by major source categories. The growth in demand and general source plan is shown is shown graphically in Figure 2-60. Review of Table 2-18 and Figure 2-60 shows that there will be about 40,000 to 50,000 acre-ft/yr of Chino Basin production that will incur a replenishment obligation. The replenishment obligation can be met by the recharge of imported and reclaimed water, in-lieu replenishment involving imported water, and from water in local storage accounts. In the long run, the replenishment obligation of about 40,000 to 50,000 acre-ft/yr will need to be met with imported and recycled water. Thus the imported and recycled water components in Table 2-18 and Figure 2-60 should sum to a total of 40,000 to 50,000 acre-ft/yr higher.

Chino Basin Groundwater. The Chino Basin is the largest groundwater basin in the Upper Santa Ana Watershed. Water is reallocated from the Overlying Agricultural Pool to the Appropriative Pool when it is not put to use by the agricultural users. As agricultural production declines, the reallocations to the Appropriative Pool will increase. Total production from the Chino Basin is projected to range between 180,000 to 190,000 acre-ft/yr over the planning period. Production in excess of safe yield must be replaced through the purchase of replenishment water, which is imported into the Chino Basin, by the Watermaster.

Other Local Supplies. Other local water sources provide a portion of the water supplies for Chino Basin water agencies. These supplies include surface water and groundwater.

Surface Water. A number of water supply agencies, which produce groundwater from the Chino Basin, obtain a portion of their water supplies from local surface water sources. These agencies include the: City of Pomona, City of Upland, Cucamonga County Water District, Fontana Water Company, San Antonio Water Company, West End Consolidated Water Company, and West San Bernardino County Water District. The principal surface water sources include San Antonio Canyon, Cucamonga Canyon, Day Creek, Deer Creek, Lytle Creek and several smaller surface sources. For the most part, these surface water sources are fully developed and no significant additional supplies are anticipated to be developed in the future. Usage is expected to remain at 16,000-17,000 acre-ft/yr.

Other Groundwater. Other local groundwater supplies represent a significant supplemental source of water for Chino Basin water agencies. Other groundwater supplies in the study area include the Claremont Heights, Live Oak, Pomona and Spadra Basins in Los Angeles County, the Riverside South

and Temescal Basins in Riverside County, and the Colton-Rialto, Cucamonga, Lytle Creek Bunker Hill, and Riverside North Basins in San Bernardino County. Agencies using other local groundwater include: City of Pomona, City of Upland, Cucamonga County Water District, Fontana Water Company, San Antonio Water Company, Southern California Water Company, West End Consolidated Water Company, and West San Bernardino County Water District. These supplies may increase slightly in the future as additional wells are constructed. However, most of these sources are essentially fully developed. Descriptions of these groundwater basins were presented in the CBWRMS Final Report (1995). The aggregate supply from these basins is currently 63,000 acre-ft/yr and is projected to be 76,000 acre-ft/yr in 2020.

Imported Water. Two regional agencies are responsible for imported water deliveries within the study area: Metropolitan Water District of Southern California (Metropolitan) and San Bernardino Valley Municipal Water District (SBVMWD). Metropolitan is a wholesale water agency serving supplemental imported water to 27 members (city and water agencies) in portions of Los Angeles, Orange, Riverside, San Bernardino, San Diego and Ventura counties. This service area has a current population of more than 16 million people. Approximately one-half of the total water used throughout the entire Metropolitan service area is imported water purchased from Metropolitan to supplement the local water supplies in its service area. Metropolitan obtains imported supplies from the Colorado River and the State Water Project (SWP). The demand for direct delivery of imported water for the Chino Basin purchased from Metropolitan is projected to increase from about 68,000 acre-ft/yr in 1997 to 129,000 acre-ft/yr by 2020, an increase of about 90% percent. The demand for replenishment water in the Chino Basin could reach 40,000 acre-ft/yr by 2020 if reclaimed water is not used for replenishment or direct uses and water in local storage accounts is not available for use as replenishment.

SBVMWD is a wholesale water purveyor in the easternmost portion of the study area and adjacent portions of San Bernardino County. SBVMWD is a SWP Contractor having an entitlement of 102,600 acre-ft/yr. In addition, SBVMWD is responsible for basin management in the Bunker Hill basin. The City of Rialto and West San Bernardino County Water District obtain water from SBVMWD through its Baseline Feeder that supplies Bunker Hill groundwater (included in *other groundwater* above).

Recycled Water. There are several existing sources of recycled water in use within the Chino Basin study area. These are the Pomona Water Reclamation Plant (operated by the Los Angeles County Sanitation Districts), Regional Plants 1, 2 and 4, and Carbon Canyon Water Reclamation Plant operated by IEUA, Upland Hills Water Reclamation Plant operated by the City of Upland, CIM Water Reclamation Plant operated by the California Institution for Men at Chino, and Indian Hills Water Reclamation Plant operated by Jurupa Community Services District. For this section, only existing and planned recycled water uses that will be implemented in the next two years are included in the water supply plans. This is about 11,500 acre-ft/yr.

Summary. The plans summarized in this section represent the current non-OBMP water supply plans of each individual water agency, as qualified previously. Future evaluation of these plans may indicate problems relative to their long-term feasibility. Availability of imported water supplies will have a significant effect on plan feasibility.

WASTEWATER FLOWS, TREATMENT AND DISPOSAL

This section summarizes existing and proposed municipal wastewater treatment and disposal plans for the Chino Basin study area for the planning period of 2000 through 2020. Existing municipal wastewater treatment facilities are described briefly along with a review of present and projected wastewater flows. Future treatment and disposal plans for the study area are also discussed.

Wastewater Flow Projections

Wastewater flow projections are made using a combination of methods similar to water demand projections. Depending on the planning data available, wastewater flow projections are made using per capita-based, EDU-based, area-based, and water consumption-based methods. The per capita method uses projected populations and average unit wastewater flows per person (90-110 gallons per day per person). EDU-based projections use unit flows per equivalent dwelling unit (EDU), where an EDU is the average amount of sewage generated by a single-family residential household (about 270 gallons per day). EDUs are estimated for commercial and industrial land uses using fixture unit counts or estimated wastewater flows. Flow projections are computed by projecting future EDUs and multiplying by the unit flow per EDU. Area-based methods typically use unit flow factors for each land use type. Flows are computed by multiplying the unit factor for each land use type by the corresponding acreage and totaling the individual flows for each land use type. Water consumption-based methods compute wastewater flows based on the difference between water demand and water consumption. Water consumption is the amount of water that does not return to the sewer system and is a function of the particular land use type and water use group. Currently, most wastewater flow projections in the study area are based on either per capita or EDU methods. Figure 2-61 illustrates the projected wastewater flows for each service area described below.

LACSD Service Area. The Los Angeles County Sanitation Districts (LACSD) furnishes wastewater services for Pomona and Claremont. Using the SCAG-98 growth projections and a wastewater generation factor of 110 gpcd, the wastewater flows for this area are estimated to increase from 22,000 acre-ft/yr to 30,000 acre-ft/yr in 2020.

IEUA Service Area. IEUA develops ten-year wastewater forecasts for its service area in conjunction with its annual capital improvement plan (CIP). As part of its current CIP, IEUA also prepared a fifty-year projection of wastewater flows. These projections indicate wastewater flows will increase from 57,000 acre-ft/yr in 1997 to 112,000 acre-ft/yr in 2020. This represents an increase of 96 percent.

Riverside County Service Area. Wastewater collection for the portion of the study area in Riverside County is provided by several agencies including Jurupa Community Services District and Norco. Other portions are unsewered. Wastewater flows for the Riverside County area are estimated to increase from 10,000 acre-ft/yr in 1997 to 15,000 acre-ft/yr by 2020 based on projected population increases. This includes wastewater generated by unsewered areas. Additional wastewater from outside the study area is expected to be treated at the Western Riverside Regional Water Reclamation Plant. However, no estimates of these additional flows were received.

Treatment and Disposal

Seven agencies are responsible for wastewater treatment and disposal for their respective areas. In Los Angeles County, LACSD is the treatment and disposal agency. In western San Bernardino County, IEUA and the City of Upland perform this role. In the easterly portion of the study area, the City of Rialto provides this service. In Riverside County, several agencies are responsible for wastewater treatment, including the Cities of Riverside and Corona, and JCSD.

There are three basic wastewater service areas within the study area. These areas include:

- LACSD System (Los Angeles County)
- IEUA System (Western San Bernardino County)
- Riverside County

LACSD System. The LACSD provides regional wastewater collection and treatment for most of Los Angeles County. LACSD is divided into districts that handle wastewater management within their service areas. LACSD No. 21 provides this service for the Claremont, La Verne, and Pomona service areas. Urban and industrial wastewater flows from the Los Angeles County portion of the study area are collected by the cities of Claremont, La Verne, and Pomona. This wastewater is routed to LACSD No. 21 for treatment at LACSD's Pomona WRP and San Jose Creek WRP. With the exception of recycled water used by the City of Pomona from the Pomona WRP, all wastewater reaching the sewer system is exported out of the study area. The Pomona WRP has capacity of 15 MGD and is expected to operate at that level during the planning period.

IEUA System. IEUA has constructed a Regional Sewerage System within its service area to collect, treat and dispose of wastewater delivered by contracting local agencies. The contracting cities and water districts are responsible for wastewater collection within their individual service areas. A system of regional trunk and interceptor sewers that convey sewage to regional wastewater treatment plants is owned and operated by IEUA. IEUA's wastewater collection system is divided into two major service areas: the Northern Service Area and the Southern Service Area.

IEUA currently operates four wastewater treatment plants: Regional Plant No. 1 (RP1), Regional Plant No. 2 (RP2) Regional Plant No. 4 (RP4), and Carbon Canyon Water Reclamation Plant (CCWRP). A fifth regional plant, known as Regional Plant No. 3 (RP3), is no longer in service. One new treatment plant, Regional Plant No. 5 (RP5), is in the planning stages. All of these plants are or will be capable of producing effluent that meets Title 22 requirements for water reclamation. Figure 2-62 illustrates the projected flows and capacity staging of these plants. Each of these plants are described below

Regional Plant No. 1. Although RP1 is designed to treat 44 mgd, the capacity was downrated to 32 mgd in 1992 due to more stringent permit requirements. The plant is being operated at an interim capacity of 41 mgd while plant upgrades are completed. A 1996 Regional Board cease and desist order requires the plant to be restored to its design capacity by 1999. RP1 is expected to operate at near its design capacity and treat wastewater flows from its service area and excess flows from RP4 until 2014. A plant expansion to about 56 mgd is planned to be on-line by 2014 to meet increased flows from its service area.

Regional Plant No. 2. RP2 serves the City of Chino and surrounding areas. A 1994 cease and desist order by the Regional Board requires the plant to be flood protected or relocated. Consequently, the plant will be potentially abandoned and its capacity replaced by a new RP5 by 2001. Solids handling facilities will continue to operate at this site.

Regional Plant No. 4. RP4 is a 7-mgd wastewater treatment facility that recently began operation. The plant will be expanded to 14 mgd by 2008 and 21 mgd by 2021. Population growth and corresponding wastewater production in the northeastern region of the District, including portions of City of Fontana and Cucamonga County Water District will determine the rate of expansion.

Carbon Canyon Water Reclamation Plant. Carbon Canyon Water Reclamation Plant (CCWRP) became operational in May 1992. CCWRP is designed to produce recycled water that can be used for non-potable purposes including industrial and irrigation uses in the western region of the Chino Basin. The initial design capacity of 10.2 mgd is planned for increase to 15.3 mgd in the year 2014. Sludge generated at the CCWRP is treated at the RP2 sludge processing facilities and will be for the foreseeable future.

Regional Plant No. 5. Growth in the southern portion of the IEUA service area will require additional treatment capacity. IEUA plans to construct a new RP5 by 2001. The initial phase of this plant will be 12 mgd of which 5 mgd will replace capacity at RP2. The new RP5 is expected to serve the San

Bernardino Agricultural Preserve area as well as treating 3.6 mgd from southern Ontario. A second phase expansion to 18 mgd is projected to be completed by 2008 with a third phase expansion by 2021.

Western Riverside County Regional Wastewater Treatment System. The Western Riverside County Regional Wastewater Authority, a Joint Powers Authority, has constructed a regional wastewater treatment facility to serve portions of Jurupa CSD, Norco, Home Gardens Sanitary District and Western MWD. This facility is located in Western Riverside County near the intersection of McCarty Road and Hellman Avenue. This facility has an initial treatment capacity of 8.5 mgd. The treatment plant will be expanded to an ultimate capacity of 13.3 mgd. The facility provides tertiary filtration and nitrogen removal to meet projected discharge requirements. Effluent from this plant will be discharged to the Santa Ana River. Projections of flows to this plant are not available as of the date of this report.

SUMMARY OF GROUNDWATER LEVEL, STORAGE, PRODUCTION AND WATER QUALITY PROBLEMS

Groundwater Level Problems

Overall, groundwater levels have declined between 50 to 200 feet in the Chino Basin since the turn of the century. The western side of the Basin, notably Management Zones 1a and 1b, has experienced the greatest decline in groundwater levels. The City of Chino and CIM have recently experienced ground-surface fissures that are thought to be related to increased groundwater production in the vicinity of the City of Chino. Groundwater producers that affect groundwater levels in this area include the cities of Chino, Chino Hills, Ontario, Pomona, the Monte Vista Water District, CIM, and agricultural producers. The City of Chino Hills has reported loss of production at one well due to recently declining groundwater levels. The management steps to eliminate groundwater-level problems in this area are described below.

Ground Level Survey. Conduct a ground-level survey of the area in Management Zone 1. This would include a review of past surveys and new surveys. The survey results would be compared to historical surveys to determine the location, rate, and magnitude of subsidence in the Basin. Periodic surveys should be conducted afterwards to monitor for further subsidence.

Monitoring. Develop and implement a groundwater-level and quality monitoring program that can be used to observed groundwater trends. This program should be developed and implemented before a groundwater recharge/production management plan is developed for Management Zone 1 in order to define local groundwater flow systems for better management of recharge and production.

Balance Groundwater Production and Recharge. Balance groundwater production with recharge in Management Zone 1, or, if necessary, balance production and recharge more locally within Management Zone 1. This may require temporarily reducing production below the level at which balance occurs to bring groundwater levels up to a safe level. A *safe* level needs to be determined. Recharge of local or native and imported water should be increased as much as practical. Given that recharge in the area is maximized, production may still have to be reduced in Management Zone 1 and replaced with either production from Management Zone 2 or some other source of water.

Groundwater Storage

The Chino Basin has immense storage capacity. Since the Judgment was implemented, total groundwater storage appears to have stabilized. However, as noted earlier, the storage in the Basin has declined by about 1,000,000 acre-ft since 1933. Therefore, there is at least 1,000,000 acre-ft of unused storage capacity available in the Basin. Increasing storage has some costs. There will be losses to the Santa Ana River due to rising groundwater. The analysis previously presented suggests that the losses from local

and cyclic storage accounts due to rising groundwater during the period 1978 to 1997 could be as high as 50,000 acre-ft (or 18 percent of the volume that Watermaster assumes is in storage). Ignoring these losses will result in overdraft of the Chino Basin. A significant increase in groundwater storage, say on the order of 100,000s of acre-ft, may induce large groundwater losses to the Santa Ana River. In addition, a storage increase of this magnitude may have groundwater quality impacts due to flushing of contaminants within the vadose zone. The volume of safe storage from a water quality perspective is unknown. The management steps to mitigate the significant issues with groundwater storage are described below:

Develop Storage Accounting System that Includes Losses. Presently, Watermaster keeps track of transfers to and from local and cyclic storage accounts without accounting for groundwater losses. Watermaster should adopt a loss-estimating procedure and adjust the volume in storage accounts each year.

Water Quality Impacts from Conjunctive Use Programs. Mitigation measures need to be developed to protect producers in the event that large conjunctive-use programs cause unacceptable water quality impacts.

Groundwater Production

The primary issues for groundwater production are localized overdraft in Management Zone 1, and the potential changes in safe yield that can occur with changes in the location and magnitude of pumping. The location and amount of groundwater production generally appears to be balanced in the Basin except for Management Zone 1. Groundwater levels need to be increased in Management Zone 1 to minimize future subsidence and ground fissures, maintain production at a sustainable level, and improve groundwater quality. The management steps for this issue are identical to those for *Groundwater Levels.*

Groundwater production in the southern half of the Basin will need to be managed to ensure that safe yield is not reduced as agricultural areas convert to urban uses. Losses in safe yield due to decreases in agricultural production in the southern part of the Basin are distributed among the appropriators based on their initial share of safe yield. Thus, the loss in yield is translated throughout the Basin. Increasing production near the Santa Ana River could enhance exiting safe yield. The management steps for addressing this issue are listed below.

Optimization Studies. Conduct studies to optimize groundwater production patterns in southern Chino Basin. These studies will involve geologic investigations and modeling of southern Chino Basin.

Southern Basin Water Supply Plan. Develop a groundwater production and treatment plan that matches the emerging water demands of development in the southern Chino Basin with facilities necessary to provide water of appropriate quality.

Water Quality

The TDS and nitrate problems in the Basin are the most costly ones to deal with and are primarily non-point source related. By contrast, point-source dischargers of organic solvents and other contaminants are dealing with most of their related groundwater plumes. The cost of TDS and nitrate removal is estimated to be about $700 per acre-ft. The cost to remove solvents is generally under $100 per acre-ft. Figure 2-59 shows the locations of known point sources and areas with impaired water quality in the Chino Basin.

The source of the TDS and nitrate contamination in the northern part of the Basin has mostly disappeared. The primary sources of TDS and nitrate contamination in the southern part of the Basin are dairies and they will probably remain active for the next 20 years. TDS and nitrate degradation should continue in

the southern basin for the foreseeable future and the cost to treat contaminated groundwater will escalate over current costs due to past and continued animal waste disposal practices. The steps to manage groundwater quality problems in the Basin are described below.

Point-Source Management. Watermaster should work with the Regional Board, Department of Toxic Substances Control and other regulatory agencies to identify point-source discharge related problems, facilitate their solution, and where necessary, use its institutional influence to obtain prompt and satisfactory mitigation. In some cases, the solution to a point-source problem and a non-point source problem can be addressed through one coordinated capture and treat project with reduced cost to all parties.

Non-point Source Management. The groundwater contaminated from non-point sources in the northern and southern parts of the Basin will need to be treated through dilution, demineralization or some other process, so that the water can be put to beneficial use. This is absolutely necessary in the southern Chino Basin to maintain safe yield. The *Optimization Studies* and *Southern Basin Water Supply Plan* steps listed under *Groundwater Production* apply here as well. The export of dairy waste from the Basin should be maximized.

Safe Yield

All the problems listed above need to be addressed to maintain safe yield. In addition to those steps, maximizing the capture and recharge of storm water and reclaimed water could increase safe yield. The SBCFCD, Riverside County Flood Control and Water Conservation District (RCFCWCD), and the USACE have developed and continue to develop new flood control projects that efficiently convey flood waters out of the Chino Basin and reduce recharge. This has a negative impact on safe yield. Watermaster needs to participate in these flood control projects to maximize recharge. Watermaster and the Chino Basin Water Conservation District initiated a multiphase recharge master plan study and completed Phase 1 in May 1998. Phases 2 and 3 need to be completed.

SECTION 3
GOALS OF THE OBMP

This section presents the mission statement for the OBMP, the issues, needs and interests that were articulated by the stakeholders, and the goals of the OBMP. Each of these items was developed as part of the institutional process. These items were discussed in numerous public meetings and their final form is based on the consensus of those stakeholders that participated in the process.

MISSION STATEMENT

The stakeholders have met twice per month since the February 19, 1998 ruling by Judge Gunn, to develop the OBMP. As part of this process, the stakeholders defined a new paradigm from which they view their stewardship responsibilities, current and anticipated problems in the Basin, and the solution approaches to those problems. This new paradigm is described in the following mission statement and core values developed by the stakeholders:

> *The purpose of the Optimum Basin Management Program is to develop a groundwater management program that enhances the safe yield and the water quality of the Basin, enabling all groundwater users to produce water from the Basin in a cost-effective manner.*

The stakeholders have adopted the following core values associated with the mission statement.

Water Quality. All producers desire to produce water of a quality that is safe and suitable for the intended beneficial use.

Long View. All producers desire a long term, stable planning environment to develop local water resources management projects. The producers, independently and through Watermaster, will strive to take the long view in their planning assumptions and decisions to ensure a stable and robust management program.

Increased Local Supplies. All producers will, for an undetermined time into the future, be dependent on high quality imported water for direct uses and for groundwater replenishment. Because high quality imported supplies may not be available, the producers will strive to minimize their dependency on imported water and to increase their dependency on local supplies when economically justified.

Groundwater Storage. Unused groundwater storage capacity in the Chino Basin is a precious natural resource. The producers will manage the unused storage capacity to maximize the water quality and reliability and minimize the cost of water supply for all producers. The program will encourage the development of regional conjunctive use programs.

Storm Water Recharge. The producers will strive to increase storm water recharge and thereby maintain and enhance the safe yield and water quality.

Reclaimed Water Recharge. The safe yield of the Chino Basin will be enhanced through the recharge of reclaimed water. The producers will strive to maximize the recharge of reclaimed water to enhance the safe yield and water quality.

Cost of Groundwater Supplies. The producers are committed to finding ways to subsidize the cost of using poor quality groundwater in a cost-effective and efficient manner.

MANAGEMENT ISSUES, NEEDS, AND INTERESTS

As part of the OBMP scoping process, issues, needs and interest were solicited from the stakeholders in the Basin. These issues, needs and interests have been summarized in a tabular form in Tables 3-1 through 3-7, where each table refers to a class of issues, needs and interests that include:

- safe yield
- native and imported water recharge
- quality and quantity
- reclaimed water
- conjunctive-use storage
- costs
- human resources and administration

Attribution for the source of each issue, need, and interest is listed in these tables. In some cases, a specific issue, need and interest may show up in more than one class. These needs and interests were discussed at several scoping meetings and were used to focus problem identification, OBMP goals, and the resulting OBMP scope of work.

MANAGEMENT GOALS OF THE OBMP

In June 1998, the stakeholders began the process of developing management goals for the OBMP that address the issues, needs, and interests of the producers. The process involved the proposal of an initial set of goals followed by discussion and group editing at the bi-monthly meetings. The initial set of goals of the OBMP is listed below.

Goal No. 1 – Enhance Basin Water Supplies. This goal applies not only to local groundwater, but also to all sources of water available for the enhancement of the Chino Groundwater Basin. The following activities enhance basin water supplies:

- *Enhance recharge of storm water runoff*. Increasing the recharge of storm water in the Basin will increase the water supplies in the Chino Basin. The relatively low TDS and nitrate concentrations of storm flow will improve groundwater quality.
- *Increase the recharge of recycled water*. The recharge of recycled water above that required for replenishment obligations can be used for safe yield augmentation and/or conjunctive use.
- *Develop new sources of supplemental water*. New sources of supplemental water, including surface and groundwater from other basins, can be used to meet Chino Basin area demands, reduce dependency on Metropolitan supplies, and improve drought reliability.
- *Promote the direct use of recycled water*. Promoting the direct use of recycled water for non-potable uses will make more native groundwater available for higher-priority beneficial uses.
- *Promote the treatment and use of contaminated groundwater*. Groundwater in some parts of the Basin is not produced because of groundwater contamination problems and thus the yield of the Basin may be reduced. The yield of the Basin can be maintained and enhanced by the production and treatment of these contaminated waters.

- *Reduce groundwater outflow*. Increasing groundwater production near the Santa Ana River will increase the streambed percolation of the Santa Ana River into the groundwater basin, and reduce groundwater outflow from the Basin and thereby increase the supply of groundwater in the Basin.
- *Re-determine safe yield.* Recent studies suggest that the safe yield may be greater than the 140,000 acre-ft as stated in the Judgment. The activities listed above will cause the yield to increase further. Continuing to operate the Basin at 140,000 acre-ft/yr will cause groundwater in the Basin to be lost to the Santa Ana River. The safe yield will be re-determined on an as needed basis to maximize the current yield and to cause future increases in yield

Goal No. 2 – Protect and Enhance Water Quality. This goal will be accomplished by implementing activities that capture and dispose of contaminated groundwater, treat contaminated groundwater for direct high-priority beneficial uses, and encourage better management of waste discharges that impact groundwater. The following activities will protect and enhance water quality:

- *Treat contaminated groundwater to meet beneficial uses*. Groundwater in some parts of the basins is not produced because of groundwater contamination problems. Groundwater quality can be protected by intercepting contaminants before they spread. Intercepted groundwater could be treated and used directly for high priority beneficial uses or injected back to the aquifer.
- *Monitor and manage the Basin to reduce contaminants and to improve water quality*. Actively assisting and coordinating with the Regional Board, the EPA, and other regulatory agencies in water quality management activities would help improve water quality in the Basin.
- *Manage salt accumulation through dilution or blending, and the export of salt*.
- *Address problems posed by specific contaminants.*

Goal No. 3 – Enhance Management of the Basin. This goal will be accomplished by implementing activities that will lead to optimal management of the Chino Basin. The following activities will protect and enhance management of the Basin:

- *Develop policies and procedures that will encourage stable, creative and fair water resources management in the Basin*.
- *Optimize the use of local groundwater storage.* Policies and procedures for local storage, cyclic storage and other types of storage accounts will be created to maximize drought protection and improve water quality, and to create an efficient system to transfer water from producers with surplus water to producers that need water.
- *Develop and/or encourage production patterns, well fields, treatment and water transmission facilities and alternative water supply sources to ensure maximum and equitable availability of groundwater and to minimize land subsidence*.
- *Develop conjunctive-use programs with others to optimize the use of the Chino Basin for in-basin producers and the people of California*.

Goal No. 4 – Equitably Finance the OBMP. This goal is based on the following principles:

- *The primary source of revenue to finance the implementation will be the consumers of the Chino Basin groundwater.*

- *The consumers in the Chino Basin must be treated equitably by passing the cost of the OBMP on a per acre-foot basis or by other methods, based on formulas to be determined.*
- *Financial incentives and disincentives will be established to assure that existing groundwater is pumped out of the Basin and a higher quality of water is used to replenish the Basin.*
- *Opportunities for creativity will be provided to the producers so that they are motivated to use their assets and abilities in the implementation of the OBMP.*
- *Recover value from utilization of storage of supplemental water and from rising water outflow.*

The Special Referee and her engineer reviewed these goals and provided direction to the stakeholders. In particular, the Special Referee suggested that the goals and action items were too vague. The goals and action items were refined and produced in a tabular format. The goals setting process concluded on November 26, 1998. The final set of goals is listed in Table 3-8. Table 3-8 lists each goal, the impediments to each goal, action items to surmount each impediment and achieve the goal, and the implication of the individual action items. The stakeholders were asked to review the final set of goals and action items listed in Table 3-8 to make sure that their individual issues, needs, and interests were addressed by the management goals. The stakeholders concluded that the set of goals listed in Table 3-8 addressed their needs and interests.

SECTION 4
MANAGEMENT PLAN

INTRODUCTION

The Optimum Basin Management Program (OBMP) goals, impediments to the goals, action items to remove the impediments, and implications of the action items are summarized in Table 3-8. This section of the OBMP report describes the actions that, when implemented, will achieve the goals of the OBMP. Table 3-8 includes a column that cross-references the action items listed for each goal with OBMP program elements. The program elements described herein include:

- Program Element 1 – Develop and Implement Comprehensive Monitoring Program
- Program Element 2 – Develop and Implement Comprehensive Recharge Program
- Program Element 3 – Develop and Implement Water Supply Plan for the Impaired Areas of the Basin
- Program Element 4 – Develop and Implement Comprehensive Groundwater Management Plan for Management Zone 1
- Program Element 5 – Develop and Implement Regional Supplemental Water Program
- Program Element 6 – Develop and Implement Cooperative Programs with the Regional Water Quality Control Board, Santa Ana Region (Regional Board) and Other Agencies to Improve Basin Management
- Program Element 7 – Develop and Implement Salt Management Program
- Program Element 8 – Develop and Implement Groundwater Storage Management Program
- Program Element 9 – Develop and Implement Conjunctive-Use Programs

The scope of the program elements was developed by the Chino Basin stakeholders. Each program element contains a series of comprehensive actions and plans to implement those actions. It is anticipated that a specific implementation program will be the result of Phase II of the OBMP development process. It will include the specific details of how the plan will be implemented and funded, and by whom. Implementation of all program elements is necessary to achieve the goals of the OBMP. Because of overlap and synergies, some of the program elements were combined as they were developed. The following program elements were combined: 3/5, 6/7, and 8/9. The program elements are summarized in this section. Task Memorandums were prepared for each program element during development of the OBMP Phase I Report and are available from the Watermaster offices. They describe each program element in detail and generally include:

- need and function
- description of program element actions
- cost
- implementation entities
- implementation schedule for the short-term (first three years), mid-term (4th through 10th years) and-long term (11th through 50th years)

The emphasis in this section is on a description of OBMP actions, schedule and cost. The program element descriptions provide Watermaster and the Court with a means of comparing actions taken in OBMP implementation with progress in achieving the goals of the OBMP.

PROGRAM ELEMENT 1 – DEVELOP AND IMPLEMENT COMPREHENSIVE MONITORING PROGRAM

Need and Function

Program Element 1 – Develop and Implement a Comprehensive Monitoring Program contains monitoring activities that are action items explicitly listed in Table 3-8 and provides information required by other program elements of the OBMP.

The first impediment to *Goal 1 – Enhance Basin Water Supplies* can be stated as: "Unless certain actions are taken, safe yield of the Basin will be reduced … due to groundwater outflow from the southern part of the Basin." This impediment speaks to the reduction in groundwater production in the southern part of the Basin as agricultural land is converted to urban uses, and to increase outflow as groundwater storage is increased due to other management activities. The amount of safe yield lost due to these activities needs to be computed and used in the administration of the Judgment – otherwise the Basin will be overdrafted. The re-determination of safe yield and estimation of losses from groundwater storage programs require comprehensive water level mapping across the Basin, analysis of water level time histories at wells, and accurate estimations of groundwater production. The current groundwater level monitoring is not adequate. The primary problems with the current groundwater level monitoring program include poor areal distribution of wells in the monitoring program, short time histories, questionable data quality, and insufficient resources to develop and conduct a comprehensive program. Groundwater production estimates from the agricultural pool rely on water duty methods for most of the producers and some producers do not provide the Chino Basin Watermaster (Watermaster) with information upon which production estimates can be made. Rigorous groundwater level and production monitoring programs are described below.

The first impediment to *Goal 2 – Protect and Enhance Water Quality* can be stated as: "Watermaster lacks comprehensive, long-term information on groundwater quality." The primary uses of water quality information include, but are not limited to:

- locate and characterize water quality challenges in the Basin and formulate corrective management plans;
- provide an understanding of how the Basin works;
- determine whether water quality produced by a well is suitable for the desired use (*e.g.*, potable quality for potable use); and
- design treatment systems to improve water quality to a level to meet a desired use.

Currently, Watermaster obtains water quality data from all the appropriators for their active wells and from the Regional Board for wells monitored under their supervision (*e.g.*, landfill monitoring and other special water quality investigations). Watermaster has a limited groundwater quality monitoring program in the southern part of the Basin measuring general minerals and physical properties at about 60 wells. There is little historical or current water quality information for most of the 600 agricultural wells in the southern half of the Basin, for wells in the overlying non-agricultural pool, and for inactive appropriative pool wells. The water quality being produced at a majority of the wells in the Basin is unknown.

A salt budget approach has been proposed as a management tool for the Basin. The salt management steps included in *Program Element 7 Develop and Implement Salt Management Program* will be used by

the Watermaster and other stakeholders to reduce the rate of salt accumulation in the Basin. Groundwater quality monitoring will be used to help assess the state of salt in the Basin in the future after the salt management plans are implemented. The direction and cost of future water management activities in the Basin depends on the water quality. A comprehensive groundwater quality monitoring program is fundamental to management of the Basin. A rigorous groundwater quality monitoring program is described below.

The fifth impediment to *Goal 2 – Protect and Enhance Water Quality* can be stated as: "The Basin is not using as much high quality storm water as it could for recharge." The first step in determining how much storm water recharge is occurring is to monitor the volume of inflow and outflow that is occurring at existing facilities, the amount of storm water that is available for recharge in the absence of recharge facilities, and to estimate the associated water quality. Characterizing the water quality of local and imported waters used for recharge in the Basin is necessary to protect water quality for beneficial uses, assess salt balance, design treatment processes to produce water of a quality suitable for intended uses, and to minimize the cost of recycled water recharge. Engineering investigations can utilize these data to design new facilities, and modify/operate existing facilities.

Storage of water in the Basin for local or regional conjunctive use may cause outflow to the Santa Ana River and some of its tributaries in the Chino Basin to increase. The water quality of this outflow may cause water quality deterioration in the Santa Ana River and require mitigation. Watermaster needs to develop a long-term database to assess losses from storage, and surface water impacts in the Santa Ana River and its Chino Basin tributaries from groundwater management activities.

The second impediment to *Goal 3 – Enhance Management of the Basin* can be stated as: "Existing production patterns are not balanced, cause losses, can contribute to local subsidence, and water quality problems." The impediment speaks to a lack of local balance between groundwater recharge and production. The lack of information on how groundwater moves in the Basin can lead to production and replenishment patterns that cause loss of yield and other problems as stated in the impediment. Groundwater level, groundwater quality, and accurate production estimates are necessary to define the groundwater flow systems and to implement equitable and cost-effective management plans.

Monitoring Programs to Support Water Resources Management in the Chino Basin

Groundwater Level Monitoring Program. Watermaster began a process to develop a comprehensive groundwater level monitoring program in the spring of 1998. The process consists of two parts – an initial survey followed by long-term monitoring at a set of key wells. The initial survey was to consist of collecting groundwater level data at all wells in the Basin from which groundwater level measurements can be obtained for spring 1998, fall 1998, spring 1999, and fall 1999. Due to resource limitations at the Watermaster, the initial survey is partially complete and will not be completed until after fall 2001. The data from the initial survey will be mapped and reviewed. Based on this review and Watermaster management needs, a long-term monitoring program will be developed and implemented in the fall of 2001. Watermaster staff will conduct this program with minimal outside assistance. Watermaster staff expects that they will measure groundwater levels in the initial survey at about 400 wells in overlying agricultural pool and about 100 other wells from the other pools and unassigned monitoring wells. The long-term monitoring program will use about half of the wells used in the initial survey plus all wells in the other pools and unassigned wells monitored under the direction of the Regional Board and others. Keys well located in agricultural areas will be replaced as necessary if the original well must be destroyed when the agricultural land surrounding the well is converted to other use.

Groundwater Quality Monitoring Program. Watermaster will begin the development of a comprehensive water quality monitoring program in July 1999. As with the groundwater level monitoring program, the water quality monitoring program will consist of an initial survey and a long-term monitoring effort. The initial survey will consist of:

- collection of all water quality data from appropriators' wells that are tested by appropriators;
- collection of all water quality data from Regional Board for water quality monitoring efforts that are conducted under their supervision; and
- collection and analysis of at least one water quality sample at all (or a representative set of) other production wells in the Basin. Assumed maximum number of wells sampled by Watermaster staff in the initial survey is 600.

Re-sampling and analysis will be done at wells sampled by Watermaster if volatile organic compounds (VOCs) are detected. These data will be mapped and reviewed. Based on this review and Watermaster management goals in the OBMP, a long-term monitoring program will be developed and implemented in the fall of 2002. The long-term monitoring program will contain a minimum set of key wells that can be periodically monitored to assess water quality conditions in the Basin over time. Table 4-1 lists the analytes and the analytical costs for sampling 200 wells per year for three years (plus an estimated 10 more wells for verification re-sampling). The average annual analytical cost is about $185,000 per year and totals about $555,000 if all wells were sampled. Watermaster staff will be trained to obtain samples at these wells and will require a total of about 140 person-days per year. Outside services will cost about $60,000 per year. Water quality data for all operable wells in the other pools will be provided by the well owners in those pools.

Production Monitoring Program. All wells that produce more than 10 acre-ft/yr will have in-line totalizing flow meters. To accomplish this, about 600 agricultural wells will be equipped with in-line totalizing flow meters. Production records from wells owned by appropriators and overlying non-agricultural pool members will report quarterly as has been done in the past. Watermaster staff will read the meters of wells owned by agricultural pool members at least once a year during the period of mid-May through June. Watermaster staff will digitize all production records in Watermaster's database and use this information in the administration of the Judgment. The cost of the installing in-line flow meters in the overlying agricultural pool is summarized in Table 4-2 and totals about $810,000. It has been recommended by the overlying agricultural pool that Watermaster fund up to 50 percent of the cost, with the remaining funds coming from the individual producers.

In addition to the above, all producers will provide Watermaster on an annual basis a *water use and disposal survey* form that describes the sources of water used by each producer and how that water is disposed after use. The purpose of the form is to provide information to Watermaster that will enable accurate salt budget estimates as described in *Program Element 6 – Develop and Implement Cooperative Programs with the Regional Board and Other Agencies to Improve Basin Management*, and for other water resources management investigations that may be undertaken by Watermaster in the future as part of the OBMP.

Surface Water Discharge and Quality Monitoring. The current program of measuring water quality at recharge basins should be expanded to all recharge and retention basins that contribute significant recharge to the Basin. Water level sensors will be installed in all recharge and retention basins that contribute significant recharge to the Chino Basin. These facilities were listed in Table 3 of the *Program Element 2 – Develop and Implement a Comprehensive Recharge Program* draft memorandum and are reproduced here in Table 4-3. A total of 16 new water-level sensors will be required at a total cost of

$192,000. Water level data acquisition and water quality sampling will be done by Watermaster staff. The annual cost of laboratory analysis and interpretation of water level and water quality data is about $45,000.

Watermaster needs to assess the existing surface water discharge and associated water quality monitoring programs for the Santa Ana River and its Chino Basin tributaries to determine the adequacy of the existing monitoring programs for characterizing historical ambient conditions and their utility in detecting water quality impacts from future Chino Basin management activities. If necessary, Watermaster could contract with the agencies conducting these programs to modify their programs to accommodate Watermaster. Ideally, a cooperative program involving all the interested agencies could be developed at a reduced cost for all. The cost of the initial assessment of surface water data for the Santa Ana River is about $15,000.

Ground Level Monitoring Program. Ground level surveys are proposed herein as an offshoot of the subsidence issues in Management Zone 1. The stakeholders are interested in determining if and how much subsidence has occurred in the Basin. Watermaster will conduct an analysis of historical ground level survey and remote sensing data to make this determination. The analysis consists of the following tasks:

- Historical survey data collected and/or on file by federal, state, and local agencies will be compiled, mapped, and reviewed to estimate total subsidence for as long a period as possible. Estimated cost to complete this review is about $15,000.
- Synthetic aperture radar (SAR) imagery will be used to assess the time history of subsidence in the Basin for the period 1993 though 1999. Estimated cost to develop this time history is about $20,000. It should be noted that the City of Chino has already conducted a similar investigation for most of the Basin and that the effort described herein is to expand on the work already done by the City.
- Based on the above information, a network of ground elevation stations in subsidence-prone areas will be developed and periodic surveys of these stations will be done. The frequency of periodic surveys will be established for the Basin as a whole with more frequent surveys done for some areas of the Basin. The estimated cost of this effort is not certain. It should be noted that the City of Chino has already conducted a similar survey within the City of Chino and that the effort described herein is to expand on the surveys done by the City to the entire Basin.

These tasks can be accomplished in the first year.

Well Construction, Abandonment and Destruction Monitoring. Watermaster maintains a database on wells in the Basin and Watermaster staff makes frequent well inspections. Watermaster sometimes finds a new well during routine well inspections. The near-term frequency of inspection is expected to increase due to the groundwater level, quality and production monitoring programs. Watermaster needs to know when new wells are constructed as part of its administration of the Judgment. Valuable information for use in managing the Chino Basin is usually developed when wells are constructed including: well design, lithologic and geophysical logs, groundwater level and quality data, and aquifer stress test data. Producers generally notify Watermaster when they construct a new well but seldom, if ever, provide the information listed above. Watermaster has not generally asked for these data. Well owners must obtain permits from the appropriate county and state agencies to drill a well and to put the well in use. Watermaster will develop cooperative agreements with the counties of Los Angeles, Orange, Riverside, and San Bernardino, and the California Department of Health Services (DHS) to ensure that the

appropriate entities know that a new well has been constructed. Watermaster staff will obtain well design, lithologic and geophysical logs, groundwater level and quality data, and aquifer stress test data.

The presence of abandoned wells is a threat to groundwater supply and a physical hazard. Watermaster staff will review its database, make appropriate inspections, consult with well owners, and compile a list of abandoned wells in the Chino Basin. The owners of the abandoned wells will be requested to properly destroy their wells following the ordinances developed by the county in which the abandoned well is located. Watermaster staff will update its list of abandoned wells annually and provide this list to the counties for follow-up and enforcement.

Cooperative Efforts with Appropriate Agencies to Implement Program

Groundwater Level Monitoring. Watermaster will develop a groundwater level measurement protocol for use by all cooperating entities. Groundwater levels will be obtained by the following entities:

- Overlying Agricultural Pool – Watermaster staff
- Overlying Non-agricultural Pool – pool member or Watermaster staff
- Appropriative Pool – pool member or Watermaster staff
- Other wells – Watermaster staff will obtain data from Regional Board or owners.

Groundwater Quality Monitoring. Watermaster will develop groundwater sampling and analysis protocols for use by all cooperating entities. Groundwater quality analyses will be obtained by the following entities:

- Overlying Agricultural Pool – Watermaster staff
- Overlying Non-agricultural Pool – pool member
- Appropriative Pool – pool member
- Other wells – Watermaster staff will obtain data from Regional Board or owners.

Proposed Production Monitoring Program. Watermaster will develop and implement an in-line meter installation program for the overlying agricultural pool. The installation program will take place over a three-year period starting in Watermaster fiscal year 1999/00. Groundwater production estimates and water use and disposal survey forms will be obtained by the following entities:

- Overlying Agricultural Pool – Watermaster will read meters and producers will prepare and submit water use and disposal survey forms
- Overlying Non-agricultural Pool – pool member will read the meters and prepare and submit the water use and disposal survey forms
- Appropriative Pool – pool member will read the meters and will prepare and submit the water use and disposal survey forms.

Surface Water Discharge and Water Quality Program. Watermaster will take the lead in completing the following activities:

- Chino Basin Water Conservation District (Conservation District) and Watermaster will jointly install water level sensors in all existing recharge and retention facilities that have potential for storm water recharge.
- Watermaster staff will obtain grab samples approximately every two weeks for all basins during the rainy season and have these samples analyzed.

- Watermaster will review the surface water discharge and associated water quality monitoring programs for the Santa Ana River and the lower Chino Basin tributaries, and compare what is available from these programs to what is needed for Watermaster investigations under the OBMP.

Ground Level Survey. Watermaster will conduct the analysis to estimate historical subsidence and to monitor future subsidence in the Chino Basin.

Monitoring of Well Construction, Abandonment and Destruction. Watermaster will take the lead in completing the following activities:

- Develop agreements with county and state agencies to notify each other regarding construction of new wells and to obtain construction related information.
- Watermaster staff will prepare a list of abandoned wells and request the owners of abandoned wells to properly destroy their wells.

The counties will follow-up to ensure that abandoned wells within their jurisdiction are properly destroyed.

Implementation Actions and Schedule

First Three Years (1999/00 to 2001/02). The following actions will be completed in the first three years commencing fiscal year 1999/00:

- Complete initial survey for the groundwater level program.
- Complete initial survey for groundwater quality program.
- Complete meter installation program for overlying agricultural pool.
- Complete ground level survey.
- Complete installation of water level sensors in recharge and retention facilities.
- Complete Santa Ana River surface water monitoring adequacy analysis.
- Start and continue surface water discharge and quality monitoring at recharge and retention facilities.
- Develop agreements with county and state agencies regarding notification of new well drilling.
- Well construction and related information will be requested as new wells are identified.
- A list of abandoned wells will be developed annually and the owners will be requested to properly destroy their abandoned wells.

Years Four to Ten (2002/03 to 2010/11). The following actions will be completed in years four through ten, commencing fiscal year 2002/03:

- Start and continue long-term groundwater level monitoring program, cause key wells to be relocated as necessary.
- Start and continue long-term groundwater quality monitoring program, cause key wells to be relocated as necessary.
- Continue production monitoring.

- Conduct remote sensing analysis using synthetic aperture radar or other techniques at least every ten years (2010/11) or sooner, if necessary.
- Participate, as necessary, in the Santa Ana River surface water monitoring.
- Continue surface water discharge and quality monitoring at recharge and retention facilities.
- Well construction and related information will be requested as new wells are identified.
- A list of abandoned wells will be developed annually and the owners will be requested to properly destroy their abandoned wells.

Years Eleven to Fifty (2011/12 to 2050/51). The following actions will be completed in years eleven to fifty, commencing fiscal year 2011/12:

- Continue long-term groundwater level monitoring program, cause key wells to be relocated as necessary.
- Continue long-term groundwater quality monitoring program, cause key wells to be relocated as necessary.
- Continue production monitoring.
- Conduct remote sensing analysis using synthetic aperture radar or other technique at least every ten years (2020/21, 2030/31, 2040/41, 2050/51) or sooner, if necessary.
- Participate as necessary in the Santa Ana River surface water monitoring.
- Continue surface water discharge and quality monitoring at recharge and retention facilities.
- Well construction related information will be requested as new wells are identified.
- A list of abandoned wells will be developed annually and the owners will be requested to properly destroy their abandoned wells.

PROGRAM ELEMENT 2 -- DEVELOP AND IMPLEMENT COMPREHENSIVE RECHARGE PROGRAM

Need and Function of the Program Element

The need for a comprehensive recharge program was described in the introduction to the Final Report for Phase 1 of the Chino Basin Recharge Master Plan (Wildermuth, 1998). Program Element 2 -- Develop and Implement Comprehensive Recharge Program contains action items explicitly listed in Table 3-8.

The first impediment to Goal 1 – Enhance Basin Water Supplies can be stated as: "Unless certain actions are taken, safe yield of the Basin will be reduced … due to groundwater outflow from the southern part of the Basin" speaks to poorly planned recharge where recharge of storm water and recycled water could be placed too low in the Basin to be recovered. Some recycled water projects that are currently being planned will increase recharge when groundwater production downgradient of these proposed recharge projects is decreasing. The result will be increased outflow to the Santa Ana River and no yield improvement. A comprehensive program must ensure that the locations of recharge and production are such that yield is maximized.

The second impediment to *Goal 1 – Enhance Basin Water Supplies* and the fifth impediment to *Goal 2 – Protect and Enhance Groundwater Quality* can be stated as: "The Basin is not using as much high quality storm water as it could for recharge." At the time the Chino Judgment was adopted (1978), about

41 percent of the safe yield was estimated to come from irrigation returns. Since that time, irrigated agriculture has declined and is projected to be almost completely converted to urban uses by 2020. This will result in a decline of irrigation returns to groundwater and a potential decrease in the safe yield. San Bernardino County, Riverside County, and the US Army Corps of Engineers (USACE) have constructed flood control projects that efficiently capture and convey storm flow to the Santa Ana River, effectively eliminating the groundwater recharge that formerly took place in the stream channels and flood plains in the Chino Basin. In most cases, no provisions were made to mitigate the loss of recharge from flood control projects. Also, there have been no mitigation efforts to preserve recharge when land use is converted from native and agricultural uses to urban uses. Thus, the safe yield may have decreased in the Chino Basin due to land use changes and flood control improvements. Water harvesting opportunities exist that can be used to offset the yield lost to urbanization and flood control improvements. Water harvesting consists of capturing and recharging new storm flow caused by urbanization. Most of the precipitation falling on undeveloped land or land in agricultural uses is lost to evapotranspiration. Storm flow increases dramatically with urbanization due to an increase in impervious land cover, decrease in evapotranspiration of rainfall, and construction of drainage improvements. The potential yield from this additional storm flow is numerically equal to the increase in storm flow that occurs when the land is converted to urban uses. The actual yield is equal to the additional rainfall-storm flow that is captured and put to beneficial use. In the Chino Basin, the best and least expensive way to put this new water to beneficial use is groundwater recharge.

Increasing the yield of the Chino Basin by increased capture of storm flow will improve ambient water quality and increase the assimilative capacity of the Chino Basin. Increasing the capture of storm flow will reduce the cost of mitigation requirements for recharge of recycled water. The Basin Plan assumes that a certain average annual quantity of storm flow will be recharged each year. The volume of recycled water that can be used in the Basin, without total dissolved solids (TDS) mitigation, is numerically-tied to the average annual quantity of storm flow that recharges the Basin. A decrease in the recharge of storm flow will result in a decrease in the volume of recycled water that will be permitted in the Basin without TDS mitigation. Likewise, an increase in the recharge of storm flow will result in an increase in the volume of recycled water that will be permitted in the Basin without TDS mitigation. Therefore, the volume of storm flow recharge from storm flow has a dramatic impact on the future and cost of recycled water recharge.

The annual replenishment obligation will grow from about 30,000 to 55,000 acre-feet per year (acre-ft/yr) over the next 20 to 30 years. Watermaster has access to spreading facilities with a current capacity of about 29,000 acre-ft/yr when imported water from Metropolitan is available. Assuming replenishment water is available seven out of ten years, the average annual recharge capacity of recharge facilities available to Watermaster is about 20,000 acre-ft year. The in-lieu recharge potential for the Chino Basin is about 57,000 acre-ft/yr and will remain constant over the next 20 to 30 years based on the water supply plan included in this OBMP. Assuming in-lieu replenishment water is available seven out of ten years, the average annual in-lieu recharge capacity available to Watermaster is about 40,000 acre-ft year. The replenishment obligation, available recharge capacity over the next 20 years is (acre-ft/yr):

Year	Replenishment Obligation	----------Recharge Capacity----------			Surplus Recharge Capacity
		Physical	In-Lieu	Total	
2000	31,000	20,000	40,000	60,000	29,000
2020	55,000	20,000	40,000	60,000	5,000

The surplus recharge capacity could be used up quickly by future replenishment needs and implementation of conjunctive-use programs. A modest conjunctive use program consisting of an annually occurring seasonal shift of imported demands and a dry year yield component that would use up 150,000 acre-ft of storage will require about 46,000 acre-ft of recharge capacity. New recharge capacity is needed immediately for even a modest conjunctive-use program. The availability of in-lieu recharge capacity listed above is not a certainty. In the present mode of basin management, in-lieu recharge capacity is available on an ad hoc basis and requires the cooperation of water supply agencies that have access to supplemental water. Watermaster needs to obtain enough recharge capacity to meet its replenishment obligations for ultimate demands on the Chino Basin. The safest and most conservative way to ensure that recharge capacity will be available is for Watermaster to develop new recharge capacity that will meet ultimate replenishment obligations. For an average annual recharge capacity of 55,000 acre-ft/yr, Watermaster will need an annual recharge capacity of about 80,000 acre-ft/yr (80,000~55,000/0.7). The new recharge capacity by management zone for the year 2020 is estimated to be about:

Management Zone 1	18,000 acre-ft/yr
Management Zone 2 and 3	34,000 acre-ft/yr
Total	52,000 acre-ft/yr

The allocation of recharge capacity to management zones is based on balancing recharge and production in each management zone with the year 2020 production pattern described in Program Elements 3 and 5. Figure 4-1 shows the existing spreading and storm water retention basins in the Chino Basin. Figure 4-1 also shows the preferred area, based on current knowledge, for new recharge basins in Management Zone 2 and 3. The preferred recharge area is rapidly developing. It is unlikely that Watermaster will be able to purchase lands already in urban use and construct new basins. Therefore, Watermaster needs to obtain new recharge sites in the preferred area immediately. Recharge capacity in Management Zone 1 can be obtained by expanding recharge capacity at the Montclair Basins, improving the Upland and Brooks Basins, and through groundwater injection. During Phase II of the OBMP, Watermaster will develop an implementation plan to secure a total physical recharge capacity of about 80,000 acre-ft/yr with recharge facilities sized and located that will balance the production and recharge.

Past Efforts by Watermaster and the Conservation District

The Conservation District and the Watermaster completed phase 1 of a three-phase work plan to improve recharge and establish a long-range recharge master plan for the Chino Basin. The three phases consist of:

Phase 1 - Initial Screening and Assessment. Conduct an assessment of how much storm flow is currently recharged and how much additional recharge could occur at new and existing spreading basin sites. From this assessment a list of promising spreading basins will be developed. Research questions will be developed for the promising sites and a detailed scope of work will be developed for Phase 2. Phase 1 was completed in January 1998 and is summarized below.

Phase 2 - Engineering Assessments of Promising Sites. Site-specific investigations, percolation rate monitoring and the preparation of cost estimates for developing and managing these basins will be developed in this phase. The institutional issues regarding ownership of facilities, management of non-Conservation District-owned facilities, disposition of water recharged, and Basin Plan modifications will be identified.

Principles of agreement will be developed that describe the institutional issues and means to resolve these issues through agreements. A list of recharge projects will be identified and prioritized based on need and cost effectiveness. A detailed scope of work will be developed for Phase 3.

Phase 3 - Develop an Implementation Plan. A plan to develop and manage spreading basins will be prepared. The plan will include existing and new basins and a schedule for spreading basin improvements based on developing recharge capacity to match need for increased groundwater yield at minimum cost.

The Phase 1 effort was completed in January 1998. The objective of the Phase 1 analysis of the Recharge Master Plan was to determine the potential for artificial recharge given the resources in the Chino Basin. This was accomplished through data collection, research, and a massive computational and engineering assessment. Existing storm water recharge in the Chino Basin was estimated to be about 12,000 acre-ft/yr. This 12,000 acre-ft is part of the existing safe yield. The potential storm water recharge was estimated to range from about 25,000 to 30,000 acre-ft/yr given proper routine maintenance at existing and then-current planned facilities. Subsequent investigations by the Conservation District suggest that the potential recharge is lower. Incorporating the Conservation District's recent work, the potential range is probably around 12,000 to 22,000 acre-ft/yr. Table 4-4 lists the existing flood control/spreading basins and annual average recharge estimates based on updated Phase 1 modeling results. Most basins are not maintained to optimize recharge and there is little quantitative information on basin conditions or current recharge performance. Recharge of storm flows at existing basins could reach about 28,000 acre-ft/yr under ultimate land use conditions. The investigation also showed that it was economical to construct recharge facilities in areas with low percolation rates (<0.25 ft/day) if the facilities were part of a flood retention project. The potential recharge capacity and cost for recharge of imported and recycled water were developed. Operational plans that specify the amount and scheduling of imported water and recycled water recharge were developed. About 17,000 acre-ft/yr of recycled water recharge capacity was developed. The potential for imported water recharge ranges from about 100,000 acre-ft/yr to 135,000 acre-ft/yr at existing basins and one new large facility. Based on the work done for Program Elements 3 and 5 of the OBMP, the imported water recharge capacity needs to be expanded from its current capacity of 29,000 acre-ft/yr to about 80,000 acre-ft/yr to accommodate Watermaster replenishment activities.

Phase 2 Scope of Work for Hydrogeologic and Engineering Investigations

The Phase 2 work, as recommended in the Phase 1 report, was not formally started. Phase 2 consists of eight tasks.

Task 1 Conduct Reconnaissance Analysis to Identify Existing Recharge Basins and Potential New Recharge Sites. The purpose of this task is to develop a list of existing basins that can be used to recharge storm water, recycled water and imported water; and to identify areas for new recharge facilities. Based on the results of this task, some existing basins and new sites with potential for recharge by spreading and injection will be studied in detail in subsequent tasks and others with little potential recharge will either be studied later or not considered as recharge sites. This task consists of the following subtasks:

1.1 Meeting(s) with San Bernardino County Flood Control District (SBCFCD), Riverside County Flood Control and Water Conservation District (RCFCWCD), Los Angeles County Public Works Department (LACPWD) (collectively, the flood control agencies), the USACE, the Conservation District and the Watermaster. The purpose of these meetings is to discuss the use of existing flood control/recharge basins, recharge potential of these basins, past

investigations, future flood control plans that could in include recharge, and institutional impediments to storm water recharge.

1.2 Meetings with planning agencies and the flood control agencies to inform these agencies of the need to set aside open space for recharge and to locate suitable areas for future recharge sites; to seek their cooperation in obtaining such lands, and to develop incentive programs to set aside land for recharge. A permanent basin-wide water conservation planning committee chaired by the Watermaster will be formed to facilitate the process of building and maintaining recharge facilities.

1.3 Develop a financing concept to provide capital for the improvement of existing facilities, construction of new facilities, operations and maintenance, and to mitigate adverse impacts of new spreading basins.

1.4 Review new hydrogeologic and facilities information that became available after completion of the Phase 1 analysis.

1.5 Evaluate Phase 1 computer simulation results to determine the location and magnitude of storm flow that is not being captured at existing facilities and that could be captured and recharged in either new facilities or from improved operations at existing facilities.

1.6 Develop a list of existing and proposed recharge facilities that merit detailed investigation. The priority list should be based on management issues (*e.g.*, subsidence and water quality), cost effectiveness, and for existing facilities, the availability of the facilities for recharge.

1.7 Conduct reconnaissance level feasibility investigation of using injection wells for recharge in Management Zone 1. The purpose of this recharge will be to increase the piezometric levels, reduce future subsidence, and improve water quality.

Task 2 Preliminary Assessment of the Capture of New Recharge. The objective of this task is to estimate the fate of artificial recharge. That is, to estimate the recharge benefits, areas of potential high groundwater, and losses to the Santa Ana River. The scenarios to be tested include recharge scenarios developed in the Phase 1 analysis (modified based on the results of Conservation District investigations and the results of Task 1). The *Rapid Assessment Model (RAM) Tool,* currently under development by the Watermaster, or *Chino Integrated Groundwater Surface Water Model (CIGSM)* are two models that could be used to make this assessment. It is not likely that the CIGSM would be used due to the time and expense to make it ready for use (see Program Elements 6 and 7 later in this section).

Task 3 Conduct Field Program. The purpose of this task is to develop fundamental information that can be used to assess the recharge potential of some existing and proposed basins, and to develop design information for new basins. The field program recommended for Phase 2 includes:

- obtaining and interpreting continuous cores for the upper 50 feet of sediment in existing facilities and the upper 100 feet of sediments from areas adjacent to existing and proposed basins;
- trenching to observe and interpret the near surface soil profiles;
- gradation tests of materials obtained from the trenches; and

- the installation of water level sensors identical to what Conservation District has installed in some of their basins.

Water level data will be collected at basins that are equipped with water level sensors. These data will be interpreted to produce percolation rates at each basin. The percolation rates will be correlated to soil properties and subsurface conditions to determine what is controlling recharge at a specific facility and to develop general design guidelines for the Chino Basin area. The field program is summarized in Table 4-5 covers 16 existing basins and up to three new surface water recharge facilities. Table 4-5 includes a cost estimate for this field program. Field programs for injection tests in Management Zone 1 will be developed in the work done in Program Element 4 – Develop and Implement Comprehensive Groundwater Management Plan for Management Zone 1.

Task 4 Develop Principles of Agreement. This task involves developing principles of agreement between SBCFCD, RCFCWCD, USACE, the Conservation District, and the Watermaster regarding the operation of existing and proposed storm flow management facilities. The goals of the principles are to maintain flood protection and maximize recharge. This work will involve the preparation of draft principles and many meetings. New technical information will need to be developed on an *ad hoc* basis in response to technical issues that will be involved in the principles. A set of principles will be developed with the Regional Board regarding TDS and nitrogen offset credits for recharge of recycled water.

Task 5 Develop Preliminary Operating Plans and Designs. Preliminary operating plans and facility improvements will be developed for all (new and proposed) recharge basins in the Chino Basin based on the results of Tasks 1 through 4. Preliminary capital and operating cost estimates will be developed.

Task 6 Estimate the Average Annual Recharge for Each Basin. Given the results of Tasks 1 through 5, the input data for the computer simulation models used in Phase 1 will be updated. The simulation models will be used to estimate the average annual recharge in each recharge basin. Estimates of imported water and recycled water recharge capacity will be updated. The priority list developed in Task 1 will be updated based on the results of this task.

Task 7 Develop Early Action Plan and Scope of Work for Phase 3. Given the results of Tasks 1 through 6, an early action plan and scope of work for Phase 3 will be developed. The early action plan, will include a list of high priority recharge projects that can be implemented with minimal additional analyses, and a list of lower priority projects that will require longer lead times to implement. These projects may include operating existing facilities to increase recharge, other non-controversial modifications to existing facilities, and construction of new recharge facilities. The scope of work will contain engineering design, environmental assessment and processing, and financing tasks. The scope of work will contain parallel tracks for the early action plan and the lower priority projects.

Task 8 Prepare Report. Technical memoranda will be prepared for Tasks 1 through 7. A final summary report will be prepared incorporating the task memoranda and a scope of work for Phase 3.

Cooperative Efforts with Appropriate Agencies to Implement Program

There are two fundamental levels of implementation appropriate for the comprehensive recharge program: one to develop the program, and one to construct, manage and operate the program. For development of the program, the implementing agencies include:

- the Watermaster, representing the producers who will benefit from the recharge and who will pay the cost of the plan development and implementation;

- the Conservation District, the flood control agencies, and the USACE who own the existing facilities and who (for the flood control agencies) will benefit from reduced flood control costs and improved storm water quality in the Santa Ana River and its tributaries;
- the planning agencies whose cooperation will be necessary to site new recharge facilities within their service areas; Inland Empire Utilities Agency (IEUA), Three Valleys Municipal Water District (TVMWD), and Western Municipal Water District (WMWD) as the provider of imported and recycled water for recharge; and producers that will utilize their own facilities for groundwater injection.

Watermaster will develop the recharge program for the Basin in the first four years of OBMP implementation. Watermaster will enter in to agreements with cooperative entities to implement the recharge program. Potential cooperative entities include Conservation District, the flood control agencies, USACE, Metropolitan Water District of Southern California (MWDSC), IEUA, TVMWD, and WMWD. These contracts will include specific performance goals and schedule. Watermaster will monitor these contracts very closely. If the cooperative entities fail to perform according to the terms of their contract, then Watermaster will terminate the agreements and either enter into an agreement with another cooperative entity or implement the program itself.

Implementation Actions and Schedule

First Three Years (1999/00 to 2001/02). The following actions will be completed in the first three years commencing fiscal year 1999/00:

- The Phase 2 scope of work should be completed within the first three years.
- Based on the results of the Phase 2 work, a list of high priority and low priority recharge projects will be identified. An action plan will be developed to implement the high priority projects as soon as possible and to implement the low priority projects as resources will allow.
- Task 1.1 and 1.2 should begin immediately, prior to the OBMP being submitted to the Court for approval.
- Watermaster advisory committee should form an *ad hoc* committee to start the coordination process and formalize the permanent basin-wide water conservation planning committee. Task 1.5 should also begin immediately.
- In year three, all high priority projects that involve re-operation of existing recharge/flood control facilities should be implemented, and Phase 3 should be started.
- Watermaster should begin the process of acquiring new recharge sites and easements identified in the Phase 2 and 3.

Years Four to Ten (2002/03 to 2010/11). The following actions will be completed in years four through ten, commencing fiscal year 2002/03:

Years four and five

- Complete Phase 3.
- Implement all high priority projects that involve construction and re-operation at existing facilities.

- Watermaster should continue the process of acquiring new recharge sites and easements identified in the Phase 2 and 3. By year five, recharge sites should have acquired to recharge at least 55,000 acre-ft/yr.
- Update the comprehensive recharge program in year 5.

Years five to ten

- Implement all high priority projects that involve the construction of new recharge facilities.
- Update the comprehensive recharge program in year 10.

Years Eleven to Fifty (2011/12 to 2050/51). The following actions will be completed in years eleven to fifty, commencing fiscal year 2011/12:

- Implement all other recharge projects based on need and available resources.
- Update the comprehensive recharge program every five years.

PROGRAM ELEMENT 3 – DEVELOP AND IMPLEMENT WATER SUPPLY PLAN FOR THE IMPAIRED AREAS OF THE BASIN

PROGRAM ELEMENT 5 – DEVELOP AND IMPLEMENT REGIONAL SUPPLEMENTAL WATER PROGRAM

Need and Function of the Program Elements

These program elements serve the OBMP goals listed in Table 3-8. The specific goals, impediments and action items are described below.

The first impediment in *Goal 1 – Enhance Basin Water Supplies* can be stated as: "Unless certain actions are taken, safe yield of the Basin will be reduced due to outflow from the southern part of the Basin." The fourth impediment in *Goal 2 – Protect and Enhance Water Quality* can be stated as: "Poor ambient groundwater quality limits direct use of groundwater and can lead to loss of Basin yield." Most of the agricultural land use in the southern part of the Basin will convert to urban uses over the next 20 to 30 years. Groundwater from the southern part of the Basin will have to be treated prior to use for these new land uses. Groundwater outflow to the Santa Ana River will occur if the decrease in agricultural groundwater production in the southern part of the Basin is not matched by an increase in municipal groundwater production in the same area. The increase in outflow will result in a decrease in safe yield that will reduce the initial rights of the producers in appropriative pool by about 74 percent. The increase in groundwater outflow to the Santa Ana River will cause an increase in river discharge and a degradation of water quality in the river. Currently, agricultural production in the southern part of the Basin is estimated using primarily water duty methods to be about 40,000 acre-ft/yr. Annual estimates of agricultural production are expected to be larger after in-line meters are in place. If the current level of groundwater production in the southern part of the Basin were to cease, the rising water discharge to the Santa Ana River could increase by approximately the numerical equivalent of the current production – about 40,000 acre-ft/yr. This new discharge would have an associated TDS concentration of about 1,300 milligrams per liter (mg/L) (almost twice the basin plan objective of 740 mg/L and 2.5 times the secondary drinking water MCL of 500 mg/L) and a nitrogen concentration of 30 mg/L-N (three times the basin plan objective of 10 mg/L-N and primary drinking water MCL of 10 mg/L-N). The Santa Ana River downstream of the Chino Basin is the primary drinking water supply for most of Orange County. Therefore, Santa Ana River water quality impacts caused by not producing Chino Basin groundwater will adversely affect the municipal water supplies in Orange County. The Regional Board has indicated that

any adverse impacts to the Santa Ana River water quality associated with increased outflows from Chino Basin groundwater will have to be completely mitigated – presumably by desalting recycled water discharges to the Santa Ana River.

The third impediment in Goal 1 – Enhance Basin Water Supplies can be stated as: "Because there is a lack of assimilative capacity for total dissolved solids and nitrogen in the Chino Basin, there are economic limitations on the recharge of recycled water." Most of the recycled water produced in the Basin is exported out of the Basin because of either lack of demand for direct use or economic limitations caused by the lack of assimilative capacity in the Chino Basin. The TDS and nitrogen objectives in the Santa Ana Watershed are under rigorous review and new water quality objectives and water recycling guidelines should be implemented in the next few years. Recharge of recycled water could be used to replenish over-production, supplement the yield of the Basin, and lower the demand for imported water from the Sacramento Delta. There are three treatment options that that can be used to enable the recharge of recycled water: desalting recycled water prior to recharge, desalting groundwater to offset the salt load in the recycled water, and blending recycled water with low TDS imported and/or storm waters.

The fourth impediment in *Goal 1 – Enhance Basin Water Supplies* can be stated as: "Because future demands are increasing and there are limitations on basin and traditional supplies, new sources of supplemental water need to be developed." Alternatives to the use of imported water from MWDSC need to be developed to meet future demands, improve reliability and minimize cost of supplies. The new supplies include recycled water, groundwater from adjacent basins, Santa Ana River water and other waters as can be identified and conveyed to the Chino Basin.

The third impediment in *Goal 2 – Protect and Enhance Water Quality* can be stated as: "There is ongoing legacy contamination in the vadose zone with TDS and nitrogen from agriculture." The vadose zone that underlies areas that were or are currently in agricultural use is likely to be degraded with TDS and nitrogen. The vadose zone will contribute to future TDS and nitrogen degradation of the saturated zone. The primary areas of concern are the areas that were formerly in citrus in the northern part of the Basin and the entire southern half of the Basin. There are two significant implications of legacy contamination in vadose zone: groundwater degradation from TDS and nitrogen will continue into the future long after the agriculture has left – even if extraordinary efforts are used to clean up degraded groundwater; and, groundwater treatment ranging from blending to desalting will be necessary far into the future to put the degraded groundwater to beneficial use.

There are other goals and impediments to goals that are listed for these program elements, but they are somewhat redundant with those listed above and are not described herein. Fundamentally, the goal of Program Elements 3 and 5 is to develop a regional, long range, cost-effective, equitable, water supply plan for producers in the Chino Basin that incorporates sound basin management. The water supply plan developed during Phase II of the OBMP process will include:

- a cost-effective plan to maximize the beneficial use of Chino Basin groundwater and the safe yield.
- a program to reliably meet the long-term water supply needs of area purveyors.
- an implementation program.

Water Demand Planning Assumptions

The planning assumptions and basic data used to develop and evaluate water supply plans are described below.

Available Water Supply from the Impaired Area. As urbanization of the agricultural areas of San Bernardino and Riverside counties in the southern half of the Basin occurs, the agricultural water demands will decrease and urban water demands will increase significantly. Future development in these areas is expected to be a combination of urban uses (residential, commercial, and industrial). The cities of Chino, Chino Hills, and Ontario, and the Jurupa Community Services District (JCSD) are expected to experience significant new demand as these purveyors begin serving urban customers in the former agricultural area. For planning purposes, the agricultural area is assumed to be fully developed by the year 2020.

Based on current estimates of overlying agricultural pool production, it is expected that at least 40,000 acre-ft/yr of groundwater will need to produced in the southern part of the Basin to maintain the safe yield. Actual replacement groundwater production required could be far greater than 40,000 acre-ft/yr if current agricultural production is greater than reported to Watermaster. Recall in the Section 2 discussion on Chino Basin production, that there was a difference in the agricultural production reported to Watermaster (based on water duty methods) and the production estimates developed in the CBWRMS based on water duty methods and water budget modeling, with Watermaster's estimates being about 26,000 acre-ft/yr lower for the period 1978 to 1989. Watermaster will install in-line meters on all wells over the next three years after which accurate estimates of agricultural production will be available. If these estimates show that agricultural production is higher than previously reported, then the groundwater production rates from the southern part of the Basin will have be increased to maintain yield.

Water Supply Plans. Water demands, supply projections for agencies that produce groundwater from the Chino Basin, and estimates of the safe operating yield of the Basin are the basis for evaluating the water supply plans presented in this analysis. Initial water supply plans were developed by Montgomery Watson in 1998 and modified by WE, Inc., based on information supplied by the municipal and industrial producers. The initial plans are shown in Table 2-17.

Based on the data presented in Section 2, the municipal and industrial demands are projected to increase 30 percent between 2000 and 2020. Several agencies will experience increases in demand exceeding 30 percent over the next 20 years, including the cities of Chino, Chino Hills, Norco, Ontario, Cucamonga County Water District (CCWD), Fontana Water Company (FWC), JCSD, and the West San Bernardino County Water District (WSBCWD). Forecasts from municipal and industrial entities indicate that water supply sources for the Chino Basin in 2020 will consist predominantly of Chino Basin wells through direct use or treatment and use, groundwater and treated surface water from other basins, and MWDSC supplies.

The demand data in Section 2 and individual water supply plans were used to quantify the future demand for each purveyor that will need to be satisfied from new water supply sources. Future sources for each purveyor were evaluated and classified into two categories: secure sources and non-secure sources. Secure sources are those with a high probability of being available throughout the planning period. These include existing and available supplies from Chino Basin wells, existing water and desalter plants (*i.e.*, WFA/JPA, CCWD, and TVMWD water treatment plants and Santa Ana Watershed Project Authority [SAWPA] Desalter), imported treated MWDSC water from the Weymouth treatment plant, and imported surface water from other basins. Non-secure sources are not currently available and must be developed to serve the Basin purveyors. These depend on a future event, such as the construction of a treatment plant or acquisition of a new water source.

Table 4-7 lists the 2020 demand projections, projected secure water supply sources including Chino Basin groundwater, production rights, over/under production, the water needed in the future, and the

replenishment obligations. The quantity of water that will be required by each water purveyor was found by subtracting the secure water supply for each purveyor from the purveyor's 2020 demand.

As shown in Table 4-6 of the 404,000 acre-ft/yr of total demand predicted in 2020, approximately 364,000 acre-ft/yr will be met from secure water sources with the remaining 40,000 acre-feet of demand being met from projects described in this program element. The breakdown of the 40,000 acre-ft/yr by purveyor from largest to smallest user is as follows:

Jurupa CSD	10,720 acre-ft/yr
City of Chino	9,540 acre-ft/yr
City of Ontario	8,400 acre-ft/yr
City of Chino Hills	5,600 acre-ft/yr
City of Norco	3,260 acre-ft/yr
Santa Ana River WC	2,170 acre-ft/yr
Swan Lake	350 acre-ft/yr
Total in 2020	40,040 acre-ft/yr

The demand in years 2005, 2010, and 2015 was predicted assuming a uniform increase in annual demand for each of the above purveyors. Table 4-7 lists the demands for these intermediate planning years.

For the purpose of this analysis, it was assumed that there is approximately 48,000 acre-ft/yr of agricultural production in the southern part of the Chino Basin in the year 2000, and that this production will reduce to about 8,000 acre-ft/yr in the year 2020. This decline in agricultural production must be matched by new production in the southern part of the Basin or the safe yield in the Basin will be reduced. The remaining 8,000 acre-ft/yr of production in the southern part of the Basin will be used by the State of California.

Potential Supplemental Water Supply Sources. An evaluation of potential future supplemental water supply sources is given in Table 4-8. Of these sources, the most viable is supplied through existing basin conventional water treatment plants that treat imported State Water Project (SWP) water from MWDSC. For the purposes of this analysis, it is assumed that future supplemental water supplies will come from expansion of the CCWD Lloyd Michael water treatment plant (WTP) and the WFA/JPA Agua de Lejos WTP.

Alternative Water Supply Plan Descriptions

Four initial water supply plan alternatives and ten subalternatives were developed. The initial alternatives consisted of various combinations of wells, desalters, water treatment plants, water and brine pipelines, and pumping stations. Purveyors that will require new water supplies include the cities of Chino, Chino Hills, Ontario, Norco, JCSD, Santa Ana River Water Company (SARWC), and Swan Lake. A fifth alternative was also developed that included three subalternatives for various levels of recycled water use. The water supply plans are described in detail in the Task Memorandum on file with the Watermaster for this Program Element. The initial alternatives that were evaluated included:

Alternative 1: Supplemental Water Deliveries Only

- Subalternative 1A: Supplemental Water Delivery – Agricultural Converts to Urban Uses
- Subalternative 1B: Supplemental Water Delivery – Agricultural Use Stays

Alternative 2: Groundwater Pump, Treat, and Serve Only

- Subalternative 2A-1: Regional Groundwater Pump, Treat, and Serve – Agricultural Converts to Urban Uses
- Subalternative 2A-2: Ad Hoc Groundwater Pump, Treat, and Serve – Agricultural Converts to Urban Uses
- Subalternative 2B-1: Regional Groundwater Pump, Treat, and Serve – Agricultural Use Stays
- Subalternative 2B-2: Ad Hoc Groundwater Pump, Treat, and Serve – Agricultural Use Stays

Alternative 3 – Conjunctive Use

- Subalternative 3A: Conjunctive – Agricultural Converts to Urban Uses
- Subalternative 3B: Conjunctive – Agricultural Use Stays

Alternative 4: Supplemental Water Delivery and Regional Groundwater Pump, Treat, and Serve

- Subalternative 4A: Supplemental Water Delivery and Regional Pump, Treat, and Serve – Agricultural Converts to Urban Uses
- Subalternative 4B: Supplemental Water Delivery and Regional Pump, Treat, and Serve – Agricultural Use Stays

Alternative 5: Reclaimed Water Delivery

- Subalternative 5A: Direct Non-Potable Reuse Only
- Subalternative 5B: Reclaimed Water Delivery for Spreading Only
- Subalternative 5C: Direct Non-Potable Reuse and Recharge of Reclaimed Water

Recommended Water Supply Plan for the OBMP

Considerable discussion of the alternative water supply plans occurred at the OBMP workshops in February through May of 1999. The discussions focused, in part, on the assumption and details of each alternative and cost. Based on technical, environmental, and cost considerations, the stakeholders selected Alternative 4A for detailed review and refinement. Alternative 6A was developed based on Alternative 4A and 5C, includes an accelerated desalting schedule and has no future supplemental water deliveries to the southern part of the Basin. The Alternative 6A water supply plan consists of the following key elements.

Groundwater Production Pattern. Groundwater production for municipal use will be increased in the southern part of the Basin to: meet the emerging demand for municipal supplies in the Chino Basin, maintain safe yield, and to protect water quality in the Santa Ana River. All new southern Basin production will require desalting prior to use. The cities of Chino, Chino Hills, Ontario and Norco, and the JCSD will maximize their use of groundwater from the southern part of the Basin prior to using other supplies. The SAWPA desalter, currently under construction will have to be expanded from 8 million

gallons per day (mgd) to 10 mgd by 2003. Two new desalters will be constructed – the *east* and *west* desalters. The east desalter will need to be on-line by late 2003 at a capacity of 14 mgd. The west desalter will need to be on-line by 2010 with a capacity of 7.5 mgd. Both these new desalters will be expanded in the future. The cost of the southern Basin desalting system will be shared by all Basin producers such that the agencies making direct use of this water above are not unfairly burdened with the cost of treating this water. It was demonstrated during discussions on this program element that equitable cost sharing could be achieved. It was also demonstrated that the groundwater production pattern in the Alternative 6A water supply plan was the least cost plan when lost safe yield and Santa Ana River water quality mitigation costs are avoided. The stakeholders came to an agreement on May 27, 1999 that the Alternative 6A water supply plan should be included in the OBMP.

The total replenishment obligation associated with this groundwater production pattern is 31,000 acre-ft/yr in the year 2000 and will increase to about 55,000 acre-ft/yr by the year 2020. The replenishment obligation can be satisfied using water in local storage, direct recharge of imported and recycled water, and by in-lieu exchange.

Imported Water. Imported water use will increase to meet emerging demands for municipal and industrial supplies in the Chino Basin area, Watermaster replenishment, and conjunctive use. Expanded use of imported water in the northern part of the Basin will have a lower priority than maintaining groundwater production in the southern part of the Basin.

Recycled Water. Recycled water use (direct use and recharge) will increase to meet emerging demands for non-potable water and artificial recharge. Under the current Basin Plan, all new recycled water use will require mitigation for TDS and nitrogen impacts. Recycled water use will be expanded as soon as practical. The two new desalters described above and the increase in storm water recharge will provide mitigation for the expanded use of recycled water.

Under Alternative 6A , two new desalters will be constructed and the SAWPA desalter currently under construction will be expanded immediately. The general location of these desalters, their respective well fields, product water pipelines, and delivery points are shown in Figure 4-2. Table 4-9 shows the timetable for the new desalters along with the salt removal capacity of these desalters. Table 4-10 contains the capital and annual costs for these facilities. An initial financing and cost sharing plan for this part of the OBMP will be developed during the Phase II OBMP process.

Implementation Requirements and Issues

Technical evaluation requirements and issues relating to facilities siting, facilities description and operations, and technical feasibility include:

- Basin exploration to assess ambient water quality and potential well field locations.
- Geotechnical and hydrogeological investigations.
- Siting investigations for desalters, wells, pipelines, and other facilities.
- Pump tests to determine viability of aquifer production.
- Modeling for safe yield impacts for alternatives identified in the OBMP.
- Preliminary engineering (reverse osmosis [RO] process design, facility layouts, pipeline alignments).
- Aquifer and groundwater quality monitoring.
- Santa Ana Regional Interceptor (SARI) capacity/availability.

- Analyses of the availability/capacity of existing infrastructure.
- Project phasing schedule.
- Construction delivery method (design-bid-build versus design-build).

Financial evaluation requirements and issues include:

- Economic feasibility analysis.
- Project financing plan.
- Interagency agreements/approvals/contracts.
- Potential impact on replenishment obligations.
- Cost/benefit analyses to evaluate incentives.
- Method of operation (agency operation versus contract operation).
- Future availability of MWDSC incentives.
- Sale of rising groundwater to Orange County.

California Environmental Quality Act (CEQA) and permitting requirements and issues include:

- Selection of implementing/lead agency.
- Preparation of necessary documents for CEQA/ National Environmental Policy Act (NEPA) compliance.
- Compliance with Basin Plan.
- Regulatory requirements/approvals from DHS and Regional Board Requirements.
- Interagency agreements/approvals/contracts.

Implementing Agencies

There are a number of specific responsibilities that must be defined when implementing any of the previously discussed alternatives. These responsibilities are listed in Table 4-11. One agency could assume all the responsibilities listed in Table 4-11; however, reality dictates that no single agency can typically meet all of these responsibilities. The following section provides a description of the agencies that could become the lead implementing agency for the construction, operation, and technical and financial support of the chosen water supply alternative.

Chino Basin Watermaster. Watermaster was created on January 27, 1978 by the San Bernardino County Superior Court after extensive negotiations between the municipal, industrial, and agricultural producers. The Chino Basin Watermaster is the entity charged with administering adjudicated water rights and managing groundwater resources within the Chino Basin. The Watermaster's primary responsibilities include: manage and control the replenishment of water supplies in the Basin, acquire and spread replenishment water as needed, approve and facilitate the storage of supplemental water in the Basin, and develop and implement an optimum basin management program to manage the Basin.

Inland Empire Utilities Agency. IEUA, formerly the Chino Basin Municipal Water District, serves 570,000 people and covers 242-square miles in the areas of Chino, Chino Hills, Fontana, Montclair, Ontario, Rancho Cucamonga, Upland and the Chino Agricultural Preserve. The Agency's major responsibilities are: wastewater treatment and disposal; supplemental water supply; industrial waste or non-reclaimable waste disposal; and water recycling. Under the *Regional Sewage Service Program*, the Agency operates three domestic wastewater treatment plants. The program enables local communities to take advantage of shared facilities and to further reduce costs by combining staffs and operations. Two

additional water recycling facilities will be on-line in the next 10 years to accommodate the growth of the area's industrial and residential communities, as well as to meet increasingly stringent environmental regulations.

Three Valleys Municipal Water District. In recognition of the need for additional sources of water for the growing region, the Pomona Area Water Committee was organized in 1945 for securing annexation to the MWDSC. Through the efforts of the committee, the District was formed on January 26, 1950 by public election. The District is a local government agency with a board of directors elected by the registered voters residing within the District's boundaries. The District's boundary includes approximately 133 square miles with a current population of 475,000. Approximately 126,600 retail customers are served by the local agencies to whom the District provides supplemental water.

Western Municipal Water District. Western Municipal Water District of Riverside County was formed in 1954 to bring supplemental water to growing western Riverside County. Western's district consists of a 510-square mile area of western Riverside County, with a population of nearly one-half million people. Western is in the heart of the Santa Ana Basin and within its district lies the communities of Jurupa, Mira Loma, Rubidoux, Riverside, Norco, Corona, Elsinore Valley, and Rancho California. A member agency of the Metropolitan Water District of Southern California, Western serves imported water directly to more than 10,000 retail customers who are located in the unincorporated and non-water bearing areas around Lake Mathews and portions of the city of Riverside. The District also serves ten wholesale customers with Colorado River and SWP water. In addition to its retail water service, the District has committed to retail sewer service to 2600 customers in the Lake Hill/Home Gardens area.

Santa Ana Watershed Project Authority. SAWPA is a joint powers agency that was originally formed to develop water and wastewater management plans for the Santa Ana River watershed. The agency is now responsible for regional water quality planning and implements projects at the request of its member agencies. Members of SAWPA include: IEUA, Eastern Municipal Water District (Riverside County), San Bernardino Valley Municipal Water District (SBVMWD), WMWD (Riverside County), and the Orange County Water District (OCWD). SAWPA owns and operates the Santa Ana Regional Interceptor (SARI) sewer brine disposal system that offers a means of exporting non-reclaimable wastewater from the southern portion of the Chino Basin (CBMWD Reclaimed Water Master Plan, 1993). In addition to the SARI, SAWPA, in cooperation with a number of other agencies who provided support and financial resources, constructed the Arlington Desalter to begin reversing the Arlington Basin's salinity. The Arlington Desalter produces approximately 6 mgd of drinking quality water. SAWPA also owns and operates the SAWPA Chino Desalter that, upon construction by the year 2000, will supply approximately 8 mgd of potable drinking water to JCSD, Chino, Chino Hills, and Norco.

Cooperative Efforts with Appropriate Agencies to Implement Program

Watermaster will assume the leadership role for developing and implementing the OBMP regional water supply plan (Alternative 6 described above) including the development of new desalting plants and the expansion of the new SAWPA desalter. Watermaster will enter into agreements with cooperative entities to implement the OBMP regional water supply plan. Potential cooperative entities include CCWD, IEUA, TVMWD, WMWD, SAWPA, WFA/JPA, and private entities. These contracts will include specific performance goals and schedule. If a cooperative entity fails to perform according to the terms of their agreement, then Watermaster will terminate the agreements and either enter into an agreement with another cooperative entity or implement the program itself.

The new desalting projects could be designed, built, operated and owned by IEUA, WMWD, SAWPA, or by private entity under long-term contract to supply water from the desalters. A private entity may be the preferred way to construct the east desalter because of rapid implementation requirements of that desalter.

CCWD, IEUA, TVMWD, and WFA/JPA will be responsible for providing imported supplies.

IEUA and WMWD will be responsible for expanding the recycled water use in the Basin.

Implementation Actions and Schedule

First Three Years (1999/00 to 2001/02). The following actions will be completed in the first three years commencing fiscal year 1999/00:

Preliminary Engineering – Year 1

- Basin exploration to assess current water quality and identify well field locations.
- Geotechnical and hydrogeological investigations.
- Siting investigations for desalters, wells, pipelines, and other facilities.
- Re-evaluation of potential purveyor water supplies/demands.
- Analysis of availability & capacity of existing infrastructure.
- Analysis of SARI capacity & availability.
- Concept design for new treatment facilities.
- Preparation of necessary documents for CEQA/NEPA compliance.
- Regulatory requirements/approvals from DHS and Regional Board Requirements.
- Conditional use and other permits from local agencies.
- Economic feasibility analysis.
- Project financing plan.
- Selection of implementing/lead agency.
- Interagency agreements/approvals/contracts.
- Method of operation (agency operation versus contract operation).

Design and Construction of East Desalter and
Design and Construction of Expansion of SAWPA Desalter – Years 2 and 3

- Purchase land for ultimate facilities.
- Pre-design investigations.
- Pump tests to determine groundwater production.
- Re-evaluation of purveyor water supplies/demands.
- Preliminary engineering.
- RO process design.
- Facility site layouts.
- Pump station design.
- Final design.
- Bidding and contract award.
- Construction.

- Start-up by 2003.

Years Four to Ten (2002/03 to 2010/11). The following actions will be completed in years four through ten, commencing fiscal year 2002/03

Design and Construction of Western Desalter

- Purchase land for ultimate facilities.
- Pre-design investigations.
- Pump tests to determine groundwater production.
- Re-evaluation of potential purveyor water supplies/demands.
- Geotechnical and hydrogeological investigations.
- Preliminary engineering.
- RO process design.
- Facility site layouts.
- Pump station design.
- Final design.
- Bidding and contract award.
- Construction
- Start-up by 2010

East, West, and SAWPA desalters:

- Operate facilities through period.
- Upgrade facilities as necessary to maintain state-of-the-art and to meet regulatory requirements.

Years Eleven to Twenty (2010/11 to 2019/20). The following actions will be completed in years eleven to twenty, commencing fiscal year 2010/11

Expansion of Eastern Desalter, and
Expansion of Western Desalter

- Pre-design investigations.
- Pump tests to determine groundwater production.
- Re-evaluation of potential water supplies/demands.
- Geotechnical and hydrogeological investigations.
- Preliminary Engineering.
- RO process design.
- Facility site layouts.
- Pump station design.
- Final design.
- Bidding and contract award.
- Construction.
- Start-up by 2015.

East, West, and SAWPA desalters:

- Operate facilities through period.

- Upgrade facilities as necessary to maintain state-of-the-art and to meet regulatory requirements.

PROGRAM ELEMENT 4 – DEVELOP AND IMPLEMENT COMPREHENSIVE GROUNDWATER MANAGEMENT PLAN FOR MANAGEMENT ZONE 1 (MZ1)

Need and Function

Program Element 4 – Develop and Implement Comprehensive Groundwater Management Plan for Management Zone 1 contains action items explicitly listed in Table 3-8.

The second impediment to *Goal 1 – Enhance Basin Water Supplies* can be stated as: "Unless certain actions are taken, piezometric levels in the deep aquifers of Management Zone 1 will continue to decline adding to the potential for additional subsidence and fissures, lost production capability and water quality problems. This impediment speaks to a localized subsidence and fissuring problem within the City of Chino and to a potentially larger and similar problem in the southern end of Management Zone 1 in the former artesian area. This part of the Basin contains a higher fraction of fine-grained materials that originated from sedimentary deposits in the Chino and Puente Hills. This area also consists of a multiple aquifer system. The upper aquifer(s) are moderately high in TDS and are often very high in nitrate. The City of Chino Hills has drilled a series of wells into the deeper aquifer(s) to obtain better quality water. The storage and hydraulic properties of the deeper aquifers are quite limited relative to the upper aquifer. The correlation of the recent groundwater production in the deep aquifers and the timing of the subsidence and fissuring, and a review of the hydrogeologic data from the area very strongly suggest that deep aquifer production is the likely cause of the subsidence. Figure 4-2 illustrates the location and magnitude of subsidence and fissuring in the City of Chino and Figure 4-3 shows the location of the this subsidence anomaly relative to Management Zone 1 and the former artesian area. The *Program Element 4 – Develop and Implement Comprehensive Groundwater Management Plan for Management Zone 1* task memorandum is on file and available from the Watermaster offices. It describes the subsidence problem in the Management Zone 1 area as it is currently understood in more detail.

MZ 1 Management Plan

The continued occurrence of subsidence and fissuring in Management Zone 1 is not acceptable and must be reduced to tolerable levels or completely abated. However, there is some uncertainty as to the causes of subsidence and fissuring and more information is necessary to distinguish among potential causes. An interim management plan must be developed and implemented to:

- minimize subsidence and fissuring in the short-term;
- collect the information necessary to understand the extent and causes of subsidence and fissuring; and
- formulate an effective long-term management plan.

MZ 1 Interim Management Plan. The interim management plan would consist of the following activities:

- Voluntarily modify groundwater production patterns in Management Zone 1 for a five-year period. For example, there is some indication that deep aquifer production beneath the City of Chino contributed to recent subsidence and fissuring in the area. Reduction or elimination of deep aquifer production beneath the area of subsidence and fissuring is a logical short-term mitigation strategy.

- Balance recharge and production in Management Zone 1. Based on preliminary engineering investigations with RAM tool, it appears that current levels of pumping and recharge are balanced. However, increases in pumping should be balanced with increases in recharge.
- Determine gaps in existing knowledge. Primarily, there is a lack of understanding of Management Zone 1 hydrogeology, of the nature and extent of subsidence and fissuring, and of the exact causes of subsidence and fissuring.
- Implement a process to fill the gaps in existing knowledge. This would include hydrogeologic, geophysical, and remote sensing investigations of Management Zone 1, as well as certain monitoring programs, such as piezometric, production, water quality, ground level, and subsidence monitoring.
- Formulate a long-term management plan. The long-term management plan will include goals, activities to achieve those goals, and a means to evaluate the success of the plan.

MZ 1 Long-Term Management Plan. The long-term management plan will be formulated during the interim management plan based on investigations, monitoring programs and data assessment. It will likely include modifications to groundwater pumping rates and the locations of pumping, recharge, and monitoring. The long-term management plan will be adaptive in nature – meaning monitoring and periodic data assessment will be used to evaluate the success of the management plan and to modify the plan, if necessary.

Cooperative Efforts with Appropriate Agencies to Implement Plan

The subsidence and fissuring problem appears to be currently focused in the City of Chino and the California Institution for Men (CIM). However, it is reasonable given the current knowledge, to expand the minimum area of concern to the entire former artesian area shown in Figure 4-3 and slightly beyond that area. Changes in pumping and recharge patterns in Management Zone 1, and more generally the area of concern, will most likely be part of the management plan. The producers in the area include the cities of Chino, Chino Hills, Ontario, Pomona and Upland, the Monte Vista Water District (MVWD), San Antonio Water Company (SAWC), Southern California Water Company (SCWC), the State of California (CIM, California Institution for Women [CIW]), and SAWPA. Watermaster may need to have entities that increase their production to provide for the recharge of an equivalent amount of water to maintain the balance of pumping and recharge. Watermaster will take the leadership role in the development and implementation of the Management Zone 1 management plan.

Implementation Actions and Schedule for the First Five Years

Year 1

- Establish a Management Zone 1 committee and develop interim management plan.

Years 2 to 5

- Implement the interim management plan, including appropriate monitoring.

Years 3 to 5

- Annual assessment of data from monitoring programs, and modification of monitoring programs if necessary.

Year 5

- Develop long-term management plan.

Implementation Actions and Schedule for Years Six to Ten.

Year 6

- Implement the long-term management plan.

Years 6 to 10

- Annual assessment of data from monitoring programs, and modification of management plan if necessary.

Implementation Actions and Schedule for Years Eleven to Fifty.

Assessment of data from monitoring programs every three years and modification of management plan if necessary.

PROGRAM ELEMENT 6 – DEVELOP AND IMPLEMENT COOPERATIVE PROGRAMS WITH THE REGIONAL BOARD AND OTHER AGENCIES TO IMPROVE BASIN MANAGEMENT

PROGRAM ELEMENT 7 – DEVELOP AND IMPLEMENT SALT MANAGEMENT PROGRAM

Need and Function

These program elements are needed to address some of the water quality management problems that have occurred in the Basin. These water quality problems are described in Section 2 *Current Physical State of the Basin* and Table 3-8 in Section 3 *Goals of the OBMP*. The specific water quality issues addressed by these program elements are listed below:

- The Special Referee has indicated that Watermaster needs to routinely demonstrate that implementation of the OBMP will lead to groundwater quality improvements. Watermaster should develop and use a method to determine water quality trends and to verify whether the OBMP is improving water quality.
- There is legacy contamination in the vadose zone from past agricultural activities (TDS and nitrogen) that will continue to degrade groundwater long into the future.
- Watermaster does not have sufficient information to determine whether point and non-point sources of groundwater contamination are being adequately addressed.
- There is ongoing salt and nitrogen loading from agriculture.

Demonstration of Water Quality Improvement

The TDS and nitrogen challenges in the Chino Basin are caused by agriculture and safe yield management. The TDS and nitrogen impacts from agriculture were described in Section 2. Table 4-12 shows in summary format how the TDS concentration in source supplies and fertilizer affect the TDS concentration in irrigation return flows to groundwater. The TDS concentration in the irrigation return flow is about four times higher than the TDS concentration in the irrigation supply. The majority of the increase in TDS concentration is caused by consumptive use and a negligible contribution from the fertilizer. The table also shows the affect of the use of dairy manure for fertilizer and soil improvement. The TDS contribution from manure is much larger than from commercial fertilizer, however the concentration increase from consumptive use is more significant particularly for source water TDS concentrations typical in the southern part of the Basin (>500 mg/L). Similar TDS concentration increases in irrigation return flows occur for other crop types such as citrus and grapes, both of which were significant in the past. Table 4-12 shows TDS concentrations for urban irrigation return flows for a

representative range in municipal source water TDS concentration. The range of TDS concentrations in urban irrigation returns is from about 1,200 to 1,800 mg/L with less than ten percent coming from fertilizers and the overwhelming majority of the TDS increase coming from consumptive use.

Figure 4-4 is a map that shows the general groundwater flow directions in the Chino Basin. The map contains velocity vectors that show direction and relative velocity of groundwater flow. One of the more interesting interpretations of this map is that groundwater generally flows away from the Santa Ana River. Small amounts of rising groundwater occur seasonally in Chino and Mill Creeks and are typically less than 11,000 acre-ft/yr. The only way significant amounts of groundwater can leave the Basin are through consumptive use, the discharge of recycled water to the Santa Ana River near Prado, and the discharge of brine to either the Santa Ana Regional Interceptor (SARI) or the Non-Reclaimable Waste Line (NRWL). The groundwater flow pattern shown in Figure 4-5 is largely influenced by production. If there were a significant reduction in groundwater production in the southern part of the Basin, then groundwater outflow to the Santa Ana River would increase and the safe yield would be reduced. The safe yield of the Basin depends on recharge of Santa Ana River water and minimal outflow of groundwater to the river. Without the recycled water discharges to the Santa Ana River near Prado dam and brine discharges to the SARI and the NRWL, the Chino Basin would almost be a completely closed system.

The vadose zone is the part of the aquifer that lies between the soil and the water table. The vadose zone is partially saturated and buffers the mineral salt loads entering from the soil. The buffering effect reduces the magnitude of the peak loads to the saturated zone and spreads out the loading of the saturated zone over a period of time that is longer than the soil loading. Salts in the vadose zone are being released to the saturated zone now and will continue to be released to the saturated zone for some time after the agricultural lands are converted to urban uses. The quantity of salt reaching groundwater should reduce in the future for two reasons:

- salt loading to the soil from agricultural will reduce over time
- less water will percolate through the vadose zone as the agricultural area becomes paved through urbanization (60 to 80 percent impervious).

If current rates of agricultural loading were to continue indefinitely, TDS and nitrate concentrations in groundwater could continue to rise. TDS projections for the Chino Basin that were made during the *Chino Basin Water Resources Management Study* (CBWRMS) suggested that the TDS concentrations would continue to rise in groundwater throughout most of the 50-year planning horizon of 1990 through 2040. These graphs are included in the Program Element 6 Task Memorandum on file and available from the Watermaster offices. In the CBWRMS, agricultural activities were assumed to decline to minimum levels by the year 2020. If and when the land use in the area is converted to urban uses, the source water TDS served to the new urban areas will be always less than 400 mg/L and the mineral salts from the source water will be mostly discharged in recycled water discharges to the Santa Ana River, brine line discharges (from new desalters) and increased rising groundwater flows to the Santa Ana River. The TDS concentration in groundwater will, after some period of time, decline slowly but should still remain significantly higher than be served as a municipal supply.

The Court will require Watermaster t develop and use a method to demonstrate that actions taken in the OBMP will improve groundwater quality. The question arises: how *do we assess progress towards improving groundwater quality if groundwater monitoring alone will continue to show degradation even after significant steps are taken to improve water quality?*

The alternatives available to the Watermaster range from groundwater quality monitoring alone to the application of numerical models in conjunction with monitoring. As mentioned above, if groundwater monitoring were the only metric for measuring improvement, then it will appear for many years that

construction of desalters and the export of dairy waste will have no benefit. The use of numerical models to assess progress in improving water quality is extremely expensive if their only use were to assess such progress.

A method that combines monitoring and a salt budget is more practical and cost-effective than large-scale modeling. The salt budget approach consists of a salt mass accounting in each management zone and the Basin as a whole. The magnitude of each inflow and outflow component would be estimated. The TDS and nitrogen concentration of each inflow and outflow component would be estimated. Water quality will improve if the flow-weighted concentration in the inflow is less than the flow-weighted concentration in the outflow.

$$[S\ I_k * C_k] / [S\ I_k] - [S\ O_j * C_j] / [S\ O_j] < 0 \quad \text{water quality is improving}$$

$$[S\ I_k * C_k] / [S\ I_k] - [S\ O_j * C_j] / [S\ O_j] > 0 \quad \text{water quality is degrading}$$

$$[S\ I_k * C_k] / [S\ I_k] - [S\ O_j * C_j] / [S\ O_j] = 0 \quad \text{water quality is not changing}$$

where: I_k is volumetric recharge component *k*
C_k is the TDS or nitrogen concentration associated with recharge component *k*
O_j is volumetric discharge component *j*
C_j is the TDS or nitrogen concentration associated with discharge component *j*

The inflow components include: precipitation, artificial recharge of storm flows, artificial recharge of recycled water, and applied water. The outflow components include: evapotranspiration, surface water outflow, recycled water export, groundwater export and brine export. The TDS and nitrogen mass increments added to water as it is applied to irrigated lands or to disposal land needs to be estimated. The inflow and outflow components used in this approach will produce average recharge and discharge from the Basin, that is, there will be no change in groundwater storage.

The salt budget will be computed for existing conditions to assess the current balance, hereafter referred to as the baseline case. An assessment of future water quality improvements that will occur from the OBMP will be made by changing the water and waste management assumptions in the baseline case to reflect OBMP implementation. The changes in the inflow and outflow components and their associated TDS and nitrogen concentration will be made and the salt budget equations would be re-solved. The relative improvement of water quality will be assessed by comparing the salt budget of the OBMP to the baseline plan. Later, during periodic OBMP updates, the salt budget will be computed based on the then current water quality (from monitoring programs) and the then current water and waste management plans. These periodic assessments will allow Watermaster to determine if the OBMP is improving water quality.

There are some limitations to the salt budget method and the use of such a method should be considered in light of all anticipated water quality assessment needs in the Basin. Table 4-13 presents a tabular comparison of future water quality information requirements with alternative methods and approximate costs to use those methods over the next 20 years. The CBWRMS developed a comprehensive set of models for the Chino Basin that is capable of assessing the impact of past and future water resources management activities on groundwater level, streamflow, and water quality. The *Chino Integrated Groundwater and Surface Water Model* (CIGSM) is extremely complex and expensive to maintain and use.

The salt budget method will cost about $80,000 to $100,000 to develop and use the first time. Subsequent uses, in either OBMP updates or *ad hoc* investigations, will involve developing new water quality input

data based on new monitoring data and revised water and waste management scenarios. Total cost over the next 20 years should range between $300,000 to $400,000. CIGSM is composed of series of models. In contrast to the salt budget method, CIGSM is very complex and difficult to use. The cost to re-calibrate CIGSM, to update the planning data, and to use the model to evaluate the initial OBMP is about $700,000 based on recent detailed estimates developed for the TIN/TDS Study (Wildermuth Environmental, 1999). The cost to use CIGSM over the next 20 years will run between $3,000,000 to $4,000,000.

Cooperative Efforts with the Regional Water Quality Control Board

Watermaster does not have sufficient information to determine whether point and non-point sources of groundwater contamination are being adequately addressed. Watermaster's past monitoring efforts have been largely confined to mineral constituents in the southern half of the Basin and to available monitoring data supplied by municipal and industrial producers. The Regional Water Quality Control Board (Regional Board) has limited resources to detect, monitor and cause the clean up of point and non-point water quality problems in the Chino Basin. The Regional Board commits its resources to enforce remedial actions when it has identified a potential responsible party. The Regional Board does not take action when the sources are not easily identified or when the sources are diffuse, such as non-point sources. Notable examples include the mercury problem in the east Ontario area and some solvent plumes in the lower Chino Basin. It is not a question of Regional Board willingness to in this area; it is the allocation of limited RWQCB resources. Watermaster can improve water quality management in the Basin by committing resources to:

- identify water quality anomalies through monitoring;
- assist the Regional Board in determining sources of the water quality anomalies;
- establish priorities for clean-up jointly with RWQCB; and
- remove organic contaminants through its regional groundwater treatment projects in the southern half of the Basin.

The last bulleted item requires some explanation. The well field for SAWPA desalter will eventually intercept a solvent plume of unknown origin that is emanating from the Chino airport area. There is a second solvent plume northeast of the Chino airport area that could be intercepted by the current desalter or another future desalter. This will require additional treatment for the water produced by the desalter. The desalter project can be used to clean up these plumes at some additional cost. The cost of cleaning up the solvent plumes at the desalters will be less than the cost of a dedicated solvent removal system. The additional cost should be paid for by the entity responsible for the solvent discharge. A similar process was used by the Regional Board and Kaiser Steel Corporation to mitigate a TDS plume in the north half of the Chino Basin.

TDS and Nitrogen (Salt) Management in the Chino Basin

TDS and nitrogen management will require minimizing TDS and nitrogen additions by fertilizers and dairy wastes, desalting of groundwater in the southern part of the Basin (for water supply purposes), and maximizing the artificial recharge of storm water. The latter two management components are included in Program Elements 3 and 2, respectively

The agricultural area in the southern part of the Chino Basin will gradually convert to urban uses over the next 20 to 30 years and, thus, in the long term, the TDS and nitrogen challenges from irrigated agriculture and dairy waste management will go away. The Regional Board will adopt new dairy waste discharge requirements in the summer of 1999. The requirements will include the following:

- Each dairy will develop and implement an engineered waste management plan that will contain dairy process water and on-dairy precipitation runoff for up to a 25-year, 24-hour storm
- Manure scraped from corrals must be exported from the dairy within 180 days
- All manure stockpiled in the Chino Basin as of December 1, 1999, will be exported from the Basin by December 1, 2001.
- No manure may be disposed of in the Chino Basin
- Some manure can be applied to land at agronomic rates if and only if in the opinion of the Executive Officer there is reasonable progress toward the construction of a new desalter in the Chino Basin.

The Santa Ana River Watershed Group (SARWG) is a stakeholder group made up of municipal, county, regional and federal agencies, and private individuals that are working through complex land use and environmental issues in the Santa Ana Watershed. One of their work products is a draft manure management strategy (MMS) for the Chino Basin. The primary component of MMS is the export of manure either as a raw or an improved material. The MMS describes the economics of manure management and the means to finance manure export.

The new dairy waste discharge requirements may have the unintended result of actually causing Santa Ana River quality to degrade. Some or all of the dairy farmers could move out of the Basin if they cannot afford to continue dairy operations as a result of the new waste discharge requirements. A rapid departure of the dairies will result in a rapid decline in groundwater production in the southern part of the Basin and a subsequent increase in poor quality rising water. The rising groundwater will degrade the river. As part of the OBMP, Watermaster will annually review the economics of dairy waste management in the Chino Basin and may contribute funds to subsidize the removal of manure from the Basin. In the first year of the OBMP implementation, Watermaster will contribute $150,000. Watermaster will closely monitor the activities of the Regional Board, SARWG and others whose actions will influence the amount of TDS and nitrogen entering the Basin.

The urban land use that will replace agriculture will require low TDS municipal supplies that in turn will produce lower TDS irrigation returns to groundwater than those generated by agriculture. The construction of desalters in the southern part of the Basin (as described in Program Elements 3 and 5) will extract and export huge quantities of salt from the Basin. Table 4-9 lists the salt removal capacity of desalters described in Program Elements 3 and 5. By 2020, the salt removal capacity of the desalters will reach over 80,000 tons per year. The dairy salt contribution is currently about 30,000 tons per year. It is premature to set salt reduction goals until the salt budget method described above is developed and the salt budget is assessed for the Basin. However, it seems reasonable to expect that the salt budget will be impacted favorably by the desalters and future land use conversions, and that Watermaster should expect a reduction in salt loading of about 80,000 to 100,000 tons of salt per year in the next 20 to 30 years.

Implementation Actions and Schedule

First Three Years (1999/00 to 2001/02). The following actions will be completed in the first three years commencing fiscal year 1999/00:

- Watermaster will form an ad hoc committee, hereafter *water quality committee*. The purposes of the *water quality committee* are to review water quality conditions in the Basin and to develop (with the Regional Board) cooperative strategies and plans to improve water quality in the Basin. The committee would meet regularly with

Regional Board staff to share information and to recommend cooperative efforts for monitoring groundwater quality and detecting water quality anomalies. The schedule and frequency of meetings will be developed with the Regional Board during the first year of the OBMP implementation.

- Watermaster will refine its monitoring efforts to support the detection and quantification of water quality anomalies. This may require additional budgeting for analytical work and staff/support.
- If necessary, Watermaster will conduct investigations to assist the Regional Board in accomplishing mutually beneficial objectives.
- Watermaster will seek funding from outside sources to accelerate detection and clean up efforts.
- Develop salt budget goals, develop the salt budget method described above and review all the OBMP actions.
- Watermaster will annually review the economics of dairy waste management in the Chino Basin and may contribute funds to subsidize the removal of manure from the Basin. In the first year of the OBMP implementation, Watermaster will contribute $150,000.

At the conclusion of the third year, the *water quality committee* will have met several times, developed and implemented a cooperative monitoring plan with the Regional Board, and developed a priority list and schedule for cleaning up all known water quality anomalies.

Years Four through Fifty (2002/03 to 2050/51). The following actions will be completed in years four through fifty, commencing fiscal year 2002/03:

- Continue monitoring and coordination efforts with the Regional Board.
- Annually update priority list and schedule for cleaning up all known water quality anomalies.
- Continue to seek funding from outside sources to accelerate clean up efforts.
- Implement projects of mutual interest.
- As part of periodic updates of the OBMP, re-compute the salt budget using the salt budget method. The salt budget method would be used to reassess future OBMP actions to ensure that salt management goals are attained.
- Annually review the economics of dairy waste management in the Chino Basin and consider contributing funds to subsidize the removal of manure from the Basin.

PROGRAM ELEMENT 8 – DEVELOP AND IMPLEMENT GROUNDWATER STORAGE MANAGEMENT PROGRAM

PROGRAM ELEMENT 9 – DEVELOP AND IMPLEMENT CONJUNCTIVE USE PROGRAMS

Need and Function

The first impediment to *Goal 1 – Enhance Basin Water Supplies* can be stated as: "Unless certain actions are taken, safe yield of the Basin will be reduced … (because) the current manner in which Watermaster manages cyclic and local storage accounts will cause overdraft." Watermaster is concerned about the magnitude of water lost from the Chino Basin from rising groundwater when groundwater is stored in the

local storage, cyclic, conjunctive use and other storage accounts. Watermaster is interested in determining how much water can be stored without significant loss from local accounts and in developing a procedure to equitably distribute these losses among entities that have storage accounts. Watermaster may consider setting limits for individual storage accounts for members of the overlying non-agricultural and appropriative pools that ensure reasonable and beneficial use of Chino Basin water.

The third impediment to *Goal 3 – Enhance Management of the Basin* can be stated as: "About 500,000 acre-ft of storage in the Chino Basin cannot be used due to water quality and institutional issues." The impediment speaks to two issues. The first issue is a concern by the producers of adverse water quality impacts if groundwater storage is significantly (see Section 2) increased. The second issue is the past inability of Watermaster, producers, and MWDSC to be able to agree on a conjunctive use program for the Chino Basin.

Parties to the Judgment can store un-pumped groundwater rights for various reasons that include:

> **Future use during shortage of other less expensive water supplies.** Some parties to the Judgment have access to other sources of water that are less expensive than producing Chino Basin groundwater. The alternative water supplies available to these parties include imported water, local streamflow, and other groundwater basins. By not pumping their Chino Basin rights, they can then store water in the Chino Basin for later use when their other less expensive sources are scarce. This is conjunctive use.
>
> **Exchange or sell to other producers.** Some parties to the Judgment produce less than their rights resulting from decreased demand, groundwater quality problems, or because they have access to other less expensive supplies. The un-pumped water pursuant to the Judgment can be exchanged or sold to other parties to the Judgment.
>
> **Temporary shortfall in production capacity.** Some parties may not be able to use all their rights due to temporary shortfalls in production capacity caused by water quality or mechanical problems. The un-pumped water goes into local storage accounts until production capacity is recovered or increased.

As a means of efficiently managing their available water supply, each appropriative and overlying non-agricultural producer tries to minimize the cost of water from the sources of supply available to that producer. Some producers have multiple sources of supply and some have limited supplies. Some agencies are in a position, because of the sources of supply available to them, to accumulate water in local storage accounts in most years. Conversely, some agencies produce groundwater from the Chino Basin in excess of their rights and cannot make use of local storage accounts except through the purchase or lease of other water. There are two fundamental reasons why storage limits should be considered.

> **Ensure reasonable beneficial use.** The accumulation of water in local storage accounts in quantities that cannot be put to a reasonable beneficial use is in conflict with Section 2 of Article X of the California Constitution. Therefore, if a local storage account maximum storage limit needs to be set, the limit should be based on the producer's ability to put the stored water to reasonable beneficial use.
>
> **Reduce groundwater losses to the Santa Ana River.** The cumulative losses of water from local storage accounts can grow to be large and, thus, the ability to use the stored water to Chino Basin producers is lost. These losses could be minimized by storing water for shorter periods of time prior to use and by limiting the water put into storage accounts to an amount that can be put to reasonable beneficial use.

Estimate of the Water Lost from Storage

The accumulation of groundwater in storage without an increase in groundwater production will cause the baseflow to increase in the Santa Ana River and some of its tributaries (Chino Creek and Mill Creek). Investigations conducted by Watermaster in 1995 concluded that losses from water in local storage accounts and cyclic storage are about two percent per year of the water in storage. These losses could reach over four percent in the future if groundwater production patterns are not managed in the southern part of the Basin. Exhibit A in the Program Element 8 Task Memorandum (on file and available from the Watermaster offices) shows the estimated losses from each local storage account, the cyclic storage account, and the Basin as a whole for the 20-year post-Judgment period of 1978 to 1997. The total water lost from local storage accounts and cyclic storage for the 20-year period of 1978 through 1997 is about 50,500 acre-ft. If the water in these storage accounts is produced without accounting for the losses then the Basin will be overdrafted by an amount equal to the water lost from storage.

Storage Limit Concepts

Currently there is no existing aggregate limit for local storage accounts. Watermaster's Uniform Groundwater Rules and Regulations (UGRR) contains an aggregate threshold storage value of 100,000 acre-ft above which losses to rising water are to be computed and allocated to the storage parties on a pro rata basis. The UGRR does not specify whether the loss is to be computed for the increment of storage above 100,000 acre-ft or total storage. The 100,000 acre-ft threshold value is an arbitrary number. Some loss will occur when water is placed into local storage. Using 100,000 acre-ft as a threshold value ensures that up to 2,000 acre-ft/yr of unaccounted-for-losses from storage will occur every year. This water will not be in the Basin when the storage parties attempt to recover the stored water. If losses are not accounted for, then the Basin is not being operated in the safe yield mode as required by the Judgment. Therefore, regardless of how storage limits are set, Watermaster should deduct the rising water losses from planned storage for all local storage accounts and for the storage accounts of non-Judgment parties. There are several different ways to develop upper limits on the individual local storage accounts. Some of these are described below.

Limit based on the ability to use. In this concept, an upper limit is based on the storage party's ability to store and recover all the water in its account over a fixed period, say five years. The storage party would have to demonstrate that it has enough production capacity to recover all the water in storage over a five-year period. The fixed period would be the same for all storage parties. In this concept, each storage party would have to demonstrate to Watermaster that they have the ability to put a specific volume of water into storage and be able to recover that water, adjusted for losses, over a fixed period of time. Thus, the storage party will have the facilities in place for groundwater production. This type of limit ensures that the water is put to a reasonable beneficial use. For example, suppose an agency has Chino Basin production capacity of 25,000 acre-ft/year, an operating yield of 15,000 acre-ft/yr and the fixed period has been set at five years. Then they would be allowed to put 50,000 acre-ft into its local storage account. If an agency were to increase its Chino Basin production capacity then its local storage account limit could be increased by an amount equal to five times the increase in production capacity. The five-year period used above is arbitrary – Watermaster would need to determine the length of the fixed period.

Arbitrary limits. In discussions regarding storage limits in prior years, Watermaster considered setting storage limits based on a multiple of safe yield for overlying non-agricultural pool and a multiple of operating safe yield for the appropriative pool. Parties that have historically over-produced and that will continue to over-produce may not ever be able to use such a local storage account. Parties that under-produce will fill their accounts and may hold water in these accounts for long periods of time and incur

large storage losses. This has been the trend with the past operation of the local storage accounts. Upper limits based on this concept are arbitrary and may not provide for reasonable beneficial use of Chino Basin water. Storage limits based on a multiple of prior years production, an arbitrary volume equal for all parties, or any other arbitrary volume suffer from the same limitations.

Limit based on time water is in storage. In this concept, no volume limit would be set. Water could not be kept in storage for more than some fixed period of time, say ten years, regardless of the amount of water in storage. Water transferred from the local storage account for use by the storage party would be taken from the earliest water put into the local storage account. The storage party would be required to recover a volume of groundwater from its local storage account, sell or transfer a similar volume to another party, or sell a similar volume to Watermaster in order to reduce the quantity in its storage account by an amount equal to the water stored prior to the fixed period less losses to rising water. Simply stated, unused water from the first year would either be used or sold to Watermaster or other producer in the eleventh year, unused water from the second year would either be used or sold in the twelfth year, and so on if a ten year time limit is used.

Upper limit based on total storage and time water is in storage. This is a composite of the *ability to use* and *time in storage* concepts. In this case a volumetric upper limit would be set for each storage party based on the storage party's ability to store and recover water over a fixed period of time. A time constraint would be added such that water would not be kept in storage more than some fixed period of time.

In all the above storage limit concepts, the storage parties would sell their current year under-production to Watermaster or other parties to the Judgment each year that their local storage accounts are full. Watermaster, or parties to the Judgment, would then use this water to meet current replenishment obligations.

Implementation of Local Storage Account Limits

Watermaster's UGRR presently require an *initial determination of local storage requirements to be made*. Watermaster then allocates this storage to members of the appropriative and overlying non-agricultural pools when specific parties make an application for a local storage agreement. Watermaster must periodically review the status of the local storage accounts and adjust the local storage requirement as described in the UGRR. While not explicitly described in the Judgment or UGRR, local storage account limits based on the *ability to us*e, *time in storage,* or a composite of the two, are consistent with the Judgment and could be implemented with some changes in the UGRR.

Local storage account limits based on the *ability to use* require that each agency make a determination of their Chino Basin groundwater production capacity and submit that finding to Watermaster. Watermaster would determine the duration over which the volume in local storage accounts would be used. Storage account limits for each storage party would be computed as:

Storage Limit = duration of storage period * (Chino Basin production capacity – average operating yield)

The average operating yield would equal the average of previous years operating yield entitlements (*e.g.*, five year average). Watermaster could periodically, or upon petition by a storage party, review and adjust the storage limits.

Local storage account limits based on the *time in storage* require that Watermaster determine the time-in-storage limit. Watermaster could then go through production and local storage account records to determine if water must be either used or sold to Watermaster. Local storage account limits based on the composite of the *ability to use* and *time in storage* require the implementation steps described for both concepts.

Some storage parties may currently have more water in their local storage accounts than would be allowed in the storage limit concepts listed above. In this case, the storage party would not be allowed to put water into their local storage accounts and under-production would be purchased by Watermaster.

If, as a result of these storage limits, Watermaster is required to purchase more water than is required for replenishment, then either the storage party will be allowed to temporarily store additional water in its local storage account or Watermaster payments for that water may have to be temporarily deferred.

Water in local storage accounts is used for replenishment of overdraft either by the producer's that hold a local storage account, or is sold to other producers with replenishment obligations. It is possible that Watermaster could fulfill all replenishment obligations exclusively from local storage accounts for several years. Watermaster should fulfill the need for replenishment from increased production with imported water for those areas that have a critical need for imported water and use the water stored in local storage accounts for the rest of the replenishment obligation.

Storage Management Program

Since 1995, the producers have developed numerous storage management proposals. This storage management program described here was developed in April and May of 1999 and differs from the previous proposals that sought to assign all the readily-useful storage in the Basin up among producers. If successfully implemented, storage limits on individual storage accounts may not need to be considered by Watermaster. The proposal described herein will allow:

- Watermaster to develop conjunctive use programs that will benefit <u>all</u> the producers in the Basin;
- ensure that Basin water and storage are put to maximum beneficial use; and
- maintain the integrity of the Judgment.

Definitions. *Operational Storage Requirement* – The operational storage requirement is the storage or volume in the Chino Basin that is necessary to maintain safe yield. In the context of this storage management program, the operational storage is estimated to be about 5,300,000 acre-ft. An engineering analysis will be done to assess the operational storage requirement of the Basin as part of the implementation of this program.

Safe Storage – Safe storage is an estimate of the maximum storage in the Basin that will not cause significant water quality and high groundwater-related problems. In the context of this storage management program, the safe storage is estimated to be about 5,800,000 acre-ft. An engineering analysis will be done to assess the safe storage requirement of the Basin as part of the implementation this plan.

Safe Storage Capacity – The safe storage capacity is the difference between safe storage and operational storage requirement and is the storage that could be safely used by producers and Watermaster for storage programs. Based on the above, the safe storage capacity is about 500,000 acre-ft. The allocation and use of storage in excess of safe storage will preemptively require mitigation, that is, mitigation must be defined and resources committed to mitigation prior to allocation and use.

Key Elements

- No maximum storage limit will be placed on local storage accounts for a period of five years ending on June 30, 2004, and water that becomes eligible for storage can be stored.
- The need for storage limits will be re-evaluated in five years based on the ability of the storing party to use the water in storage (ability to use concept) and on Watermaster's need for storage programs that provide regional benefits.
- Storage is not assignable.
- All water in local storage and other storage accounts will incur losses at a rate of 2 percent of water in storage each year starting in fiscal year 2002/03.
- The storage loss rate and safe yield will be estimated in the year 2012/13 and every ten years thereafter.
- Watermaster will develop regional conjunctive-use programs to store supplemental water for MWDSC and other entities that can cause supplemental water to be stored in the Basin.
- The regional conjunctive-use programs will provide benefits to all producers in the Basin, the people of California and the nation. Watermaster's conjunctive-use programs will take priority over conjunctive-use programs developed by others.
- Storage committed to conjunctive-use programs may consist of two parts, storage within the safe storage capacity and storage in excess of safe storage. Storage in excess of safe storage capacity will preemptively require mitigation.
- The initial target storage for Watermaster's conjunctive-use program will be 150,000 to 300,000 acre-ft within the safe storage capacity.
- Cyclic storage will be folded into conjunctive-use storage.
- Watermaster's conjunctive-use program tentatively consists of the following elements:
  - complete the existing short term conjunctive-use project;
  - seasonal peaking program for in Basin use and dry year program to reduce the demand on Metropolitan to 10 percent of normal summer demand (requiring 150,000 acre-ft of storage);
  - dry-year export program; and
  - seasonal peaking export program.

Re-determination of Safe Yield and Storage Loss Rates. The safe yield and storage loss rate will be assessed every ten years starting in the year 2012/13. The ten-year period of 2002/03 to 2011/12 will be used to compute the safe yield and to estimate the storage loss rate.

Safe yield and storage loss rate determinations require accurate groundwater level and production data. Watermaster does not have accurate production data from agricultural producers. Watermaster estimates most of the production in the agricultural pool using a water duty method that does not meet the requirements of the Judgment. Program Element 1 of the OBMP includes a program to install meters and obtain production measurements from all wells in the Basin. It will take three years to fully meter all agricultural wells. Watermaster will have accurate production monitoring at all wells starting in year

2002/03. Watermaster is in the process of developing a groundwater level monitoring program for the Basin. This plan should be implemented in the year 1999/00.

The safe yield in the Judgment was developed over the period 1965 to 1974 using the procedure described in Section 2 of the OBMP report. The safe yield will be re-determined in year 2012/13 using the ten-year period 2002/03 to 2011/12 because it will contain accurate production data and groundwater level data. A ten-year period is proposed to be consistent with the method used in the engineering work for the Judgment and is the minimum necessary to estimate a safe yield.

Re-determination of the storage loss rate will require the use of a numerical flow model. The *RAM Tool* developed by Watermaster will be modified and used for this purpose. The model would be used as follows:

- Calibrate the RAM tool for the safe yield period. In the calibration process, the hydrology for the period 2002/03 to 2011/12 will be developed including deep percolation of applied water and precipitation, unmeasured storm water recharge, subsurface inflow from adjacent basins, and uncontrolled discharges from the Basin (rising water).
- Once calibrated, the water supply plans of the producers and other storage entities will be modified to assume that no water would be put into storage accounts. The model will be rerun with this assumption and the results would be compared to the calibration run to determine losses from storage and the storage loss rate.
- The storage loss rate would be set based on the relationship of water in storage and associated losses.

Watermaster's new groundwater level and production monitoring are crucial to this effort.

Implementation Actions and Schedule

First Three Years (1999/00 to 2001/02). The following actions will be completed in the first three years commencing fiscal year 1999/00:

- Receive Court approval of OBMP.
- Evaluate need to modify Watermaster UGRR to reflect the storage management plan.
- Determine the operational storage requirement and safe storage.
- Begin formal implementation of comprehensive monitoring programs described in Program Element 1 (including groundwater level, groundwater quality, production, and surface water monitoring in the Santa Ana River).
- Complete the existing short-term conjunctive-use pilot project with MWDSC.
- Conduct engineering and environmental analyses, other feasibility efforts, and negotiate agreements to:
- implement a conjunctive-use program that includes seasonal peaking for in Basin use and dry year program to reduce the demand on MWDSC to 10 percent of normal summer in-Basin demand (requiring 150,000 acre-ft of storage);
- implement a conjunctive-use program for dry-year export; and
- implement a seasonal peaking program for export.

Years Four through Ten (2002/03 to 2008/09). The following actions will be completed in years four through ten, commencing fiscal year 2002/03:

- Continue monitoring as described in Program Element 1.
- Begin construction of facilities to implement the conjunctive-use projects listed in *years one through three*, in year 2003/04.
- Commence conjunctive-use operations.
- Start assessing losses in year 2002/03.

Years Eleven through Fifty (2009/10 to 2048/49). The following actions will be completed in years eleven through fifty, commencing fiscal year 2009/10:

- Continue monitoring as described in Program Element 1.
- Continue conjunctive-use operations.
- In year 2012/13, compute safe yield and storage loss rate for period 2002/03 through 2011/12, and reset safe yield and storage loss rates for the next the next ten-year period 2012/13 to 2021/22. Reassess storage management plan and modify Watermaster UGRR, if needed.
- In year 2022/23, compute safe yield and storage loss rate for period 2012/13 through 2021/22, and reset safe yield and storage loss rates for the next the next ten-year period 2022/23 to 2031/32. Reassess storage management plan and modify Watermaster UGRR, if needed.
- In year 2032/33, compute safe yield and storage loss rate for period 2022/23 through 2031/32, and reset safe yield and storage loss rates for the next the next ten-year period 2042/43 to 2041/42. Reassess storage management plan and modify Watermaster UGRR, if needed.
- In year 2042/43, compute safe yield and storage loss rate for period 2032/33 through 2041/42, and reset safe yield and storage loss rates for the next the next ten-year period 2052/53 to 2051/52. Reassess storage management plan and modify Watermaster UGRR, if needed.

PROGRAM COST AND EARLY IMPLEMENTATION PLAN

Table 4-14 contains a 20-year cost projection for implementation of the OBMP. The 20-year cost of OBMP implementation is about $400,000,000. The following program elements will be implemented entirely by Watermaster:

- Program Element 1 – Develop and Implement Comprehensive Monitoring Program
- Program Element 4 – Develop and Implement Comprehensive Groundwater Management Plan for Management Zone 1
- Program Element 6 – Develop and Implement Cooperative Programs with the Regional Water Quality Control Board, Santa Ana Region (Regional Board) and Other Agencies to Improve Basin Management
- Program Element 7 – Develop and Implement Salt Management Program
- Program Element 8 – Develop and Implement Groundwater Storage Management Program

Watermaster has committed to fund these program elements in their entirety through Watermaster assessments and through grants obtained directly by Watermaster. The Watermaster budget for fiscal 1999-2000 provides funding necessary to begin the efforts described in these program elements. The cost of the first three years is about $2,900,000 and average annual cost for the next 20 years is about $480,000.

The following program elements will be started by Watermaster in fiscal 1999-2000 and will be completed by others by agreement with Watermaster:

- Program Element 2 – Develop and Implement Comprehensive Recharge Program
- Program Element 3 – Develop and Implement Water Supply Plan for the Impaired Areas of the Basin
- Program Element 5 – Develop and Implement Regional Supplemental Water Program

The Watermaster budget for fiscal 1999-2000 provides funding necessary to begin the planning processes for these program elements. For Program Element 2, Watermaster's projected budget includes funds for completion of Phases 2 and 3 of the recharge master plan of $430,000 to be spent in the first three years of OBMP implementation. For Program Elements 3 and 5, the Watermaster budget contains funds to start the planning process and to define the scope of the facilities at enough detail so that agreements can be done for others to build and operate the facilities required in these program elements. Watermaster has budgeted about $650,000 for this process over the first three years of OBMP implementation. These agreements will be described in Part 2 of the OBMP report documents.

The Watermaster budget includes funds to begin the planning process for Program Element 9 – Develop and Implement Conjunctive-Use Programs. Watermaster has budgeted about $430,000 for this process over the first three years of OBMP implementation. The stakeholders envision that the cost of conjunctive use will be borne by outside interests that will store water in the Chino Basin.

OBMP PROGRESS REPORTS AND PROGRAM UPDATES

Watermaster will report progress on the OBMP in its annual report to the Court. Watermaster will formally review and update the OBMP at a frequency of five years or less.

LEGAL QUESTIONS AND ISSUES

The Judgment prescribes the process by which the Watermaster Board receives recommendations from the producers and is empowered to make decisions. To address the unresolved legal questions and issues identified below, the items will be brought to the individual pool committees for discussion and consideration. The pools in turn will develop their positions and recommendations for discussion and consideration by the Advisory Committee. The Advisory Committee will meet to discuss and consider the questions. The Advisory Committee's recommendations will be forwarded to the Watermaster Board for its consideration and implementation. Should the Watermaster Board disagree with the Advisory Committee recommendation, it has several options based on the Judgment and past practice. These options are:

If the Advisory Committee vote is equal to or greater than 80 percent:

1. Ask the Advisory Committee to reconsider the question based on a Board recommendation.

2. If the Advisory Committee does not wish to reconsider the matter, the Watermaster Board may ask the Court to consider the matter.

If the Advisory Committee vote is less than 80 percent:

1. Hold a hearing on the matter and develop written findings and conclusions.

During implementation of the OBMP, all unresolved legal questions and issues listed below will be addressed through the process described above. A schedule to address these items will be developed, and Watermaster will prepare written findings and conclusions to be submitted to the Court as part of the implementation process. This will be done regardless of the Advisory Committee vote or Watermaster findings and conclusions in an effort to more effectively keep the Court apprised of the OBMP implementation progress.

Watermaster recommends this manner of addressing legal questions and issues pursuant to the Judgment and in keeping with the Plaintiff's Post Trial Memorandum filed with the Court on July 12, 1978. At 4:13-20 in Paragraph B. 2. Watermaster Organization and Powers, of the Post Trial Memorandum it states:

> "At the same time, the Watermaster Advisory Committee was created and given broad powers to review, advise and consent to the actions of the Watermaster, subject to more detailed actions by the pool committees formed to advise, consent and administer the affairs of the several pools established under the Physical Solution. In these many provisions, there is a balance created to assure the protection of the private rights of the parties and the general public interest in the preservation of the resource. (emphasis added)."

The process described above will be used to address the legal questions and issues listed below.

- Transfers of water within and from the overlying non-agricultural pool
- Clarification and/or expansion of definitions of types of water in Judgment
- Evaluation of Judgment provisions and rules and regulations affected by the OBMP

These questions and issues will be resolved in the first three years of the OBMP implementation.

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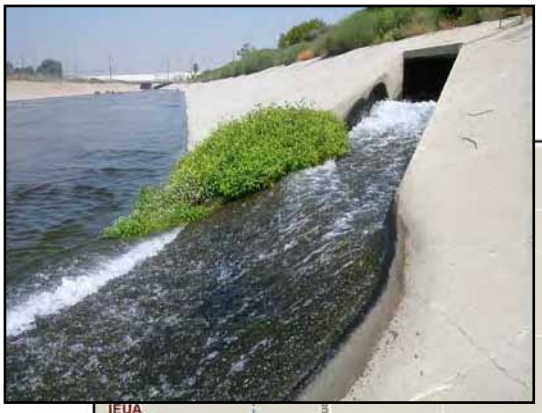
CHINO BASIN
OPTIMUM BASIN MANAGEMENT PROGRAM

State of the Basin Report – 2004



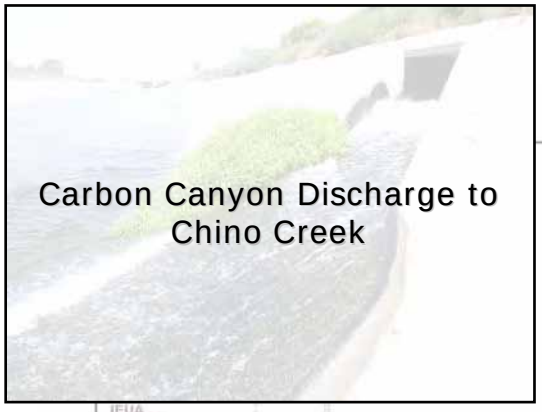
Prepared for:

Prepared by:

July 2005

CHINO BASIN
OPTIMUM BASIN MANAGEMENT PROGRAM

State of the Basin Report – 2004



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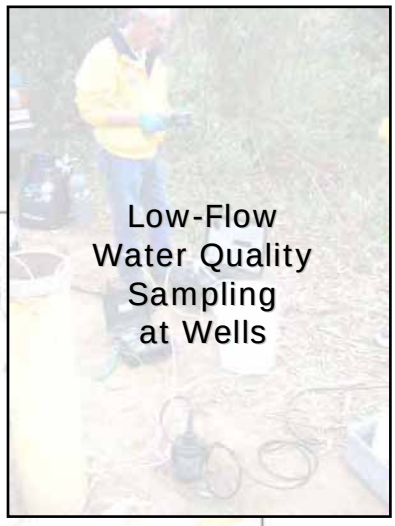
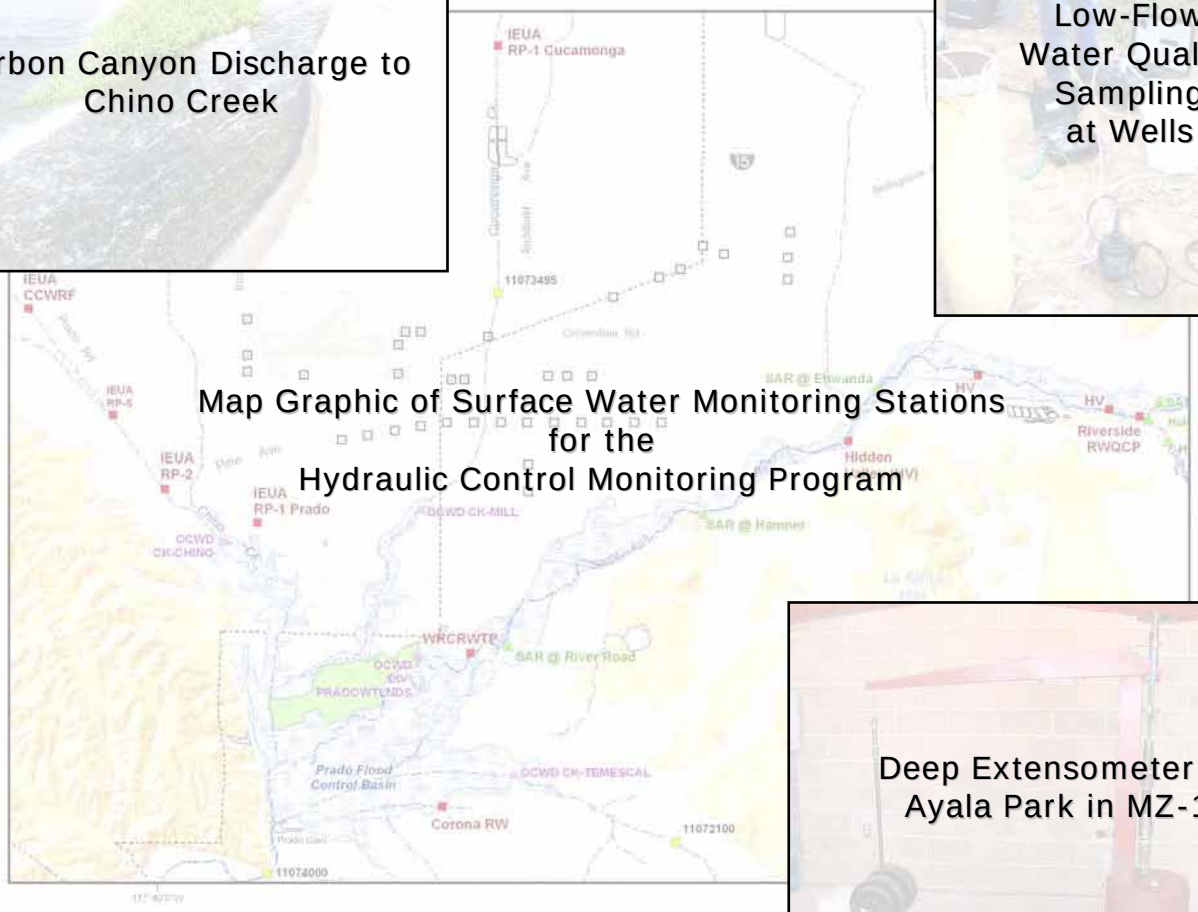


Low-Flow Water Quality Sampling at Wells



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ACRONYM AND ABBREVIATIONS LIST	
µg/L	micrograms per liter
acre-ft/mo	acre feet per month
acre-ft/yr	acre feet per year
ADFM	accumulated departure from the mean
bgs	below ground surface
CALFED	California-Federal Bay-Delta Program
CBDCAMP	Chino Basin Data Collection and Monitoring Program
CBWCD	Chino Basin Water Conservation District
CDA	Chino Desalter Authority
CIM	California Institution for Men
CMP	Comprehensive Monitoring Program
DBCP	1,2-dibromo-3-chloropropane
DHS	California Department of Health Services
DWR	California Department of Water Resources
EDB	1,2-dibromoethane
EPA	US Environmental Protection Agency
ERD	entity relationship diagram
GE	General Electric
GIS	geographic information system
IEUA	Inland Empire Utilities Agency
JCSD	Jurupa Community Services District
JMM	James M. Montgomery, Consulting Engineers, Inc.
MAF	million acre feet
MCL	maximum contaminant level
mg/L	milligrams per liter
MJW	Mark J. Wildermuth, Water Resources Engineers
MOA	Memorandum of Agreement
msl	mean sea level

ACRONYM AND ABBREVIATIONS LIST	
MTBE	methyl-tert-butyl-ether
MWD	Metropolitan Water District of Southern California
MWDSC	Metropolitan Water District of Southern California
ND	not detected
NO_3	nitrate
NO_3-N	nitrate as nitrogen
O&M	operations and maintenance
OBMP	Optimum Basin Management Program
OCWD	Orange County Water District
PDR	preliminary design report
PWMP	Private Well Monitoring Program
QAP	Quality Assurance Plan
RAM	Rapid Assessment Model
RFP	Request for Proposals
RO	reverse osmosis
RP1	IEUA's Regional Plant 1
RWQCB	Regional Water Quality Control Board, Santa Ana Region
SAP	Sampling and Analysis Plan
SAR	Santa Ana River
SEIR	Supplemental Environmental Impact Report
SWQIS	State Water Quality Information System
SWRCB	State Water Resources Control Board
TCE	trichloroethene
TDS	total dissolved solids
TIN	total inorganic nitrogen
TMDL	total maximum daily load
USCGS	US Coast and Geodetic Survey
USGS	US Geological Survey
WEI	Wildermuth Environmental, Inc.

EXECUTIVE SUMMARY

The baseline for the Initial State of the Basin is on or about July 1, 2000 – the point in time that represents the start of Optimum Basin Management Program (OBMP) implementation. This initial state or baseline is one metric that can be used to measure progress from implementation of the OBMP.

Section 2 Geology and Hydrogeology

Since 2002, three investigations to support OBMP-related programs have improved Watermaster's hydrogeologic understanding of Chino Basin. These investigations were related to (1) the Hydraulic Control Monitoring Program (HCMP) in southern Chino Basin, (2) subsidence and fissuring in Management Zone 1, and (3) basin-wide groundwater modeling to predict the effects of various storage-and-recovery program alternatives on groundwater levels and quality. These investigations resulted in a new, three-dimensional, hydrogeologic conceptual model of Chino Basin. Current and future well drilling programs to support monitoring of the HCMP and recycled water recharge projects will provide additional hydrogeologic data, and likely will refine the hydrogeologic conceptual model.

Section 3 Groundwater Basin Operation and Response

Future re-determinations of safe yield for Chino Basin will be based largely on accurate estimations of groundwater production, artificial recharge, and basin storage changes over time. Watermaster is actively improving its programs to track production, recharge, and groundwater levels (storage). A meter installation program has improved production estimates in the agricultural areas. Watermaster also has established three groundwater-level monitoring programs – a semiannual basin-wide program; an intensive key well monitoring program associated with the Chino Desalter well fields and the Hydraulic Control Monitoring Program (HCMP); and an intensive piezometric monitoring program associated with the land subsidence and ground fissuring investigations in Management Zone 1. Since 2003, Watermaster has been installing pressure transducers/data loggers in many of the wells it monitors for water levels to improve data quality. In addition, nine (9) nested sets of monitoring wells are currently being installed in the southern Chino Basin for the HCMP, and will provide highly-detail, depth-specific piezometric (and water quality) data. Likely, additional monitoring wells will need to be constructed in southern Chino Basin as private wells (that are currently being used for monitoring by Watermaster) are destroyed as agricultural land uses convert to urban.

A groundwater elevation contour map of the uppermost saturated aquifer system in Chino Basin was created for Fall 2003. A storage model was created (using data obtained and generated in Section 2) to estimate storage change in the basin over the Fall 2000 to Fall 2003 time period. Basin-wide, the groundwater storage decreased by about 93,000 acre-feet over this three-year period. Sub-areas of Chino Basin that experienced a decrease in storage were in the northwest near Pomona and Montclair; in the northeast near Fontana, eastern Ontario, and Rancho Cucamonga; and near the Chino-1 Desalter well field which began producing water in 2000. Sub-areas that experienced an increase in storage were in the southwest near Chino (area of production forbearance due to land subsidence investigation); and in the south, just north of the Santa Ana River, where many agricultural wells are being destroyed as urban land uses replace agricultural. Storage change was also estimated based on Watermaster operations (production and recharge) over a similar period (July 2000 to June 2003), and indicated a storage decrease of about 79,000 acre-ft. As Watermaster continues to improve the quality of its production monitoring, recharge monitoring, and groundwater level monitoring, the quality and accuracy of estimating storage changes will also improve.

Section 4 Groundwater Quality

Watermaster has completed an initial comprehensive assessment of groundwater quality in the Chino Basin that included every well that could be sampled. Watermaster continues to monitor water quality in the basin and stores these data in a relational database, which also includes all the historical data that Watermaster has been able to acquire for wells in the region. Watermaster has instituted a cooperative process whereby water quality data are acquired on a routine basis from the appropriators. This alleviates some of the data quality control issues with downloading data from the state water quality database.

The groundwater quality in Chino Basin is generally very good, with better groundwater quality found in the northern portion of Chino Basin where recharge occurs. Salinity (TDS) and nitrate concentrations increase in the southern portion of Chino Basin. Seventy-two percent of the private wells south of the 60 Freeway (169 wells) had TDS concentrations above the secondary MCL. About 83 percent of the private wells south of the 60 Freeway had nitrate concentrations greater than the MCL. The other constituents that have the potential to impact groundwater quality from a regulatory or Basin Plan standpoint are certain VOCs, arsenic, and perchlorate. There are a number of point source releases of VOCs in Chino Basin. These are in various stages of investigation or cleanup. Likewise, there are known point source releases of perchlorate (MVSL area, Stringfellow, *et cetera*) as well as what appears to be non-point source-related perchlorate contamination from currently undetermined sources. Arsenic at levels above its WQS appears to be limited to the deeper aquifer zone within the City of Chino. Total chromium and hexavalent chromium, while currently not a groundwater issue for Chino Basin, may become so depending on the promulgation of future standards.

The Water Quality Committee (WQC) was a requirement of the OBMP (Program Element 6) and was formed in spring 2003. The WQC is reviewing both existing and emerging contaminants. The WQC is developing plans to collect data on the active cleanup of basin contaminants, so that lessons learned concerning mitigation measures and cleanup technologies can be effectively shared.

Section 5 Ground-Level Monitoring

Monitoring of land surface deformation in Chino Basin focuses on land subsidence and ground fissuring that likely is related to fluid withdrawal. Specifically, the area underlying the City of Chino and the California Institution for Men (CIM) has experienced ground fissuring (associated with land subsidence) as early as 1973, but an accelerated occurrence of ground fissuring ensued after 1991.

Watermaster has developed and implemented a Management Zone 1 (MZ-1) Interim Monitoring Program (IMP) to investigate the mechanisms that cause land subsidence in MZ-1, and to use the results of the IMP to develop a long-term plan to minimize or abate future subsidence and fissuring. The IMP employs traditional ground level surveying, remote-sensing analysis of satellite radar data, and monitoring of the aquifer-system hydraulics and mechanics. The centerpiece of the IMP is the Ayala Park Extensometer facility, which was constructed in 2002-03 and consists of multi-depth piezometers and a dual-extensometer.

Under current conditions of aquifer utilization in MZ-1, the aquifer-system deformation appears to be mainly elastic. At the Ayala Park Extensometer, 0.13 feet of elastic land subsidence and rebound were observed during the pumping and recovery seasons of 2003-04. Minor amounts (~0.02 feet) of permanent compaction and associated land subsidence apparently occurred over this same period (confirmation

pending). A recent pumping test in this area demonstrated that permanent compaction may be triggered when the magnitude and duration of drawdown exceeds certain threshold limits. Analytical and numerical computer models are being constructed to predict future drawdown and associated land subsidence that would result from potential basin management practices (*i.e.* the models can evaluate the effectiveness of various long-term plan alternatives). One unforeseen but key finding of the IMP has been the discovery of a previously unknown groundwater barrier that exists within the deep aquifer-system in the same location as the historic fissure zone.

Section 6 Recharge Basin Monitoring

Watermaster, working with the Chino Basin Water Conservation District, is conducting a program to monitor the volumetric recharge at the Montclair, Brooks, and Turner 1, and Grove Basins. In addition, the water quality of recharge is being monitored at these and other basins that have some level of storm water conservation. This recharge monitoring program is important to Watermaster because of new yield implications associated with storm water recharge and water quality mitigation requirements associated with recycled water recharge. Implementation of the Chino Basin Facilities Improvement Program resulted in an increased ability to capture and recharge storm water at several basins.

Section 7 Basin Plan Update for the Chino Basin

The TIN/TDS Task Force was formed in the mid 1990s to perform certain investigations that would lead to the establishment of new total dissolved solids (TDS) and nitrate-nitrogen objectives for groundwater basins in the Santa Ana River Watershed. The Regional Water Quality Control Board (RWQCB), Chino Basin Watermaster, water-recycling agencies, and many other entities participated in the Task Force. The RWQCB used the reports and other information developed by the Task Force to amend the Water Quality Control Plan for the Santa Ana River Watershed (Basin Plan) in 2004.

The TIN/TDS Task Force developed estimates of historical ambient water quality (objectives) and current ambient water quality by management zone. A comparison of these values determines whether or not assimilative capacity exists in a given management zone. The Task Force demonstrated that there is no assimilative capacity in any of the management zones in Chino Basin for TDS or nitrate. For much of the Chino Basin, the TDS and nitrate objectives would be below 300 mg/L and 5 mg/L, respectively.

The new water quality objectives would, from a practical standpoint, make the large-scale use of recycled water very difficult and potentially impractical in the Chino Basin. However, the OBMP anticipated the use of about 26,000 acre-ft/yr of recycled water for direct use by 2025, and about 20,000 to 30,000 acre-ft/yr for recharge by 2025. Recycled water is a critical resource that the OBMP stakeholders are counting on to implement the OBMP. If the groundwater objectives were adopted, Watermaster, the parties to the Judgment, and IEUA would have substantial mitigation obligations for the use of recycled water.

In December 2002, Watermaster and IEUA proposed to the RWQCB to develop new TDS and nitrate objectives based on criteria contained in California Water Code Section 13241 and “the need to develop and use recycled water.” The Task Force modified the delineation of the Chino Basin management zones, and established the new (elevated) TDS and nitrate-nitrogen objectives of 420 mg/L and 5 mg/L, respectively, that would permit recycled water re-use in Chino Basin. In exchange, Watermaster and IEUA committed to establishing and documenting “hydraulic control” of the groundwater basin (see Section 8). The Basin Plan Amendment, as it pertains to managing the Chino Basin, is now in effect.

Section 8 Hydraulic Control Monitoring Program

Under virgin conditions in Chino Basin (pre- to early-1900s), groundwater flowing in a southerly direction from the northern part of the basin would rise to become surface flow in the southwestern part of the basin, ultimately discharging to the Santa Ana River. Since the onset of pumping and associated regional drawdown of groundwater-levels, this southerly flow of groundwater is thought to be intercepted by agricultural wells, and in the last few years, by desalter wells before rising as surface flow in significant quantities. The condition where groundwater is intercepted before discharging to the Santa Ana River is herein referred to as "hydraulic control." Past data collection and groundwater modeling efforts suggest that hydraulic control could be occurring, but are not sufficient to conclude that hydraulic control is actually occurring.

As part of the 2004 Basin Plan update, Watermaster and IEUA committed to establishing and documenting "hydraulic control" of the groundwater basin in exchange for elevated groundwater quality objectives that would permit and encourage recycled water re-use in Chino Basin (see Section 7). Subsequently, Watermaster and IEUA developed and began implementation of the Hydraulic Control Monitoring Program (HCMP). The HCMP employs four engineering or scientific showings can be used to corroboratively demonstrate the state of hydraulic control in the southern portion of Chino Basin:

- analysis of surface water and groundwater chemistry
- estimation of hydrologic balance
- analysis of piezometric levels
- groundwater modeling

While any individual demonstration may not be adequate to demonstrate complete containment, all four elements can be combined to assess the state of hydraulic control and to optimize the management of the basin to minimize discharge of poor quality groundwater to the Santa Ana River and Prado Basin (*i.e.* protect downstream beneficial uses).

1. INTRODUCTION

The Chino Basin Watermaster completed the *Initial State of the Basin* (ISOB) Report in October 2002. The baseline for the ISOB was on or about July 1, 2000 – the point in time that represents the start of Optimum Basin Management Program (OBMP) implementation. The ISOB and subsequent *State of the Basin* (SOB) reports is one metric that can be used to measure progress for the implementation of the OBMP. This current SOB report contains water level, water quality, ground-level data *et cetera* through 2003/2004 and Watermaster activity through fall 2004.

An OBMP for the Chino Basin (see Figure 1-1 for location of Chino Basin and its management zones) was developed pursuant to a Judgment entered in the Superior Court of the State of California for the County of San Bernardino and a February 19, 1998 ruling as described below (WEI, 1999). Pursuant to the OBMP Phase 1 Report, Peace Agreement and associated Implementation Plan, and a November 15, 2001 Order of the Court, Watermaster staff has prepared this *State of the Basin* (SOB) Report. The intent of this report is twofold.

- During Watermaster fiscal year 2000/01 several OBMP-spawned investigations and initiatives were started. Groundwater level and quality, ground level, annual recharge assessment, recharge master planning, hydraulic control, desalter planning and engineering, and meter installation. This report describes the progress made in these activities through fall 2004.
- This report also describes the general state of the basin with respect to geology, groundwater levels and storage, groundwater quality, ground level, recharge, and hydraulic control.

OBMP Management Zones

- Chino 1
- Chino 2
- Chino 3
- Chino 4
- Chino 5

Geology

Water-Bearing Sediments

- Quaternary Alluvium

Consolidated Bedrock

- Undifferentiated Pre-Tertiary to Early Pleistocene Igneous, Metamorphic, and Sedimentary Rocks

Faults & Groundwater Divides

- Location Certain
- Location Approximate
- Location Concealed
- Location Uncertain
- Groundwater Divide

Other Features

- Flood Control and Conservation Basins

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0 1 2 3 4 Miles
0 2 4 6 KM

State of the Basin Report – 2004

OBMP Management Zones

Chino Basin

Figure 1-1

2. GEOLOGY AND HYDROGEOLOGY

2.1 Background

The Chino Basin was formed as a result of tectonic activity along major fault zones. It is part of a larger, broad, alluvial-filled valley located between the San Gabriel/San Bernardino Mountains to the north (Transverse Ranges) and the elevated Perris Block/San Jacinto Mountains to the south (Peninsular Ranges). The Santa Ana River is the main tributary draining the valley and, hence, the valley is commonly referred to as the Upper Santa Ana Valley. Chino Basin is located in the western portion of this valley as shown in Figure 2-1.

The major faults in the Chino Basin area – the Cucamonga Fault Zone, the Rialto-Colton Fault, the Red Hill Fault, the San Jose Fault, and the Chino Fault – are at least in part responsible for the uplift of the surrounding mountains and the depression of Chino Basin. The bottom of the basin – the effective base of the freshwater aquifer – consists of impermeable sedimentary and igneous bedrock formations that are exposed at the surface in the surrounding mountains and hills. Sediments eroded from the surrounding mountains have filled Chino Basin to provide the reservoirs for groundwater. In the deepest portions of Chino Basin, these sediments are greater than 1,000 ft thick.

The major faults also are significant in that they are known barriers to groundwater flow within the aquifer sediments and, hence, define some of the external boundaries of the basin by influencing the magnitude and direction of groundwater flow. The location of the major faults and their spatial relation to Chino Basin are shown in Figure 2-1. These faults, their effects on groundwater movement, and the hydrogeology of the general Chino Basin area have been documented by various entities and authors (Eckis, 1934; Gleason, 1947; Burnham, 1953; MacRostie and Dolcini, 1959; Dutcher & Garrett, 1963; Gosling, 1966; DWR, 1970; Woolfenden and Kadhim, 1997).

Clearly, there have been numerous past studies of the geology and hydrogeology of the Chino Basin, but typically these studies have been general in content or of local extent. Very few of these studies addressed the three-dimensional variability of the aquifer-system sediments and the groundwater hydraulics across the entire Chino Basin.

2.2 Activities and Accomplishments to Date

Watermaster is committed to a more thorough characterization and understanding of Chino Basin hydrogeology to support its many scientific investigations and management programs. Since 2002, three investigations to support OBMP-related programs have improved the hydrogeologic understanding of Chino Basin. These investigations and their related programs are:

- Groundwater modeling investigation to predict the effects of various Dry-Year Yield program alternatives on groundwater levels and quality
- Hydrogeologic characterization of southern Chino Basin to locate proposed monitoring wells to support the Hydraulic Control Monitoring Program
- Subsidence investigation to support the Management Zone 1 Interim Monitoring Program

2.3 Results of Hydrogeologic Investigations

The hydrogeologic results of the investigations listed above are:

2.3.1 Stratigraphy

The stratigraphy of Chino Basin is divided into two natural divisions: (1) the pervious formations that comprise the groundwater reservoirs are termed the water-bearing sediments and (2) the less pervious formations that enclose the groundwater reservoirs are termed the consolidated bedrock. The consolidated bedrock is further differentiated as (a) metamorphic and igneous rocks of the basement complex, overlain in places by (b) consolidated sedimentary rocks. The water-bearing sediments overlie the consolidated bedrock, with the bedrock formations coming to the surface in the surrounding hills and highlands. Below, these geologic formations are described in stratigraphic order, the oldest formations first.

It should be noted that the terms used throughout this section to describe bedrock, such as “consolidated,” “non-water-bearing,” and “impermeable,” are used in a relative sense. The water content and permeability of these bedrock formations, in fact, is not zero. However, the primary point is that the permeability of the geologic formations in the areas flanking the basin is much less than the aquifers in the groundwater basin.

2.3.1.1 Consolidated Bedrock

The consolidated bedrock formations of the Chino Basin area include the basement complex that is comprised of crystalline igneous and metamorphic rocks of pre-Tertiary age, the marine sedimentary and volcanic strata of late Cretaceous to late Tertiary age, and the continental deposits of late Pliocene to middle-Pleistocene age. Figure 2-2 shows the surface outcrops of the consolidate bedrock formations that surround Chino Basin. Note that the basement complex is the exposed bedrock north and southeast of the Chino Basin. Consolidated sedimentary rocks are the exposed bedrock west of Chino Basin.

The bedrock formations also occur at depth, underlying the water-bearing sediments of Chino Basin. Pervious strata or fracture zones in the bedrock formations may yield water to wells locally; however, the storage capacity is typically inadequate for sustained production. Figure 2-2 shows the contact between the bedrock formations and the water-bearing sediments as equal elevation contour lines – referred to herein as the base of the freshwater aquifer. The contours were originally generated by DWR (1970) and modified based on work performed for this study. Note that the base of the freshwater aquifer forms an irregular bowl-shaped depression, with its deepest areas located in the central portions of Chino Basin.

Eckis (1934) speculated that the contact between the consolidated bedrock and the water-bearing sediments is unconformable, as indicated by an ever-present weathered zone in the consolidated bedrock directly underlying the contact with the water-bearing sediments. This observed relationship suggests that the consolidated bedrock in the Chino Basin area was undergoing erosion prior to deposition of the water-bearing sediments.

Well boreholes have penetrated the various bedrock formations in Chino Basin. Figure 2-2 shows the locations of these boreholes, and the type of bedrock penetrated. Much like the bedrock surface exposures that surround Chino Basin, the basement complex is typically the bedrock formation first penetrated on the east side of Chino Basin, and sedimentary rocks are typically the bedrock formations first penetrated

on the west side of Chino Basin. The nature of the buried contact between the basement complex and the sedimentary bedrock is largely unknown, but is likely an angular unconformity or a fault contact, and strikes north-south through the central portions of Chino Basin.

The general character of the consolidated bedrock formations is known from drillers' logs and surface outcrops, and is described below.

Basement Complex. The basement complex consists of deformed and re-crystallized metamorphic rocks that have been invaded and displaced in places by huge masses of granitic and related igneous rocks. The intrusive granitic rocks, which make up most of the basement complex, were emplaced about 110 million years ago in the late Middle Cretaceous (Larsen, 1958). These rocks were subsequently uplifted and exposed by erosion, as presently seen in the San Gabriel Mountains and in the uplands of the Perris block (Jurupa Mountains and La Sierra Hills). They have been the major source of detritus to the younger sedimentary formations, in particular, to the water-bearing sediments of Chino Basin.

Undifferentiated Pre-Pliocene Formations. Outcropping along the western margin of Chino Basin (in the Chino and Puente Hills) are consolidated sedimentary and volcanic rocks that unconformably overlie the basement complex. They consist of well-stratified marine sandstones, conglomerates, shales, and interlayered lava flows that range in age from late Cretaceous to Miocene. According to Durham and Yerkes (1965), this sequence reaches a total stratigraphic thickness of more than 24,000 feet in the Puente Hills and is down-warped more than 8,000 feet below sea level in the Prado Dam area. Wherever mapped, these strata are folded and faulted and in most places dip from 20 to 60 degrees.

Plio-Pleistocene Formations. Overlying the older consolidated bedrock formations is a thick series of semi-consolidated clays, sands, and gravels of marine and non-marine origin. These sediments have been named the Fernando Group (Eckis, 1934), and outcrop in two general locations of the study area: the Chino Hills on the western margin of Chino Basin and in the San Timoteo Badlands southeast of Chino Basin. In surface outcrop, the entire Group is mapped as consolidated bedrock for this study, and is likely the first bedrock penetrated in southwest Chino Basin. However, the upper portion of the Fernando Group is more permeable than the lower portion, and thus represents in the subsurface, a gradual transition from the non-water-bearing consolidated rocks to the water-bearing sediments. Furthermore, the upper Fernando sediments are similar in texture and composition to the overlying water-bearing sediments, which complicate the distinction between the formations from borehole data.

2.3.1.2 Water-Bearing Sediments

Beginning in the Pleistocene and continuing to the present, an intense episode of faulting depressed the Chino Basin area and uplifted the surrounding mountains and hills. Detritus eroded from the mountains were transported and deposited in Chino Basin atop the consolidated sedimentary and crystalline bedrock as interbedded, discontinuous layers of gravel, sand, silt, and clay to form the water-bearing sediments.

The water-bearing sediments can be differentiated into the Older Alluvium of Pleistocene age and Younger Alluvium of Holocene age. The general character of these formations is known from driller's logs and surface outcrops, and is described below.

Older Alluvium. The Older Alluvium varies in thickness from about 200 feet thick near the southwestern end of Chino Basin to over 1,100 feet thick southwest of Fontana, and averages about 500 feet throughout the basin. It is commonly distinguishable in surface outcrop by its red-brown or brick-red color, and is generally more weathered than the overlying Younger Alluvium. Pumping capacities of wells completed in the Older Alluvium range between 500 and 1,500 gallons per minute (gpm). Capacities exceeding 1,000 gpm are common, with some modern production wells test-pumped at over 4,000 gpm (*e.g.*, Ontario Wells 30 and 31 in southeastern Ontario). In the southern part of the basin where sediments tend to be more clayey, wells generally yield 100 to 1,000 gpm.

Younger Alluvium. The Younger Alluvium occupies streambeds, washes, and other areas of recent sedimentation. Oxidized particles tend to be flushed out of the sediments during transport, and the Younger Alluvium is commonly light yellow, brown, or gray. It consists of rounded fragments derived from erosion of bedrock, from reworked Older Alluvium, and from the mechanical breakdown of larger fragments within the Younger Alluvium itself. The Younger Alluvium varies in thickness from over 100 feet near the mountains to a just few feet south of Interstate 10, and generally covers most of the north half of the basin in undisturbed areas. The Younger Alluvium is not saturated and thus does not yield water directly to wells. Water percolates readily in the Younger Alluvium and most of the large spreading basins are located in the Younger Alluvium.

2.3.2 Groundwater Occurrence and Movement

The physical nature of the groundwater reservoirs of Chino Basin is described below with regard to basin boundaries, recharge, groundwater flow, discharge, distinct aquifer systems, hydrostratigraphy, aquifer properties, and internal faults.

2.3.2.1 Chino Basin Boundaries

The physical boundaries of the Chino Basin are shown in Figure 2-1 and include:

- **Red Hill Fault to the north.** The Red Hill Fault is a recently active fault evidenced by recognizable fault scarps such as Red Hill at the extreme southern extent of the fault near Foothill Boulevard. The fault is a known barrier to groundwater flow and groundwater elevation differences on the order of several hundred feet on opposite sides of the fault are typical (Eckis, 1934; DWR, 1970). Groundwater seeps across the Red Hill Fault as underflow from the Cucamonga Basin to the Chino Basin, especially during periods of high groundwater elevations within the Cucamonga Basin.
- **San Jose Fault to the northwest.** The San Jose Fault is known as an effective barrier to groundwater flow with groundwater elevation differences on the order of several hundred feet on opposite sides of the fault (Eckis, 1934; DWR, 1970). Groundwater seeps across the San Jose Fault as underflow from the Claremont and Pomona Basins to the Chino Basin, especially during periods of high groundwater elevations within the Pomona and Claremont Heights Basins.
- **Groundwater divide to the west.** A natural groundwater divide near Pomona separates the Chino Basin from the Spadra Basin in the west. The divide, which extends from the eastern tip of the San Jose Hills southward to the Puente Hills, is produced by groundwater seepage from the Pomona Basin across the southern portion of the San Jose Fault (Eckis, 1934).
- **Puente Hills/Chino Hills to the southwest.** The Chino Fault extends from the northwest to the southeast along the western boundary of the Chino Basin. It is, in part, responsible for uplift of the Puente Hills and Chino Hills, which form a continuous belt of low hills west of the fault. The Chino

and Puente Hills, primarily composed of consolidated sedimentary rocks, form an impermeable barrier to groundwater flow.

- **Flow system boundary with Temescal Basin to the south.** Comparison of groundwater elevation contour maps over time suggests a consistent distinction between flow systems within the lower Chino Basin and Temescal Basin. As groundwater within Chino Basin flows southwest into the Prado Basin area, it converges with groundwater flowing northwest out of the Temescal Valley (Temescal Basin). These groundwaters commingle and flow southwest toward Prado Dam and can rise to become surface water in Prado Basin. This area of convergence of Chino and Temescal groundwaters is indistinct and probably varies with changes in climate and production patterns. As a result, the boundary that separates Chino Basin from Temescal Basin was drawn along the legal boundary of the Chino Basin (Chino Basin Municipal Water District v. City of Chino, *et al*., San Bernardino Superior Court, No. 164327).
- **La Sierra Hills to the south.** The La Sierra Hills outcrop south of the Santa Ana River and are primarily composed of impermeable bedrock and form a barrier to groundwater flow between the Chino Basin and the Arlington and Riverside Basins.
- **Shallow bedrock at the Riverside Narrows to the southeast.** Between the communities of Pedley and Rubidoux, the impermeable bedrock that outcrops on either side of the Santa Ana River narrows considerably. In addition, the alluvial thickness underlying the Santa Ana River thins to approximately 100 feet or less (*i.e.*, shallow bedrock). This area of narrow and shallow bedrock along the Santa Ana River is commonly referred to as the Riverside Narrows. Groundwater upgradient of the Riverside Narrows within the Riverside Basins is forced to the surface to become rising water within the Santa Ana River (Eckis, 1934). Downstream of the Riverside Narrows, the bedrock configuration widens and deepens, and surface water within the Santa Ana River can infiltrate to become groundwater in Chino Basin.
- **Jurupa Mountains and Pedley Hills to the southeast.** The Jurupa Mountains and Pedley Hills are primarily composed of impermeable bedrock and form a barrier to groundwater flow that separates the Chino Basin from the Riverside Basins.
- **Bloomington Divide to the east.** A flattened mound of groundwater exists beneath the Bloomington area as a likely result of groundwater flow from the Rialto-Colton Basin through a gap in the Rialto-Colton Fault north of Slover Mountain (Dutcher and Moyle, 1963; Gosling, 1966; DWR, 1970). This mound of groundwater extends from the gap in the Rialto-Colton Fault to the southwest towards the northeast tip of the Jurupa Mountains. Groundwater to the northwest of this divide recharges the Chino Basin and flows westward staying north of the Jurupa Mountains. Groundwater southeast of the divide recharges the Riverside Basins and flows southwest towards the Santa Ana River.
- **Rialto-Colton Fault to the northeast.** The Rialto-Colton Fault separates the Rialto-Colton Basin from the Chino and Riverside Basins. The fault is a known barrier to groundwater flow along much of its length – especially in its northern reaches (south of Barrier J) where groundwater elevations can be hundreds of feet higher within the Rialto-Colton Basin (Dutcher and Garrett, 1963; DWR, 1970; Woolfenden and Kadhim, 1997). The disparity in groundwater elevations across the fault decreases to the south. To the north of Slover Mountain, a gap in the Rialto-Colton Fault exists. Groundwater within the Rialto-Colton Basin passes through this gap to form a broad groundwater mound (divide) in the vicinity of Bloomington and, hence, is called the Bloomington Divide (Dutcher and Moyle, 1963; Gosling, 1966; DWR, 1970).
- **Extension of the Rialto-Colton Fault north of Barrier J.** Little well data exist to support the extension of the Rialto-Colton Fault north of Barrier J (although hydraulic gradients are steep through this area). Groundwater flowing south out of Lytle Creek Canyon, in part, is deflected by Barrier J and likely flows across the extension of the Rialto-Colton Fault north of Barrier J and into the Chino Basin.

2.3.2.2 Groundwater Recharge, Flow, and Discharge

Predominant recharge to the groundwater reservoirs of Chino Basin is from percolation of direct precipitation and infiltration of stream flow within tributaries exiting the surrounding mountains and hills and within the Santa Ana River. The following is a list of all potential sources of recharge in Chino Basin:

- Infiltration of flow (and, locally, imported water) within unlined stream channels overlying the basin.
- Underflow from the saturated sediments and fractures within the bounding mountains and hills.
- Artificial recharge at spreading grounds of storm water, imported water, and recycled water.
- Underflow from seepage across the bounding faults, including the Red Hill Fault (from Cucamonga Basin), the San Jose Fault (from the Claremont Heights and Pomona Basins), and the Rialto-Colton Fault (from the Rialto-Colton Basin).
- Intermittent underflow from the Temescal Basin.
- Deep percolation of precipitation and returns from use.

In general, groundwater flow mimics surface drainage patterns: from the forebay areas of high elevation (areas in the north and east flanking the San Gabriel and Jurupa Mountains) towards areas of discharge near the Santa Ana River within Prado Flood Control Basin. Figure 2-3 is a groundwater elevation contour map for fall 2000 that shows this general groundwater flow pattern (perpendicular to the contours). Comparing this contour map to groundwater elevation contour maps from other periods shows similar flow paths, indicating consistent flow systems within Chino Basin (WEI, 2000a).

While considered one basin from geologic and legal perspectives, the Chino Basin can be hydrologically subdivided into at least five flow systems that act as separate and distinct hydrologic units. Each flow system can be considered a management zone. Each management zone has a unique hydrology, and water resource management activities that occur in one management zone have limited impact on the other management zones.

Figure 2-3 shows the location of the five management zones in Chino Basin that were developed during the TIN/TDS Study (WEI, 2000a) of which Watermaster, the Chino Basin Water Conservation District (CBWCD), and the Inland Empire Utilities Agency (IEUA) were study participants. Nearing the southwestern (lowest) portion of the basin, these flows systems become less distinct as all groundwater flow within Chino Basin converges and rises beneath Prado Basin. In detail, groundwater discharge throughout Chino Basin primarily occurs via:

- Groundwater production.
- Rising water within Prado Basin (and potentially other locations along the Santa Ana River depending on climate and season).
- Evapotranspiration within Prado Basin (and potentially other locations along the Santa Ana River depending on climate and season) where groundwater is near or at the ground surface.
- Intermittent underflow to the Temescal Basin.

2.3.2.3 Aquifer Systems

The saturated sediments within Chino Basin comprise one groundwater reservoir, but the reservoir can be sub-divided into distinct aquifer systems based on the physical and hydraulic characteristics of the aquifer-system sediments and the contained groundwater. These aquifer systems include a shallow aquifer system and at least one deep aquifer system.

The sediments that comprise the shallow aquifer system are saturated in the southern portion of Chino Basin, but are unsaturated in the northern forebay regions where they provide a thick vadose zone for percolating groundwater (see Figure 2-3). The sediments that comprise the deep aquifer system are always at least partially saturated, but pinch out near bedrock outcrops and in the southern-most portion of Chino Basin. Section 2.3.2.4—*Hydrostratigraphy* describes and illustrates the detailed configurations of the shallow and deep aquifer systems.

The shallow aquifer system is generally characterized by unconfined to semi-confined groundwater conditions, high permeability within its sand and gravel units, and high concentrations of dissolved solids and nitrate. The deep aquifer system is generally characterized by confined groundwater conditions, lower permeability within its sand and gravel units, and lower concentrations of dissolved solids and nitrate. Where both aquifer systems are present and saturated, hydraulic head tends to be higher in the shallow aquifer system, indicating a downward vertical hydraulic gradient.

To illustrate the above generalizations, Figure 2-4 shows the location of Well 1A and Well 1B owned by the City of Chino Hills. These two wells are physically located within 30 feet of each other on the west side of Chino Basin, but their non-pumping water-level time histories are dramatically different. Figure 2-5 is a water-level time history of Well 1A (perforated within the shallow aquifer system), which maintains a relatively stable water level that fluctuates annually by about 20 feet (and a maximum of about 50 feet), probably in response to seasonal production and recharge. Depth to water averages about 80 feet-bgs. Comparatively, Well 1B (perforated within the deep aquifer system) displays a wildly fluctuating piezometric level that can vary seasonally by as much as 250 feet. Depth to water in Well 1B averages about 220 feet-bgs. The water level fluctuations observed in the deep aquifer system are typical of confined groundwater conditions where small changes in storage can generate large changes in piezometric levels.

Wells 1A and 1B also display significant differences in water quality. Nitrate concentrations in 1A and 1B averaged 7 mg/L and 1 mg/L, respectively from 1997 to 2002. Total dissolved solids concentrations in 1A and 1B averaged 288 mg/L and 175 mg/L, respectively from 1997 to 2002. Arsenic concentrations are relatively high in the deep aquifer system (average of 66 micrograms per liter [µg/L] in Well 1B from 1997 to 2002 compared to non-detectable in Well 1A). Similar water quality disparities have been noted between deep and shallow groundwater in the area of the Chino-1 Desalter well field (see Figure 2-4) and its eastward expansion currently under construction (GSS, 2001; Dennis Williams, GSS, pers. comm., 2003).

Also shown in Figure 2-4 – near Wells 1A and 1B – is Watermaster's recently constructed Ayala Park Extensometer facility. At this facility are 11 piezometers with screens of 5-20 feet in length that were completed at various depths that range from 139-1,229 ft-bgs. Slug tests were performed at a number of

these piezometers to, among other objectives, determine the permeabilities of the sediments at various depths within the total aquifer-system. In general, the piezometers in the shallow aquifer system (less than about 350 ft-bgs) display relatively high hydraulic conductivities of 20 to 27 ft/day. The piezometers within the deep aquifer system display relatively low hydraulic conductivities of 1.6 to 0.5 ft/day. A notable exception is a piezometer completed in gravelly sand in the uppermost portion of the deep aquifer system (438-448 ft-bgs) that displays a relatively high hydraulic conductivity of 48 ft/day, indicating the existence of some higher permeability zones within the deep aquifer system.

The distinction between aquifer systems is most pronounced within the west-southwest portions of Chino Basin. This is likely because of the relative abundance of fine-grained sediments in the southwest (multiple layers of clays and silts). Groundwater flowing from high-elevation forebay areas in the north and east become confined beneath these fine-grained sediments in the west-southwest, and effectively isolate the shallow aquifer system from the deep aquifer system(s).

The three-dimensional extent of these fine-grained sedimentary units and their effectiveness as confining layers has never been mapped in detail across Chino Basin. However, the following data, shown in Figure 2-4, can be used to estimate the lateral extent of these units:

- Historical flowing-artesian conditions were mapped in the early 1900s in the southwest portion of Chino Basin (Mendenhall, 1905, 1908; Fife *et al*., 1976), which indicates the existence of confining layers in these areas.
- Remote sensing studies were conducted to analyze land subsidence in Chino Basin (Peltzer, 1999a, 1999b). These studies employed Synthetic Aperture Radar Interferometry (InSAR), which utilizes radar imagery from an Earth-orbiting spacecraft to map ground surface deformation. InSAR has indicated the occurrence of persistent subsidence across the western portion of Chino Basin from 1992 to 2000 – likely due to the compaction of fine-grained sediments as a result of lower pore pressures within the aquifer system (WEI, 2002). The southern extent of persistent subsidence is currently unknown because InSAR data are difficult to obtain in areas of agricultural land uses, but may extend southward to encompass the historical artesian area.

North and east of these areas, the distinction between aquifer systems is less pronounced because:

- the fine-grained layers in the west-southwest thin and/or pinch-out to the north and east, and
- much of the shallow aquifer system is unsaturated in the forebay regions of Chino Basin.
- geologic descriptions from driller's logs in Chino Basin confirm the predominance of fine-grained sediments in the west-southwest portion of Chino Basin, and the predominance of coarser-grained sediments in the north and east portions of Chino Basin. These observations are described and illustrated in more detail in the following two Sections (2.3.2.4 – *Hydrostratigraphy* and 2.3.2.5 – *Aquifer Properties*).

2.3.2.4 Hydrostratigraphy

As described in Section 2.3.1.2, the water-bearing sediments of Chino Basin are composed of interbedded, discontinuous layers of gravel, sand, silt, and clay. These layers and their geometries are too numerous and complex to characterized on a basin-wide scale. A simplified geologic model was created to characterize the three-dimensional distribution of the water-bearing sediments and their hydrogeologic properties for input to a numerical groundwater flow model.

In order to develop this conceptual model, 10 hydrogeologic cross-sections were constructed across Chino Basin. The plan-view locations of these cross-sections are shown in Figure 2-6 and the profile-view cross-sections are shown in Figures 2-7 through 2-14. Plotted on these cross-sections are selected well and borehole data, including borehole lithology, short-normal resistivity logs, well casing perforations, and water levels.

Through analyses of these cross-sections and other hydrogeologic data, the water-bearing sediments were grouped into three hydrostratigraphic units (layers):

- Layer 1 consists of the upper 200-300 feet of sediments, and is generally representative of the shallow aquifer system (see Section 2.3.2.3). Layer 1 sediments are typically coarse-grained (sand and gravel layers) and, where saturated, transmit large quantities of groundwater to wells due to high hydraulic conductivities. On the west side of Chino Basin, Layer 1 sediments are composed of a greater fraction of finer-grained sediments (silt and clay layers), especially in the uppermost 100 feet.
- Layer 2 consists of 200-500 feet of sediments underlying Layer 1, and is representative of the upper portion of the deep aquifer system (see Section 2.3.2.3). On the west side of Chino Basin, Layer 2 sediments are primarily fine-grained (silt and clay layers) with few interbedded sand and gravel layers. Layer 2 sediments become increasingly coarse-grained in the northern and eastern portions of Chino Basin, and as a result, the distinction between Layer 1 and Layer 2 sediments becomes less pronounced.
- Layer 3 consists of 100-500 feet of sediments underlying Layer 2, and is representative of the lower portion of the deep aquifer system (see Section 2.3.2.3). Layer 3 sediments are confined to the deepest (central) portions of Chino Basin, and pinch-out toward the basin margins. Layer 3 sediments are typically coarse-grained (sand and gravel layers), but due to their greater age, consolidation, and state of weathering, these sediments have lower permeability than the coarse-grained sediments of Layer 1.

The top and bottom elevations of the three layers were brought into a Geographic Information System (GIS) as point values. These elevation values were then used as input to create a series of grids that represent the three-dimensional conceptual model of the water-bearing sediments of Chino Basin.

2.3.2.5 Aquifer Properties

The aquifer properties of critical importance for this study are effective porosity (specific yield) and hydraulic conductivity.

Effective Porosity. The effective porosity of the water-bearing sediments in Chino Basin was estimated through the analysis of lithologic descriptions from driller's logs. Watermaster maintains a library of driller's logs of all known well boreholes that have been drilled in Chino Basin. The lithologic descriptions from the driller's logs were input into a relational database along with corresponding US Geological Survey (USGS) estimates of effective porosity by sediment type (Johnson, 1967).

Effective porosity was averaged at each borehole for each layer. These values were plotted and gridded using a Kriging method within the ArcGIS Spatial Analyst extension for each layer, and are shown in Figures 2-15 through 2-17.

Figure 2-15 displays average effective porosity for Layer 1. Average effective porosities are highest, ranging up to 20 percent, in the northern (Upland) and eastern (Fontana) portions of Chino. A belt of similarly high effective porosity runs north of and parallels the Santa Ana River near Norco. This belt may represent coarse-grained sediments deposited by an ancestral Santa Ana River. Average effective

porosities are lowest, ranging down to 6 percent, on the west side of Chino Basin (Pomona and Chino). This area of relatively low effective porosity overlaps the historical artesian area, and may represent fine-grained sediments that historically acted as confining layers.

Figure 2-16 displays average effective porosity for Layer 2. As with Layer 1, average effective porosities are highest, ranging up to 20 percent, in the northern (Upland) and eastern (Fontana) portions of Chino Basin. A belt of similarly high effective porosity runs north of the Jurupa Mountains from Fontana to Norco. As with Layer 1, this belt may represent coarse-grained sediments deposited by an ancestral Santa Ana River. Average effective porosities are lowest, ranging down to 3 percent, on the west side of Chino Basin (Pomona, Chino, and west Ontario). This area of relatively low effective porosity overlaps the historical artesian area and the area of historical subsidence as indicated by InSAR, and may represent fine-grained sediments that have experienced compaction due to reduced pore pressures.

Figure 2-17 displays average effective porosity for Layer 3. Again, the primary observation is coarser-grained sediments comprising the east side of Chino Basin, and finer-grained sediments comprising the west side.

Hydraulic Conductivity. The hydraulic conductivity of water-bearing sediments is a measure of its capacity to transmit water. Generally, sands and gravels have high hydraulic conductivities while clays and silts have low hydraulic conductivities. Since the effective porosity Figures (Figure 2-15 through 2-17) were created from lithologic descriptions of well bore cuttings, they also qualitatively indicate the distribution of hydraulic conductivity of the water-bearing sediments. On average, hydraulic conductivities are highest in the northern (Upland) and eastern (Fontana) portions of Chino Basin. A belt of similarly high hydraulic conductivity runs north of the Jurupa Mountains from Fontana to Norco. Average hydraulic conductivities are lowest on the west side of Chino Basin (Pomona, Chino, and west Ontario). Generally, hydraulic conductivities decrease with depth because deeper sediments typically have experienced a greater degree of secondary alteration (*e.g.* weathering of feldspars to clay minerals, cementation of pore space, *et cetera*).

2.3.2.6 Internal Faults

- Barrier “J.” Barrier "J" appears to be a significant impediment to groundwater flow in the Rialto Basin. However, there is no conclusive evidence that Barrier "J" acts as barrier in the Chino Basin. The displacement in the effective base of the aquifer in the Chino Basin and barrier effects in Rialto Basin suggest potential for Barrier "J" to be a groundwater barrier in the Chino Basin.
- Central Avenue Fault. The effect of the Central Avenue fault on groundwater flow is unknown. The sediments west of the fault are generally finer than the sediments east of the fault and it unclear if the relatively poor production capabilities of the area west of the fault are the result of marginal aquifer properties, the Central Avenue fault acting as a hydrologic barrier, or both.

2.3.3 Southern Chino Basin

2.3.3.1 Previous Investigations

As noted in Section 2.1, the general hydrogeology of the Chino Basin area has been documented by various entities and authors (Eckis, 1934; Gleason, 1947; Burnham, 1953; MacRostie and Dolcini, 1959; Dutcher & Garrett, 1963; Gosling, 1966; DWR, 1970; Woolfenden and Kadhim, 1997). However,

relatively few investigations have been focused on the southern portion of the Chino Basin. Notable exceptions include:

- French (1972) estimated groundwater outflow from Chino Basin. He utilized Darcy's equation to calculate outflow through a cross-sectional area of water-bearing sediments that extended from the Puente Hills to the Pedley Hills (approximately parallel to Pine Avenue, which is about one mile south of the Chino-1 Desalter well field). To construct the cross-section, he utilized existing borehole data, new borehole data from test holes drilled for the study, and geophysical data (seismic and gravity traverses). To estimate permeability of the sediments along the cross-section, he utilized aquifer test data and specific capacity data from nearby wells. To estimate the hydraulic gradient perpendicular to the cross-section, he constructed piezometric contour maps.

  To summarize his hydrogeologic findings along this cross-section: east of Archibald Avenue, the base of the water-bearing sediments is the buried irregular surface of the basement complex. The maximum thickness of the water-bearing sediments in this area is about 300 feet. West of Archibald Avenue, the basement complex is depressed by thousands of feet – likely by fault displacement. The base of the water-bearing sediments in this area occurs within the sedimentary bedrock formations that overlie the basement complex, and is recognized as a vertical transition to very low permeability sediments. The maximum thickness of the water-bearing sediments in this area is about 600 feet. The permeability of the water-bearing sediments generally increases from west to east along the cross-section, and generally decreases with depth. Below a depth of about 350 ft-bgs, French notes a decrease in permeability by at least an order of magnitude in comparison to shallower aquifer sediments.
- Fox (1989) documented a test hole and production well drilling/construction project that was conducted for the City of Chino Hills. In this effort, a total of 14 boreholes were drilled within the City of Chino – located about 2 to 3 miles northwest of the Chino-1 Desalter well field. Ten of these boreholes were completed and tested as production wells. Fox (1990) also conducted a hydrogeologic investigation of a proposed well field site for the City of Chino Hills located just north of the Chino-1 Desalter well field. He named this site the Euclid Avenue Well Field, which included the area bounded by Euclid Avenue, Merrill Avenue, Grove Avenue, and Riverside Drive. In both publications, Fox documents the existence of distinct shallow and deep aquifer systems separated by a laterally extensive sequence of fine-grained sediments. Nitrate concentrations were stated to be significantly higher in the shallow aquifer system, commonly exceeding federal MCL (10 mg/L as nitrogen). Fox also stated that the clay content of the total aquifer system in southwestern Chino Basin was relatively high, thus limiting the productive capacity of water wells drilled in this locale.
- Montgomery Watson (1999) conducted the drilling and construction of the Chino-1 Desalter Well Field. None of the well boreholes penetrated basement complex – the deepest borehole stopping at 700 ft-bgs within sediments of probable Tertiary age. Much of the basic data collected and published by Montgomery Watson were utilized in this investigation.
- Geoscience (2003) conducted the drilling and construction of three wells that will increase the number of Chino-1 Desalter wells from 11 to 14. These wells are located just east of the Chino-1 Desalter well field (east of Archibald Avenue). Two of these wells penetrated basement complex at relatively shallow depths (310 to 360 ft-bgs), confirming the conceptual model of southern Chino Basin as described by French (1972). Spinner tests were performed at these wells, which help to define the transition between the shallow and deep aquifer systems at about 250-300 ft-bgs at this locale (see Section 2.3.3.2 below).

2.3.3.2 Hydrostratigraphy

Three detailed hydrostratigraphic cross-sections were constructed across the southern Chino Basin. The objective of this exercise was to better characterize and document the hydrogeology in this region, which

will aid in the placement and construction details of proposed monitoring wells. Data to construct these cross-sections came from all previous studies and well construction projects (see Section 2.3.3.1), as well as Watermaster's comprehensive water well database, and includes:

- Borehole lithologic descriptions from well driller's logs
- Borehole geophysical logs
- Spinner logs
- Well construction information
- Water level data
- Slug test data
- Specific capacity data

Figure 2-18 shows the map view locations of the three cross-sections. Cross-sections A-A'-A" and B-B' both are aligned west-east through the Chino-1 Desalter well field. However, cross-section A-A'-A" extends from the Desalter well field to the northwest to include hydrogeologic data that are currently being studied as part of Watermaster's subsidence monitoring efforts. Cross-section C-C' is aligned north-south and bisects the Desalter well field.

The sub-sections below describe the bottom of the aquifer-system and the hydrostratigraphic layering – which are shown on all three cross-sections – as well as the details of each cross-section.

Bottom of the Aquifer-System. A common observation at wells in this region that were drilled to significant depths (>500 ft) is the penetration of dark gray to black clays toward the bottom of the boreholes. Fox (1989) interpreted these black clays to be part of the sedimentary bedrock formations that comprise the Chino and Puente Hills directly to the west (see Figure 2-18). Slug test and specific capacity data (discussed below) collected from wells that are perforated below these black clays support Fox's bedrock interpretation (*e.g.* very low hydraulic conductivities and specific capacities). Where encountered, the top of the black clays are interpreted as the bottom of the aquifer-system. However, unpublished data from Watermaster's subsidence monitoring efforts indicate that the sedimentary bedrock below the black clays is water-bearing and is in hydraulic connection with the overlying aquifer-system.

East of about Archibald Avenue, well boreholes that penetrate bedrock encounter crystalline rocks, similar to the igneous and metamorphic rocks that outcrop in the La Sierra, Pedley, and Jurupa Hills located to the south and east (see Figure 2-18).

Hydrostratigraphic Layering. As discussed in Section 2.3.3.2 – *Hydrostratigraphy*, the aquifer-system sediments were grouped into three hydrostratigraphic layers to formulate the conceptual model for a basin-wide computerized groundwater flow model (WEI, 2003). The detailed work in southern Chino Basin (cross-sections and piezometric maps in the southern Chino Basin) did not significantly change the conceptual model and hydrostratigraphic layering in this region:

- In the vicinity of the Chino-1 Desalter well field, Layer 1 consists of the upper 200-250 feet of sediments, and is generally representative of the shallow aquifer-system (see Section 2.3.2.3). Layer 1 sediments are predominantly coarse-grained (sand and gravel layers) with interbedded silt and clay layers and, where saturated, transmit large quantities of groundwater to wells due to high hydraulic conductivities. Groundwater exists under unconfined to semi-confined conditions in Layer 1. Water quality in Layer 1 is generally poor, with relatively high concentrations of TDS and nitrate.

- In the vicinity of the Chino-1 Desalter well field, Layer 2 consists of 50-250 feet of sediments underlying Layer 1, and is representative of the deep aquifer system (see Section 2.3.2.3). Layer 2 sediments are predominantly fine-grained (silt and clay layers) with interbedded sand and gravel layers. As the bedrock surface rises to shallower depths from northwest to southeast, the Layer 2 sediment package becomes thinner and pinches out to the south and to the east. Groundwater exists under semi-confined to confined conditions in Layer 2. Water quality in Layer 2 is generally better than in Layer 1, with relatively low concentrations of TDS and nitrate.
- In the vicinity of the Chino-1 Desalter well field, the Layer 3 sediment package, also representative of the deep aquifer system (see Section 2.3.2.3), is very thin (<50 ft) or non-existent.

Cross-Section A-A'-A". Figure 2-19 (an E-sized drawing in an Acrobat portable document format [pdf] format on CD only) displays the profile view of cross-section A-A'-A". Where available, specific capacity and slug test data are shown on this cross-section for selected wells.

The westernmost well along A-A'-A" is Chino Hills 16, a deep municipal production well (960 ft) with a long and deep screened interval (430-940 ft-bgs). The lithologic and geophysical data collected at this well borehole indicate that Layer 2 is comprised almost entirely of clay-rich sediments. A relatively low specific capacity of 7.5 gpm/ft is consistent with its perforated interval that spans the low permeability sediments of Layer 2, Layer 3 and the upper 200 ft of sedimentary bedrock.

Two boreholes containing multiple piezometers at the Ayala Park extensometer facility are located about 7,000 ft to the southwest of Chino Hills 16. The black clays are first encountered at this site at about 975 ft-bgs, indicating an eastward thickening of the aquifer-system sediments. At this location, Layer 2 has become interbedded with coarser-grained sediments (sands and gravels). Several piezometers, completed at various depths, were slug tested to obtain estimates of hydraulic conductivity. As expected, the Layer 1 sediments have higher hydraulic conductivities (20-27 ft/day) compared to deeper sediments. However, one thin gravelly sand layer in Layer 2 displayed a relatively high hydraulic conductivity of 48 ft/day, indicating the existence of some very permeable layers, at least in the upper portions of the deep aquifer system. The hydraulic conductivity of the sedimentary bedrock is a very low 0.5 ft/day.

About two miles to the southeast of the Ayala Park extensometer (to A'), there are three deep production wells: YTS-3, and Chino-1 Desalter wells 1 and 4. The black clays are first encountered at the Desalter wells at about 510 ft-bgs, indicating an eastward thinning of the aquifer-system sediments from Ayala Park to the Desalter well field. Layer 3 sediments beneath the Desalter wells have pinched-out to practical zero thickness. However, Layer 1 and 2 sediments appear similar to Layer 1 and 2 sediments beneath Ayala Park. All three wells are perforated within the deep aquifer system (Layers 2, 3, and/or sedimentary bedrock), which is consistent with their very low specific capacities that range from 0.5 to 6.1 gpm/ft. All three wells were perforated within the deep aquifer system to capture groundwater of better quality – the Desalter wells 1 and 4 being "by-pass" wells for blending with treated water pumped from the shallow Desalter wells to the east.

From A' to A" the cross-section encounters test boreholes and production wells that pump shallow groundwater for treatment at the Chino-1 Desalter facility: from west to east, wells 5, 7, and 14. The black clays are encountered at progressively shallower depths from A' to well 7 (500 to 360 ft-bgs). Well 14 did not encounter the black clays, but instead encountered crystalline bedrock (granite) at a depth of about 500 ft-bgs. Desalter wells 13 and 15 (not shown on the cross-section, but located within 1,000 ft to the east and west of Well 14) penetrate crystalline bedrock at about 320 ft-bgs, which depicts an undulating crystalline bedrock surface in this region that gradually shallows to the east. This abrupt transition from

sedimentary to crystalline bedrock is represented by an inferred fault that strikes north-south along Archibald Avenue with downward displacement on the west side of the fault. This interpretation is consistent with those advanced by French (1972; see Section 2.3.3.1). Within the overlying aquifer sediments, Layer 2 becomes thinner from A' to A" while Layer 1 becomes thicker. Wells 5, 7 and 14 are perforated within the shallow and deep aquifer system (Layers 1 and 2). Specific capacities at wells 5 and 7 are high (40 and 27 gpm/ft, respectively) compared to the deeper wells located to the west along A-A' (YTS-3 and Desalter wells 1 and 4), suggesting that the shallow aquifer system provides the majority of water to these wells. A spinner log at Well 14 supports this interpretation by demonstrating that approximately 80% of the groundwater pumped from this well originates from sediments within Layer 1 (Geoscience, 2003).

Cross-Section B-B' Figure 2-20 displays the profile view of cross-section B-B'. This cross-section is nearly identical to eastern portion of A-A'-A", except that Desalter Well 3 replaces Well 1 on the western edge of B-B' and Desalter Well 13 replaces Well 14 on the eastern edge. Neither well reveals new observations nor warrants changes of interpretations as described for A-A'-A".

Cross-section B-B' also shows water-level data, where available, at individual wells for spring 2003. Also shown is the regional piezometric surface for Layer 1 as mapped and contoured for spring 2003. This surface broadly undulates with piezometric lows centered around the Desalter wells that are perforated within the shallow aquifer system (wells 5 and 7). Also, note that the piezometric heads at wells perforated solely in the deep aquifer system (Desalter wells 3 and 4) are lower than the piezometric surface for the shallow system. This is a common observation in this region, especially along the western portions of B-B' and A-A'-A", due to the confined nature of the deep aquifer system where small changes in storage due to pumping result in relatively large drawdown of piezometric head. To the east, this observation is not as apparent due to 1) the progressive thinning of the deep aquifer sediments, 2) the progressive thickening of the shallow aquifer sediments, and 3) the lack of wells in the east that are perforated solely in the deep aquifer system.

Cross-Section C-C' Figure 2-21 displays the profile view of cross-section C-C' which is aligned north-south and bisects the Desalter well field just east of Grove Avenue. This cross-section shows the downward slope of the ground surface from north to south. Conversely, the black clays are penetrated in deep boreholes at increasingly shallower depths from north to south, depicting an upward slope of the bottom of the aquifer. As a result, the total aquifer system sediment package becomes thinner from north to south, with the deep aquifer system pinching-out just north of Chino-Corona Road.

Cross-section C-C' also shows water-level data, where available, at individual wells for spring 2003. Also shown is the regional piezometric surface for Layer 1 as mapped and contoured for spring 2003. This surface slopes from north to south along with the topographic surface, but becomes virtually flat as it encounters the Desalter wells that are perforated within the shallow aquifer system (wells 5 and 8).

2.3.4 MZ-1 Groundwater Barrier

One significant result of the subsidence investigations in MZ-1 is the discovery of a groundwater barrier in this region. The barrier exists within the deep (> 300 ft) aquifer-system sediments, and is aligned with the historic zone of ground fissuring in the City of Chino. Multiple lines of evidence support the existence of this barrier including:

- Aquifer stress test (pumping test) data

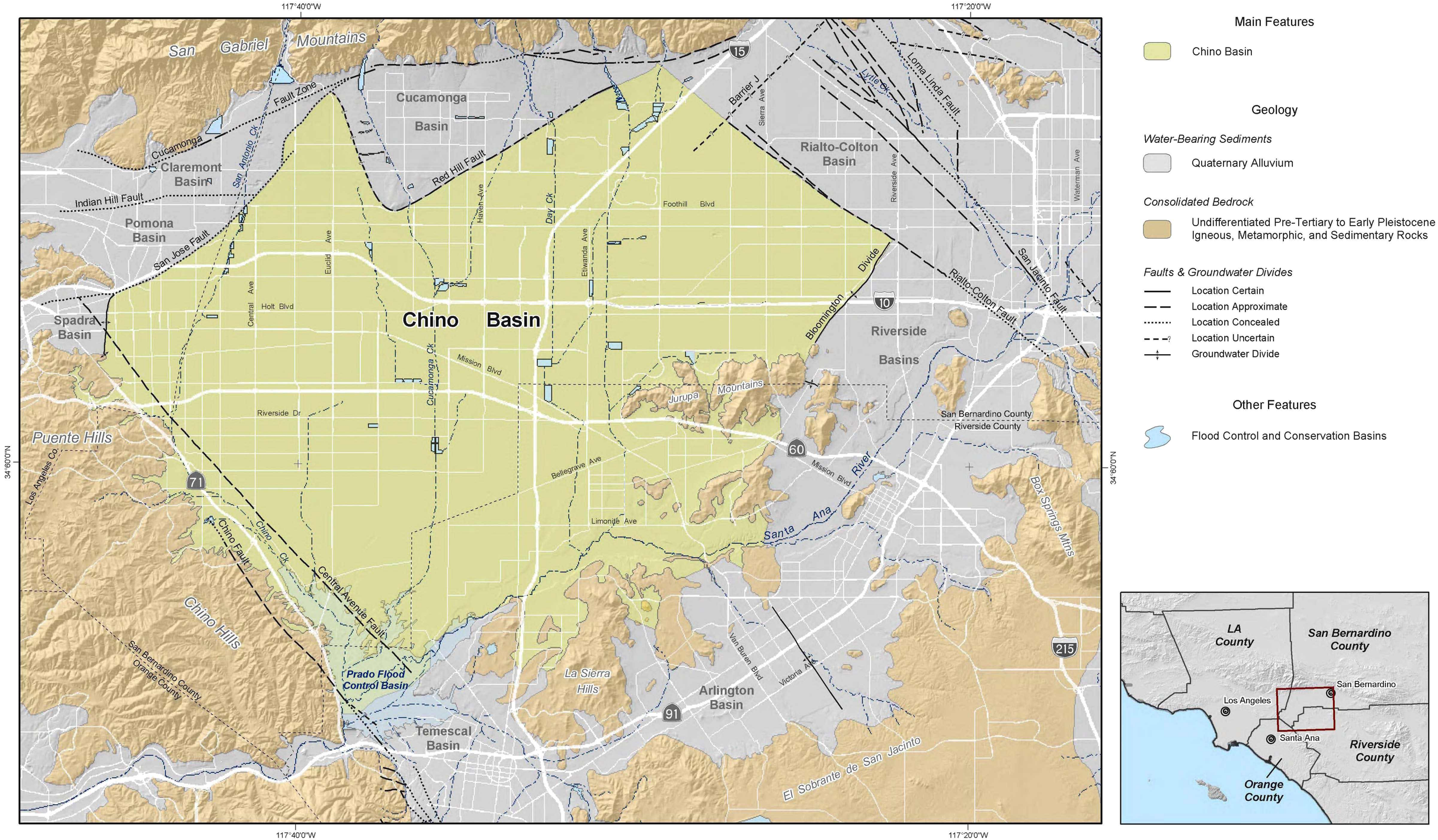
- Inverse analytical modeling of the pumping test data
- InSAR analyses
- Ground level survey data

See Section 5 for a detailed discussion of the MZ-1 barrier.

2.4 On-Going and Recommended Activities

Nine nested, multi-depth monitoring wells are being drilled in southern Chino Basin as part of the Hydraulic Control Monitoring Program. The drilling of these monitoring wells, and subsequent data collection, will be used to characterize the state of hydraulic control (see Section 8) and to improve the hydrogeologic characterization of this region.

Additional monitoring wells are currently being planned to support monitoring of recycled water recharge in the northern portions of Chino Basin. The drilling of these monitoring wells, and subsequent data collection, will improve the hydrogeologic characterization of this northern region as well.



Main Features

Chino Basin

Geology

Water-Bearing Sediments

Quaternary Alluvium

Consolidated Bedrock

Undifferentiated Pre-Tertiary to Early Pleistocene Igneous, Metamorphic, and Sedimentary Rocks

Faults & Groundwater Divides

- Location Certain
- Location Approximate
- Location Concealed
- Location Uncertain
- Groundwater Divide

Other Features

Flood Control and Conservation Basins

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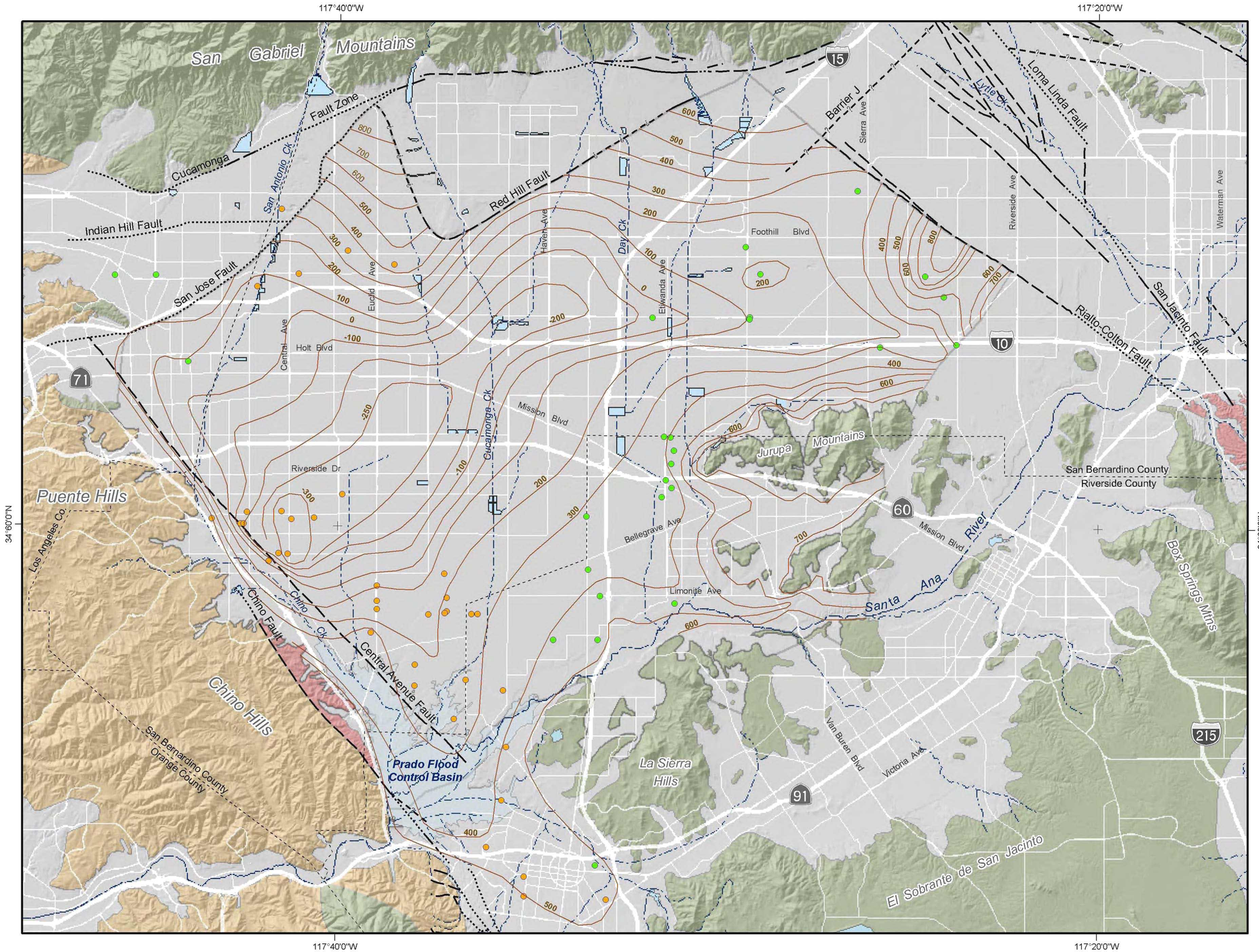
Author: AEM
Date: 20030616
File: figure_2-1.mxd

0 1 2 3 4 Miles
0 2 4 6 KM

Chino Basin Dry-Year Yield Program
Geology and Hydrogeology

Chino Basin
and Other Surrounding Groundwater Basins

Figure 2-1



Main Features

- Well Borehole Penetrated Sedimentary Bedrock
- Well Borehole Penetrated Crystalline Bedrock
- 600 — Equal Elevation Contour of Base of Freshwater Aquifer (ft-above msl)

Geology

Water-Bearing Sediments

- Quaternary Alluvium

Consolidated Bedrock

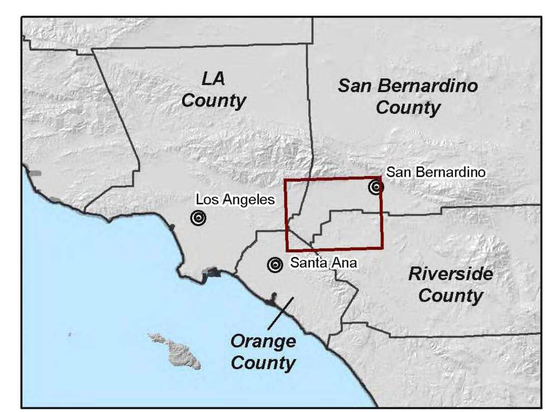
- Plio-Pleistocene Sedimentary Rocks
- Cretaceous to Miocene Sedimentary Rocks
- Pre-Tertiary Igneous and Metamorphic Rocks

Faults

- Location Certain
- Location Approximate
- Location Concealed
- Location Uncertain

Other Features

- Flood Control and Conservation Basins



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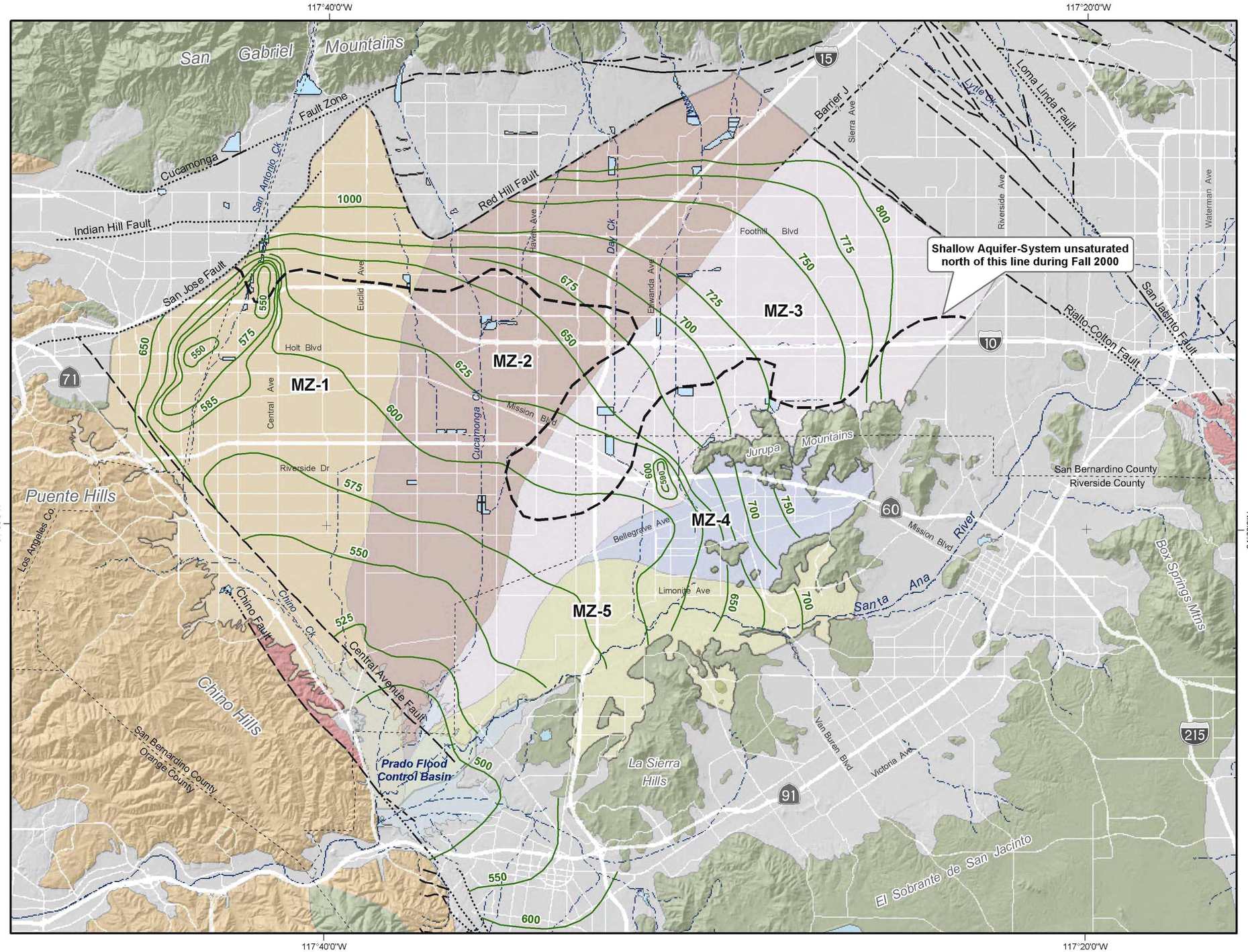
0 1 2 3 4 Miles
0 2 4 6 KM

Chino Basin Dry-Year Yield Program
Geology and Hydrogeology

Base of Freshwater Aquifer

Including Bedrock Type

Figure 2-2



Main Features

800 / 775 — Groundwater Elevation Contours -- Fall 2000 (feet above mean sea level)

Geology

Water-Bearing Sediments

- Quaternary Alluvium

Consolidated Bedrock

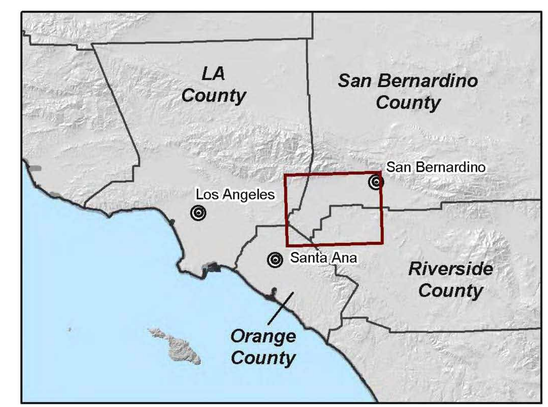
- Plio-Pleistocene Sedimentary Rocks
- Cretaceous to Miocene Sedimentary Rocks
- Pre-Tertiary Igneous and Metamorphic Rocks

Faults

- Location Certain
- Location Approximate
- Location Concealed
- Location Uncertain

Other Features

- Flood Control and Conservation Basins



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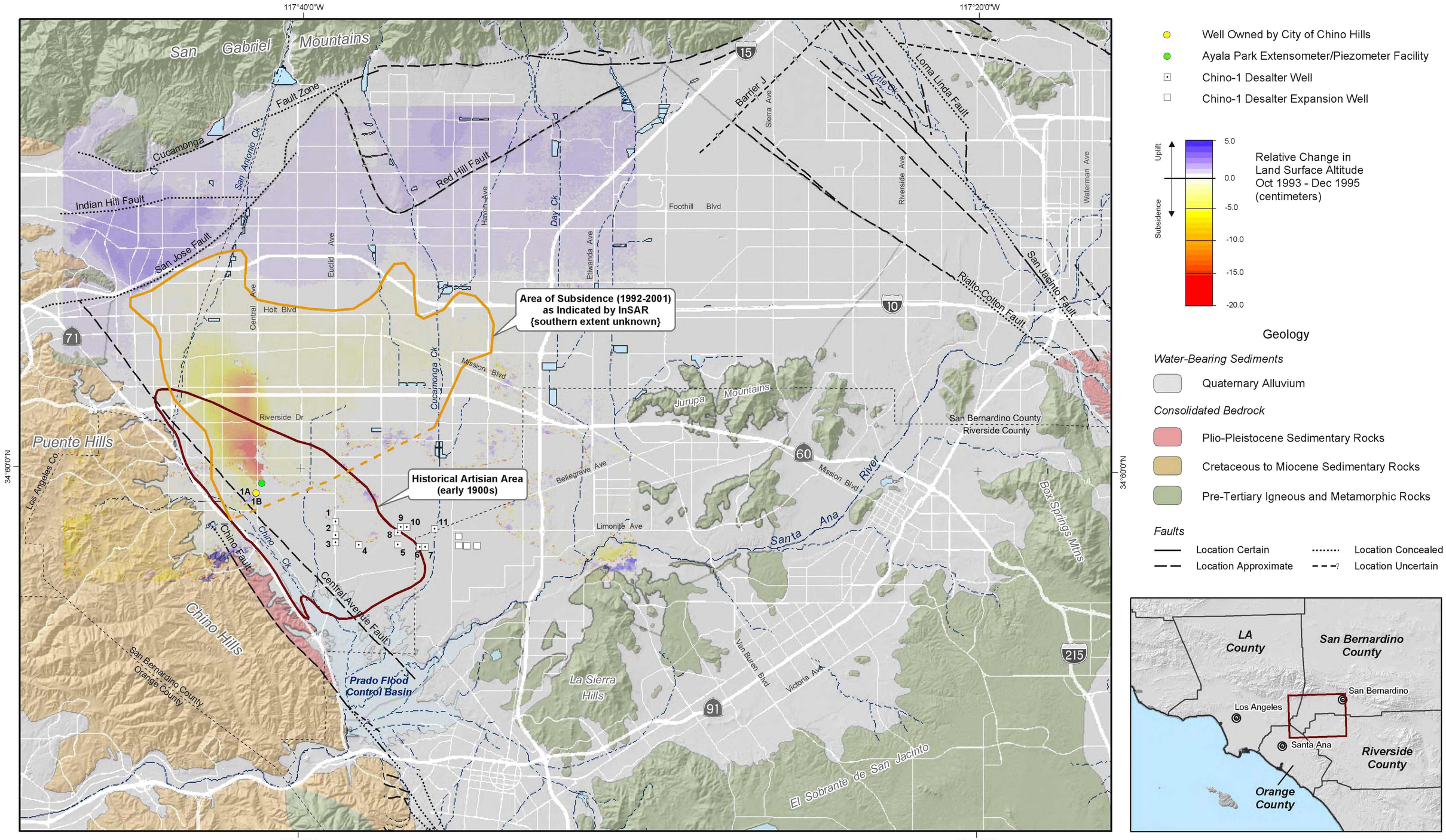
File: figure_2-3.mxd

0 1 2 3 4 Miles
0 2 4 6 KM

Chino Basin Dry-Year Yield Program
Geology and Hydrogeology

Groundwater Elevation Map
Fall 2000

Figure 2-3



- Well Owned by City of Chino Hills
- Ayala Park Extensometer/Piezometer Facility
- Chino-1 Desalter Well
- Chino-1 Desalter Expansion Well

Uplift / Subsidence

5.0
0.0
-5.0
-10.0
-15.0
-20.0

Relative Change in Land Surface Altitude Oct 1993 - Dec 1995 (centimeters)

Geology

Water-Bearing Sediments

- Quaternary Alluvium

Consolidated Bedrock

- Plio-Pleistocene Sedimentary Rocks
- Cretaceous to Miocene Sedimentary Rocks
- Pre-Tertiary Igneous and Metamorphic Rocks

Faults

- Location Certain
- Location Approximate
- Location Concealed
- Location Uncertain

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0 1 2 3 4 Miles
0 2 4 6 KM

Chino Basin Dry-Year Yield Program
Geology and Hydrogeology

Inland Empire Utilities Agency

Chino Basin Hydrogeology

Areas of Subsidence and Historical Artesian Conditions

Figure 2-4

Figure 2-5
Water-Level Time Histories (Non-Pumping)
at City of Chino Hills Wells 1A and 1B

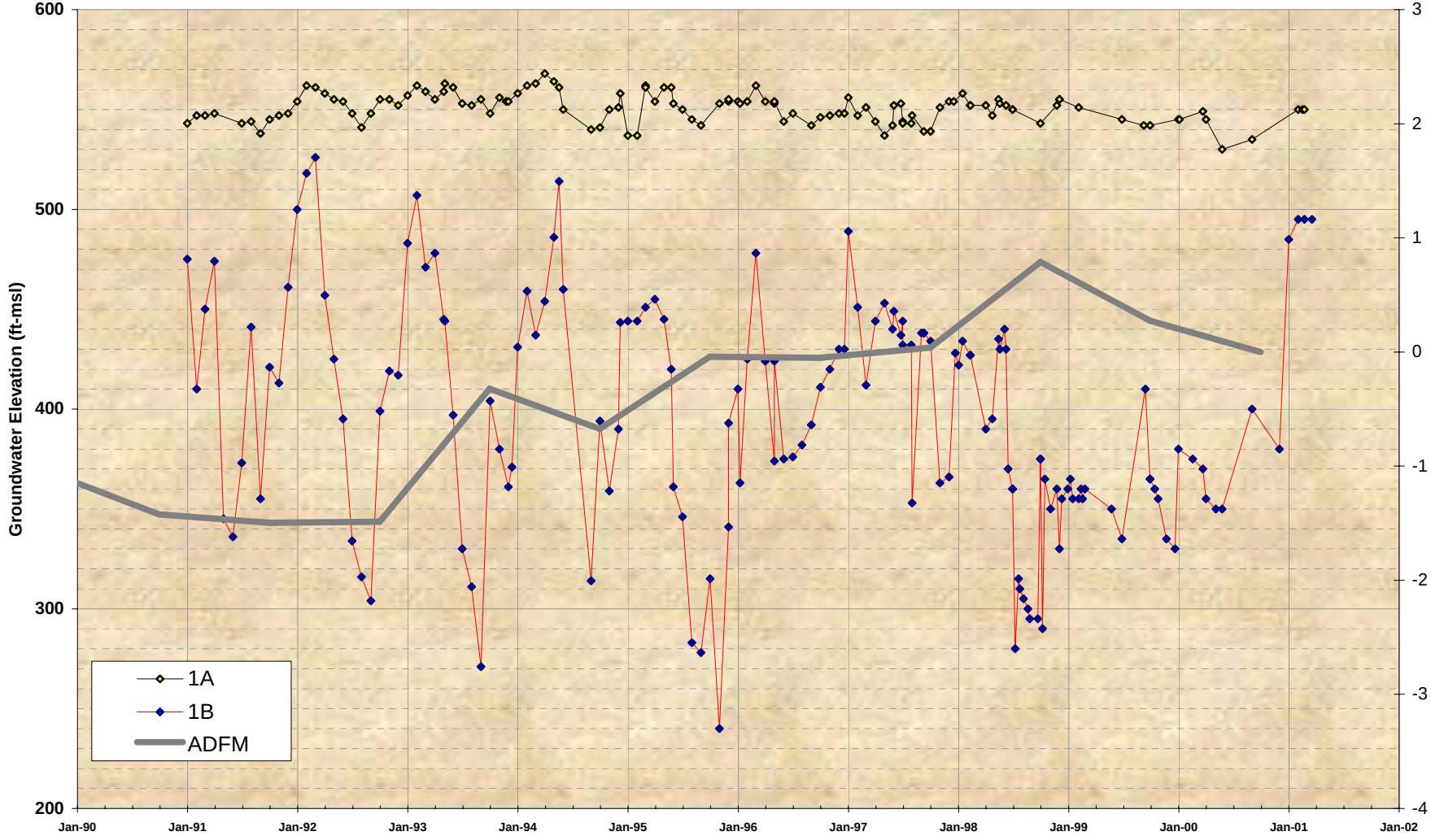

Figure_2-5.xls -- Figure_2-5
7/8/2005

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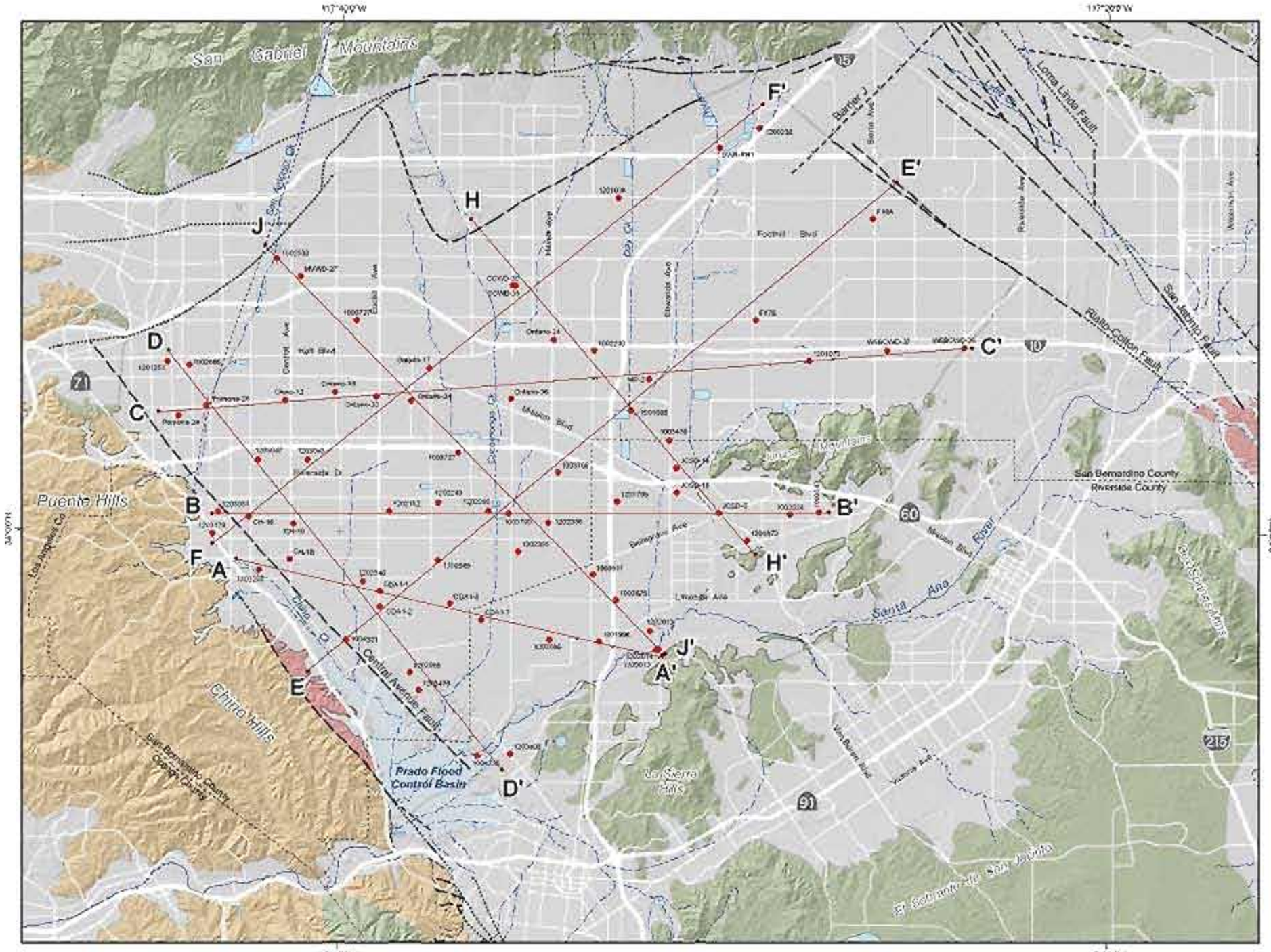

Main Features

- Line of Geologic Cross-Section *(shown in Figures 2-7 thru 2-14)*
- Well Used in Cross-Section

Geology

Water-Bearing Sediments

- Quaternary Alluvium

Consolidated Bedrock

- Plio-Pleistocene Sedimentary Rocks
- Cretaceous to Miocene Sedimentary Rocks
- Pre-Tertiary Igneous and Metamorphic Rocks

Faults

- Location Certain
- Location Approximate
- Location Concealed
- Location Uncertain

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Date: 20000616
File: figure_2-6.mxd

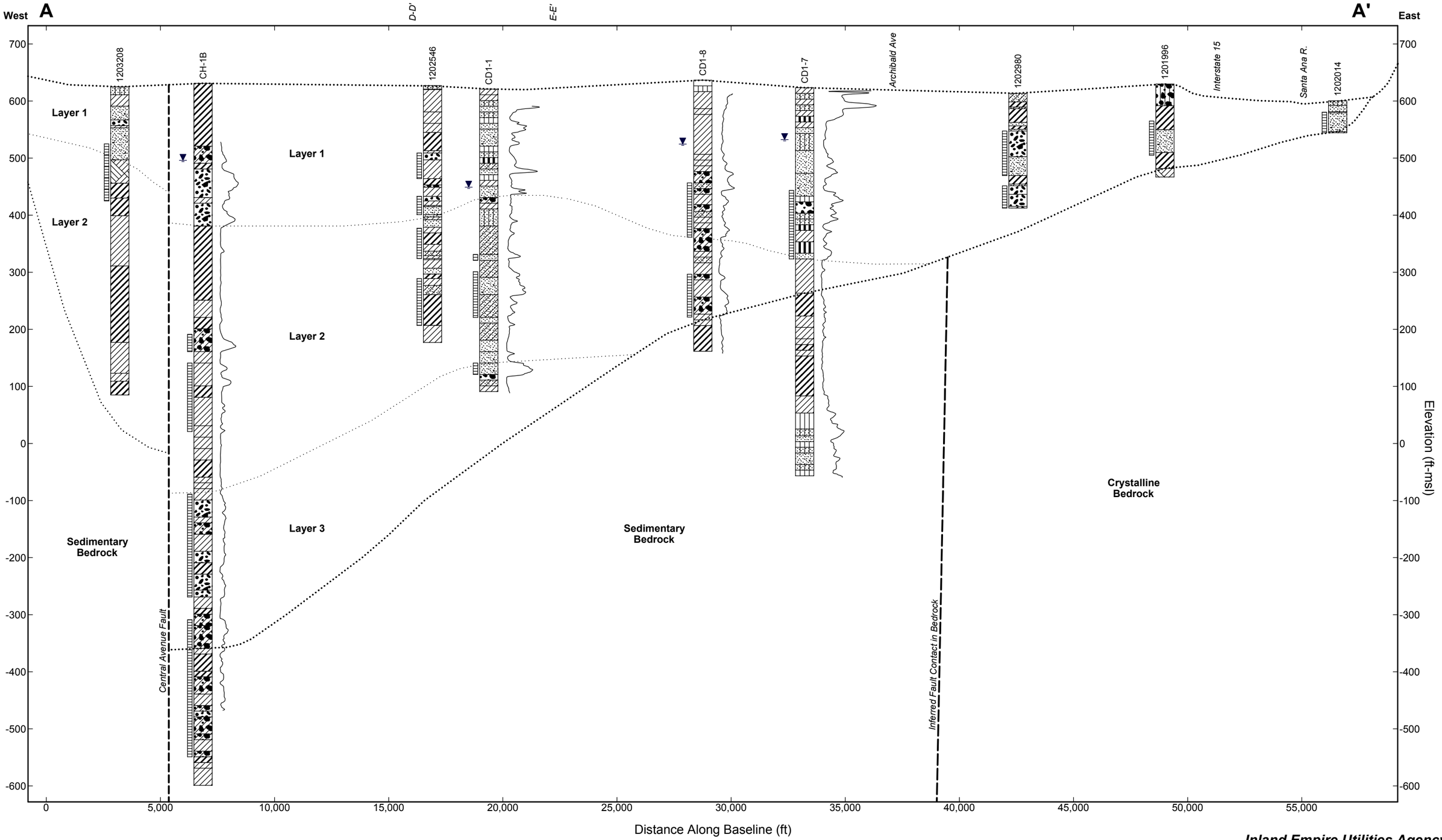
0 1 2 3 4 Miles
0 2 4 6 KM

State of the Basin Report – 2004
Geology and Hydrogeology

Map View of Geologic Cross-Sections

Chino Basin

Figure 2-6



Report: STRAT+GEOPHYSICAL_11X17; File: CROSS-SECTIONS.GPJ; 1/17/2003

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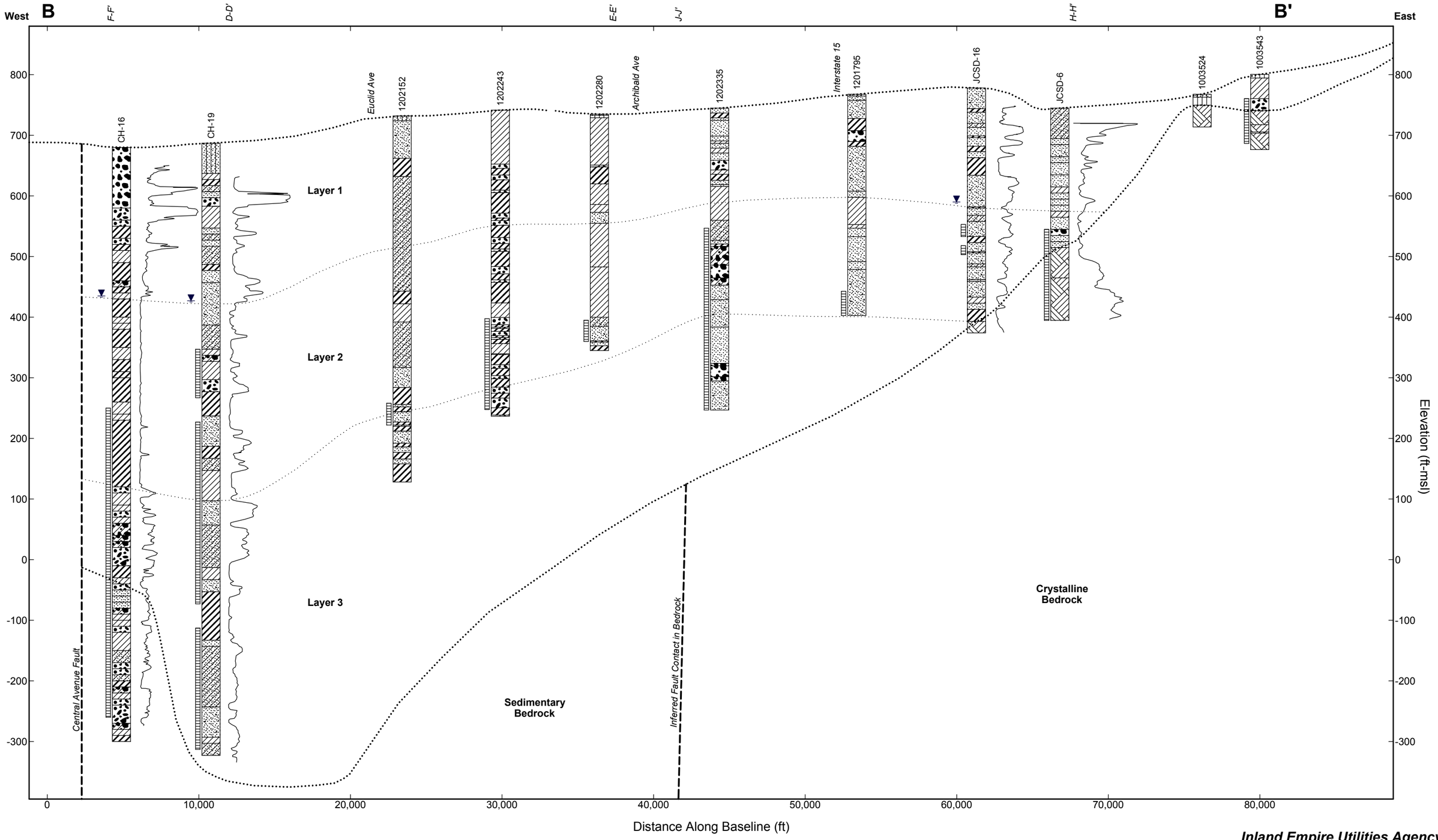
Vertical Scale: 1" = 160'
Horizontal Scale: 1" = 4000'
Vertical Exaggeration = 25:1

High Plasticity Clay
Clayey Gravel
Poorly-graded Gravel
Low Plasticity Clay
Silty Gravel
Well-graded Sand
Bedrock
Silty Sand
Poorly-graded Sand
Well-graded Gravel
Clayey Sand
Low Plasticity Silt
High Plasticity Silt
Well Screen Interval
Water Level (Fall 2000)
16" Short Normal Geophysical Log
Groundwater Model Layer Boundaries
Inferred Fault

Inland Empire Utilities Agency
Chino Basin Watermaster
Chino Basin Dry-Year Yield Program

Cross-Section A-A'

Figure 2-7



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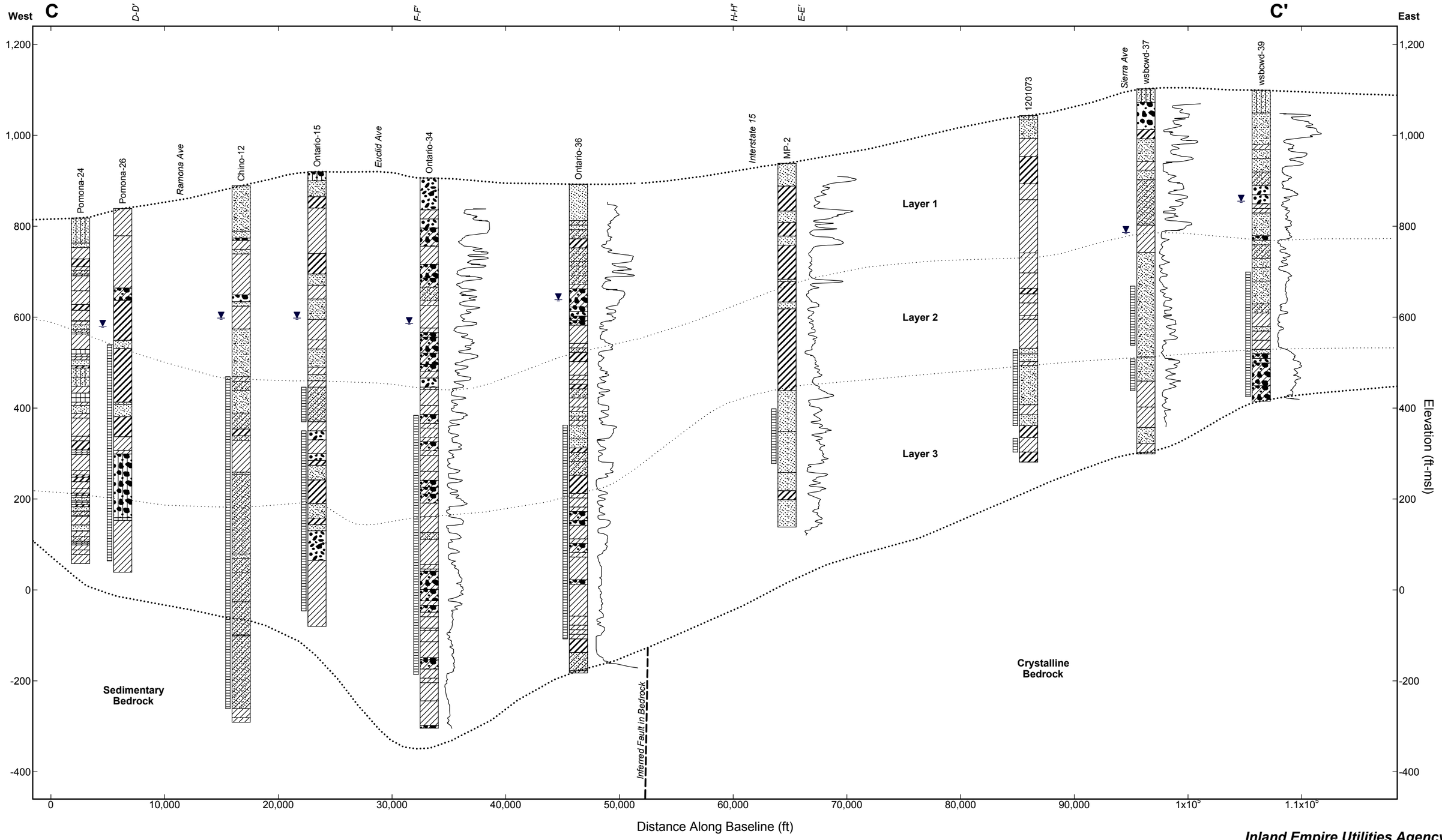
Vertical Scale: 1" = 150'
Horizontal Scale: 1" = 6000'
Vertical Exaggeration = 40:1

Well-graded Sand
High Plasticity Clay
Clayey Sand
Poorly-graded Sand
Low Plasticity Clay
Bedrock
Well-graded Gravel
Silty Sand
Low Plasticity Silt
Poorly-graded Gravel
Clayey Gravel
Well Screen Interval
Water Level (Fall 2000)
16" Short Normal Geophysical Log
Groundwater Model Layer Boundaries
Inferred Fault

Inland Empire Utilities Agency
Chino Basin Watermaster
Chino Basin Dry-Year Yield Program

Cross-Section B-B'

Figure 2-8



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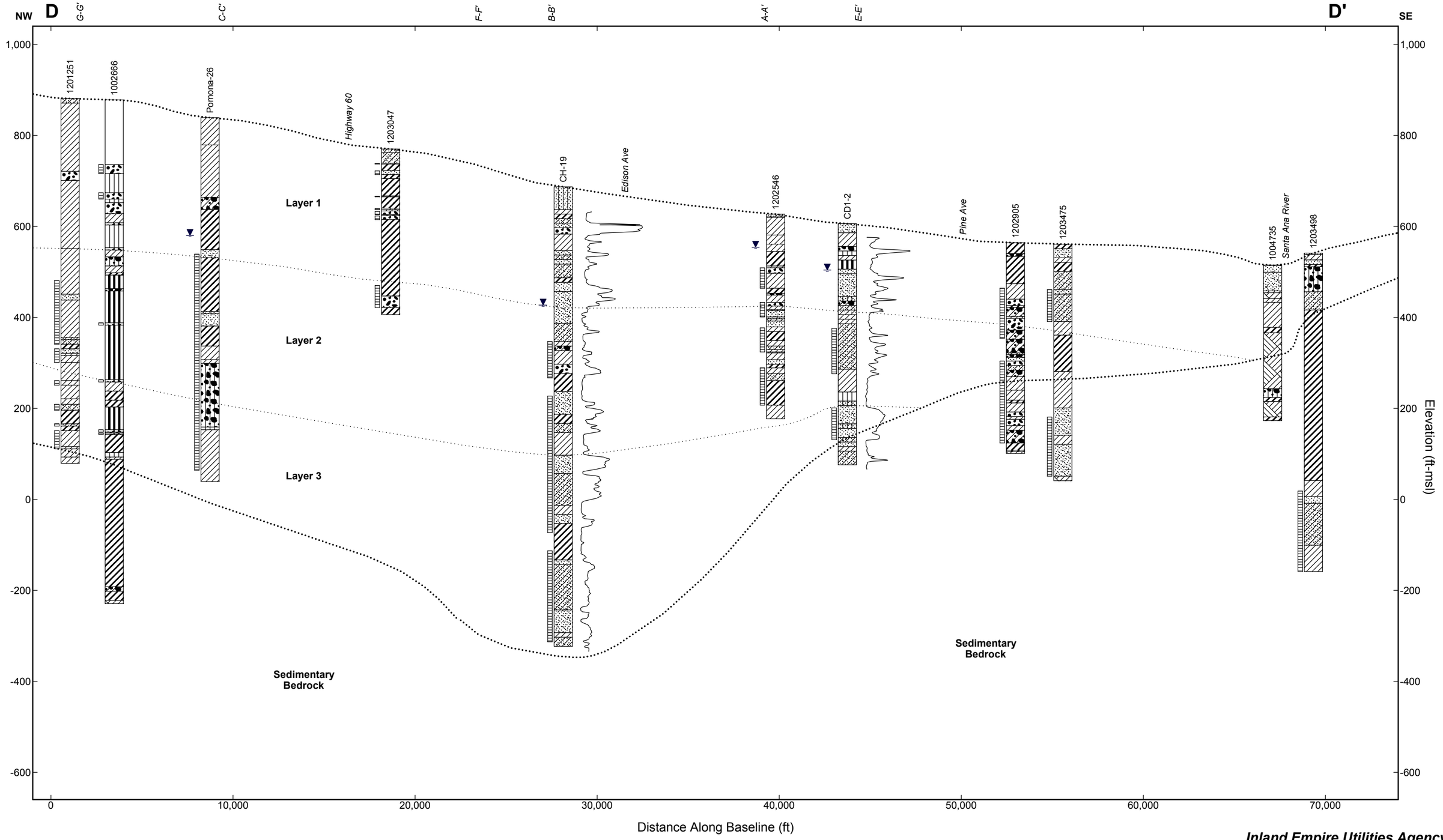
Vertical Scale: 1" = 200'
Horizontal Scale: 1" = 8000'
Vertical Exaggeration = 40:1

Silty Sand
Well-graded Gravel
High Plasticity Clay
Well-graded Sand
Low Plasticity Clay
Clayey Sand
Bedrock
Poorly-graded Gravel
Clayey Gravel
Poorly-graded Sand
Silty Gravel
Low Plasticity Silt
Well Screen Interval
Water Level (Fall 2000)
16" Short Normal Geophysical Log
Groundwater Model Layer Boundaries
Inferred Fault

Inland Empire Utilities Agency
Chino Basin Watermaster
Chino Basin Dry-Year Yield Program

Cross-Section C-C'

Figure 2-9



Report: STRAT+GEOPHYSICAL_11X17; File: CROSS-SECTIONS.GPJ; 1/20/2003

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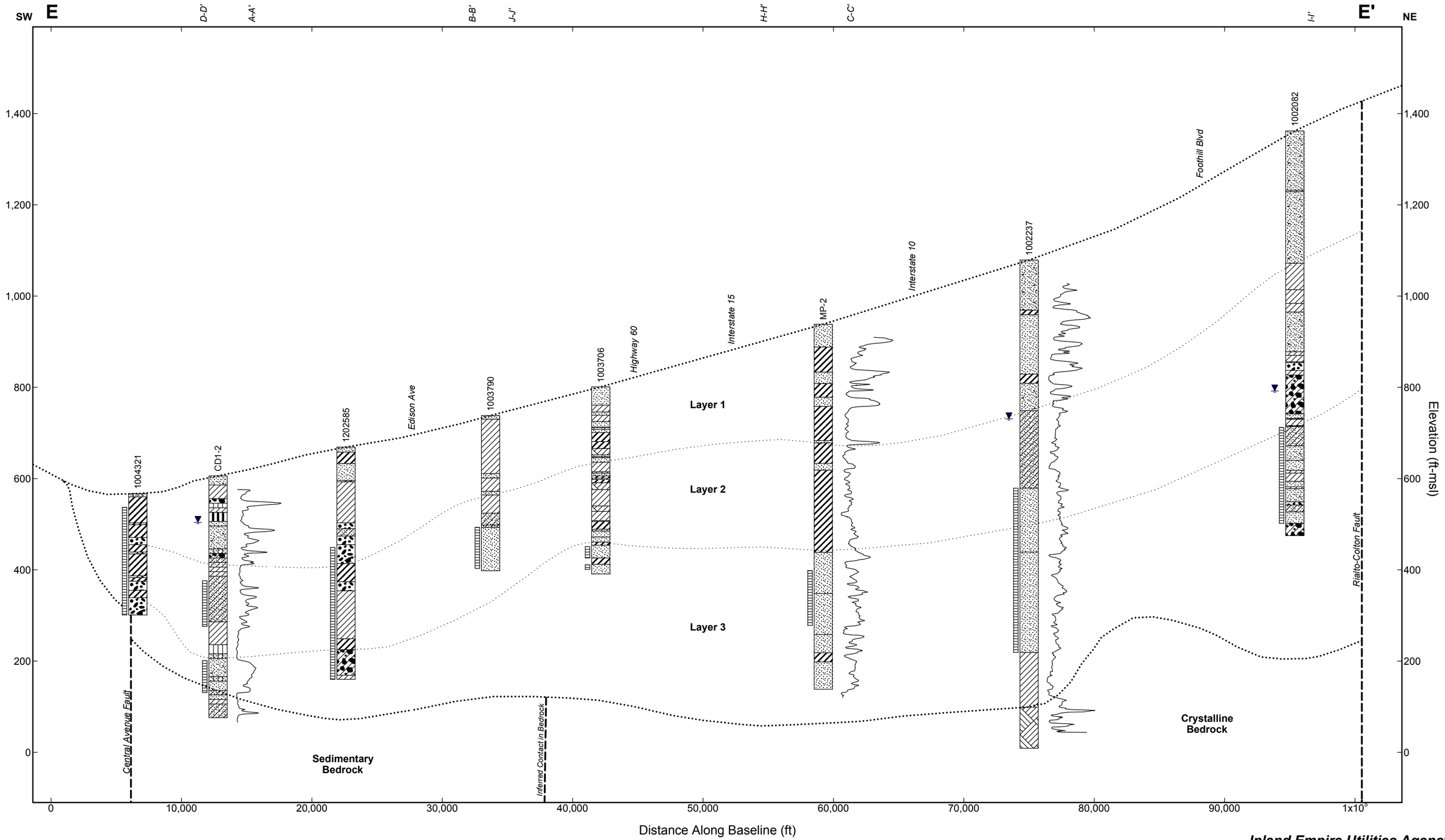
Vertical Scale: 1" = 200'
Horizontal Scale: 1" = 5000'
Vertical Exaggeration = 25:1

- Poorly-graded Gravel
- Low Plasticity Silt
- Low Plasticity Clay
- Silty Gravel
- High Plasticity Clay
- High Plasticity Silt
- Clayey Gravel
- Bedrock
- Well-graded Sand
- Poorly-graded Sand
- Clayey Sand
- Silty Sand
- Well-graded Gravel
- Well Screen Interval
- Water Level (Fall 2000)
- 16" Short Normal Geophysical Log
- Groundwater Model Layer Boundaries
- Inferred Fault

Inland Empire Utilities Agency
Chino Basin Watermaster
Chino Basin Dry-Year Yield Program

Cross-Section D-D'

Figure 2-10



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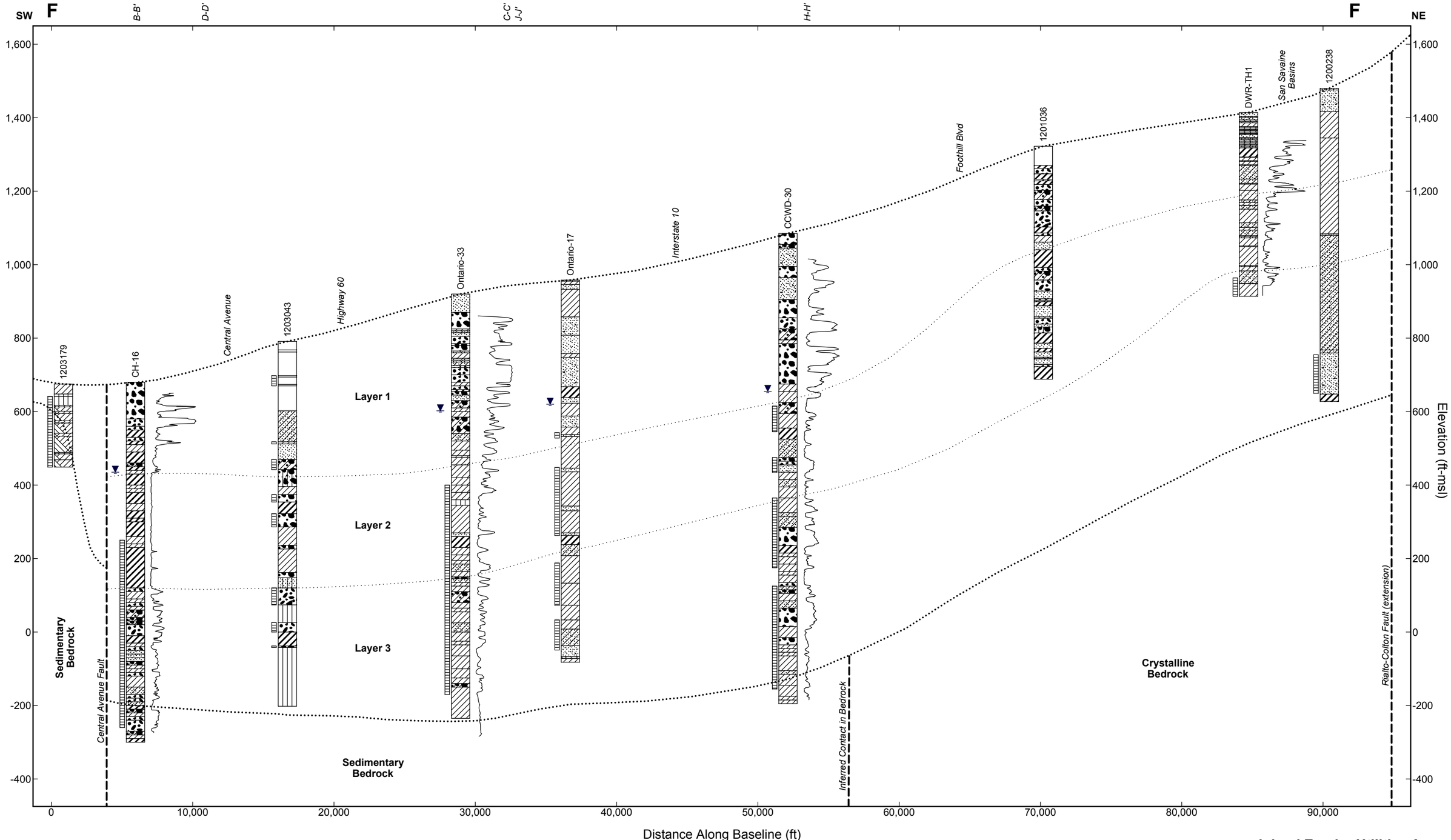
Vertical Scale: 1" = 200'
Horizontal Scale: 1" = 7000'
Vertical Exaggeration = 35:1

- Well-graded Sand
- Low Plasticity Clay
- Poorly-graded Gravel
- Clayey Gravel
- Clayey Sand
- Poorly-graded Sand
- High Plasticity Clay
- Bedrock
- Silty Sand
- Well-graded Gravel
- Low Plasticity Silt
- High Plasticity Silt
- Well Screen Interval
- Water Level (Fall 2000)
- 16" Short Normal Geophysical Log
- Groundwater Model Layer Boundaries
- Inferred Fault

Inland Empire Utilities Agency
Chino Basin Watermaster
Chino Basin Dry-Year Yield Program

Cross-Section E-E'

Figure 2-11



Report: STRAT+GEOPHYSICAL_11X17; File: CROSS-SECTIONS.GPJ; 1/23/2003

Prepared by:

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Vertical Scale: 1 = 250'
Horizontal Scale: 1 = 6500'
Vertical Exaggeration = 26:1

Well-graded Gravel
Clayey Gravel
Well-graded Sand
Poorly-graded Gravel
Low Plasticity Clay
High Plasticity Clay
Clayey Sand
Poorly-graded Sand
Bedrock
Low Plasticity Silt
Silty Sand
Silty Gravel
Well Screen Interval
Water Level (Fall 2000)
16" Short Normal Geophysical Log
Groundwater Model Layer Boundaries
Inferred Fault

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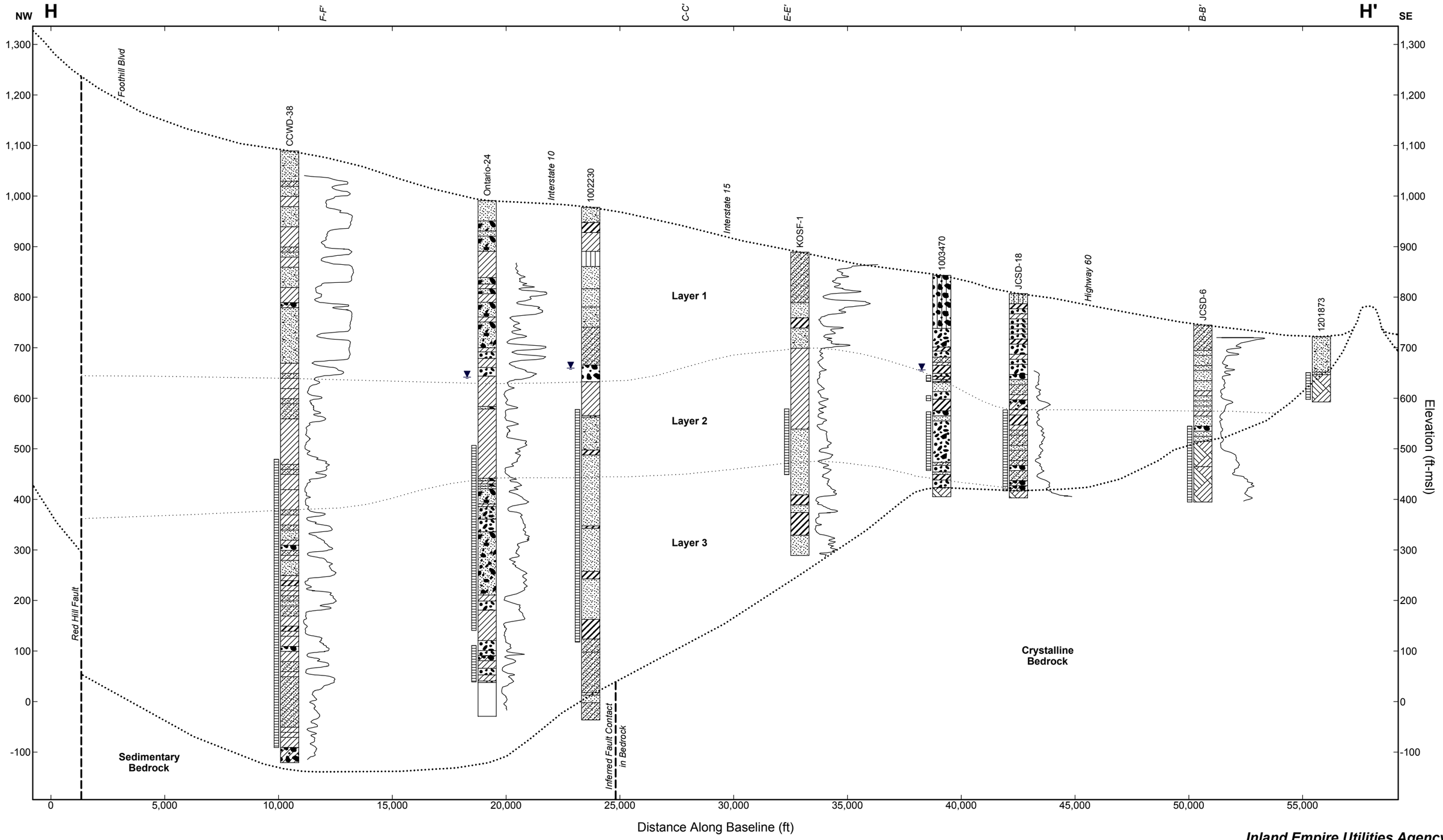
Chino Basin Watermaster
Chino Basin Dry-Year Yield Program

Cross-Section F-F'

Figure 2-12



Report: STRAT+GEOPHYSICAL_11X17; File: CROSS-SECTIONS.GPJ; 3/6/2003

Prepared by:

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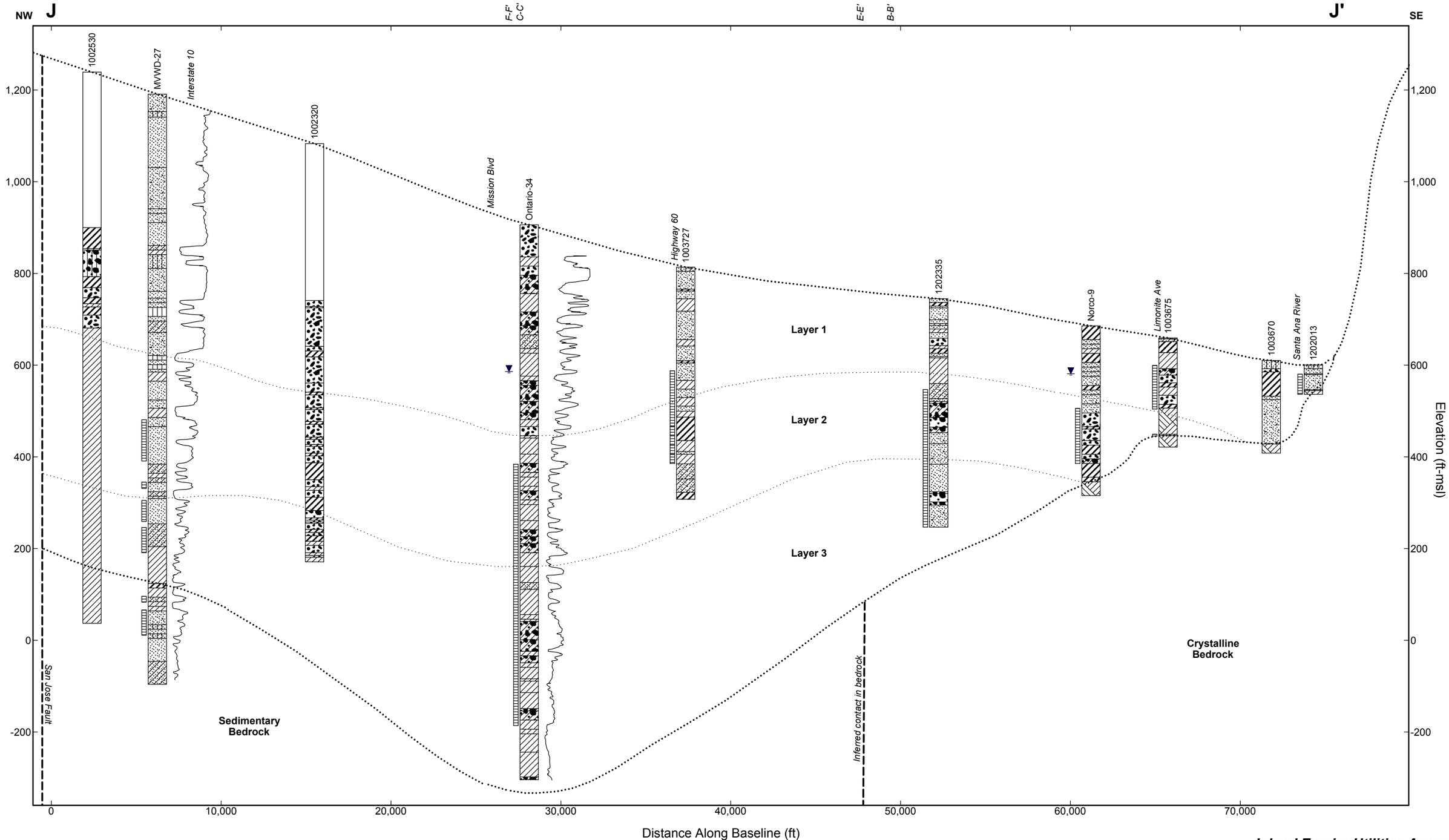
Vertical Scale: 1 = 180'
Horizontal Scale: 1 = 4000'
Vertical Exaggeration = 22:1

- Well-graded Sand
- High Plasticity Clay
- Low Plasticity Clay
- Low Plasticity Silt
- Poorly-graded Sand
- Clayey Sand
- Well-graded Gravel
- Poorly-graded Gravel
- Poorly-graded Gravelly Sand
- Poorly-graded Sandy Gravel
- Clayey Gravel
- Silty Sand
- Bedrock
- Silty Gravel
- Well Screen Interval
- Water Level (Fall 2000)
- 16" Short Normal Geophysical Log
- Groundwater Model Layer Boundaries
- Inferred Fault

Inland Empire Utilities Agency
Chino Basin Watermaster
Chino Basin Dry-Year Yield Program

Cross-Section H-H'

Figure 2-13



Report: STRAT+GEOPHYSICAL_11X17; File: CROSS-SECTIONS.GPJ; 1/27/2003

Prepared by:

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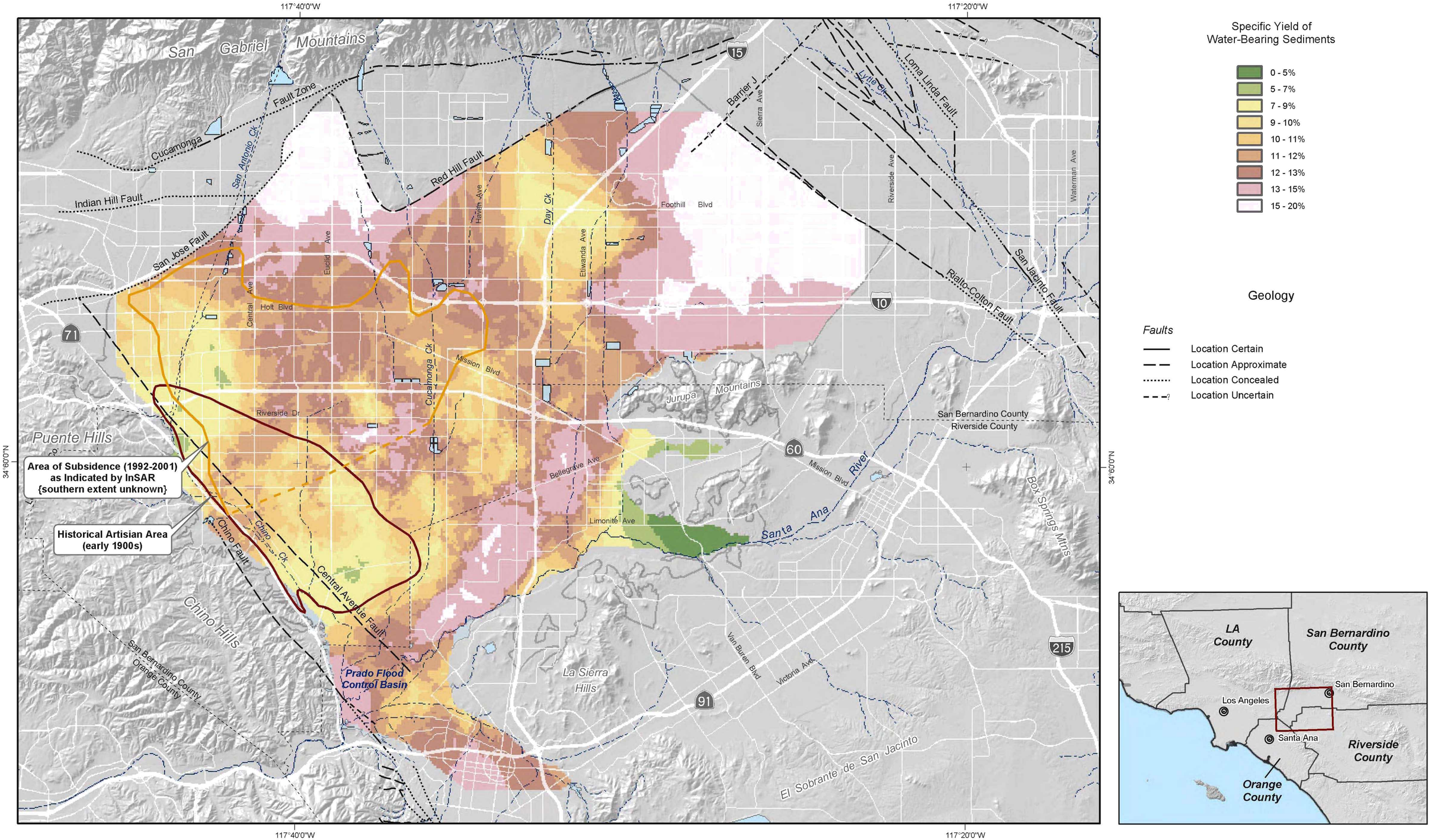
Vertical Scale: 1" = 200'
Horizontal Scale: 1" = 5400'
Vertical Exaggeration = 27:1

- Poorly-graded Gravel
- High Plasticity Clay
- Low Plasticity Clay
- Well-graded Gravel
- Clayey Gravel
- Clayey Sand
- Silty Gravel
- Well-graded Sand
- Bedrock
- Silty Sand
- Poorly-graded Sand
- Low Plasticity Silt
- Well Screen Interval
- Water Level (Fall 2000)
- 16" Short Normal Geophysical Log
- Groundwater Model Layer Boundaries
- Inferred Fault

Inland Empire Utilities Agency
Chino Basin Watermaster
Chino Basin Dry-Year Yield Program

Cross-Section J-J'

Figure 2-14



Specific Yield of Water-Bearing Sediments

- 0 - 5%
- 5 - 7%
- 7 - 9%
- 9 - 10%
- 10 - 11%
- 11 - 12%
- 12 - 13%
- 13 - 15%
- 15 - 20%

Geology

Faults

- Location Certain
- Location Approximate
- Location Concealed
- Location Uncertain

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Date: 20030616
File: figure_2-15.mxd

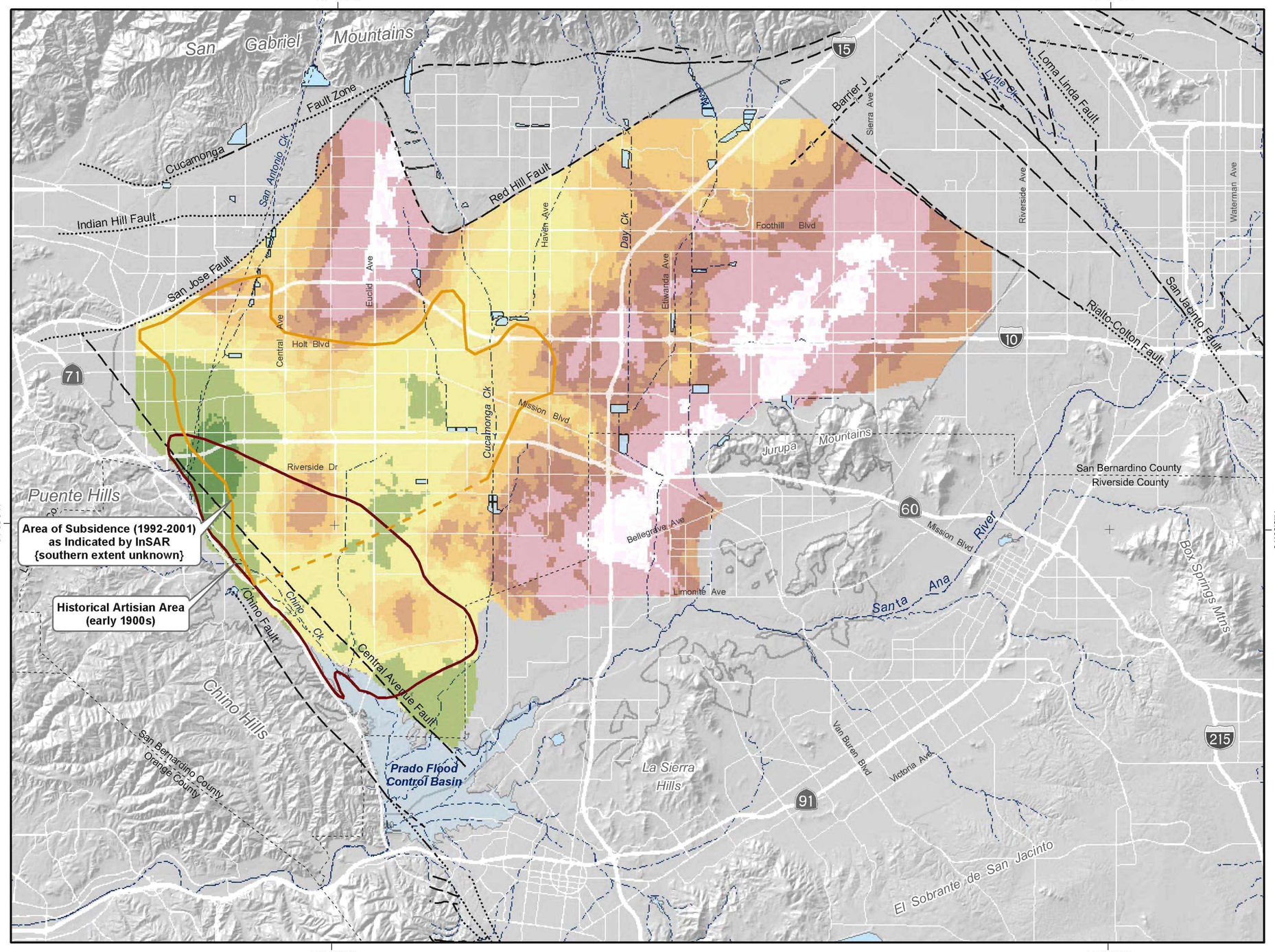
0 1 2 3 4 Miles
0 2 4 6 KM

Chino Basin Dry-Year Yield Program
Geology and Hydrogeology

Average Specific Yield of Sediments

Layer 1

Figure 2-15



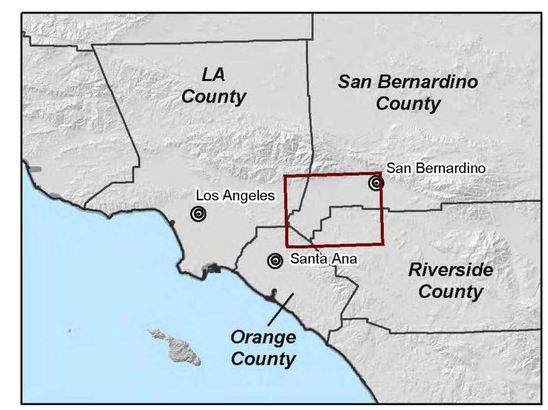
Specific Yield of Water-Bearing Sediments

- 0 - 5%
- 5 - 7%
- 7 - 9%
- 9 - 10%
- 10 - 11%
- 11 - 12%
- 12 - 13%
- 13 - 15%
- 15 - 20%

Geology

Faults

- Location Certain
- Location Approximate
- Location Concealed
- Location Uncertain



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949.498.9294
www.wild-environment.com

Author: AEM/CKM
Date: 20030616
File: figure_2-16.mxd

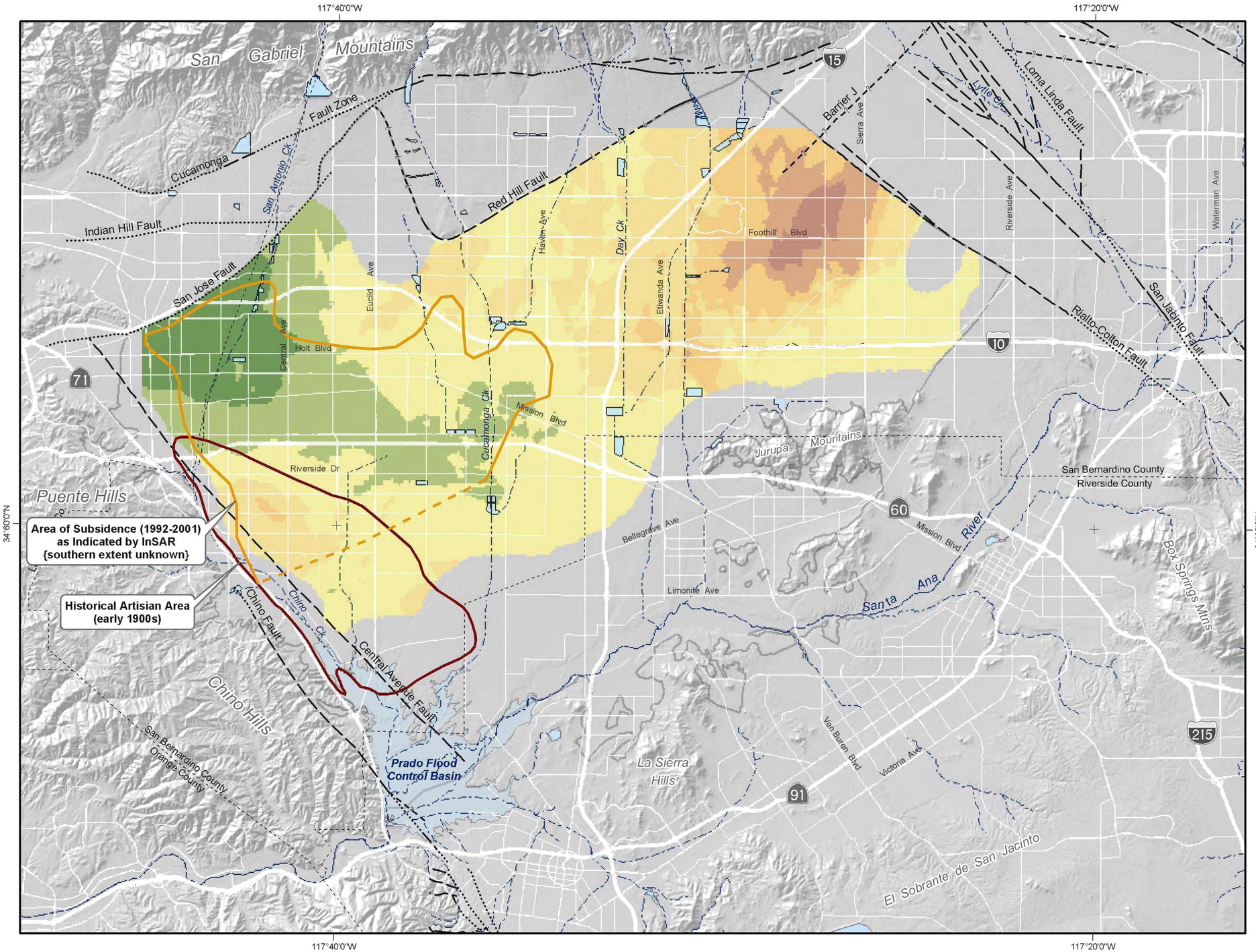
0 1 2 3 4 Miles
0 2 4 6 KM

Chino Basin Dry-Year Yield Program
Geology and Hydrogeology

Average Specific Yield of Sediments

Layer 2

Figure 2-16



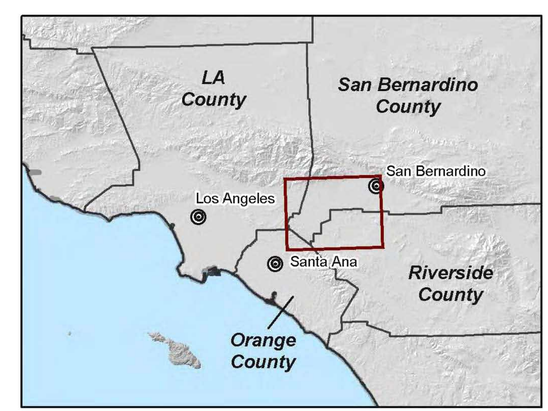
Specific Yield of Water-Bearing Sediments

- 0 - 5%
- 5 - 7%
- 7 - 9%
- 9 - 10%
- 10 - 11%
- 11 - 12%
- 12 - 13%
- 13 - 15%
- 15 - 20%

Geology

Faults

- Location Certain
- Location Approximate
- Location Concealed
- Location Uncertain



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File: figure_2-17.mxd

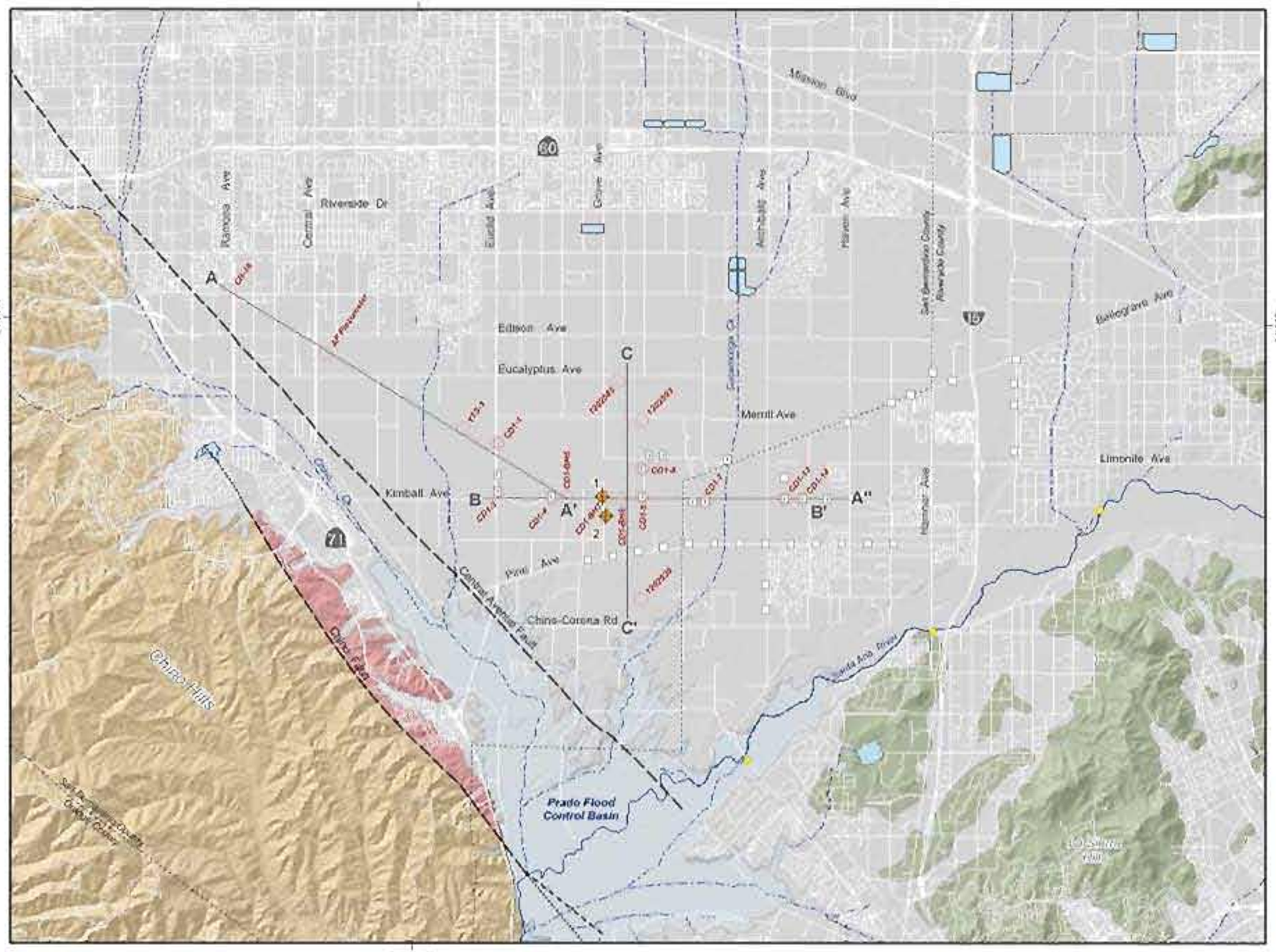
0 1 2 3 4 Miles
0 2 4 6 KM

Chino Basin Dry-Year Yield Program
Geology and Hydrogeology

Average Specific Yield of Sediments

Layer 3

Figure 2-17



Main Features

- Proposed HCMP Piezometric Monitoring Well
- Line of Geologic Cross-Section
- Well/Borehole Used in Cross-Section
- Chino-1 Desalter Well (Existing)
- Chino Desalter Well (Proposed)
- HCMP Surface Water Gaging Station

Geology

Water-Bearing Sediments

- Quaternary Alluvium

Consolidated Bedrock

- Plio-Pleistocene Sedimentary Rocks
- Cretaceous to Miocene Sedimentary Rocks
- Pre-Tertiary Igneous and Metamorphic Rocks

Faults

- Location Certain
- Location Approximate
- Location Concealed
- Location Uncertain

Produced by:

WE Wildermuth Environmental, Inc.

0 1 2 Miles

0 2 4 KM

Chino Basin Hydraulic Control Monitoring Program

Geology and Hydrogeology

Map View of Geologic Cross-Sections

Southern Chino Basin

Figure 2-18

Figure 2-19 Placeholder
(Oversized Plate on CD)

West B A' C-C' B' East

Euclid Ave CD1-3 CD1-4 CD1-BH5 Grove Ave CD1-BH7 CD1-BH8 CD1-5 CD1-7 Cucamonga Creek Archibald Ave CD1-13

Layer 1

Layer 2

Layer 3

Sedimentary Bedrock

Inferred Fault Contact in Bedrock

Crystalline Bedrock

Elevation (ft-msl)

Distance Along Baseline (ft)

Report: STRAT+GEOPHYSICAL_11X17; File: XSECTIONS.GPJ; 9/2/2003

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Vertical Scale: 1 = 100'
Horizontal Scale: 1 = 1500'
Vertical Exaggeration = 15:1

Gravel
Sand
Silt
Clay

Well Screen Interval
Water Level (Spring 2003)
16" Short Normal Geophysical Log

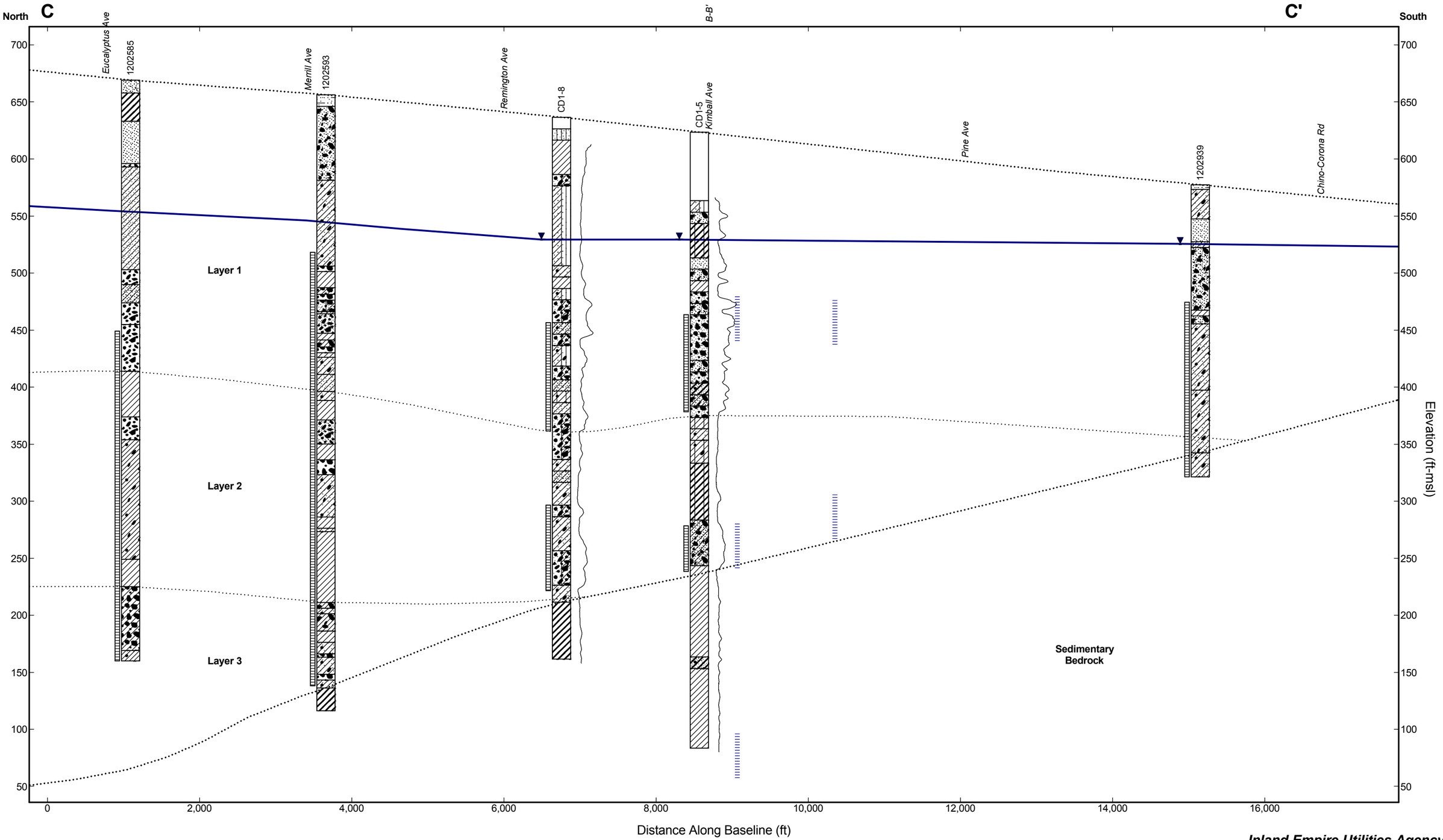
Water Level for Layer 1 (Spring 2003)
Inferred Fault

Groundwater Model Layer Boundaries
Proposed Screen Depth of Monitoring Well

Inland Empire Utilities Agency
Chino Basin Watermaster
Chino Basin Hydraulic Control Monitoring Program

Cross-Section B-B'

Figure 2-20



Report: STRAT+GEOPHYSICAL_11X17; File: XSECTIONS.GPJ; 8/28/2003

Prepared by:

WE Wildermuth Environmental, Inc.
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Vertical Scale: 1 = 80'
Horizontal Scale: 1 = 1200'
Vertical Exaggeration = 15:1

Gravel
Sand
Silt
Clay

Well Screen Interval
Water Level (Spring 2003)
16" Short Normal Geophysical Log

Water Level for Layer 1 (Spring 2003)
Inferred Fault

Groundwater Model Layer Boundaries
Proposed Screen Depth of Monitoring Well

Inland Empire Utilities Agency
Chino Basin Watermaster
Chino Basin Hydraulic Control Monitoring Program

Cross-Section C-C'

Figure 2-21

3. GROUNDWATER BASIN OPERATION AND RESPONSE

3.1 Background

The OBMP states that re-determination of safe yield and estimation of losses from groundwater storage programs requires comprehensive groundwater-level mapping across the Basin, analysis of groundwater-level time histories at wells, and accurate estimations of groundwater production and artificial recharge activities.

Monitoring basin activities such as groundwater production and artificial recharge, and the potential responses to these activities such as changes in groundwater-levels and storage, are key elements of *OBMP Program Element 1 – Develop and Implement a Comprehensive Monitoring Program*. Program Element 1 was developed, in part, to address the first impediment to *OBMP Goal 1 – Enhance Basin Water Supplies*, which can be stated as: "Unless certain actions are taken, safe yield of the Basin will be reduced … due to groundwater outflow from the southern part of the Basin." This impediment speaks to the possibility of increased groundwater outflow to the Santa Ana River as a result of (1) reduced groundwater production in the southern part of the Basin as agricultural land is converted to urban uses, and (2) increased groundwater storage due to other management activities such as artificial recharge and storage and recovery programs. In other words, increased groundwater levels in south Chino Basin (via reduced groundwater production and/or increased groundwater storage) may result in increased discharge of groundwater to the Santa Ana River (i.e. loss of basin yield). The potential loss of safe yield due to these activities will need to be computed periodically and used in the administration of the Judgment – otherwise the basin could be overdrafted.

3.1.1 Groundwater Level Monitoring

Prior to OBMP implementation, groundwater-level monitoring was not adequate. The primary problems with historical groundwater-level monitoring included an inadequate areal distribution of wells in monitoring programs, short time histories, questionable data quality, and insufficient resources to develop and conduct a comprehensive program.

The OBMP defined a new, comprehensive groundwater-level monitoring program. The program start-up occurred in two steps – an initial survey from 1998 to 2001, followed by long-term monitoring at a set of key wells.

3.1.2 Groundwater Production Monitoring

Since the 1978 Judgment was entered, Watermaster has collected information to develop production estimates. Production estimates in the appropriative pool and overlying non-agricultural pool are based on totalizing in-line flow meter data provided to Watermaster on a quarterly basis by these producers. Watermaster aggregates these quarterly values to obtain annual production for producers in these pools. Production estimates for the agricultural pool are based in part on totalizing in-line flow meter data, water duty methods, and hour-meter data combined with well efficiency tests. As with the other pools, reporting had been done by the producers. Historically, however, not all agricultural pool producers have provided Watermaster with estimates of their production.

The OBMP Phase 1 Report defined a production monitoring program wherein all wells that produce more than ten (10) acre-feet per year will have in-line totalizing flow meters installed on them and all meters in the agricultural pool will be read at least annually by Watermaster staff.

3.1.3 Artificial Recharge Monitoring

Artificial recharge monitoring has historically been accomplished using water delivery records supplied by Metropolitan Water District of Southern California for delivery of imported water to the spreading basins. Storm water recharge was incidental to flood control operations, and historically many opportunities to capture storm water were missed. Section 6 of this report details the efforts to increase and monitor storm water recharge as well as the efforts to better monitor and account for imported water recharge in the Chino Basin. As a result, this section of the report will focus primarily on groundwater level monitoring and groundwater production monitoring, with the exception of the discussion of change in basin storage (Section 3.3.3).

3.1.4 Purpose of Monitoring Basin Operations and Response

The data collected from the groundwater-level, groundwater production, and artificial recharge monitoring programs are intended to be used to:

- estimate changes in storage over time, which pertains to future safe-yield computations;
- establish a groundwater-level and groundwater storage baseline for future storage and recovery programs;
- estimate desalter well field impacts on surrounding producers,
- assist in computer simulations of groundwater flow, groundwater quality, stream-aquifer interaction, subsidence, and other phenomena, and
- other purposes as required by the Watermaster.

3.2 Activities and Accomplishments to Date

In the OBMP, Watermaster established a flow meter installation program, a flow meter reading program, and a comprehensive groundwater-level monitoring program for the Chino Basin. The groundwater-level monitoring program has developed into three related efforts: a semiannual basin-wide program; an intensive key well monitoring program associated with the Chino Desalter well fields and the Hydraulic Control Monitoring Program (HCMP); and an intensive piezometric monitoring program associated with the land subsidence and ground fissuring investigations in Management Zone 1 (MZ1).

3.2.1 Meter Installation and Production Monitoring Program

The Watermaster Rules and Regulations require that producers of groundwater in excess of ten (10) acre-feet per year shall install and maintain in good operating condition meters on their well(s). Historically, many agricultural pool wells did not have properly functioning in-line flow meters installed on their discharge pipes, nor did many agricultural pool producers report production estimates to Watermaster on a consistent basis. Hence, Watermaster initiated a meter installation program for agricultural pool wells without properly functioning in-line flow meters, and a flow meter reading program.

In the OBMP, it was estimated that up to 600 private wells would need to be equipped with in-line meters and that Watermaster staff would need to read meters on the private wells at least once a year. Watermaster staff completed meter installation on the majority of these wells and began reading the

meters in 2003. Due to the anticipated conversion of land from agricultural to urban uses, some wells were not metered by 2003. As of June 1, 2005, Watermaster counted about 530 active agricultural wells. About 390 of these wells are now equipped with operating inline flow meters. Watermaster has budgeted to install meters on 30 additional wells during the fiscal year 2005-06. Of the approximately 110 un-metered wells remaining, approximately 65 are wells producing less than 10 acre-feet per year. The other 45 wells are anticipated to become inactive within 18-24 months because of urban development in the southern portion of Chino Basin.

3.2.2 Basin-Wide Groundwater Level Monitoring Program

The objective of the basin-wide groundwater-level monitoring program is to collect groundwater-level data from all wells in the Chino Basin that can be monitored for groundwater-levels. Figure 3-1 shows the locations of wells within this monitoring program. All wells in other groundwater level monitoring programs (see Sections 3.2.3 and 3.2.4 below) are, by definition, also part of the basin-wide monitoring program.

Private wells are monitored for groundwater-levels by Watermaster staff, while the industrial and municipal wells are monitored by the well owners. The data collected by the industrial and municipal users are mailed or faxed to Watermaster along with quarterly groundwater production data, or as otherwise requested by Watermaster. All data collected and received are entered into Watermaster's groundwater-level database.

About 662 wells are monitored as part of the basin-wide program. About 491 wells are private wells measured by Watermaster staff; the remaining 171 wells are measured by the well owners. The frequency of data collection is at least two times per year – once in the spring and once in the fall.

Other sources of groundwater-level data are cooperating agencies that monitor groundwater-levels in Chino Basin. These agencies include:

- California Department of Toxic Substances and Control (Stringfellow Superfund Site);
- Orange County Water District (Prado Basin);
- Santa Ana Regional Water Quality Control Board (various remediation sites);
- USGS (special investigations);
- County of San Bernardino (landfill monitoring); and
- Private consultants (various remediation sites).

3.2.3 Key Well Monitoring Program

Watermaster has developed and implemented a key well monitoring program in the southern portion of Chino Basin. The objective of this program is to increase the measurement frequency and quality of data at a reduced (but representative) network of wells. Most importantly, this network of wells and the monitoring program must satisfy the requirements for the monitoring of Desalter impacts to local

producers and the determination of hydraulic control (see Section 8 for a detailed description of the HCMP).

The criteria used to select the key wells were:

- Wells in the key well program require a spatial distribution such that water elevation contour maps drawn using data from only these wells are comparable to a map that used data from all wells in the following respects: (1) regional (study area) gradients are comparable, and (2) local pumping depressions are represented by the key well program.
- Wells with construction information (perforated intervals) are selected preferentially over other wells.
- The time history of water level at a well is compared to those at adjacent or nearby wells to determine if there are differences in responses to aquifer stresses over time. If so, this may indicate that the adjacent wells are perforated in different aquifer zones, especially on the southwest side of Chino Basin. In that situation, both wells would be retained in the key well program.
- The density of key wells near the desalter well fields would be greater than outlying areas, given that hydraulic gradients are expected to be steeper near the desalter well fields.
- The wells must have access ports for groundwater level sounders and that reference points are marked and well documented.

About 116 wells are included in the key well network. Watermaster staff manually measures water levels at the key wells once per month. Recently, Watermaster staff installed pressure transducers/data loggers in 10 of these key wells to automatically record water levels once every 15 minutes.

3.2.4 MZ-1 Interim Monitoring Program

The MZ-1 Interim Monitoring Program (IMP) is described in detail in Section 5 – Ground-Level Monitoring. Part of this program includes an intensive aquifer-system monitoring element. An aquifer system monitoring facility was constructed in 2002-03 at Ayala Park in Chino, and includes multi-depth piezometers that record depth-specific head once every 15 minutes. In addition, about 25 production wells and monitoring wells surrounding this facility are equipped with pressure transducers that record water levels once every 15 minutes. All these data are uploaded to Watermaster's water level database.

3.3 Results of Groundwater Level and Production Monitoring Programs

3.3.1 Groundwater Production

Table 3-1 lists Watermaster's estimates of Chino Basin production by pool for the period of fiscal year 1974/75 to 2003/04. Figure 3-2 depicts the distribution of production by pool. Over this period, annual groundwater production has ranged from a high of about 187,000 acre-ft (2003/04) to a low of about 123,000 acre-ft (1982/83), and has averaged about 153,000 acre-ft/yr. The distribution of production by pool has shifted since 1975. Agricultural Pool production, mainly concentrated in the southern portion of the basin, dropped from about 55 percent of total production in 1974/75 to about 24 percent in 2003/04. During the same period, Appropriative Pool production, mainly concentrated in the northern (forebay)

portion of the basin, increased from about 40 percent of total production in 1974/75 to 75 percent in 2003/04. The increases in Appropriative Pool production have approximately kept pace with decline in agricultural production. Production in the Overlying Non-Agricultural Pool declined from about 5 percent of total production in 1974/75 to about 2 percent in the mid-1980s, rose to about 4 percent by 1990/91, remained at about 4 percent of total production through 1999/00, and recently decreased to about 2% in 2003/04.

The meter installation program was largely completed in 2003, at which time Watermaster staff began reading the meters quarterly. Review of Table 3-1 shows an increase in production in the Agricultural Pool of over 4,000 acre-ft in 2003/04, despite the known trend of destruction of agricultural wells due to urbanization. Since there were fewer wells in the agricultural pool in 2003/04, this implies that previous production estimates were low. This is most likely due to non-reported and under-reported production (see Sections 3.1.2 and 3.2.1 above).

The OBMP Phase 1 Report notes that underestimation of production occurred in prior years. In it, a comparison of annual groundwater production estimates was made from three different sources including SWRCB filings, Watermaster estimates, and production estimates developed for calibration of the CIGSM model (Chino Basin Water Resources Management Study Task 6 Report, September, 1992). For the common period of record for Watermaster and CBWRMS production estimates (1975 – 1989), the estimated average annual groundwater production was 147,900 acre-ft/yr by Watermaster and 174,000 acre-ft/yr by the CBWRMS—a difference of about 26,000 acre-ft/yr (OBMP Table 2-5).

Figures 3-3 through 3-5 illustrate the location and magnitude of groundwater production at wells in the Chino Basin for years 1978, 2000 and 2003. A closer review of these figures indicates:

- There is an increase in the number of active wells and a decrease in the per-well production between 1978 and 2000 in the southern half of the Basin. This is due to (1) the land use transition from predominately irrigated agriculture to predominately dairy and (2) the Watermaster's well inspection program (implemented in 1992). To explain, typically, irrigated agriculture results in fewer, higher capacity wells per acre compared to dairies that result in a greater number of lower capacity wells per acre. In addition, Watermaster's well inspection program resulted in the documentation of previously unknown wells.
- There is an increase in the number of wells producing over 2,000 acre-feet per year between 1978 and 2000 in the northern half of the Basin. This is consistent with (1) the land use transition from agricultural to urban and (2) the trend of increasing imported water costs. This suggests that increasing imported water costs may have caused Appropriative Pool producers to utilize the Chino Basin as a primary source of water to meet demands, and to purchase less-expensive imported replenishment water through Watermaster.
- There is an increase in the number of wells producing over 1,000 acre-feet per year in the Montclair area (northwest of Central and Holt Avenues) between 2000 and 2003. This is consistent with the trend for increasing imported water costs as indicated above.
- There is an increase in the number of wells producing over 1,000 acre-feet per year in the southern part of the Chino Basin between 2000 and 2003. These wells are primarily wells associated with the Chino-1 Desalter.

- There is a decrease in the number of wells between the Chino Airport and the Santa Ana River (Eastvale area) between 2000 and 2003. This is consistent with the conversion of agricultural to urban land use that has been occurring in the area.
- There is a decrease in the number of wells producing over 1,000 acre-feet per year in the Chino area (south of Riverside Drive, east of the Chino Airport) between 2000 and 2003. This is consistent with implementation of the MZ1 Interim Plan to reduce (or forebear) pumping by up to 3,000 acre-feet per year in this area.

3.3.2 Fall 2003 Groundwater Levels

The data collected from the various groundwater-level monitoring programs described in Section 3.2 were used to create a groundwater-level elevation contour map of Chino Basin for Fall 2003 (Figure 3-6). The procedures used to create this map are:

1. Extract the entire time history of groundwater-level data from the database for all wells in the Chino Basin.
2. Plot groundwater elevation time histories for all wells versus an accumulative departure from the mean (ADFM) curve (Appendix B).
3. Choose one "static" groundwater-level elevation data point per well for the Fall 2003 period.
4. Plot groundwater-level elevation data on maps with background geologic/hydrologic features.
5. Contour and digitize groundwater elevation data.

The groundwater elevation contours for Fall 2003 are shown in Figure 3-6, and are generally consistent with past groundwater elevation contour maps (for example, Figure 3-7 shows groundwater elevation contours for Fall 2000). Figures 3-6 and 3-7 both show that groundwater generally flows in a south-southwest direction – from the primary areas of recharge in northern parts of Chino Basin toward Prado Flood Control Basin in the south. Notable pumping depressions in the groundwater-level surface that interrupt the general flow pattern are in the northern portion of MZ-1 (Montclair and Pomona areas) and directly southwest of the Jurupa Hills. The Fall 2003 map also shows an incipient depression in groundwater levels surrounding the Chino-1 Desalter well field – a probable result of production at these wells beginning in 2000.

Close inspection of the groundwater-level data used to construct Figure 3-6 suggests the existence of hydraulically-distinct aquifer systems – primarily in MZ-1 and the western parts of MZ-2. Previous investigations have concluded that two or more distinct aquifer systems exist in Chino Basin – a shallow un-confined to semi-confined aquifer and deeper confined aquifers. The high density of wells sampled for water levels has revealed that adjacent wells sometimes have water-level differences on the order of 50-100 feet (Appendix A). For areas with significant piezometric level differences among underlying aquifers, the groundwater levels shown in Figure 3-6 correspond to the upper-most aquifer-system.

3.3.3 Changes in Groundwater Storage

Groundwater-level, production and artificial recharge data can be used to determine changes in groundwater storage in Chino Basin over time, which, in turn, will be used in future safe-yield computations. Accordingly, two methods were used to evaluate the change in groundwater storage in the Chino Basin between 2000 and 2003. The first method calculates the change in storage based on known

physical activities (basin operations), such as production and recharge tracked by Watermaster. The second method uses a Geographic Information System (GIS) to estimate change in storage based on changes in groundwater levels.

3.3.3.1 Change in Storage Based on Basin Operations

Table 3-1 shows the annual change in storage in the Chino Basin for the period 1974-75 to 2003-04. The annual change in storage is calculated by adding the safe yield to water recharged to the basin from imported and recycled sources (replenishment water, cyclic or conjunctive use water, and recycled water), and subtracting all water produced from the basin. All water artificially recharged to the basin is listed in the columns under the "Wet Water Recharge" heading. All water actually pumped from the basin is listed in the columns under the "Pumping" heading. There are no exchanges or transfers of water included in these numbers which were extracted from Watermaster assessment packages and annual reports.

The annual changes in storage listed in Table 3-1 show that before the Judgment was entered in 1978, storage decreased in the Chino Basin each year. After implementation of the Judgment, Watermaster operations, included importing and recharging water, resulted in an increase in storage for each year between 1979 and 1987. From 1999 through 2004, storage again decreased each year. For the period 2000 through 2003, the cumulative decrease in storage was approximately -79,000 acre-feet

3.3.3.2 Change in Storage Based on Change in Water-Levels

Watermaster has developed a GIS model to estimate storage changes from groundwater level data. In preparing this model, Watermaster compiled a comprehensive library of well driller's and geophysical logs for wells in Chino Basin. The geologic descriptions of borehole cuttings, and associated depth intervals, were digitized and added to Watermaster's database. All geologic descriptions were then assigned a value of specific yield based on US Geological Survey (USGS) estimates (Johnson, 1967). These data were then used to estimate average specific yield for each model layer across Chino Basin (see Section 2 and Figures 2-15 to 2-17).

The storage change model and the procedures to estimate storage change are summarized below:

- create groundwater elevation contour maps of Chino Basin for the beginning and ending of the period for which a storage change will be estimated (e.g., Fall 2000 and Fall 2003)
- create three-dimensional surfaces (ESRI grid) of groundwater elevation contour maps
- create a 400-meter by 400-meter grid of Chino Basin
- assign attributes to each grid cell in 400-meter grid for (1) surface area of grid cell and (2) overlying management zone (3) beginning groundwater elevation surface (Fall 2000), (4) ending groundwater elevation surface (Fall 2003), (5) top and bottom elevations for the model layers, and (6) specific yield of sediments for each model layer
- export attribute table of 400-meter grid to spreadsheet format for calculation of volumetric storage change

Figure 3-8 shows the 400x400-meter grid symbolized by storage change between Fall 2000 and Fall 2003. Basin-wide, the groundwater storage model estimates that storage decreased by about 93,000 acre-

feet over this three-year period. Inspection of Figure 3-8 shows that sub-areas that experienced a decrease in storage are:

- in the northwest, near Pomona and Montclair
- in the northeast, near Fontana and eastern Ontario and Rancho Cucamonga
- near the Chino-1 Desalter well field, which began producing water in 2000

Sub-areas that experienced an increase in storage are:

- in the southwest near Chino
- in the south, just north of the Santa Ana River where many agricultural wells are being destroyed as urban land uses replace agricultural

3.3.3.3 Difference in Change in Storage Results

The estimated decrease in storage due to basin operations compares well to the results of estimating the decrease in storage based on the change in water levels for the period 2000 to 2003. The difference between the results of using the two methods to estimate the change in storage could be due to a number of reasons:

- the small difference in the periods evaluated
- imperfect knowledge of Chino Basin geology
- inconsistencies and inaccuracies in the measurement of water levels across the basin
- un-reported or mis-reported groundwater production
- addition and loss of wells (water level data) which can lead to inconsistencies in the contouring of water levels
- inconsistencies in the extrapolation of water level estimates from areas with measurements toward the basin boundaries where there is no water level data

As Watermaster continues to improve the quality of its production monitoring, recharge monitoring, and groundwater level monitoring, the quality and accuracy of estimating storage changes will also improve (see Section 3.4 below).

3.4 Ongoing and Recommended Activities

3.4.1 Groundwater Production Monitoring

Watermaster will re-evaluate the status of the approximately 45 un-metered wells producing more than 10 acre-feet per year remaining in the agricultural pool as of June 1, 2005 at the end of fiscal year 2006. If it is determined that conversion from agricultural to urban use is still anticipated within the next twelve (12) months, the wells will remain un-metered. Watermaster will budget for and install meters on wells where it is determined the land use conversion will not occur during fiscal year 2007.

Additionally, Watermaster staff will continue to read all meters on agricultural pool wells at least once quarterly.

3.4.2 Groundwater Level Monitoring

Watermaster will continue to expand the use of pressure transducers/data loggers at:

- wells within the key well network in southern Chino Basin
- selected wells in the northern portions of Chino Basin

Water level recording transducers provide highly-detailed groundwater level data that can reveal aquifer-system details (e.g. groundwater barriers, head responses to nearby pumping) that are not typically revealed or provided through analysis of infrequent (semi-annual, or even monthly) water level data.

In addition, nine nested sets of monitoring wells are currently being installed in the southern Chino Basin for the HCMP (see Section 8), and will be equipped with transducers as well.

Additional monitoring wells will likely need to be constructed in southern Chino Basin as more private wells (that are currently within the key well program) are destroyed. This recommendation will likely be associated with interim findings of the HCMP.

Table 3-1
Change in Storage Time History

Fiscal Year	Safe Yield	Wet Water Recharge					Pumping								Change in Storage	
												Distribution by Pool (% of Total)				
		Replenish	Cyclic or Conj Use	Supplement	Recycled	Total	Appropriative Pool	Agricultural Pool	Overlying Non-Ag Pool	Desalter	Total	Appropriative Pool	Agricultural Pool	Overlying Non-Ag Pool	Annual	2000-03
1974 - 1975	140,000					0	70,312	96,567	8,878	0	175,757	40%	55%	5%	-35,757	
1975 - 1976	140,000					0	79,312	95,349	6,356	0	181,017	44%	53%	4%	-41,017	
1976 - 1977	140,000					0	72,707	91,450	9,198	0	173,355	42%	53%	5%	-33,355	
1977 - 1978	140,000	10,680	0	0	0	10,680	60,659	83,934	10,082	0	154,675	39%	54%	7%	-3,995	
1978 - 1979	140,000	12,638	15,757	0	0	28,395	60,597	73,688	7,127	0	141,412	43%	52%	5%	26,983	
1979 - 1980	140,000	2,507	14,243	0	0	16,751	63,834	69,369	7,363	0	140,566	45%	49%	5%	16,185	
1980 - 1981	140,000	12,228	8,662	0	0	20,890	70,726	68,040	5,650	0	144,416	49%	47%	4%	16,474	
1981 - 1982	140,000	16,609	5,047	0	0	21,656	66,731	65,117	5,684	0	137,532	49%	47%	4%	24,124	
1982 - 1983	140,000	13,188	15,501	0	0	28,689	63,481	56,759	2,395	0	122,635	52%	46%	2%	46,054	
1983 - 1984	140,000	13,777	7,960	0	0	21,737	70,558	59,033	3,208	0	132,799	53%	44%	2%	28,938	
1984 - 1985	140,000	12,188	8,709	0	0	20,897	76,912	55,543	2,415	0	134,870	57%	41%	2%	26,027	
1985 - 1986	140,000	16,332	2,095	0	0	18,427	80,859	52,061	3,193	0	136,113	59%	38%	2%	22,314	
1986 - 1987	140,000	10,086	9,921	0	0	20,007	84,662	59,847	2,559	0	147,068	58%	41%	2%	12,939	
1987 - 1988	140,000	2,494	0	0	0	2,494	91,579	57,865	2,958	0	152,402	60%	38%	2%	-9,908	
1988 - 1989	140,000	7,407	0	0	0	7,407	93,617	46,762	3,619	0	143,998	65%	32%	3%	3,409	
1989 - 1990	140,000	0	0	0	0	0	101,344	48,420	4,856	0	154,620	66%	31%	3%	-14,620	
1990 - 1991	140,000	3,291	503	0	0	3,793	86,658	48,085	5,407	0	140,150	62%	34%	4%	3,643	
1991 - 1992	140,000	3,790	1,761	0	0	5,551	91,982	44,682	5,240	0	141,904	65%	31%	4%	3,647	
1992 - 1993	140,000	12,535	1,677	0	0	14,212	86,367	44,092	5,464	0	135,923	64%	32%	4%	18,289	
1993 - 1994	140,000	8,859	7,634	0	0	16,493	80,798	44,298	4,586	0	129,682	62%	34%	4%	26,811	
1994 - 1995	140,000	0	10,300	0	0	10,300	93,419	55,022	4,327	0	152,768	61%	36%	3%	-2,468	
1995 - 1996	140,000	82	0	0	0	82	101,606	43,639	5,424	0	150,669	67%	29%	4%	-10,587	
1996 - 1997	140,000	0	17	0	0	17	110,163	44,809	6,309	0	161,281	68%	28%	4%	-21,265	
1997 - 1998	140,000	8,323	0	0	0	8,323	97,435	43,344	4,955	0	145,734	67%	30%	3%	2,589	
1998 - 1999	140,000	5,697	0	0	0	5,697	107,723	47,538	7,006	0	162,267	66%	29%	4%	-16,570	
1999 - 2000	140,000	1,001	0	0	507	1,508	126,645	44,401	7,774	0	178,820	71%	25%	4%	-37,312	
2000 - 2001	140,000	30	0	6,500	500	7,030	113,437	39,954	8,084	7,989	169,464	70%	25%	5%	-22,434	-22,434
2001 - 2002	140,000	0	0	6,500	505	7,005	121,489	39,494	5,548	9,458	175,989	73%	24%	3%	-28,984	-28,984
2002 - 2003	140,000	0	0	6,499	185	6,684	121,586	37,457	4,853	10,439	174,335	74%	23%	3%	-27,651	-27,651
2003 - 2004	140,000	4,024	2,463	3,558	48	10,093	131,340	41,978	2,915	10,605	186,838	75%	24%	2%	-36,745	
Totals	4,200,000	177,766	112,249	23,057	1,745	314,817	2,678,538	1,698,597	163,433	38,491	4,579,059				-64,242	-79,069
Average	140,000	6,584	4,157	854	65	11,660	89,285	56,620	5,448	1,283	152,635	59%	38%	4%		
Max	140,000	16,609	15,757	6,500	507	28,689	131,340	96,567	10,082	10,605	186,838	75%	55%	7%		
Min	140,000	0	0	0	0	0	60,597	37,457	2,395	0	122,635	39%	23%	2%		

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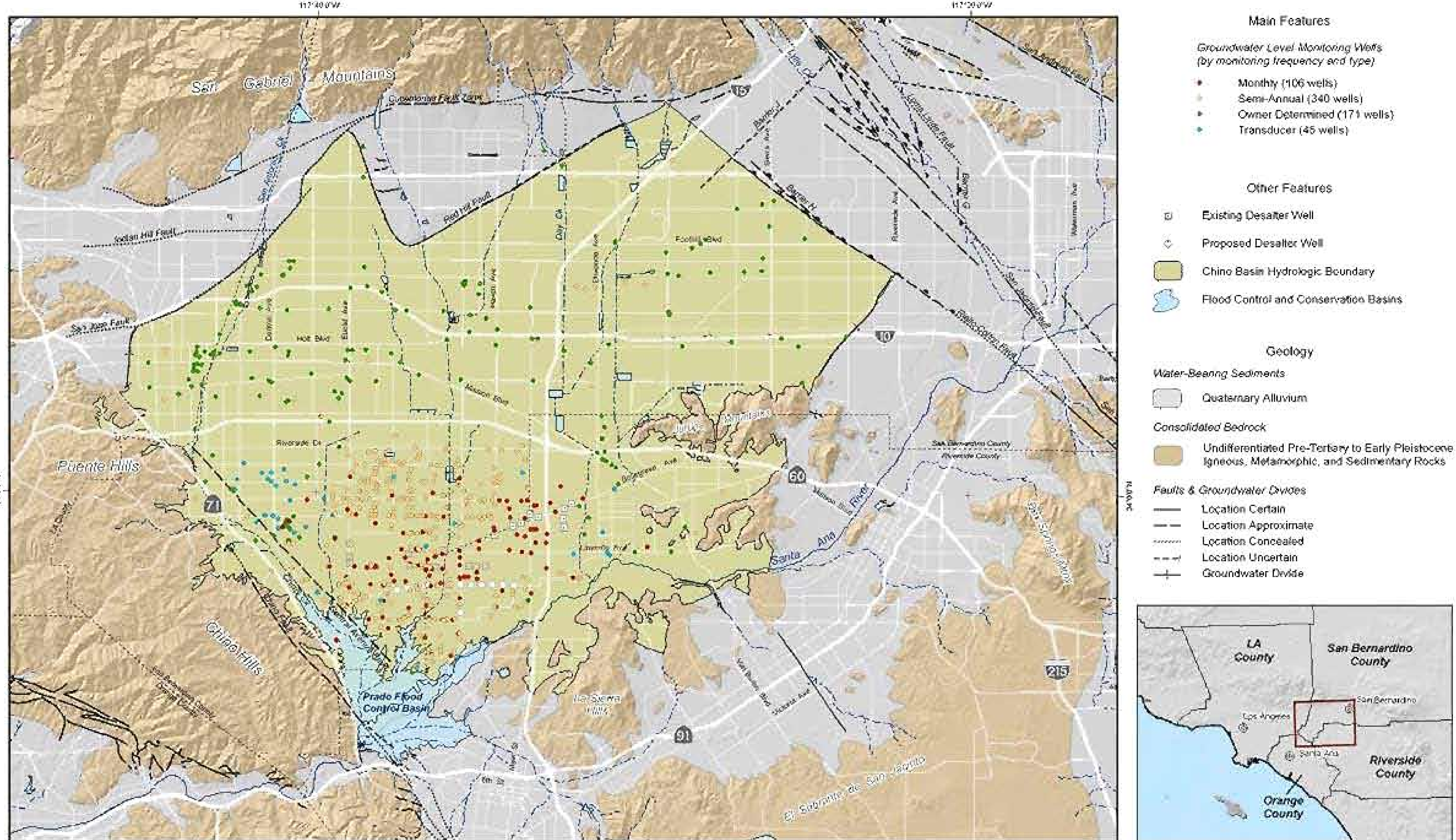

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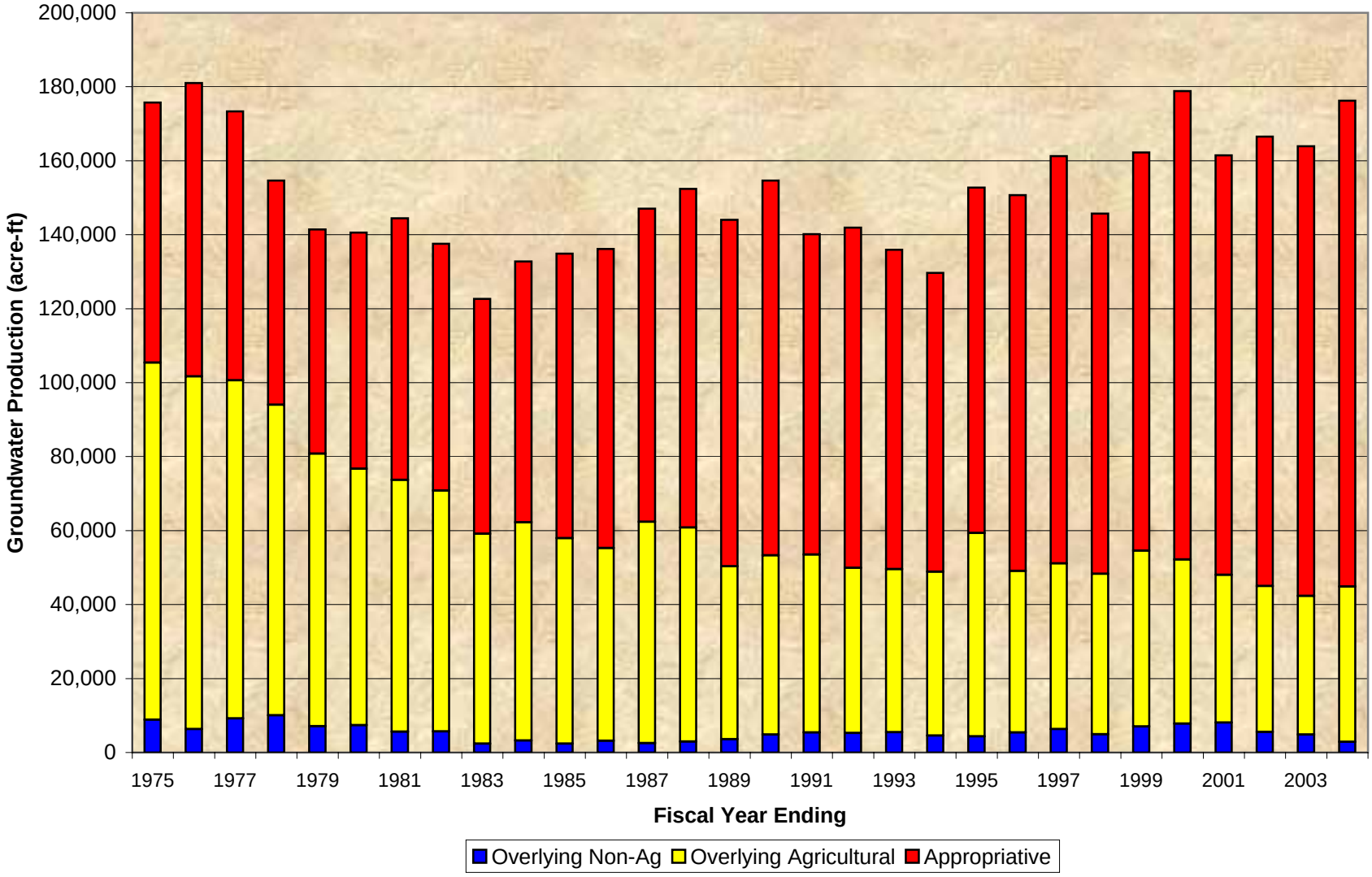
State of the Basin Report – 2004
Groundwater Levels

Groundwater Level Monitoring Network
Wells By Sampling Frequency

Figure 3-1

Figure 3-2
Distribution of Groundwater Production by Pool



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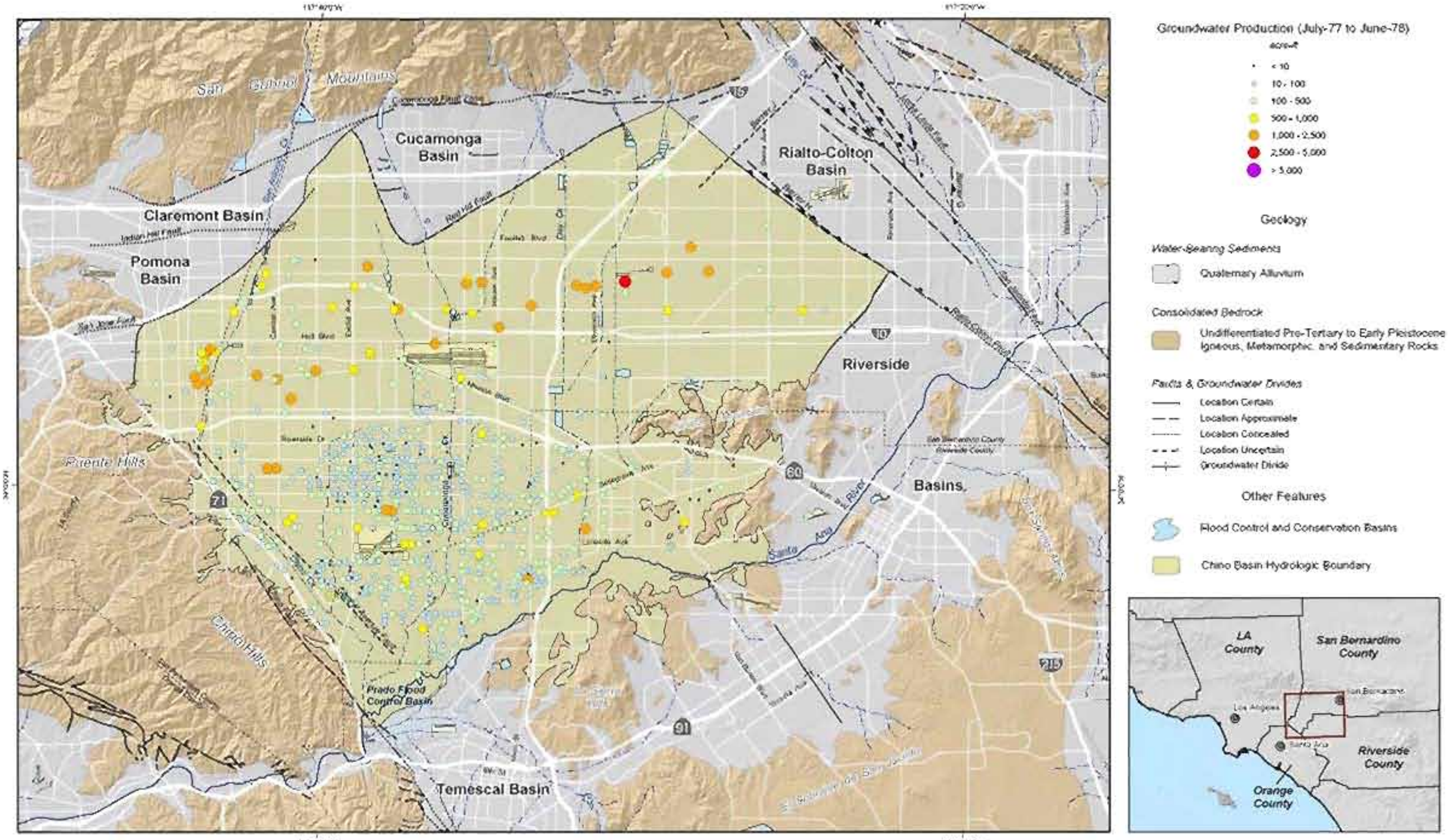

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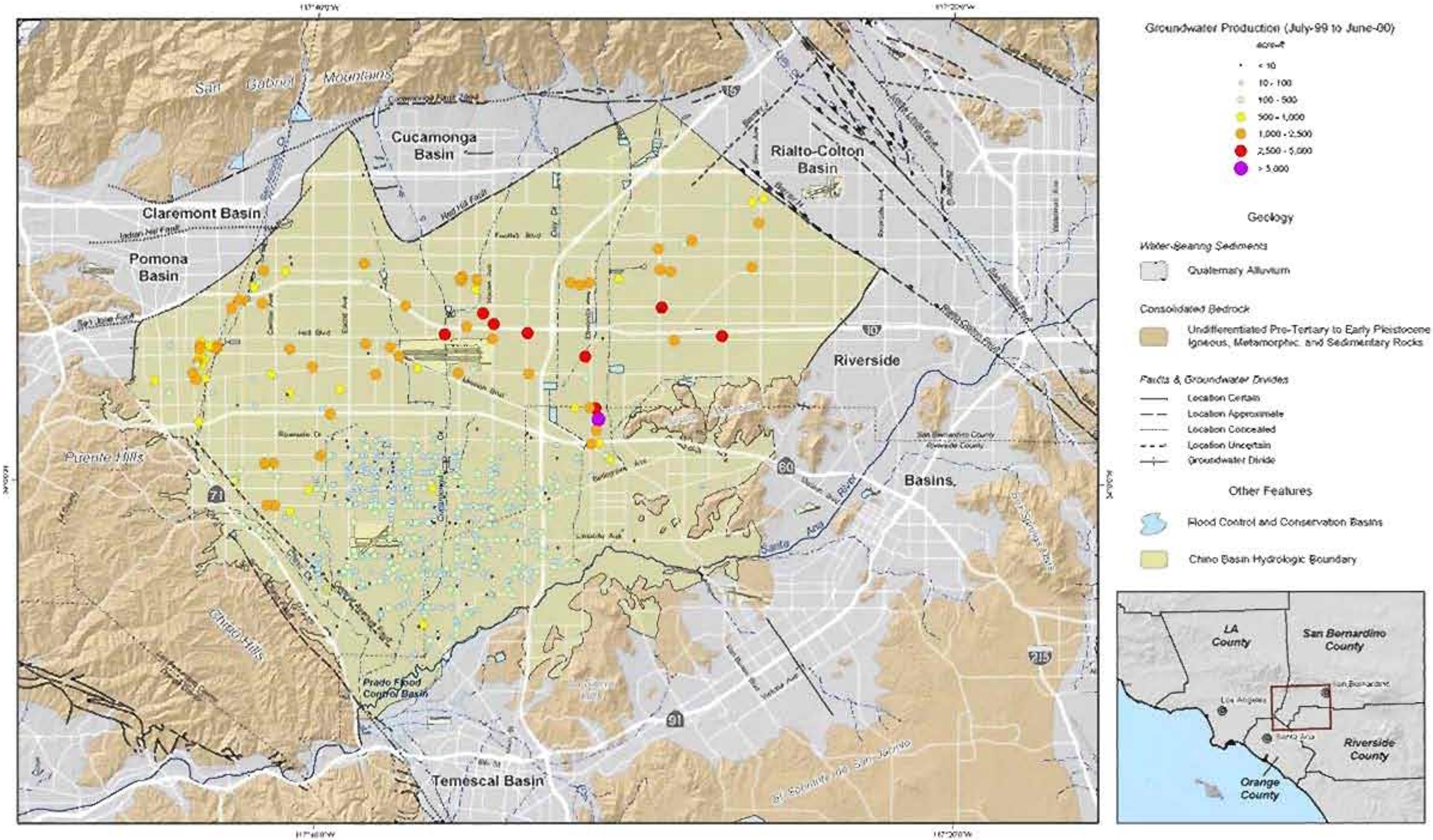
State of the Basin Report – 2004
Groundwater Basin Operation and Response

Groundwater Production by Well
Fiscal Year 1978

Figure 3-3



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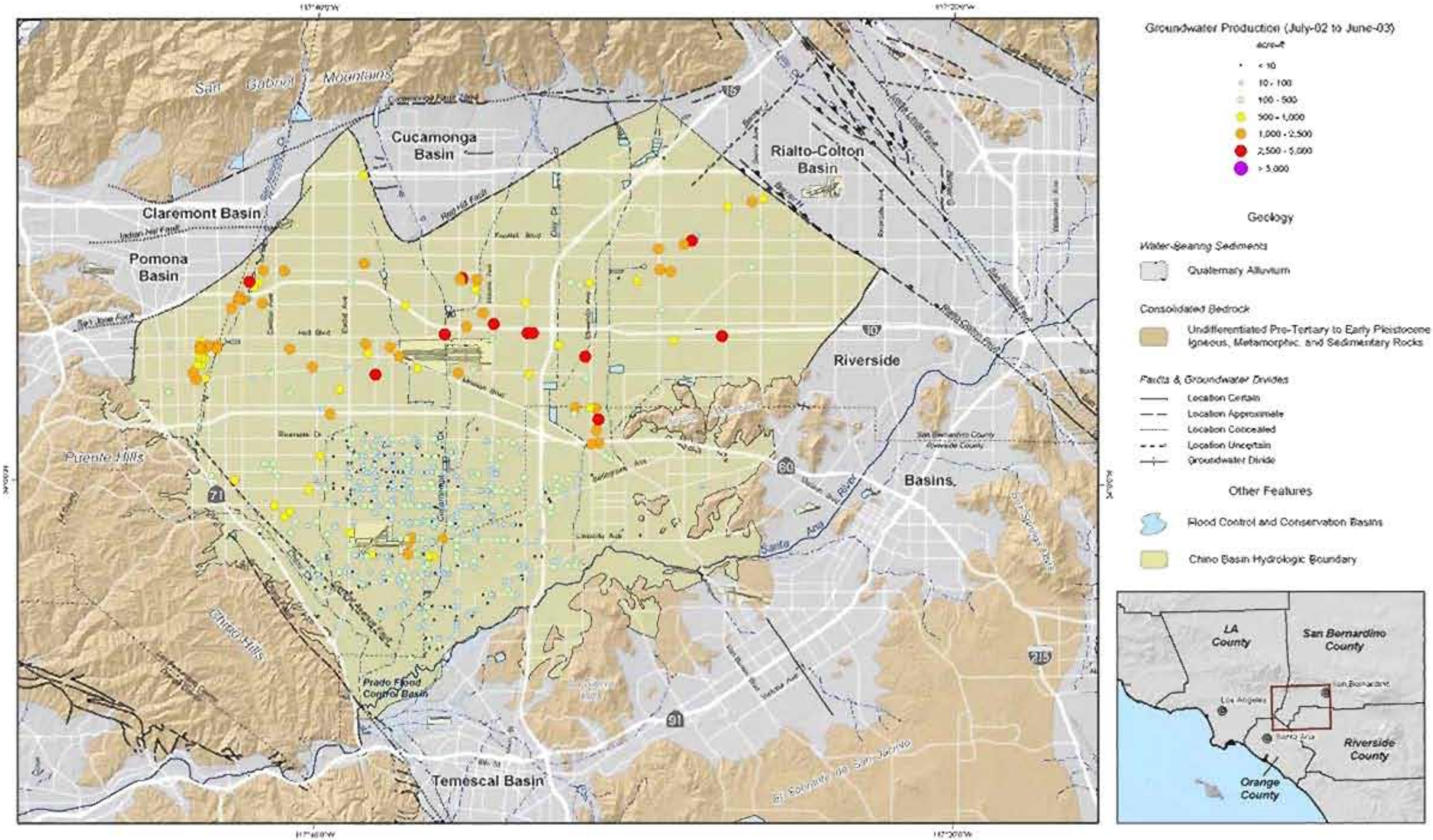
State of the Basin Report – 2004
Groundwater Basin Operation and Response

Groundwater Production by Well

Fiscal Year 2000

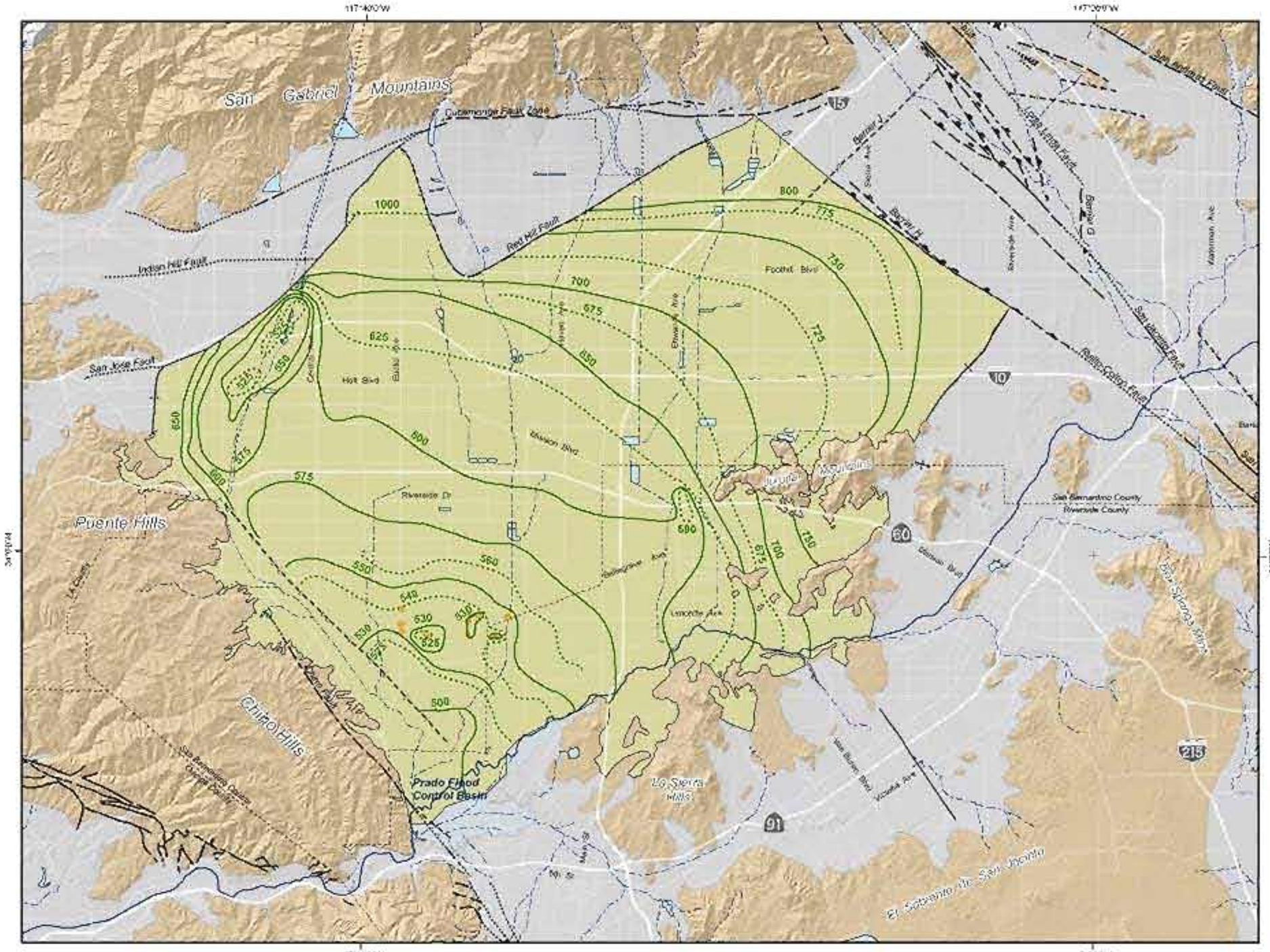
Figure 3-4



Groundwater Production by Well

Fiscal Year 2003

Figure 3-5



Main Features

- 800 / 775 — Groundwater Elevation Contours (feet above mean sea-level)
- Chino-I Desalter Well
- Chino Basin Hydrologic Boundary

Geology

Water-Bearing Sediments

- Quaternary Alluvium

Consolidated Bedrock

- Undifferentiated Pre-Tertiary to Early Pleistocene Igneous, Metamorphic, and Sedimentary Rocks

Faults & Groundwater Divides

- Location Certain
- Location Approximate
- Location Concealed
- Location Uncertain
- Groundwater Divide

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Date: 20050627
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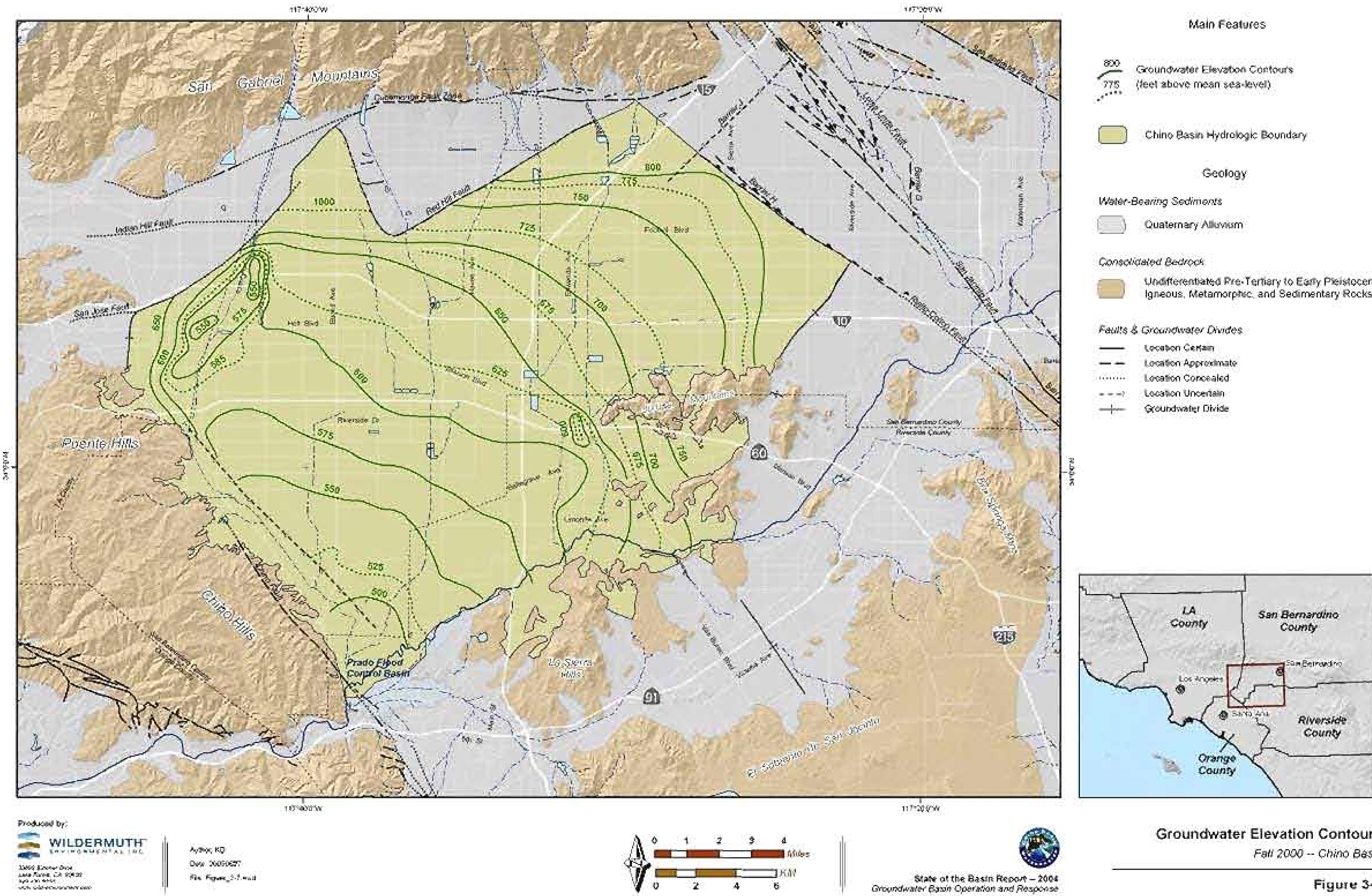
0 1 2 3 4 Miles
0 2 4 6 KM

State of the Basin Report – 2004
Groundwater Basin Operation and Response

Groundwater Elevation Contours

Fall 2003 -- Chino Basin

Figure 3-6



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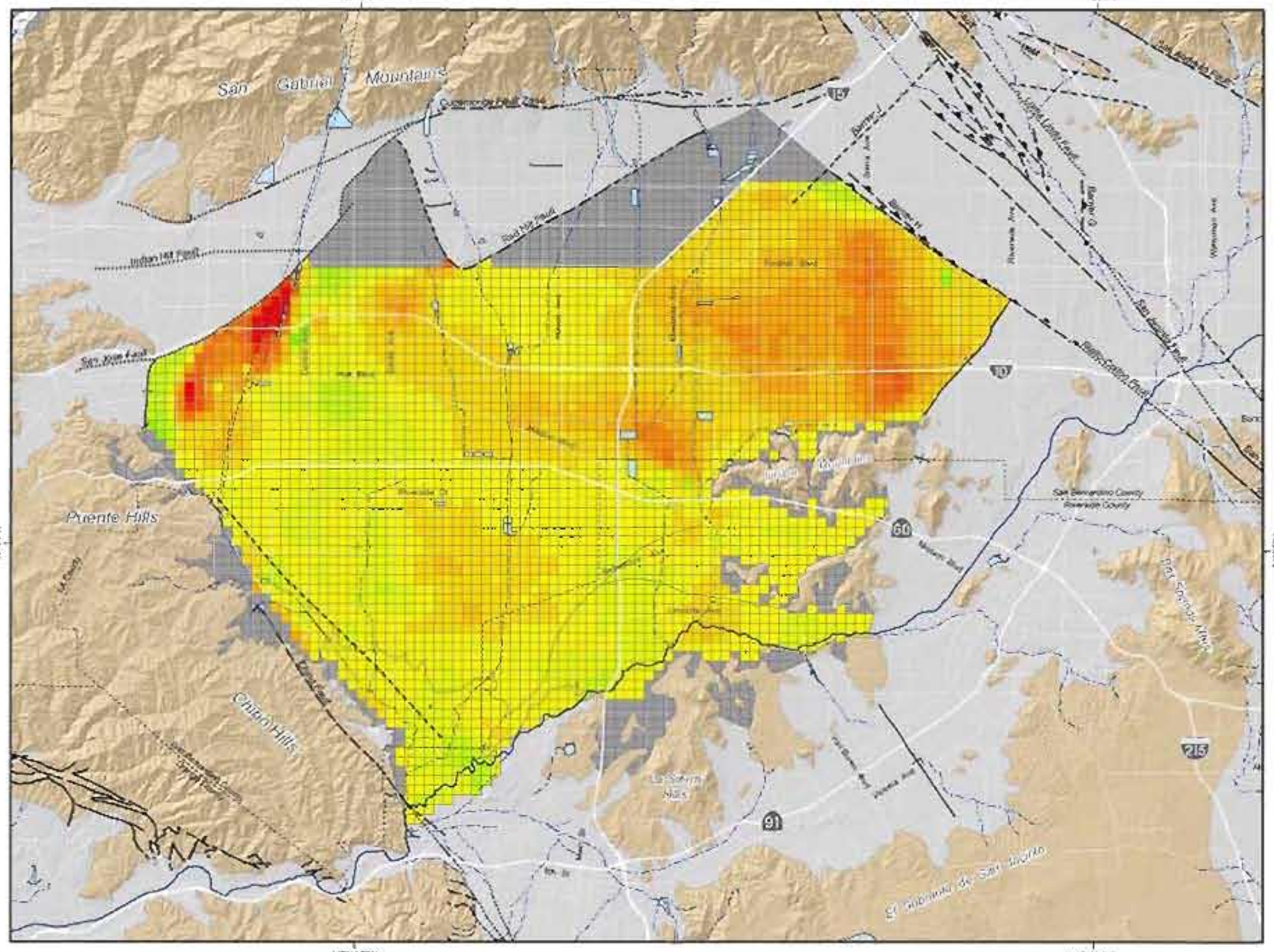
State of the Basin Report – 2004
Groundwater Basin Operation and Response

Groundwater Elevation Contours

Fall 2000 -- Chino Basin

Figure 3-7



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State of the Basin Report – 2004
Groundwater Basin Operation and Response

Change in Groundwater Storage
Fall 2000 to Fall 2003

Figure 3-8

4. GROUNDWATER QUALITY

4.1 Background

Chino Basin groundwater is not only a critical resource to overlying producers of water; it is a critical resource to the entire Santa Ana Watershed. From a regulatory perspective, the use of Chino Basin groundwater to serve potable demands will be limited by drinking water standards, groundwater basin water quality objectives, and Santa Ana River water quality objectives. In August 1999, Phase 1 of the OBMP established a necessity for conducting groundwater quality and water level monitoring in order to obtain current water quality and water level data in Chino Basin (WEI, 1999). These data are necessary to define and evaluate specific strategies and locations for the mitigation of nitrate, total dissolved solids (TDS), and other constituents of potential concern (COPCs), new recharge sites, and pumping patterns resulting from the implementation of the OBMP.

In the past, various entities have collected groundwater quality data. Municipal and agricultural water supply entities have collected groundwater quality data to comply with the Department of Health Services' requirements in the California Code of Regulations Title 22 or for programs that range from irregular study-oriented measurements to long-term periodic measurements. Groundwater quality observations have been made by the California Department of Water Resources (DWR), by participants in the 1969 Judgment on the Santa Ana River (Orange County Water District vs. City of Chino *et al.*), by dischargers under orders from the RWQCB, and by the County of San Bernardino. The DWR and the San Bernardino County Flood Control District (SBCFCD) were very active in collecting groundwater quality data in the Chino Basin prior to the settlement of the Chino Basin adjudication. After the Judgment was entered in 1978, monitoring south of State Route 60 stopped almost completely, except for monitoring conducted by the cities of Chino, Chino Hills, and Norco, the Jurupa Community Services District (JCSD), and the Santa Ana River Water Company (SARWC). Most of the pre-1978 measurements were digitized by the DWR. In 1986, Metropolitan Water District of Southern California (MWDSC) conducted the first comprehensive survey of groundwater quality covering all constituents regulated under Title 22.

In 1989, Watermaster initiated a regular monitoring program for Chino Basin. Groundwater quality data were obtained in 1990 and periodically from then on until 1998.

4.2 Activities and Accomplishments to Date

Watermaster implemented a more aggressive monitoring program as part of the OBMP implementation. Watermaster's program relies on municipal producers and other government agencies supplying their groundwater quality data on a cooperative basis. Watermaster supplements these data with data obtained through its sampling and analysis program in the area generally south of State Route 60. Water quality data are also obtained from special studies and monitoring that takes place under the orders of the Regional Water Quality Control Board (RWQCB), the California Department of Toxic Substances Control (DTSC), and others. Watermaster has combined previously digitized groundwater quality data from all known sources into a comprehensive database.

4.2.1 Title 22 Compliance Monitoring

Water quality samples from wells operated by members of the Appropriative Pool and some members of the overlying Non-agricultural Pool are typically collected as part of the formalized monitoring programs. Constituents include those: (i) regulated for drinking water purposes in the California Code of

Regulations, Title 22; (ii) regulated in the 1995 Water Quality Control Plan for the Santa Ana River Basin (Basin Plan); or (iii) that are of special interest to the pumper.

4.2.2 Historical Water Quality Monitoring Programs for Private Wells

Historically, private wells were sampled less methodically and less frequently than wells owned by members of the Appropriative Pool. There is little historical groundwater quality information for most of the 600 private wells in the southern part of Chino Basin; thus, the historical water quality of groundwater that was produced at a majority of the wells in southern Chino Basin is unknown. Watermaster did have a limited groundwater quality monitoring program in the southern part of Chino Basin, wherein general minerals and physical properties were measured at about 60 wells. Prior to the Comprehensive Water Quality Monitoring Program completed in 2001 discussed in Section 4.2.3, there was only one other monitoring program to date that included a systematic water quality sampling program of the private wells in the southern portion of the Chino Basin:

In 1986, the MWDSC (1988) sampled 149 wells in Chino Basin, including 45 privately-owned wells in the southern portion of the Chino Basin. These wells were analyzed for major cations and anions, general physical parameters, volatile organic chemicals (VOCs), base/neutral/acid-extractable organic chemicals (BNAs), organochlorine pesticides and polychlorinated biphenyls (PCBs), organophosphorous pesticides, carbamate pesticides, and triazine herbicides and soil fumigants.

4.2.3 Comprehensive Water Quality Monitoring Program (1999 – 2001)

Watermaster developed the OBMP in 1999 (WEI, 1999), and the Peace Agreement that implemented the OBMP in 2000. The OBMP established management goals for Watermaster. The management plan in the OBMP describes actions that, when implemented, will achieve the goals of the OBMP. These actions are referred to as Program Elements. A groundwater quality monitoring program is a key part of the OBMP; hence, Program Element 1 – Develop and Implement a Comprehensive Monitoring Program. Watermaster developed and conducted the Comprehensive Water Quality Monitoring Program to provide comprehensive long-term information on groundwater quality for use in managing the groundwater basin.

The Comprehensive Water Quality Monitoring Program (CMP) consisted of water quality sampling and analysis from all known active production and monitoring wells in the Chino Basin. Watermaster staff obtained and analyzed samples from all known and active private wells, and obtained water quality for all other known and active wells from cooperating well owners. From October 1999 to March 2001, Watermaster sampled 602 private wells for the private well monitoring program (PWMP) portion of the CMP (The PWMP is a subset of the CMP). These wells were analyzed for:

- general mineral analyses (including cation and anion balances);
- general physical analyses;
- dissolved inorganic chemical analyses;
- perchlorate (US Environmental Protection Agency [US EPA] 300.0-IC);
- VOCs, including MTBE (US EPA 524.2);
- semivolatile organic compounds (US EPA 525.2);

- cyanide (SM 4500 CN-F);
- 1,2-dibromo-3-chloropropane (DBCP)/1,2-dibromoethane (EDB)/1,2,3-trichloropropane (US EPA 504.1); and
- gross alpha and beta (US EPA 900.0).

All known active private wells within the Agricultural Pool of the Chino Basin were selected for sampling; active, as defined by DWR, is "an operating water well." For each of the two years in the monitoring program, wells were selected to provide sufficient aerial coverage of the entire southern portion of the Chino Basin. The selected wells for Year 1 of the PWMP were located approximately within the capture zones of existing and proposed well fields for desalter facilities. Wells known to be within another entity's regular monitoring program were excluded from the PWMP, but the data collected by the other entities were added to the program data set, if available (*e.g.*, California Institution for Men [CIM] wells).

4.2.4 205(j) Groundwater Monitoring Program

Following the completion of the CMP, the Chino Basin 205(j) Groundwater Monitoring Program (CB205JMP) provided a continued evaluation of water levels and water quality in the groundwater of Chino Basin. Approximately 200 wells located in the southern portion of the Chino Basin were sampled. The water quality data included general minerals with a focus on TDS and nitrogen species. The collected water quality and water level data were used to develop detailed water quality and water level contour maps.

Partial funding for the CB205JMP was provided through the California State Water Resources Control Board (SWRCB) under Section 205(j) of the Federal Clean Water Act, Agreement Number 00-199-250-0. Funding from the 205(j) grant program was used to partially offset the cost for the necessary water quality and water level monitoring at 200 wells located in the southern portion of Chino Basin in the capture zone of Chino-1 and Chino-2 Desalters. The sampling program took place from February 2002 to June 2002.

4.2.5 Private Well Monitoring Program - 2002/2003 (PWMP-2002/03)

Continued monitoring of water levels and water quality influent to the desalter well fields is critical to optimizing the performance of these treatment facilities. One hundred fifty-five private wells were sampled in the PWMP-2002/03 and analyzed for general mineral and general physical parameters. In addition to these parameters, the following constituents were included in the on-going groundwater quality monitoring program:

- Perchlorate (all wells). Perchlorate is a contaminant of state and national prominence and importance. Perchlorate was detected in several private wells in the PWMP and, therefore, all private wells in this program were re-tested for perchlorate so that an accurate distribution of the contaminant can be made.
- 1,2,3-Trichloropropane (all wells). 1,2,3-TCP has a new California Notification Level (NL) of 0.005 µg/L. The detection limit for 1,2,3-TCP in the previous monitoring program was 50 µg/L and there was 1,2,3-TCP detected at greater than that detection limits. Because 1,2,3-

TCP may be a basin-wide water quality issue, all wells in this program were re-tested at a lower detection limit – 0.005 µg/L.

- VOCs (wells within or near VOC plumes). Those wells that were within VOC plumes or were within 1000 feet of the suspected edge of a plume were re-tested for VOCs.
- Hexavalent chromium, silica, strontium, barium, total and fecal coliforms (selected wells). These constituents were added during the CMP-PWMP, and hence, not all wells were tested for these constituents during that monitoring program. Those wells that were not tested for these constituents were tested during the PWMP-2002/03.

4.2.6 Information Management

As with groundwater level and groundwater production data, groundwater quality data are being managed by Watermaster in order to perform the requisite scientific and engineering analyses to ensure that the goals of the OBMP are being met. Watermaster has a relational database that contains information on well location, construction, lithology, specific capacity, groundwater level, and water quality. Historical water quality data for the period prior to the mid 1980s were obtained from the DWR and were supplemented with data from producers in the Appropriative and Overlying Non-Agricultural Pools and others. For the period from the mid 1980s forward, Watermaster loaded the database with water quality data from its own sampling programs, the State of California database – State Water Quality Information System (SWQIS), and from other cooperators. Occasionally problems have been found with the SWQIS data, usually in the form of incorrect constituent identification. In 2003, Watermaster launched the Chino Basin Relational Database effort (CBDB) to collect water quality data directly from each member agency and thereby circumvent the past data problems. All data, including geologic, geophysical, water levels, water quality, production, and recharge that are used to address the hydraulic control issue, will be provided by Watermaster to stakeholders in raw (uninterpreted) and complete form upon their request.

4.3 Results of Groundwater Quality Monitoring in Chino Basin

Figure 4-1 shows all wells in that have groundwater quality monitoring results for the period ranging from 1999 to 2004. The locations of existing and proposed desalter supply wells are shown in Figure 4-1 for aerial reference.

Inorganic and organic constituents that were detected in groundwater samples from wells in the Chino Basin through 2004 were analyzed synoptically; the analysis contained all available data, including data from several monitoring programs and studies. The water quality data reviewed in this synoptic analysis are derived from production wells and monitoring wells. Hence, the data do not represent a programmatic investigation of potential sources nor do they represent a randomized study designed to ascertain the water quality status of the Chino Basin. However, the data do represent the most comprehensive information available to date. Monitoring wells targeted at a potential source will likely have a greater concentration than a municipal or agricultural production well. Wells with constituent concentrations greater than one-half the MCL represent areas that warrant concern and inclusion in a long-term monitoring program. Additionally, groundwater in the vicinity of wells with samples greater than the MCL may be impaired from a beneficial use standpoint.

As discussed previously, the database includes both production wells and monitoring wells, including many monitoring wells associated with the Stringfellow NPL Site.

There are numerous water quality standards in place by both Federal and state agencies. Primary maximum contaminant levels are (MCL) are enforceable criteria set due to health effects. Secondary standards are related to aesthetic qualities of the water such as taste and odor. In addition, for some chemicals there are "notification level" criteria set by the state. These notification levels have been set due to health concerns but are not enforceable. The following constituents exceeded at least one water quality criteria for more than 10 wells in Chino Basin for the period of January 1999 through June 2004:

Analyte Group/Constituent		Wells with Exceedances
Inorganic Constituents		
	total dissolved solids	479
	nitrate	606
	aluminum	57
	arsenic	12
	chloride	50
	fluoride	11
	iron	75
	manganese	40
	perchlorate	128
	sulfate	69
General Physical		
	color	13
	odor	14
Chlorinated VOCs		
	1,1-dichloroethene	12
	1,2,3-trichloropropane	55
	cis-1,2-dichloroethene	10
	tetrachloroethene (PCE)	30
	trichloroethene (TCE)	101
Radiological		
	gross alpha	153
	total radon 222	21

Figure 4-1 shows the Chino Basin wells with one or more set of water quality results included in the report. In the Figures that depict distributions of water quality in Chino Basin, the following convention is typically followed in setting the class intervals in the legend (where WQS is the applicable water quality standard. Variations from this convention may be employed to highlight certain aspects of the data.

Symbol	Class Interval
○	Not Detected
●	<0.5•WQS, but detected
●	0.5•WQS to WQS
●	WQS to 2•WQS
●	2•WQS to 4•WQS
●	> 4•WQS

4.3.1 Total Dissolved Solids

In Title 22, TDS is regulated as a secondary contaminant. The recommended drinking water maximum contaminant level (MCL) for TDS is 500 mg/L; however, the upper limit is 1,000 mg/L. Figures 4-2 through 4-4 show the distribution of TDS concentrations in Chino Basin for three periods:

- pre-1980;
- 1980 through 1998; and
- 1999-Present.

As discussed in Section 4.2.2, the data queried from the database are a combination of data from the Watermaster database and the State of California database (SQWIS).

In Figure 4-2 (pre-1980s), the TDS concentrations in the northern portion (*e.g.*, north of the 60 Freeway) of the Chino Basin are generally less than 250 mg/L. TDS concentrations south of the 60 Freeway were typically in the range of 250 to 500 mg/L, with the exception of the following areas, which have higher TDS concentrations: east of the Puente and Chino Hills, south of the Jurupa Hills, along the Santa Ana River, Temescal and Riverside Basins, and downgradient of the former RP1 discharge point. This pattern is replicated in the period 1980 to 1998 (Figure 4-3), with the following changes:

- TDS concentrations up to about 500 mg/L exist in the Pomona and Claremont Basins and City of Pomona Water Service Area.
- More wells in the southern Chino Basin area have TDS concentrations in the 500 to 1000 and 1000 to 2000 mg/L class intervals.

Figure 4-4 shows the distribution of TDS concentrations in Chino Basin for the post 1998 period. This sampling period reflects primarily the PWMP data in the southern part of Chino Basin. The distribution of private wells sampled since 1998 by class intervals is:

Class Interval	Percent of wells in each class		
	CMP	205J	PWMP 2002-2003
< 125 mg/L	0	0	0
125 – 250 mg/L	6	3.5	2
250 –500 mg/L	22	18.5	10
500 – 1000 mg/L	36	39.5	33
1000 – 2000 mg/L	34	36.5	45
> 2000 mg/L	2	2.5	10

Seventy-two percent of the private wells in the CMP had TDS concentrations above the secondary MCL. With each consecutive sampling program the percent of wells with concentrations above the secondary MCL has decreased.

In places, wells with low TDS concentrations are found to be proximate to wells with higher TDS concentrations, suggesting a vertical stratification of water quality. However, there is a paucity of information concerning well construction/perforation intervals; therefore, the vertical differences in water quality are currently unverifiable.

While the drinking water MCL for TDS is 500 mg/L, for irrigation uses, TDS should generally be less than 700 mg/L. Additionally, the RWQCB has established TDS limitations for all municipal wastewater plants that discharge recycled water to the Santa Ana River and its tributaries. This results in a problem due to the fact that TDS concentrations increase through municipal use, typically by about 150 to 250 mg/L. The TDS limitations for water recycling plants that discharge to the Santa Ana River and its tributaries in the Chino Basin are listed below:

Plant	TDS Limit (mg/L)
IEUA Carbon Canyon	550
IEUA RP1 (and satellite facilities IEUA RP4 and Upland Hills Plant)	515
IEUA RP2 (discharges ceased March 2004)	610
IEUA RP5	550
Western Riverside Regional	625
City of Riverside	650
Jurupa Indian Hills	650

Therefore, in general, the TDS concentration in source (drinking) water must be kept well below 500 mg/L (preferably less than 300 mg/L) to ensure that recycled water discharged to the Santa Ana River and its tributaries meets RWQCB limitations.

TDS concentrations in the northeast part of Chino Basin range from about 170 to about 300 mg/L for the pre-1980 period ranging, with typical concentrations in the mid to low 200s. TDS concentrations in excess of 200 mg/L would indicate degradation from overlying land use. With a few exceptions, areas with either significant irrigated land use or dairy waste disposal histories overlie groundwater with elevated TDS concentrations. The exceptions are areas where point sources have contributed to TDS degradation; for instance, the former Kaiser Steel site in Fontana and the former wastewater disposal ponds near the IEUA Regional Plant No. 1 (RP1) in South Ontario.

The impacts of agriculture on TDS in groundwater are primarily caused by fertilizer use on crops, consumptive use, and dairy waste disposal. As irrigation efficiency increases, the impact of consumptive use on TDS in groundwater also increases. For example, if source water has a TDS concentration of 250 mg/L and the irrigation efficiency is about 50 percent (flood irrigation); the resulting TDS concentration in the returns to groundwater will be 500 mg/L, exclusive of the mineral increments from fertilizer. If the irrigation efficiency were increased to 75 percent, the resulting TDS concentration in the returns to groundwater will be 1,000 mg/L, exclusive of the mineral increments from fertilizer. For modern irrigated agriculture, the TDS impacts of consumptive use are more significant than mineral increments from fertilizers.

4.3.2 Nitrate-Nitrogen

In Title 22, nitrate is regulated in drinking water with an MCL of 10 mg/L (as nitrogen). [As discussed previously, the data queried from the database are a combination of data from the Watermaster database and the State of California database (SWQIS). By convention, all nitrate values are reported in this document as nitrate-nitrogen (NO_3-N). Hence, the values of nitrate-nitrogen reported in this document should be compared with an MCL of 10 mg/L.] Nitrate measurements in the surface water flows of the San Gabriel Mountains and in the groundwater near the foot of these mountains are generally less than 0.5 mg/L (Montgomery Watson, 1993). Nitrate concentrations in excess of 0.5 mg/L may indicate degradation from overlying land use.

Figures 4-5 through 4-7 show the distribution of nitrate-nitrogen concentrations in Chino Basin for three periods:

- pre-1980;
- 1981 through 1996; and
- 1997 through 2002.

In Figure 4-5 (pre-1980), most of the nitrate concentrations in the northern portions (north of the 60 Freeway) of Chino-North MZ are generally less than 5 mg/L. However, the Pomona-Claremont area (up to 25 mg/L), the eastern Fontana area (up to 10 mg/L), and the Cucamonga Basin (up to 25 mg/L), all have elevated nitrate concentrations. The following areas, south of the 60 Freeway, have somewhat elevated nitrate concentrations: east of the Puente and Chino Hills, south of the Jurupa Hills, along the Santa Ana River, the Temescal and Riverside Basins, and downgradient of the former RP1 discharge point.

This pattern is generally replicated in the period ranging from 1981 to 1997 (Figure 4-6); however, several wells in the southern portion of Chino Basin have nitrate concentrations greater than the MCL and 21 wells exceed 40 mg/L (4 times the MCL).

Figure 4-7 shows the distribution of nitrate concentrations in Chino Basin for the post-1997 period. This sampling period primarily reflects the PWMP data in the southern portion of Chino Basin. The distribution of private wells sampled since 1998 by class interval is:

Class Interval	Percent of wells in each class		
	CMP	205J	PWMP 2002-2003
< 2.5 mg/L	2	1	2
2.5 – 5 mg/L	6	8	1
5 –10 mg/L	9	8	5
10 – 25 mg/L	23	20	15
25 – 50 mg/L	28	36	33
> 50 mg/L	32	27	44

The results from the CMP indicate that about eighty-three percent of the private wells in had nitrate concentrations greater than the MCL and 60 percent are more than 2.5 times greater than the MCL. As with TDS, each consecutive sampling program saw a shift toward higher nitrate concentrations.

As explained in Section 3.4.1 areas with either significant irrigated land use or dairy waste disposal histories overlie groundwater with elevated nitrate concentrations. The primary areas of nitrate degradation are the areas formerly or currently overlain by:

- Citrus in the northern parts of the Chino-North MZ; and
- Dairy areas in the southern parts of the Chino-North MZ, the Chino-South MZ, the Chino-East MZ, and the Prado Basin MZ (PBMZ).

Nitrate concentrations in groundwater have increased slightly or remained relatively constant in the northern parts of the Chino-North MZ over the period ranging from 1960 to the present. These are areas formerly occupied by citrus groves and vineyards. Nitrate concentrations underlying these areas rarely exceed 20 mg/L (as nitrogen). Over the same period, nitrate concentrations have increased significantly in the southern parts of southern parts of the Chino-North MZ, the Chino-South MZ, the Chino-East MZ, and the PBMZ. These are areas where land use was progressively converted from irrigated/non-irrigated agricultural land to dairies, and nitrate concentrations typically exceed the 10 mg/L MCL and frequently exceed 20 mg/L.

4.3.3 Other Constituents of Potential Concern

A query was developed to analyze the data from the Watermaster database. Combined these data provide a fairly comprehensive coverage of the area, although critical water quality data may still be missing from

the query. The summary results of this query are provided in Appendix C. The report in Appendix C contains the following information:

- Chemical constituent (listed alphabetically);
- Period – data were queried for 3 periods:
  - pre-1980s
  - 1980-1998
  - 1999 to present
- Reporting units;
- Water quality standards (detailed explanations are provided in the table's footnote):
  - status
  - Primary EPA MCL
  - Secondary MCL
  - Primary California MCL
  - Secondary MCL
  - California Notification Level
- Average – this is the average concentration of the given constituent for the given period. Non-detect values were assigned a value of zero.
- Median or Second Quartile. The second value that divides the items of a frequency distribution or ordered data set into four classes with each containing one fourth of the total population.
- Upper or Third Quartile. The third value that divides the items of a frequency distribution or ordered data set into four classes with each containing one fourth of the total population.
- Number of Wells Sampled. This is the number of wells sampled in the period (not the number of samples collected).
- Number of Wells with Detects. This is the number of wells in the period in which the constituent was detected at any concentration (not the number of samples greater than the detection limit).
- Number of Wells with Exceedances. This is the number of wells in the period with any value that exceeded any of the five water quality standards.

This section discusses the constituents whose water quality standards were exceeded in ten or more wells in Chino Basin (with the exception of nitrate and total dissolved solids). The details of these exceedances are displayed graphically in Figures 4-2 through 4-26. Chromium, hexavalent chromium and MTBE are not discussed in the section that follows because standards were not exceeded in 10 or more wells. However, in the future, these constituents may be problematic, depending on the promulgation of future standards.

4.3.3.1 VOCs

The following five volatile organic chemicals (VOCs) were detected at or above their MCL in more than 10 wells:

- 1,1-dichloroethene;
- 1,2,3-trichloropropane;

- *cis*-1,2-dichloroethene;
- tetrachloroethene (PCE); and
- trichloroethene (TCE).

Tetrachloroethene and Trichloroethene

PCE and TCE were/are widely used industrial solvents PCE is commonly used in the dry-cleaning industry. About 80 percent of all dry cleaners use PCE as their primary cleaning agent (Oak Ridge National Laboratory, 1989). TCE was commonly used for metal degreasing and as a food extractant. The aerial distributions of PCE and TCE are shown in Figures 4-8 and 4-9. In general, PCE is below detection limits for wells in the Chino Basin. The wells with detectable levels tend to occur in clusters such as those seen around Milliken Landfill, south and west of the Ontario Airport and along the margins of the Chino Hills. The spatial distribution of TCE resembles that of PCE. TCE was not detectable in most of the wells in the basin. Similar clustering of wells was also seen around Milliken Landfill, south and west of Ontario Airport, south of Chino Airport and in the Stringfellow plume.

Dichloroethene and *cis*-1,2-Dichloroethene

Dichloroethene (1,1-DCE) and *cis*-1,2-dichloroethene (*cis*-1,2-DCE) are degradation by-products of PCE and TCE (Dragun, 1988) formed by the reductive dehalogenation, and their aerial distributions are shown in Figures 4-10 and 4-11. In a majority of wells in the Chino Basin, dichloroethene and *cis*-1,2-dichloroethene are not detected. Dichloroethene is found in near Milliken Landfill, south and west of Ontario Airport, south of Chino Airport and at the head of the Stringfellow plume. *cis*-1,2-Dichloroethene is found in the same general locations.

1,2,3-Trichloropropane

1,2,3-Trichloropropane (1,2,3,-TCP) is a colorless liquid that is used primarily as a chemical intermediate in the production of polysulfone liquid polymers and dichloropropene, synthesis of hexafluoropropylene, and as a cross linking agent in the synthesis of polysulfides. It has been used as a solvent, extractive agent, paint and varnish remover, cleaning and degreasing agent, and it has been formulated with dichloropropene in the manufacturing of soil fumigants, such as D-D.

The current California State Notification Level for 1,2,3-TCP is 0.005 µg/L. The adoption of the Unregulated Chemicals Monitoring Requirements (UCMR) regulations occurred before a method capable of achieving the required detection limit for reporting (DLR) was available. According to the DHS, some utilities moved ahead with monitoring and the samples were analyzed using higher DLRs. Unfortunately, findings of non-detect with a DLR higher than 0.005 µg/L do not provide DHS with adequate information needed for possible standard setting. New methodologies to analyze for 1,2,3-TCP with a DLR of 0.005 µg/L have since been developed and the DHS is requesting that any utility with 1,2,3-TCP findings of nondetect with reporting levels of 0.01 µg/L or higher do follow-up sampling using a DLR of 0.005 µg/L. Private wells in the PWMP in 1999 through 2001 were analyzed for 1,2,3-TCP at a DLR of 50 µg/L. Because 1,2,3-TCP may be a basin-wide water quality issue, all private wells are being re-tested at a lower detection limit – 0.005 µg/L.

Figure 4-12 shows the distribution of 1,2,3-trichloropropane in Chino Basin, based on the data limitations discussed previously, using the legend convention typically employed throughout this report. Figure 4-12 shows that the very high values of 1,2,3-TCP are associated with the Chino Airport VOC plume. In addition, there is a cluster of wells that have 1,2,3-TCP in concentrations greater than the Notification Level north of the Chino Airport and a scattering of wells exceeding the Notification Level on the western margins of the basin.

4.3.3.2 Aluminum, Arsenic, Fluoride, Iron, and Manganese

The concentrations of aluminum, arsenic, iron, and manganese depend on mineral solubility, ion exchange reactions, surface complexations, and soluble ligands. These speciation and mineralization reactions, in turn, depend on pH, oxidation-reduction potential, and temperature.

Aluminum and Iron

In general, across the Chino Basin, aluminum and iron were non-detect (Figures 4-13 and 4-14, respectively. However, both constituents were high in the Stringfellow plume. Furthermore, iron was found at detectable levels (but still below one-half the MCL) in 2 clusters of wells on either side of Ontario Airport. Outside of the Stringfellow plume, there were 18 wells with concentrations greater then the MCL. Aluminum concentrations exceeded the primary California MCL in 5 wells outside of the Stringfellow plume. Exceedances may be an artifact of sampling methodology – relatively high concentrations of aluminum, iron, and trace metals are often the result of dissolution of aluminosilicate particulate matter and colloids caused by the acid preservative in unfiltered samples.

Arsenic

The current arsenic MCL is 50 µg/L. In January 2001, EPA mandated that compliance with the new federal arsenic MCL of 10 µg/L would be required by 2006. After adopting 10 µg/L as the new standard for arsenic in drinking water, the US EPA decided to review the decision to ensure that the final standard was based on sound science and accurate estimates of costs and benefits. In October 2001, the US EPA decided to move forward with implementing the 10 µg/L standard for arsenic in drinking water (US EPA, 2001). Figure 4-15 shows the distribution of arsenic in Chino Basin. Fourteen wells in the Chino Wells had arsenic concentrations that exceed the 2006 MCL. Only 4 wells in the basin exceeded the current MCL of 50 µg/L. Three of these wells belong to the City of Chino Hills, the remaining well is at the northern tip of the Stringfellow plume. Higher concentrations of arsenic in the Chino Hills area are found at depths greater than about 350 feet below ground surface:

Well	Arsenic Concentrations 1999 – 2004 (mg/L)			Perforated Intervals (ft bgs)
	Minimum	Maximum	Average	
Chino Hills 16	ND	67	39	430 – 940
Chino Hills 15B	13	72	51	360 – 440 480 – 900
Chino Hills 1B	58	80	66	440 – 470 490 – 610 720 – 900 940 – 1180

Chino Hills 1A is a production well that is located about 30 feet from Chino Hills 1B, the well with the highest concentration of arsenic in the period from 1999 to 2004. During this period samples from Chino Hills 1A (perforated interval: 166 – 317 ft bgs) were all non-detect.

Fluoride

Fluoride occurs naturally in groundwater in concentrations ranging from less than 0.1 mg/L to 10-20 mg/L (Freeze and Cherry, 1979). However, site-specific monitoring wells may reveal point sources (*e.g.*, wells near landfills have shown relatively high concentrations of manganese). Figure 4-16 displays the distribution of fluoride found in wells in the Chino Basin. Fluoride was detected in 954 wells within the basin, only 7 of which have concentrations that exceed the California primary MCL.

Manganese

Manganese is a naturally-occurring element that is a component of over 100 minerals. Because of the natural release of manganese into the environment by the weathering of manganese-rich rocks and sediments, manganese occurs ubiquitously at low levels in soil, water, air, and food. Manganese compounds are used in a variety of products and applications including water and wastewater treatment, matches, dry-cell batteries, fireworks, fertilizer, varnish, livestock supplements, and as precursors for other manganese compounds. Manganese is often found near landfills, especially when oxidation-reduction conditions promote its mobility in groundwater. Neither manganese nor any manganese compounds are regulated in drinking water. However, the US EPA has set a secondary standard MCL of 0.05 mg/L as has California. All these standards though are non-enforceable. Most of the wells sampled for manganese have resulted in non-detect. High concentrations of manganese in groundwater have been observed along the Santa Ana River in Reach 3, scattered throughout the southern portion of Chino Basin and near the Milliken Landfill (Figure 4-17).

4.3.3.3 Perchlorate

Perchlorate has recently been detected in several wells in the Chino Basin (Figure 4-18), in other basins in California, and in other states in the West. The probable reason that perchlorate was not detected in groundwater until recently is that analytical methodologies did not previously exist that could attain a low enough detection limit. Prior to 1996, the method detection limit for perchlorate was 400 µg/L. By March 1997, an ion chromatographic method was developed with a detection limit of 1 µg/L and a reporting limit of 4 µg/L.

Perchlorate (ClO_4^-) originates as a contaminant in the environment from the solid salts of ammonium perchlorate (NH_4ClO_4), potassium perchlorate ($KClO_4$), or sodium perchlorate ($NaClO_4$). The perchlorate salts are quite soluble in water. The perchlorate anion (ClO_4^-) is exceedingly mobile in soil and groundwater environments. Because of its resistance to react with other available constituents, it can persist for many decades under typical groundwater and surface water conditions. Perchlorate is a kinetically stable ion, which means that reduction of the chlorine atom from a +7 oxidation state in perchlorate to a -1 oxidation state as a chloride ion requires activation energy or the presence of a catalyst to facilitate the reaction. Since perchlorate is chemically stable in the environment, natural chemical reduction in the environment is not expected to be significant.

Ammonium perchlorate is manufactured for use as an oxygenating component in solid propellant for rockets, missiles, and fireworks. Because of its limited shelf life, inventories of ammonium perchlorate

must be periodically replaced with a fresh supply. Thus, large volumes of the compound have been disposed of since the 1950s in Nevada, California, Utah, and possibly in other states. While ammonium perchlorate is also used in certain munitions, fireworks, the manufacture of matches, and in analytical chemistry, perchlorate manufacturers estimate that about 90 percent of the substance is used for solid rocket fuel.

Speculation has arisen that perchlorate in groundwater may be the result of using "Chilean fertilizer" for agricultural purposes. The EPA recently completed a comprehensive survey of fertilizers and other raw materials for perchlorate to determine whether these could be significant contributors to environmental perchlorate contamination (Urbansky *et al.*, 2001). Four laboratories analyzed 48 fertilizer products from manufacturers of major commodity chemicals. Samples were collected from representative sites in the United States during the spring of 2000.

Except for those products derived from Chilean caliche (a natural perchlorate source), the specific natures of the manufacturing processes suggest that perchlorate should not be present in most fertilizers. Chilean nitrate salts constitute about 0.14% of U.S. fertilizer application. Perchlorate was positively detected only in those materials known to be derived from Chilean caliche. The data obtained here fail to suggest that fertilizers contribute to environmental perchlorate contamination other than in the case of natural saltpeters or their derivatives. (Urbansky *et al.*, 2001)

Fertilizers derived from Chilean caliche are currently used in small quantities, on specialized crops, including tobacco, cotton, fruits, and vegetables (Renner, 1999). However, there is some evidence to suggest that there may have been wider-spread usage for citrus crops in Southern California from the late 1800s through the 1930s.

The requisite toxicology data available to evaluate the potential health effects of perchlorate are extremely limited. The US Environmental Protection Agency (EPA) Superfund Technical Support Center issued a provisional reference dose (RfD) in 1992 and a revised provisional RfD in 1995. Standard assumptions for ingestion rate and body weight were then applied to the RfD to calculate the reported range in the groundwater cleanup guidance levels of 4 to 18 µg/L. In 1997, the DHS and the California EPA's Office of Environmental Health Hazard Assessment (OEHHA) reviewed the EPA's risk assessment reports for perchlorate. Consequently, California established its provisional action level of 18 µg/L. On August 1, 1997, DHS informed drinking water utilities of its intention to develop a regulation to require monitoring for perchlorate as an unregulated chemical. Legislative action to establish a state drinking water standard for perchlorate has been introduced, but has not been brought to a vote (CA Senate Bill 1033).

The California DHS (2002a) has stated that perchlorate in groundwater in California likely reflects its use in the aerospace industry as a solid rocket propellant (in the form of ammonium perchlorate). To protect the public from perchlorate's adverse health effects – and in the absence of a drinking water standard for the contaminant – DHS established an action level of 18 µg/L, which was derived from available risk assessments. "Following the release of US EPA's 2002 draft risk evaluation, DHS concluded that its Action Level needed to be revised downward. Accordingly, on January 18, 2002, DHS reduced the perchlorate Action Level to 4 µg/L, the lower of the 4- to 18-µg/L range. The 4-µg/L Action Level also corresponds to the current detection limit for purposes of reporting (DLR)" (DHS, 2002c). DHS subsequently revised the Action Level for perchlorate to 6 µg/L on March 11, 2004.

Perchlorate has been detected in 152 wells in the Chino Basin. Historical values of perchlorate exceeding the State Action Level have occurred in the following areas of Chino Basin (Figure 4-18):

- There is a significant perchlorate plume in the Rialto-Colton Basin. The source of the plume is being investigated by the RWQCB and it appears to be located near the Mid-Valley Sanitary Landfill. According to the RWQCB, other companies including B.F. Goodrich, Kwikset Locks, American Promotional Events Inc., and Denova Environmental Inc. operated nearby and used or produced perchlorate. These companies were located on a 160-acre parcel at T1N R5W S21 SW1/4. Denova Environmental also operated on a 10-acre lot at T1N R5W S20 S1/2 (along the boundary between Sections 20 and 29). The perchlorate in the Fontana area of Chino Basin may be a result of (i) the Rialto-Colton perchlorate plume migrating across the Rialto-Colton fault; (ii) other point sources in Chino Basin; and (iii) non-point application of Chilean nitrate fertilizer in citrus groves.
- Downgradient of the Stringfellow Superfund Site. Concentrations have exceeded 600,000 µg/L in on-site observation wells and the plume has likely reached Pedley Hills and may extend as far as Limonite Avenue.
- City of Pomona well field (source unknown).
- Wells in the City of Ontario water service area, south of the Ontario Airport (source(s) unknown).
- Scattered wells in the Monte Vista water service area (source(s) unknown).
- Scattered wells in the City of Chino water service area (source(s) unknown).

4.3.3.4 Radon and Gross Alpha

Radon (Figure 4-19) is a radioactive gas found in nature. It has no color, odor, or taste and is chemically inert. Its source is uranium – as the uranium molecule decays to form stable lead, a process taking many, many years, it changes from one radioactive element to another in a sequence known as the Uranium Decay Cycle. Partway through this cycle, the element radium becomes radon, which, as a gas moves up through the soil to atmosphere. Uranium is found in most soils and in granite. Radon may be found in drinking water and indoor air. Some people who are exposed to radon in drinking water may have an increased risk of getting cancer over the course of their lifetime, especially lung cancer. The US EPA has established a proposed MCL of 300 pCi/L (Macler, 2000).

Similarly, alpha radiation is a type of energy released when certain radioactive elements decay or break down. For example, uranium and thorium are two radioactive elements found naturally in the earth's crust. Over billions of years, these two elements slowly change form and produce "decay products" such as radium and radon. During this change process, energy is released. One form of this energy is alpha radiation.

Higher concentrations of radon and gross alpha in groundwater typically occur near granitic bedrock outcrops; one might expect to see higher occurrences of these constituents near the San Gabriel Mountains, Jurupa Hills, Puente Hills, and Chino Hills and along fault zones – Rialto-Colton Fault, San Jose Fault, and the Red Hill Fault. The aerial distributions of radon and gross alpha do not show the expected pattern, however, there are no spatial patterns or outside evidence to suggest a source other than

naturally-occurring (Figures 4-19 and 4-20). Based on water quality results from 1999 to the present, 58 wells in the basin are at or above the US EPA proposed MCL for Radon. For gross alpha results, while 165 wells are at or above the US EPA MCL.

4.3.3.5 Chloride and Sulfate

Chloride and sulfate both exceeded secondary MCLs. As discussed previously, secondary MCLs apply to chemicals in drinking water that adversely affect its aesthetic qualities and are not based on direct health effects associated with the chemical. Chloride and sulfate are major anions associated with TDS. Most wells in the basin had detectable levels of sulfate (Figure 4-21) but most were less then 125 mg/L (one-half the water quality standard). A total of 83 wells had concentrations at or above the sulfate MCL. In general, these wells were distributed in the southern portion of the basin, along the margins of the Chino Hills and in the Stringfellow plume. All wells had detectable levels of chloride (Figure 4-22) but most concentrations were less 125 mg/L (one-half the MCL). The secondary MCL for chloride is exceeded in 68 wells almost all of which are located in the southern portions of the basin.

4.3.3.6 Color, Odor and Turbidity

Color, odor, and turbidity were detected at greater than their secondary MCLs in more than 10 wells in the last 5 years (Figure 4-23, Figure 4-24 and Figure 4-25 respectively). These parameters are monitored purely for aesthetic reasons and should not limit water quality in Chino Basin.

4.3.4 Point Sources of Concern

The previous water quality discussion broadly described water quality conditions across the entire basin. The discussion presented below describes the water quality anomalies associated with known point source discharges to groundwater. Figure 4-26 shows the location of various point sources and areas of water quality degradation associated with these sources.

4.3.4.1 Chino Airport

The Chino Airport is located approximately four miles east of the City of Chino and six miles south of Ontario International Airport, and occupies an area of about 895 acres. From the early 1940s until 1948, the airport was owned by the federal government and used for flight training and aircraft storage. The County of San Bernardino acquired the airport in 1948 and has operated and/or leased portions of the facility ever since. Since 1948, past and present businesses and activities at the airport include modification of military aircraft, crop dusting, aircraft-engine repair, aircraft painting, stripping and washing, dispensing of fire-retardant chemicals to fight forest fires, and general aircraft maintenance. The use of organic solvents for various manufacturing and industrial purposes has been widespread throughout the airport's history (RWQCB, 1990). From 1986 to 1988, a number of groundwater quality investigations were performed in the vicinity of Chino Airport. Analytical results from groundwater sampling revealed the presence of VOCs above MCLs in six wells downgradient of Chino Airport. The most common VOC detected above its MCL was TCE. TCE concentrations in the contaminated wells ranged from 6.0 to 75.0 µg/L.

Figure 4-26 shows the approximate aerial extent of TCE in groundwater in the vicinity of Chino Airport at concentrations exceeding its MCL as of 2002. The plume is elongate in shape, up to 3,600 feet wide

and extends approximately 14,200 feet from the airport's northern boundary in a south to southwestern direction. During the period from 1997 to 2002, the maximum TCE concentration in groundwater detected at an individual well within the Chino Airport plume was 570 µg/L.

In 2002, the County of San Bernardino submitted a work plan to the Regional Board for installing up to five monitoring wells at and around Chino Airport in summer 2003. The concentrations of TCE observed by in the five monitoring wells are entirely consistent with a conceptual model of a plume that has migrated away from Chino Airport. These new data corroborate other data generated by the Watermaster and others.

4.3.4.2 California Institute for Men

The California Institute for Men (CIM) located in Chino is bounded on the north by Edison Avenue, on the east by Euclid Avenue, on the south by Kimball Avenue, and on the west by Central Avenue. CIM is a state correctional facility and has been in existence since 1939. It occupies approximately 2,600 acres – about 2,000 acres are used for dairy and agricultural uses and about 600 acres are used for housing inmates and related support activities (Geomatrix Consultants, 1996). In 1990, PCE was detected at a concentration of 26 µg/L in a sample of water collected from a CIM drinking water supply well. Analytical results from groundwater sampling indicated that the most common VOCs detected in groundwater underlying CIM were PCE and TCE. Other VOCs detected included carbon tetrachloride, chloroform, 1,2-DCE, bromodichloromethane, 1,1,1-trichloroethane (1,1,1-TCA), and toluene. The maximum PCE concentration in groundwater detected at an individual monitoring well (GWS-12) was 290 µg/L. The maximum TCE concentration in groundwater detected at an individual monitoring well (MW-6) was 160 µg/L (Geomatrix Consultants, 1996).

Figure 4-26 shows the approximate aerial extent of VOCs in groundwater at concentrations exceeding MCLs as of 2004. The plume is up to 2,900 feet wide and extends about 5,800 feet from north to south. During the period from 1999 to 2004, the maximum PCE and TCE concentrations in groundwater detected at an individual well within the CIM plume were 1,990 µg/L and 141 µg/L, respectively.

4.3.4.3 General Electric Flatiron Facility

The General Electric Flatiron Facility (Flatiron Facility) occupied the site at 234 East Main Street, Ontario, California from the early 1900s to 1982. Its operations primarily consisted of the manufacturing of clothes irons. Currently, the site is occupied by an industrial park. The RWQCB issued an investigative order to General Electric (GE) in 1987 after an inactive well in the City of Ontario was found to contain TCE and chromium above drinking water standards. Analytical results from groundwater sampling indicated that VOCs and total dissolved chromium were the major groundwater contaminants. The most common VOC detected at levels significantly above its MCL is TCE, which reached a measured maximum concentration of 3,700 µg/L. Other VOCs periodically detected, but commonly below MCLs, included PCE, toluene, and total xylenes, (Geomatrix Consultants, 1997).

Figure 4-26 shows the approximate aerial extent of TCE in groundwater at concentrations exceeding MCLs as of 2002. The plume is up to 3,400 feet wide and extends about 9,000 feet south-southwest (hydraulically downgradient) from the southern border of the site. During the period from 1999 to 2004, the maximum TCE and total dissolved chromium concentrations in groundwater detected at an individual well within the Flatiron Facility plume were 7,990 µg/L and 1,700 µg/L, respectively.

4.3.4.4 General Electric Test Cell Facility

The General Electric Company's Engine Maintenance Center Test Cell Facility (Test Cell Facility) is located at 1923 East Avon, Ontario, California. Primary operations at the Test Cell Facility include the testing and maintenance of aircraft engines. A soil and groundwater investigation, followed by a subsequent quarterly groundwater-monitoring program, began in 1991 (Dames & Moore, 1996). The results of these investigations showed that VOCs exist in the soil and groundwater beneath the Test Cell Facility and that the released VOCs have migrated off site. Analytical results from subsequent investigations indicated that the most common and abundant VOC detected in groundwater beneath the Test Cell Facility was TCE. Other VOCs detected included PCE, *cis*-1,2-DCE, 1,2-dicholoropropane, 1,1-DCE, 1,1-DCA, benzene, toluene, and xylenes, among others. The historical maximum TCE concentration measured at an on-site monitoring well (directly beneath the Test Cell Facility) was 1,240 µg/L. The historical maximum TCE concentration measured at an off-site monitoring well (downgradient) was 190 µg/L (BDM International, 1997).

Figure 4-26 shows the aerial extent of VOC contamination exceeding federal MCLs as of 2004. The plume is elongate in shape, up to 2,400 feet wide and extends approximately 10,300 feet from the Test Cell Facility in a southwesterly direction. During the period from 1997 to 2002, the maximum TCE and PCE concentrations in groundwater detected at an individual well within the Test Cell Facility plume were 1,100 µg/L and 29 µg/L, respectively.

4.3.4.5 Kaiser Steel Fontana Steel Site

Between 1943 and 1983, the Kaiser Steel Corporation (Kaiser) operated an integrated steel manufacturing facility in Fontana. During the first 30 years of the facility's operation (1945-1974), a portion of the Kaiser brine wastewater was discharged to surface impoundments and allowed to percolate into the soil. In the early 1970s, the surface impoundments were lined to eliminate percolation to groundwater (Wildermuth, 1991). In July of 1983, Kaiser initiated a groundwater investigation that revealed the presence of a plume of degraded groundwater under the facility. In August of 1987, the RWQCB issued Cleanup and Abatement Order Number 87-121, which required additional groundwater investigations and remediation activities. The results of these investigations showed that the major constituents of the release to groundwater were inorganic dissolved solids and low molecular weight organic compounds. Wells sampled during the groundwater investigations measured concentrations of total dissolved solids (TDS) ranging from 500-1,200 mg/L and concentrations of total organic carbon (TOC) ranging from 1 to 70 mg/L. As of November 1991, the plume had migrated almost entirely off the Kaiser site.

Figure 4-26 shows the approximate aerial extent of the TDS/TOC groundwater plume as of 2002. Based on a limited number of wells, including City of Ontario Well No. 30, the plume is up to 3,400 feet wide and extends about 17,500 feet from northeast to southwest.

4.3.4.6 Mid-Valley Sanitary Landfill

The Mid-Valley Sanitary Landfill (MVSL) is a Class III Municipal Solid Waste Management Unit located at 2390 North Adler Avenue in the City of Rialto. The facility is owned by the County of San Bernardino and managed by the County's Waste System Division. VOCs and perchlorate have been detected in groundwater beneath and downgradient from the MVSL. The most common and abundant VOCs in groundwater are PCE, 1,1-DCA, and 1,1-DCE. TCE, *cis*-1,2-DCE, 1,2-DCA, vinyl chloride, and

benzene also have been detected. The VOC plume from the MVSL does not appear to extend into the Chino Basin as of 2002 (Figure 4-26).

Perchlorate has been detected in the Rialto-Colton and Chino Basins (Figure 4-18). The sources of the perchlorate plume are being investigated by the RWQCB and it appears that one set of sources is located near the MVSL. According to the RWQCB, other companies including B. F. Goodrich, Kwikset Locks, American Promotional Events Inc., and Denova Environmental Inc. operated nearby and used or produced perchlorate. These companies were located on a 160-acre parcel at T1N R5W S21 SW1/4. Denova Environmental also operated on a 10-acre lot at T1N R5W S20 S1/2 (along the boundary between Sections 20 and 29). The perchlorate plume appears to migrate initially to the southeast prior to moving to the southwest in the direction of regional groundwater flow. The local groundwater flow direction at the landfill is to the southeast, potentially influenced by the Alder Avenue Barrier (GeoLogic, 2002). The perchlorate plume in the Rialto Basin appears to extend well into the Chino Basin, crossing the Rialto-Colton Fault. The plume is about seven miles long from the middle of the Mid-Valley Sanitary Landfill.

4.3.4.7 Milliken Sanitary Landfill

The Milliken Sanitary Landfill (MSL) is a Class III Municipal Solid Waste Management Unit located near the intersections of Milliken Avenue and Mission Boulevard in the City of Ontario. The facility is owned by the County of San Bernardino and managed by the County's Waste System Division. The facility was opened in 1958 and continues to accept waste within an approximate 140-acre portion of the 196-acre permitted area (GeoLogic Associates, 1998). Groundwater monitoring at the MSL began in 1987 with five monitoring wells as part of a Solid Waste Assessment Test investigation (IT, 1989). The results of this investigation indicated that the MSL has released organic and inorganic compounds to the underlying groundwater. At the completion of an Evaluation Monitoring Program (EMP) investigation (GeoLogic Associates, 1998), a total of 29 monitoring wells were drilled to evaluate the nature and extent of groundwater impacts identified in the vicinity of the MSL. Analytical results from groundwater sampling indicated that VOCs are the major constituents of the release. The most common VOCs detected were TCE, PCE, and dichlorodifluoromethane. Other VOCs detected above MCLs included vinyl chloride, benzene, 1,1-dichloroethane, and 1,2-dichloropropane. The historical maximum total VOC concentration in an individual monitoring well was 159.6 µg/L (GeoLogic Associates, 1998).

Figure 4-26 shows the approximate aerial extent of VOCs in groundwater at concentrations exceeding MCLs as of 2002. The plume is up to 1,800 feet wide and extends about 2,100 feet south of the MSL's southern border. During the period from 1999 to 2004, the maximum TCE and PCE concentrations in groundwater detected at an individual well within the MSL plume were 64 µg/L and 81 µg/L, respectively.

4.3.4.8 Municipal Wastewater Disposal Ponds

Treated municipal wastewater has been disposed into ponds located near the current IEUA Regional Plant 1 (RP1), located in south Ontario, and the former Regional Plant 3 (RP3), located in south Fontana. The ponds located just east of RP1, commonly called the Cucamonga ponds, were used to dispose of untreated effluent collected by the Cucamonga County Water District (CCWD) and the IEUA. RP3 and its disposal ponds are located on the southwest corner of Beech and Jurupa Avenues in the City of Fontana. Discharge to the Cucamonga ponds and the ponds of RP3 ceased between the early 1970s and the mid-1980s. The

areas downgradient of these recharge ponds typically have elevated TDS and nitrate concentrations. Contaminant plumes emanating from these ponds have never been fully characterized.

4.3.4.9 Upland Sanitary Landfill

The closed and inactive Upland Sanitary Landfill (USL) is located on the site of a former gravel quarry at the southeastern corner of 15th Street and Campus Avenue in the City of Upland. The facility operated from 1950 to 1979 as an unlined Class II and Class III municipal solid waste disposal site. In 1982, USL was covered with a 10-inch thick, low permeability layer of sandy silt over the entire disposal site (GeoLogic Associates, 1997). Groundwater monitoring at the USL began in 1988 and now includes three on-site monitoring wells, an upgradient well, a cross-gradient well, and a downgradient well (City of Upland, 1998). The results of historic groundwater monitoring indicate that USL has released organic and inorganic compounds to underlying groundwater (GeoLogic Associates, 1997). Groundwater samples from the downgradient monitoring well consistently contain higher concentrations of organic and inorganic compounds than samples from the upgradient and cross-gradient monitoring wells. Analytical results from historic groundwater sampling indicate that VOCs are the major constituents of the organic release. All three monitoring wells have shown detectable levels of VOCs. The most common VOCs detected above MCLs are dichlorodifluoromethane, PCE, TCE, and vinyl chloride. Other VOCs that have been periodically detected above MCLs include methylene chloride, *cis*-1,2-DCE, 1,1-DCA, and benzene. The 1990 to 1995 average total VOC concentration in the downgradient monitoring well is 125 µg/L (GeoLogic Associates, 1997).

Figure 4-26 shows the approximate aerial extent of VOCs in groundwater at concentrations exceeding MCLs as of 2002. However, the plume is defined only by the three on-site monitoring wells. The extent of the plume may be greater than currently depicted in Figure 4-26. During the period from 1999 to 2004, the maximum TCE and PCE concentrations detected in the downgradient monitoring well within the USL plume were 4.2 µg/L and 16 µg/L, respectively.

4.3.4.10 VOC Anomaly – South of the Ontario Airport

A VOC plume containing primarily TCE exists south of the Ontario Airport. The plume extends approximately from State Route 60 on the north and Haven Avenue on the east to Cloverdale Road on the south and South Grove Avenue on the west. Figure 4-26 shows the approximate aerial extent of the plume as of 2004. The plume is up to 17,700 feet wide and 20,450 feet long. During the period from 1999 to 2004, the maximum TCE concentrations in groundwater detected at an individual well within this plume was 83 µg/L.

4.3.4.11 Stringfellow NPL Site

One facility in the Chino Basin is on the current National Priorities List (NPL) of Superfund sites. The Stringfellow site is located in Pyrite Canyon, north of Highway 60, near the community of Glen Avon, in Riverside County (Figure 4-26). From 1956 until 1972, the 17-acre Stringfellow site was operated as a hazardous waste disposal facility. More than 34 million gallons of industrial waste, primarily from metal finishing, electroplating, and pesticide production were deposited at the site (USEPA, 2001). A groundwater plume of site-related contaminants exists underneath portions of the Glen Avon area. Groundwater at the site contains various VOCs, perchlorate, N-nitrosodimethylamine (NDMA), and

heavy metals such as cadmium, nickel, chromium, and manganese. Soil in the original disposal area is contaminated with pesticides, PCBs, sulfates, and heavy metals. The original disposal area is now covered with a barrier and fenced. Contamination at the Stringfellow site has been addressed by cleanup remedies described in four US Environmental Protection Agency (USEPA) Records of Decision. These cleanup actions have focused on control of the source of contamination, installation of an onsite pretreatment plant, cleanup of the lower part of Pyrite Canyon, and cleanup of the community groundwater area.

Figure 4-26 shows the approximate aerial extent of the Stringfellow plume as of 2002. The plume is elongate in shape, up to 6,000 feet wide and extends approximately 22,500 feet from the original disposal area in a southwesterly direction. During the period from 1999 to 2004, the maximum TCE concentration detected in the Stringfellow plume was greater then 175 µg/L. DTSC has contoured the plume emanating from the Stringfellow site. Watermaster has requested a copy of these plume contours. Once received, they will be added to Figure 4-26.

4.3.5 Current State of Groundwater Quality in Chino Basin

As discussed in Section 1, the baseline for the Initial State of the Basin is on or about July 1, 2000 – the point in time that represents the start of OBMP implementation. This initial state or baseline is one metric that can be used to measure progress from implementation of the OBMP. In terms of TDS and nitrate, the initial state of groundwater quality in Chino Basin is illustrated by Figures 4-4 and 4-7. These figures were developed from data derived from Watermaster's water quality database. This database can be queried in future studies to determine the state of the basin's groundwater quality for any constituent.

The groundwater quality in Chino Basin is generally very good, with better groundwater quality found in the northern portion of Chino Basin where recharge occurs. Salinity (TDS) and nitrate concentrations increase in the southern portion of Chino Basin. Twenty-eight percent of the private wells south of the 60 Freeway (169 wells) had TDS concentrations below the secondary MCL. In places, wells with low TDS concentrations are found to be proximate to wells with higher TDS concentrations, suggesting that there is a vertical stratification of water quality. About 83 percent of the private wells south of the 60 Freeway had nitrate concentrations greater than the MCL.

The other constituents that have the potential to impact groundwater quality from a regulatory or Basin Plan standpoint are certain VOCs, arsenic, and perchlorate. As discussed in Sections 4.3.3.1 and Section 4.5, there are a number of point source releases of VOCs in Chino Basin. These are in various stages of investigation or cleanup. Likewise, there are known point source releases of perchlorate (MVSL area, Stringfellow, *et cetera*) as well as what appears to be non-point source related perchlorate contamination from currently undetermined sources. Arsenic at levels above its WQS appears to be limited to the deeper aquifer zone near the City of Chino Hills. Total chromium and hexavalent chromium, while currently not groundwater issue for Chino Basin, may become so, depending on the promulgation of future standards.

4.4 On-Going and Recommended Activities

4.4.1 Water Quality Key Well Program

In the Initial State of the Basin Report the water quality section was concluded with by stating the need for future long-term monitoring.

> "A recommendation regarding the long-term groundwater quality-monitoring program is currently being developed. In developing the recommendation, consideration is being given to aerial distribution, changing land uses, sampling frequency, constituents, and the overall OBMP time frame and implementation information needs. The recommended water quality monitoring program will be presented for consideration during the Watermaster budget process for implementation in fiscal 2002/03."

This need has become even more urgent due to the rapid commercial and residential development occurring within the Chino Basin. Many of the private agricultural wells that have been used for monitoring activities are being destroyed as the land is developed. As a response to the need stated in the ISOB and the loss of wells historically utilized, CBWM has developed a water quality key well program which designates a series of well across a wide aerial distribution for monitoring activities (the key well program is described in detail in Section 7). A grid was laid out across the basin and where possible at least one well was chosen per grid cell. Wells that were part of the water level monitoring program and located on property not likely to be developed were preferentially chosen (refer to Section 7 for a more detailed description of the selection process and the program). Sampling of wells in the Key well program began in fall 2005 and will run in two-year cycles. As has been done with past agricultural water quality monitoring, the results will be added to the Watermaster database.

4.4.2 Chino Basin Relational Database

Water quality results for appropriative wells have typically been downloaded from SWQIS (as discussed in Section 4.3). However, quality assurance issues have arisen. For this reason, Watermaster has begun collecting current water quality data directly from each agency or the contract lab conducting the analyses. This will help eliminate parameter identification (from STORET number conflicts) and unit conversion issues that are frequently the root of problems with SWQIS. Watermaster has also set up protocols for periodic updates with each agency to ensure site information is kept current. To augment this effort, archived water quality data are being collected directly from each agency for the period of 1997 to present (thereby capturing the OBMP baseline period). Most of the appropriative agencies in the basin keep past water quality data in hardcopy form. Watermaster is currently having the data entered into electronic form, checked for quality assurance and entered into the database. Table 4-1 summarizes the progress of these efforts to date.

4.4.3 Water Quality Committee

Chino Basin Watermaster formed the Water Quality Committee (WQC) in spring 2003 to reflect that Watermaster is the "go-to" entity because of its role as an arm of the Court. The WQC is reviewing both existing and emerging contaminants. WQC is developing plans to collect data on the active cleanup of basin contaminants, so that lessons learned concerning mitigation measures and cleanup technologies can be effectively shared. The WQC is developing a database of water quality, but may not be the lead agency for cleanup. The following specific objectives of the WQC were developed in the April and May 2003 WQC meetings:

1. Identify, review, and compile relevant data to create a comprehensive database of water quality in the Chino Basin, including data from adjoining basins to the extent that they may impact water quality in Chino Basin.
2. The committee should develop strategies and a management plan to improve basin water quality.
3. The committee will work through the Watermaster process and its available resources to take a lead role on funding and legislative strategies on behalf of its member agencies.

4. The committee will assist and provide input to Watermaster and to IEUA on implementation of the recharge master plan
5. The Committee will assist Watermaster in gathering and sharing data with the RWQCB to the greatest extent practicable.
6. The committee will conduct an assessment and evaluation of existing production and recharge patterns to determine their effect on water quality conditions within the basin. This should also extend to production adjacent to existing barriers and faults.
7. The committee will meet to monitor and measure progress of management plans and recommend adjustments where necessary.
8. The committee, working with Watermaster and its consultant team will provide written reports to the WM Board and to the Pools and Committee relative to its findings, work product and recommendations. The annual "State of the Basin Report" will continue to dedicate a section of the report to water quality issues.

4.4.3.1 Funding Acquisition

The WQC assisted IEUA in submitting a Local Groundwater Assistance Fund Grant Application for $250,000 in January 2004. This grant application was resubmitted after changes requested by DWR were made in December 2004. The project described in this application will help IEUA to continue implementation of critical program elements identified in the OBMP. The project proposed in the application will further Watermaster's understanding of the basin characteristics to meet the goals and objectives of the OBMP. Specifically, the grant funding would be used to install piezometric monitoring wells in Chino Basin Management Zone 3 (MZ3), where there are sources of groundwater contamination. IEUA and Watermaster will conduct groundwater investigations to characterize the MZ3 area. In addition to sampling existing wells, IEUA and Watermaster proposes to drill, install, develop, and sample two nested, multiple-depth piezometers in the projected path of the Kaiser Steel Mill plume. The two piezometers – requested to be funded through this AB303 grant – will help to characterize and monitor the Kaiser plume, which is currently the most immediate threat to the downgradient potable supply wells. This is discussed further in Section 4.6.1.2.4.

4.4.3.2 Database Development

As discussed in Section 4.6.2, water quality data are routinely collected by Watermaster from appropriators, the SQWIS database, other entities monitoring plumes (*e.g.*, DTSC for the Stringfellow plume, the County of San Bernardino for landfill data and Chino Airport, *et cetera*), and from samples the Watermaster collects from private wells. These data are routinely uploaded into a relational database management system managed by Watermaster. This database is used to supply the underlying data for time history analyses, map development (through Watermaster's GIS), and other analyses. The Watermaster database will be a key component of the Watermaster/IEUA integrated data management system called Data Exchange System (DataX, see Section 9.4).

4.4.3.3 Assessment of the State of the Basin's Water Quality

Watermaster analyzes the water quality data collected (Section 4.6.1.2.1) on an on-going basis. Exceedance tables are completed to determine which constituents currently exceed any water quality

standard. Time histories are developed to examine trends of key constituents and any parameter with ten or more exceedances is mapped using Watermaster's GIS. These water quality data are discussed in the State of the Basin report (this section) as mandated by Objective 8 of the WQC.

4.4.3.4 Known and Managed Water Quality Anomalies

Table 4-2 shows Watermaster activities regarding known water quality anomalies. All of these anomalies are under regulatory oversight – either Regional Board or DTSC – except for the Kaiser Steel plume and the specific occurrences of perchlorate throughout Chino Basin.

WEI was tasked at the July 21, 2003 WQC meeting to prepare a list of tasks to help define potential source areas and/or potentially responsible parties (PRPs). This section describes WEI/Watermaster activities to date and proposed on-going activities:

- Monitor the cleanup activities at CIM, GE Flatiron and Test Cell, Milliken and Upland Landfills, and the Stringfellow Acid Pits.
- Identify source(s) of the Chino Airport VOC plume. The Regional Water Quality Control Board (Regional Board) has identified a PRP and a groundwater investigation to better characterize the plume prior to mitigation is already underway. Watermaster is tracking the progress of this investigation.
- Identify the source(s) of the VOC anomaly located south of the Ontario Airport and north of the Chino-1 Desalter well field.
- Locate the leading edge of the total dissolved solids/total organic carbon/volatile organic chemicals (TDS/TOC/VOC) plume created by Kaiser Steel.
- Identify the potential sources of perchlorate throughout the basin.

The goal of these water quality investigations in Chino Basin is to compile enough evidence for the Regional Board to issue Investigation Orders to the PRPs. This will facilitate the regulatory process, while shifting the majority of the investigation/cleanup cost burden to the PRPs.

<u>Chino Airport Plume</u>

Current Situation. Tetra Tech, Inc. prepared the Groundwater Monitoring Report, Winter 2003/2004 and Spring 2004. Chino Airport, San Bernardino County, California. May 2004 for the County of San Bernardino, Department of Architecture and Engineering. Chino Airport was an operating airfield since the 1940s and was operated at different stages by the Department of Defense, Pacific Aeromotive, and most recently by the County of San Bernardino. The County has owned the airfield since 1948. Activities at the airport over the last 60 plus years include: aircraft operation, storage, maintenance, aircraft and munitions manufacturing, and aircraft salvage operations. These activities involved the use of aviation fuel, lubricants, and solvents.

A timeline of activities associated with the volatile organic chemical (VOC) plume in groundwater is provided below.

- 1986 – Trichloroethene (TCE) detected in groundwater during sampling conducted as part of Metropolitan Water District's Chino Basin Storage Program Environmental Impact Report (EIR).
- 1988 – Regional Water Quality Control Board (RWQCB) suspects Chino Airport based on additional samples.

- 1990 – RWQCB issues Cleanup & Abatement Order 90-134 for County of San Bernardino, Department of Airports, Chino Airport, and San Bernardino County.
- 1991-1992 – Contractors dispose of 310 containers of hazardous waste. 81 soil borings drilled. VOCs, including TCE, found in soil samples.
- 2002 – Tetra Tech is hired by the County and completes a work plan for the installation of groundwater monitoring wells.
- 2003 – Five shallow, water table wells are drilled, installed, developed and sampled in June/July.

Watermaster Staff Activities. Watermaster technically reviewed Tetra Tech's *Groundwater Monitoring Report* and had the following comments, which were transmitted to the Regional Board in a letter dated July 8, 2004:

- Groundwater level and groundwater quality data generated by the Tetra Tech investigation are consistent with data generated by Watermaster and others and indicates that the Chino Airport is the most likely source of this contamination.
- The Chino Airport plume has degraded groundwater quality in Chino Basin, affecting several private wells and Chino Desalter Well No. 3.
- In addition to continued groundwater level and groundwater quality monitoring, active groundwater remediation needs to begin. The County should develop a work plan for the installation of extraction wells and a treatment facility as soon as possible in order to comply with Cleanup & Abatement Order 90-134, Requirement 5a: "submit a work plan and a time schedule…[for] mitigation of groundwater contamination attributable to the Airport." The remediation of this groundwater plume is consistent with the goals and objectives of the Chino Basin Watermaster's Optimum Basin Management Program.

It was due to Watermaster's robust water level and water quality database that Watermaster was able to demonstrate that the source of the Chino Airport plume originated at the Chino Airport and not at CIM or the Ontario International Airport as speculated by Tetra Tech. Watermaster also worked closely with the Agricultural Pool to release water level and water quality data from private wells to Tetra Tech and the County of San Bernardino. Watermaster will continue to review Tetra Tech monitoring reports when they are published.

VOC Plume South of the Ontario International Airport

Current Situation. A VOC plume containing primarily TCE exists south of the Ontario International Airport (OIA). The plume extends approximately from State Route 60 on the north and Haven Avenue on the east to Cloverdale Road on the south and Grove Avenue on the west. Figure 4-26 shows the approximate aerial extent of the plume as of 2004. The plume is up to 17,700 feet wide and 20,450 feet long. During the period from 1997 to 2004, the maximum TCE concentrations in groundwater detected at an individual well within this plume was 83 μg/L.

Watermaster Staff Activities. The Regional Board has identified PRPs at the Ontario Airport. The WQC tasked WEI to assist the Regional Board in reviewing and assessing information available regarding PRPs at the OIA so that the Regional Board staff could determine whether further investigation is necessary or cleanup and abatement orders could be issued. During this review, the work focused on PRPs previously identified for the Regional Board, specifically those having a high probability of being responsible for the volatile organic chemical (VOC) contamination tributary to the Chino Desalter 1.

The criteria for the Regional Board to issue clean-up and abatement or investigative orders under Section 13267 of the California Water Code was clarified in a February 11, 2002 internal memorandum by the State Water Resources Control Board's (SWRCB) Chief Counsel, Craig M. Wilson, regarding recent amendments to the Porter-Cologne Water Quality Control Act, resulting from Assembly Bill No. 1664 (2001). According to Mr. Wilson's memorandum, the Regional Board can issue a Cleanup and Abatement Order provided that:

a. there is a basis for suspicion;
b. the suspected dischargers are provided with a written explanation as to why the requirement is being made; and
c. the evidence on file is identified.

Draft Cleanup and Abatement Orders have been written (but not sent) for the following entities:

- Aerojet General Corporation
- Lockheed Martin Corporation
- McDonnell Douglas Aircraft Company
- Northrop Aviation Corporation

Kaiser Plume

Current Situation. The estimated location of the Kaiser plume as the mid 1980s is shown in Figure 4-26. Figure 4-26 also shows the estimated location of the Kaiser plume as of 2004. The mid-1980 location is based on modeling studies conducted by James M. Montgomery, Consulting Engineers (JMM, 1986) and was confirmed in part by groundwater monitoring in the late 1980s and early 1990s. The estimated 2003 plume location is based on recent groundwater modeling studies (WEI, 2003), where the plume as located in the mid-1980s was translated using the 2003 Watermaster model. The 2003 Watermaster model was used to simulate the movement of the Kaiser plume from its year 2003 location for a 25-year period starting in 2003. The model projections suggest that the Kaiser plume will enter the well field of Jurupa Community Services District (JCSD) – specifically JCSD wells 6, 13, 17, 19, 20 and Mira Loma #4 – during the simulation period. The Cleanup and Abatement Order Number 87-121 that concerned the Kaiser plume was rescinded in 1993 and there has been no formal monitoring of the Kaiser plume since the order was rescinded. In summary, recent model projections suggest that the Kaiser plume may impact the JCSD within the next 10 to 15 years and there is no monitoring in place that could be used to confirm this projection or to warn JCSD of the attendant changes in water quality if the modeling projection is correct.

Watermaster Staff Activities. Watermaster activities are currently concentrated in two areas: reactivation of the Kaiser off-site monitoring wells and an assessment of what the chemical signature of the Kaiser plume would look like if it were to impact the JCSD wells.

Watermaster staff has located the two monitoring wells sites located off the Kaiser site:

- MP-2 located at the K-Mart warehouse facility in Ontario, approximately at the corner of Milliken and San Bernardino Road; and
- KOFS-1 well located adjacent to Etiwanda Creek on the Inland Container property.

MP-2 has four piezometers each screened at different depths and KOFS-1 has one piezometer. As mentioned above, these and the other wells used to locate and characterize the Kaiser plume have not been sampled since 1993. MP-2 and KOFS-1 are the most downstream monitoring wells for the plume. KOFS-1 was constructed to find the leading edge of the plume and to provide early warning of the plume to downstream well owners.

These wells can be sampled to determine the location of the main part of the Kaiser plume. Prior to sampling these wells, the pumps within these wells will need to be removed and the wells will need to be redeveloped. The estimate cost for redevelopment is about $15,000. All development and purge water must be hauled away and discharged to the Non-Reclaimable Waste Line (NRWL). Samples would be collected for chemical analyses, including: general mineral and physical, VOCs, semi-volatile organic chemicals (SVOCs), and TOC. The result of these analyses would be compared to past analyses to determine is the Kaiser plume has moved substantially east or west (MP-2, and other wells, *e.g.*, Ontario Wells 30 and 31) and has passed the KOFS-1 wells.

Contact of the plume with the KOFS-1 well could suggest that the plume is on track to reach the JCSD wells in the near future. The plume could also miss the JCSD wells altogether and enter the Chino-2 desalter well field.

Watermaster staff reviewed past work regarding the chemistry of the Kaiser discharge and groundwater contaminated by this discharge. Staff used piper diagrams to show how JCSD well chemistry could change if the Kaiser plume enters the JCSD well field. This information can be used by JCSD and Watermaster to determine if and when the JCSD wells are being impacted by the Kaiser plume. If the Kaiser plume were to move into the JCSD wells field, the anion-cation distribution would start to shift from the calcium-carbonate character currently seen in the JCSD wells to the calcium sulfate character exhibited by wells impacted by the Kaiser plume. Watermaster (or JCSD) should review the anion-cation distribution annually in JCSD and Desalter 2 wells to determine if the Kaiser plume is being captured by these wells.

Perchlorate in Chino Basin

Current Situation. Perchlorate has recently been detected in several wells in the Chino Basin (Figure 4-18), in other basins in California, and in other states in the West. The probable reason that perchlorate was not detected in groundwater until recently is that analytical methodologies did not previously exist that could attain a low enough detection limit. Prior to 1996, the method detection limit for perchlorate was 400 μg/L. By March 1997, an ion chromatographic method was developed with a detection limit of 1 μg/L and a reporting limit of 4 μg/L.

As discussed extensively in the WQC meetings, a number of wells in the Chino Basin have been impacted and shut down due to relatively low levels of perchlorate (but above the State Notification Level of 6 micrograms per liter [μg/L]):

- There is a significant perchlorate plume in the Rialto-Colton and Chino Basins. The source of the plume in Rialto-Colton Basin is being investigated by the RWQCB and it appears to be located near the Mid-Valley Sanitary Landfill. According to the RWQCB, other companies including B. F. Goodrich, Kwikset Locks, American Promotional Events Inc., and Denova Environmental Inc. operated nearby and used or produced perchlorate. These companies were located on a 160-acre parcel

at T1N R5W S21 SW1/4. Denova Environmental also operated on a 10-acre lot at T1N R5W S20 S1/2 (along the boundary between Sections 20 and 29).

- Management Zone-3 in Chino Basin, across the Rialto-Colton Fault from the Mid-Valley Landfill site.
- Downgradient of the Stringfellow Superfund Site. Concentrations have exceeded 600,000 µg/L in on-site observation wells and the plume has likely reached Pedley Hills and may extend as far as Limonite Avenue.
- City of Pomona well field (source unknown).
- Wells in the City of Ontario Water Service Area, south of the Ontario Airport (source(s) unknown).
- Scattered wells in the Monte Vista Water Service Area (source(s) unknown).
- Scattered wells in the City of Chino Water Service Area (source(s) unknown).

The WQC initially concentrated on perchlorate in MZ-3. There are three potential sources of perchlorate in MZ-3: (i) an unidentified point source(s) of man-made perchlorate physically located in MZ-3; (ii) a point source in the Rialto-Colton Basin that has "leaked" into Chino Basin; or (iii) non-point source application of Chilean fertilizer in the early 1900s.

Literature indicates that perchlorate has been associated with the manufacture, use, or operation of solid rocket/missile propellants, fireworks, matches, road flares, air bag inflators, analytical chemistry (ionic strength stabilization), nuclear reactors, electronic tubes, lubricating oil additives, leather tanning and finishing, fabric and dye fixers, electroplating, aluminum refining, rubber products, paints and enamels, and fertilizers.

The process of attempting to locate potential point sources of perchlorate in MZ-3 involved a multi-step approach that included groundwater modeling, securing an EDR report for the entire Chino Basin region, and sifting through the EDR report data using ArcMap techniques. This review was done as a due diligence effort on the part of Watermaster, with an understanding that considerable additional effort may be required to locate a perchlorate point source in MZ-3 – if one exists.

1. Environmental Data Resources, Inc. (EDR) was contracted to conduct an environmental records search of all applicable federal and state databases. The database search covered Chino, Cucamonga, Rialto, Claremont, Pomona Basins, and a 1-mile buffer zone. The search resulted 16,249 geo-coded listings for the area in a PDF document. The geo-coding allowed the listings to be entered into the regional GIS-based database. A listing search was performed on the document for the following key words: perchlorate, rocket, propellant, pyro, fireworks, flare, explosive, air bag, and match.

2. WEI used the existing MODFLOW model that was previously developed for Watermaster, which showed future groundwater elevation changes under transient conditions over a 25-year period as a basis. With the assumptions of current groundwater conditions (and calibration parameters) particle movement was simulated backward over a 60-year period from the current perchlorate plume geometry for the region.

3. Using ArcMap, WEI performed a search for listings within the Fontana area that could represent perchlorate sources that may have impacted Fontana Water Company wells. A total of 799 initial listings were identified from the EDR data. The next step involved categorizing these listings into 28 groups, 12 of which could be potentially associated with perchlorate usage based upon the aforementioned literature (162 listings), and 16 of which were not (637 listings). Initially, the listings within each group were assigned one of the following probability rankings indicating the potential for perchlorate usage.

- Agriculture (6)
- Auto dismantler (14)
- Body/paint/finishes/coatings (36)
- Chemicals (1)
- Cleaners/tailors/clothing (12)
- Environmental/hazardous materials/hazardous waste (17)
- Industry (3)
- Landfills (3)
- Oil-based lubricants/refining (9)
- Machining (10)
- Unknown (9)
- Unknown commerce (42)

After reviewing the data from the environmental records search, a strong candidate for a perchlorate point source in MZ-3 was not determined. Additional work (aerial photography review, personal interviews, *etc.*) would need to be conducted to pursue this further.

Some parties in the basin believe that the significant perchlorate source near the Mid-Valley Landfill (Goodrich, Aerojet, Quickset, Emhart Industries, Denova Environmental, Pyro Spectacular, Rialto Ammunition Storage Point, *et al.*) in the Rialto-Colton Basin may also be the source of perchlorate in Chino Basin. The proposed transport pathway is leakage across the Rialto-Colton Fault. Members of the WQC proposed that Watermaster perform a hydrogeologic investigation of that area to understand how plausible this may be. The WQC determined that this approach may be prohibitively expensive, given the complexity of the fault system and aquifer heterogeneity.

Non-Point Source Application of Chilean fertilizer

The Regional Water Quality Control Board has done an extensive historical literature review and has produced a sizable volume of circumstantial evidence that large quantities of Chilean fertilizer may have been used for citrus in the Fontana area. This fertilizer was mined from Caliche Ore found in the Atacama Desert of northern Chile, the most arid desert in the world. These deposits are a conglomerate of mineral salts comprised of nitrates, sulfates, sodium, chlorides, calcium, potassium, magnesium, and smaller quantities of trace constituents, such as, iodate and perchlorate. It is believed that these deposits were most likely formed from nitrogen fixation by microorganisms in playa lakes 10-15 million years ago.

Perchlorate was first imported into the US in the 1830s and large-scale importation began in the 1880s. Chilean fertilizer was the most important source of nitrogen until 1921. During World War I, Chilean nitrate was needed for the manufacturing of explosives and world demand dramatically increased. Germany was banned from importing Chilean nitrate in World War I. In response,

two German scientists, Fritz Haber and Carl Bosch developed the Haber-Bosch process for directly synthesizing ammonia from hydrogen and nitrogen. As a result, worldwide demand for Chilean fertilizer dropped and by 1950, Chilean nitrate production was 15 percent of the world's supply and by 1980 it was only 0.14 percent. Below are a couple of trade advertisements that suggest that Chilean fertilizer was indeed imported into California, and specifically Fontana and San Bernardino County.

CITRUS GROWERS!

You Can't Afford to Ignore This!

San Bernardino County with 18.63 per cent of the bearing citrus acreage (California Crop Report) produces 25 per cent of the citrus fruits of the state. (San Bernardino County Associated Chambers of Commerce.)

Or 100 boxes in San Bernardino to 68.68 boxes on equal acreage elsewhere.

WHY?

BECAUSE San Bernardino growers use more Nitrate of Soda in citrus groves than any other county in the state.

The splendid agricultural success at Fontana is largely due to the wisdom of the management in using liberally Chilean Nitrate of Soda.

Another Truth!

The Citrus Experiment Station's experiments at Arlington Heights resulted as follows:

With equal amounts of nitrogen:	Relative Production
Nitrate of Soda	100
Blood	73.66
Sulphate of Ammonia	55.78
3 Check plots nearest to Nitrate plot (regardless of nitrogen)	53.41

If you want more proof that Nitrate of Soda is the best source of nitrogen or the best way to use it write our Los Angeles office.

CHILEAN NITRATE OF SODA,
Educational Bureau,
3413 2nd Ave., Los Angeles, Calif.

Hurt Building, Atlanta, Ga. 55 State St., Columbus, Ohio
701 Cotton Exchange Building, New Orleans, La.
25 Madison Ave., New York.

The Past Six Critical Years

Remember the old-timer who said "I'm an old, old man and I have had many, many troubles...*most of which were imaginary*"?

Folks were plenty worried about their nitrogen supply when war broke out in 1939, but, thanks largely to heavy increases in shipments from Chile, everybody has had enough for essential needs. Yes, west coast fruit and vegetable growers received over a quarter of a million tons of natural nitrate in the six years since 1939-40 – and almost all of it in California.

That's a lot of nitrate . . . it has settled a lot of doubts among folks who feared the consequences of not being able to get their accustomed fertilizers. Results have shown their fears to be groundless. In fact, quite the reverse, because in those same six years, when they used about seven times as much Chilean Nitrate as normally, California growers produced the largest and best citrus and vegetable crops on record – *the best they ever made.*

Yes, Chilean Nitrate saved the day, as far as nitrogen is concerned. These last six years and the quarter of a million tons of nitrate from Chile, made a tremendous field demonstration of its value and effectiveness to California growers.

The old man with his imaginary troubles sure had something.

Much has been accomplished in the past but much more remains to be accomplished. While the going was tough and the results in doubt, Chilean Nitrate was in there, pitching. And this year and in all the years to come, it stands ready and able to continue as in the past – serving – helping out – wherever the opportunity offers.

NATURAL CHILEAN NITRATE

Land use in the MZ-3 area was predominately citrus and vineyards from the 1900s to the 1940s. The land use map on the next page is 1933.

Neil Sturchio, Professor and Head of the Earth and Environmental Sciences at the University of Illinois at Chicago, has developed a technique for using stable isotopes of chloride and oxygen to distinguish the origin of perchlorate (man-made or Chilean fertilizer). There are several per mile shifts in isotopes of both ions between the two sources. He has tested several samples of leachate from fertilizer nitrogen (from the Atacama Desert in Chile) and rocket fuel sources. One of the innovations that Prof Sturchio has

developed is the use of a flow-through column with an anion-exchange resin. These bifunctional anion exchange resins were originally developed at Oak Ridge National Laboratory and the University of Tennessee to selectively sorb the pertechnetate ion TcO_4^- – technetium is mobile with a long half-life, much like perchlorate. A resin regeneration step is added to recover the perchlorate ion. The exchange resin is required to concentrate the typically low levels of perchlorate in groundwater so that the perchlorate can be analyzed isotopically.

The isotope fractionation analyses may provide a reasonably unequivocal determination of the source of perchlorate in Chino Basin – man-made versus Chilean fertilizer. Watermaster is pursuing the isotope fractionation analyses in selected portions of central and western Chino Basin.

Table 4-1
Current Status of the Chino Basin Relational Database Effort

Agency	Requested	Received	Format	Data In Electronic Form	QA/QC	Upload to Database	Periodically Receiving Current Data
Chino Hills, City of	X	X	Hardcopy	In Progress	In Progress		
Chino, City of	X	X	Hardcopy	X	In Progress		X
Cucamonga Valley Water District	X	X	Spreadsheet	X	X	X	X
Fontana Water Company	X	X	Spreadsheet/DHS	X	In Progress		
Inland Empire Utilities Agency	X	X	Spreadsheet	X	X	X	X
Jurupa Community Services District	X	X	Hardcopy	In Progress			X
Marigold Mutual Water Company	X	X	Hardcopy	X	In Progress		
Norco, City of	X	In Progress	Hardcopy				X
Ontario, City of	X	X	Hardcopy	X	In Progress		
Pomona, City of	X	X	Database Tables	X	In Progress		
San Antonio Water Company	X	X	Hardcopy	X	In Progress		X
Santa Ana River Water Company	X	X	Hardcopy	X	In Progress		X
Southern California Water Company	X	X	Hardcopy	X	In Progress		
Upland, City of	X	X	Hardcopy and Spreadsheet	In Progress			X
West Valley Water District	X	X	Hardcopy	In Queue			

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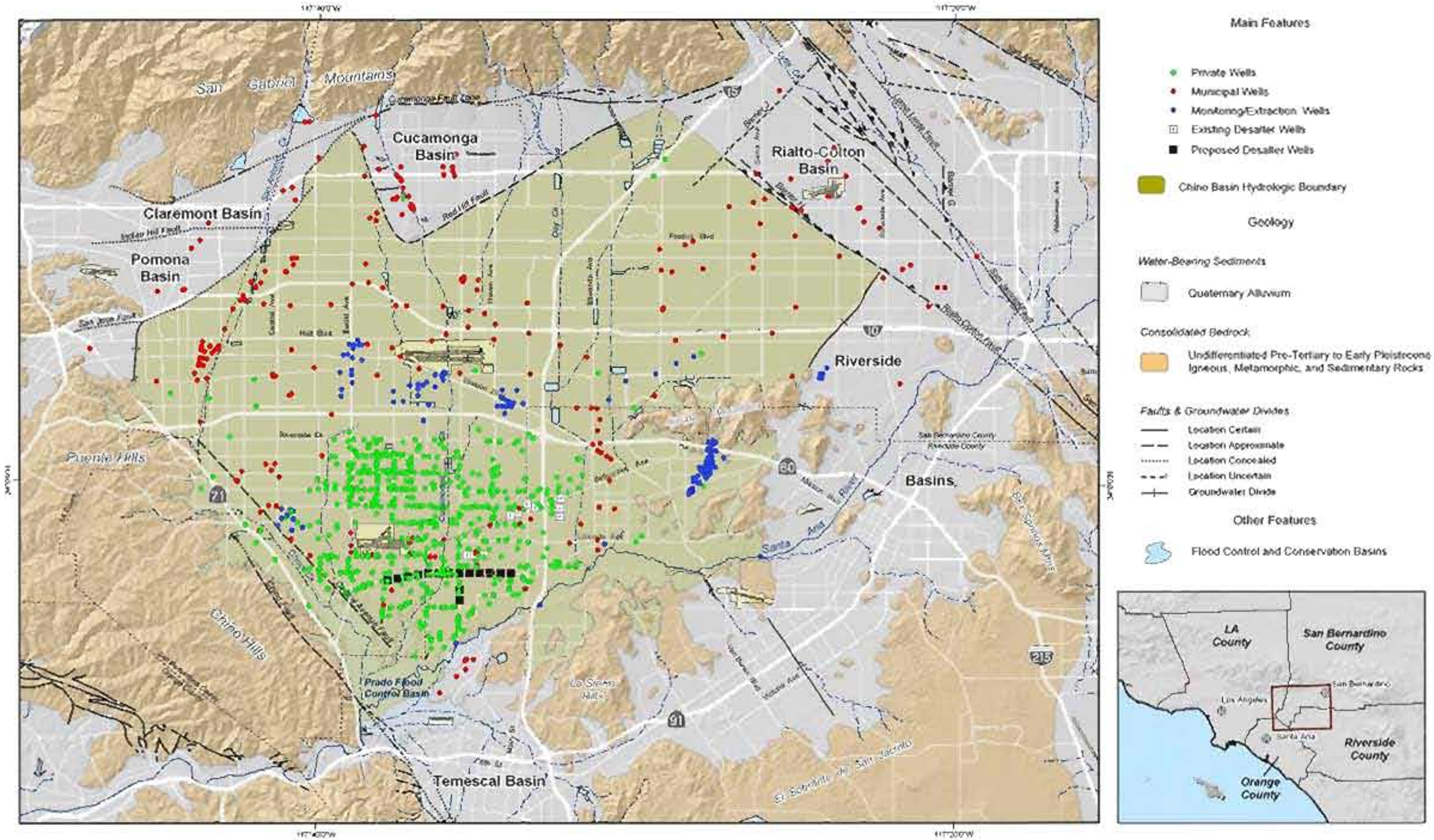
Table 4-2
Watermaster Activities Regarding Known Water Quality Anomalies

Anomaly	Current Regulatory Oversight	Watermaster Activities			
		Monitor Groundwater	Conduct Investigation	Monitor Process	Seek Outside Funding
Chino Airport	Yes	✕		✕	
California Institute for Men	Yes	✕		✕	
GE Flatiron	Yes	✕		✕	
GE Test Cell	Yes	✕		✕	
Milliken Landfill	Yes	✕		✕	
Upland Landfill	Yes	✕		✕	
Stringfellow Acid Pits	Yes	✕		✕	
Agricultural Area	Yes	✕		✕	✕
Kaiser Steel Mill	No	✕	✕	✕	✕
South of Ontario Airport	Yes	✕	✕	✕	
Perchlorate	Maybe	✕	✕	✕	✕



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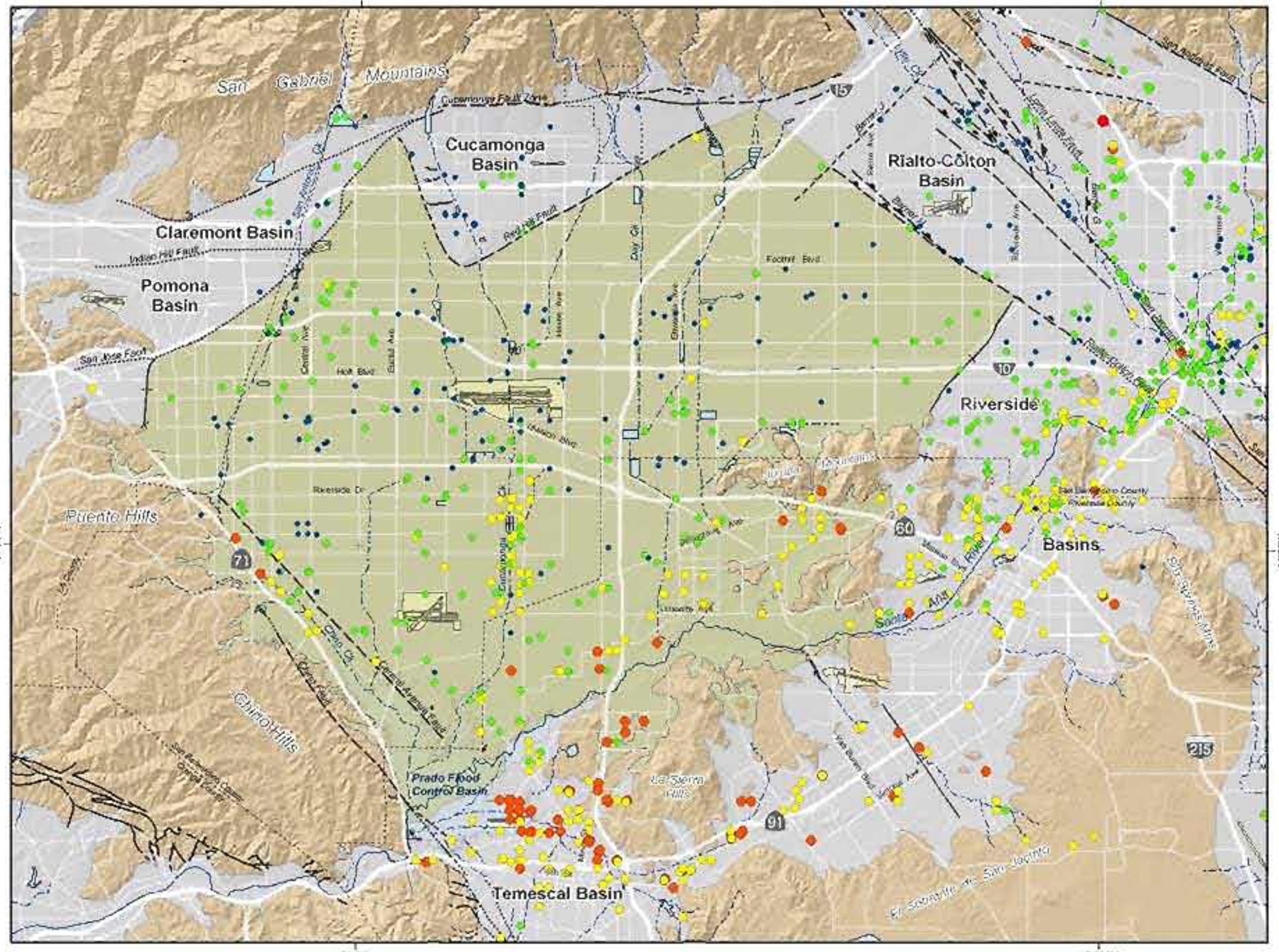
State of the Basin Report – 2004
Groundwater Quality

Groundwater Wells with Water Quality Data
(1999-2004)

Figure 4-1



Main Features

Total Dissolved Solids Concentration (mg/L)

- <125
- 125-250
- 250-500
- 500-1000
- 1000-2000
- >2000

Secondary US EPA MCL = 500 mg/L

Chino Basin Hydrologic Boundary

Geology

Water-Bearing Sediments

Quaternary Alluvium

Consolidated Bedrock

Undifferentiated Pre-Tertiary to Early Pleistocene Igneous, Metamorphic, and Sedimentary Rocks

Faults & Groundwater Divides

- Location Certain
- Location Approximate
- Location Concealed
- Location Uncertain
- Groundwater Divide

Other Features

Flood Control and Conservation Basins

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Author: BMW
Date: 20041229
File: Figure_4-2.mxd

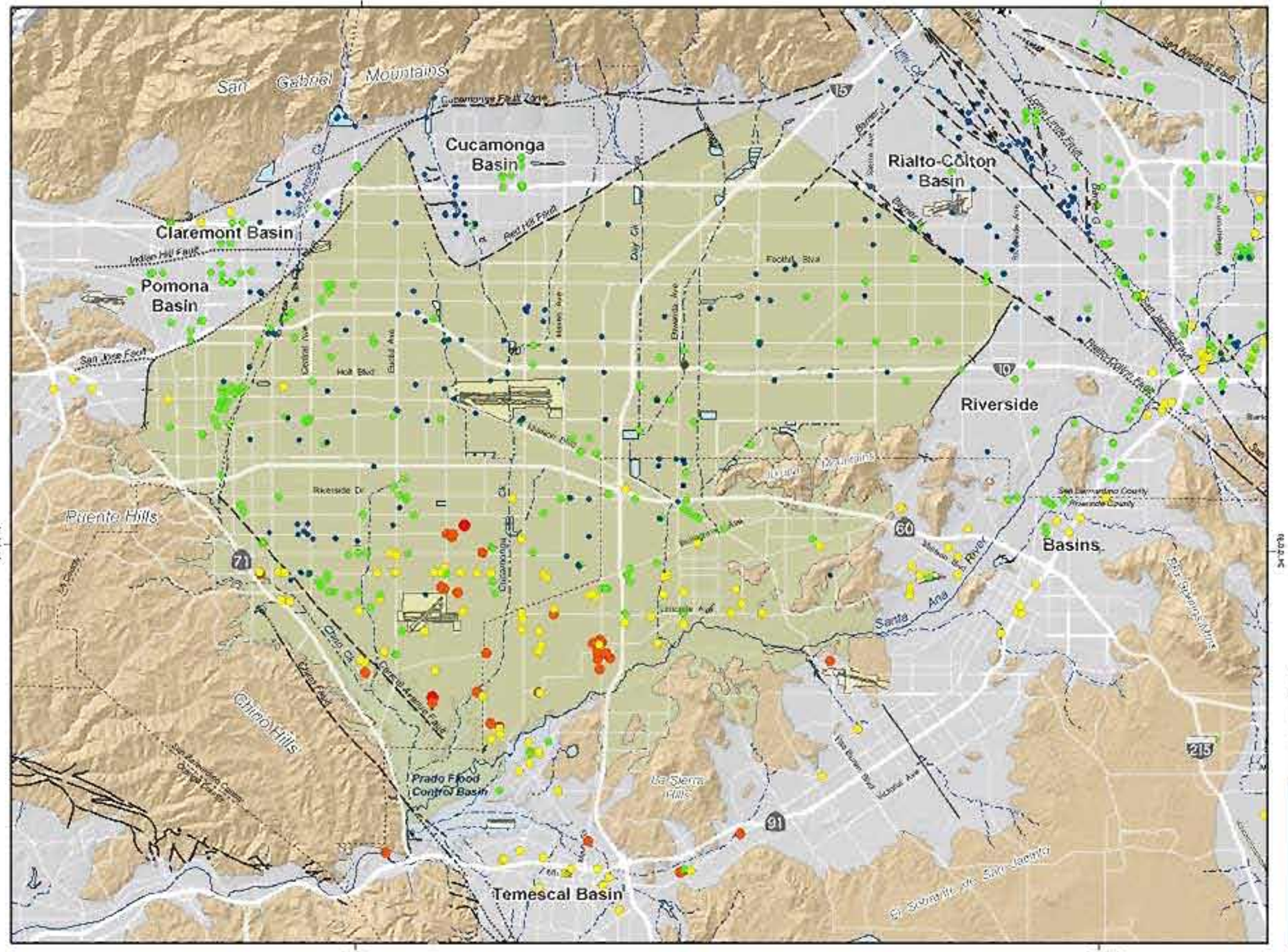
0 1 2 3 4 Miles
0 2 4 6 KM

State of the Basin Report – 2004
Groundwater Quality

Total Dissolved Solids in Groundwater

Maximum Concentration (pre-1980)

Figure 4-2



Main Features

Total Dissolved Solids Concentration (mg/L)

- <125
- 125-250
- 250-500
- 500-1000
- 1000-2000
- >2000

Secondary US EPA MCL = 500 mg/L

Chino Basin Hydrologic Boundary

Chino Basin Legal Boundary

Geology

Water-Bearing Sediments

Quaternary Alluvium

Consolidated Bedrock

Undifferentiated Pre-Tertiary to Early Pleistocene Igneous, Metamorphic, and Sedimentary Rocks

Faults & Groundwater Divides

- Location Certain
- Location Approximate
- Location Concealed
- Location Uncertain
- Groundwater Divide

Other Features

Flood Control and Conservation Basins

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Author: BMW
Date: 20041223
File: Figure_4-3.mxd

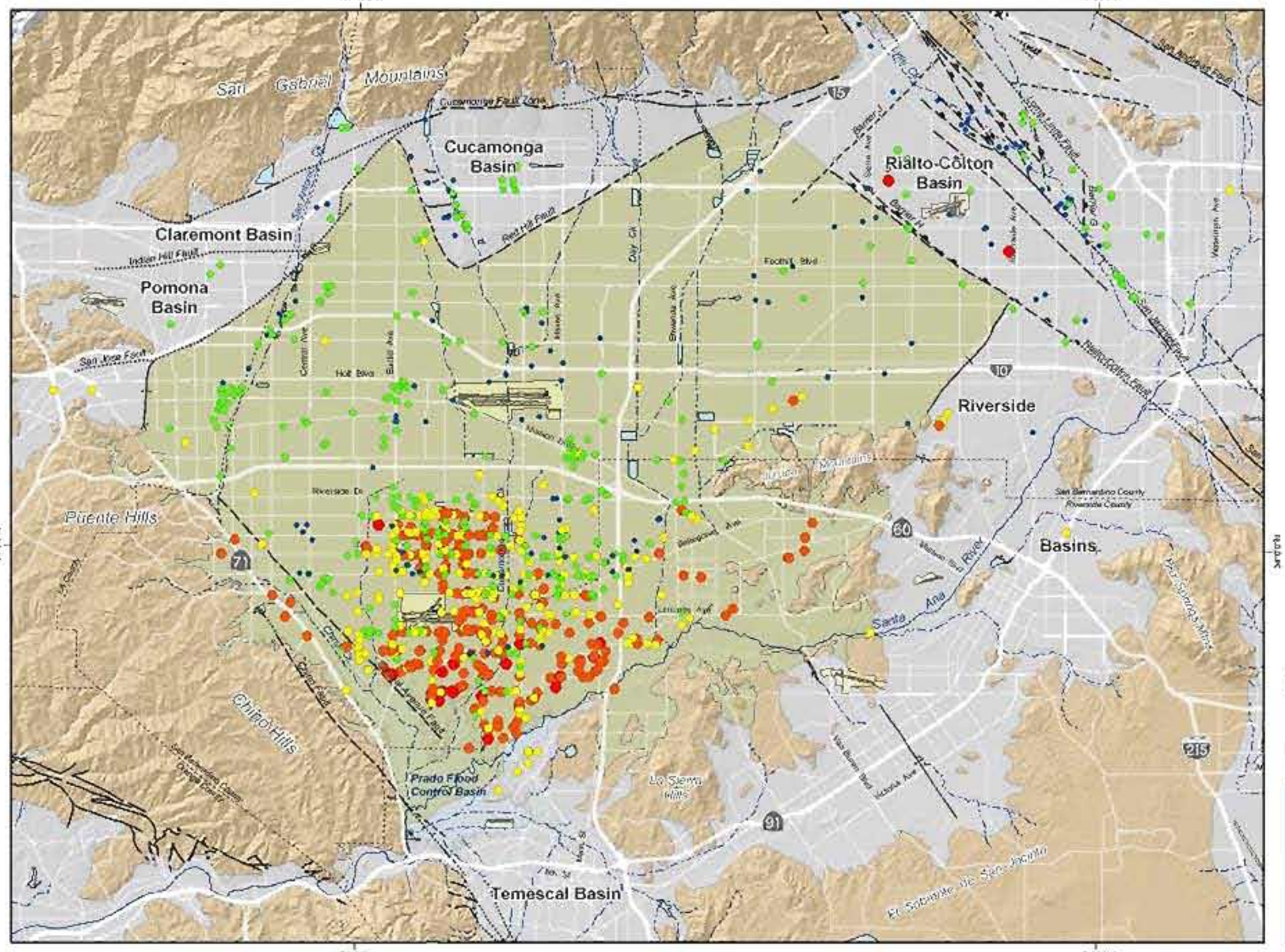
0 1 2 3 4 Miles
0 2 4 6 KM

State of the Basin Report – 2004
Groundwater Quality

Total Dissolved Solids in Groundwater

Maximum Concentration (1980-1998)

Figure 4-3



Main Features

Total Dissolved Solids Concentration (mg/L)

- <250
- 75-150
- 150-300
- 300-500
- 500-750
- >750

Secondary US EPA MCL = 500 mg/L

Chino Basin Hydrologic Boundary

Geology

Water-Bearing Sediments

Quaternary Alluvium

Consolidated Bedrock

Undifferentiated Pre-Tertiary to Early Pleistocene Igneous, Metamorphic, and Sedimentary Rocks

Faults & Groundwater Divides

- Location Certain
- Location Approximate
- Location Concealed
- Location Uncertain
- Groundwater Divide

Other Features

Flood Control and Conservation Basins

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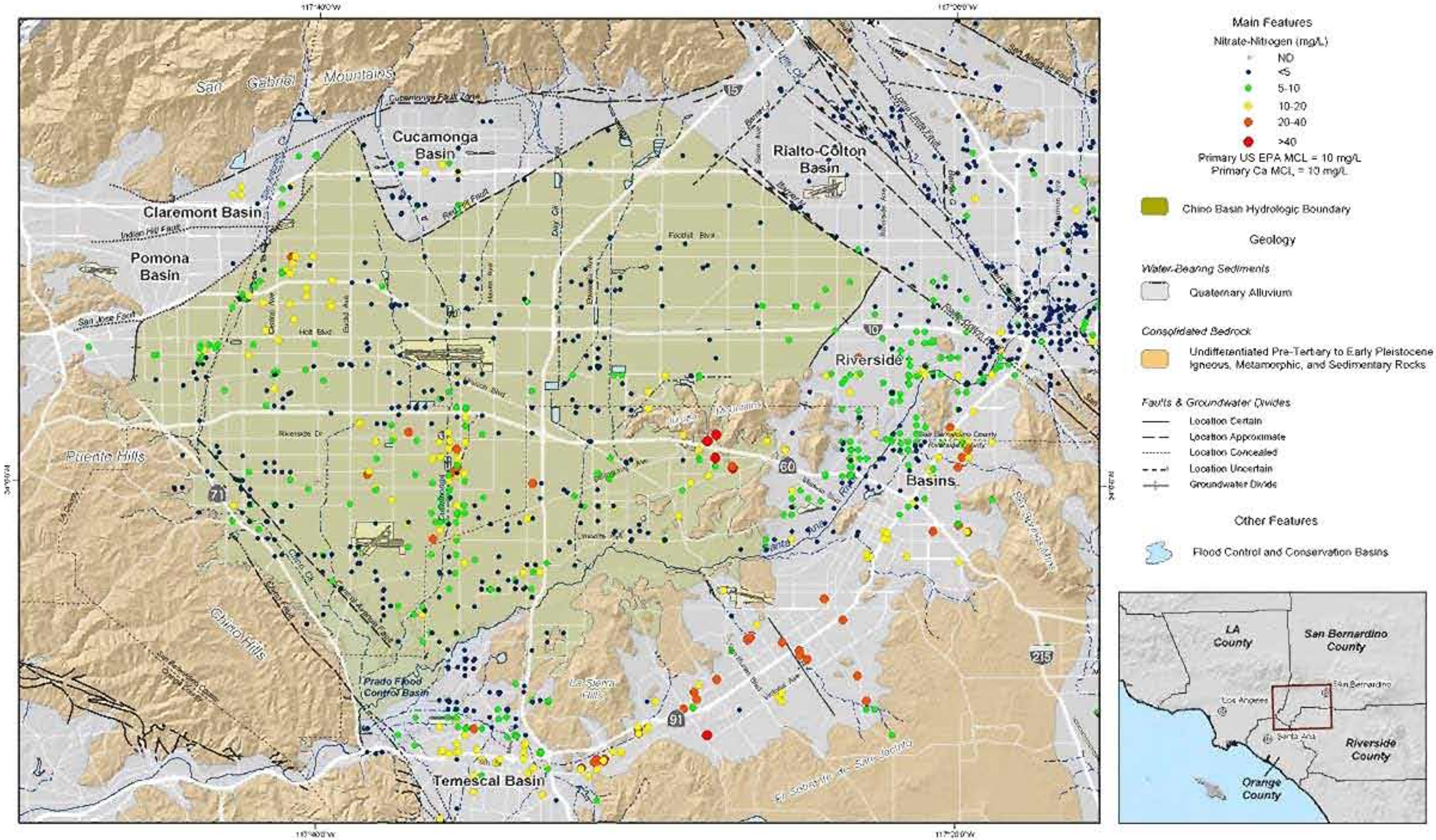
Date: 20041229
File: Figure_4-4.mxd

State of the Basin Report – 2004
Groundwater Quality

Total Dissolved Solids in Groundwater

Maximum Concentration (1999-2004)

Figure 4-4



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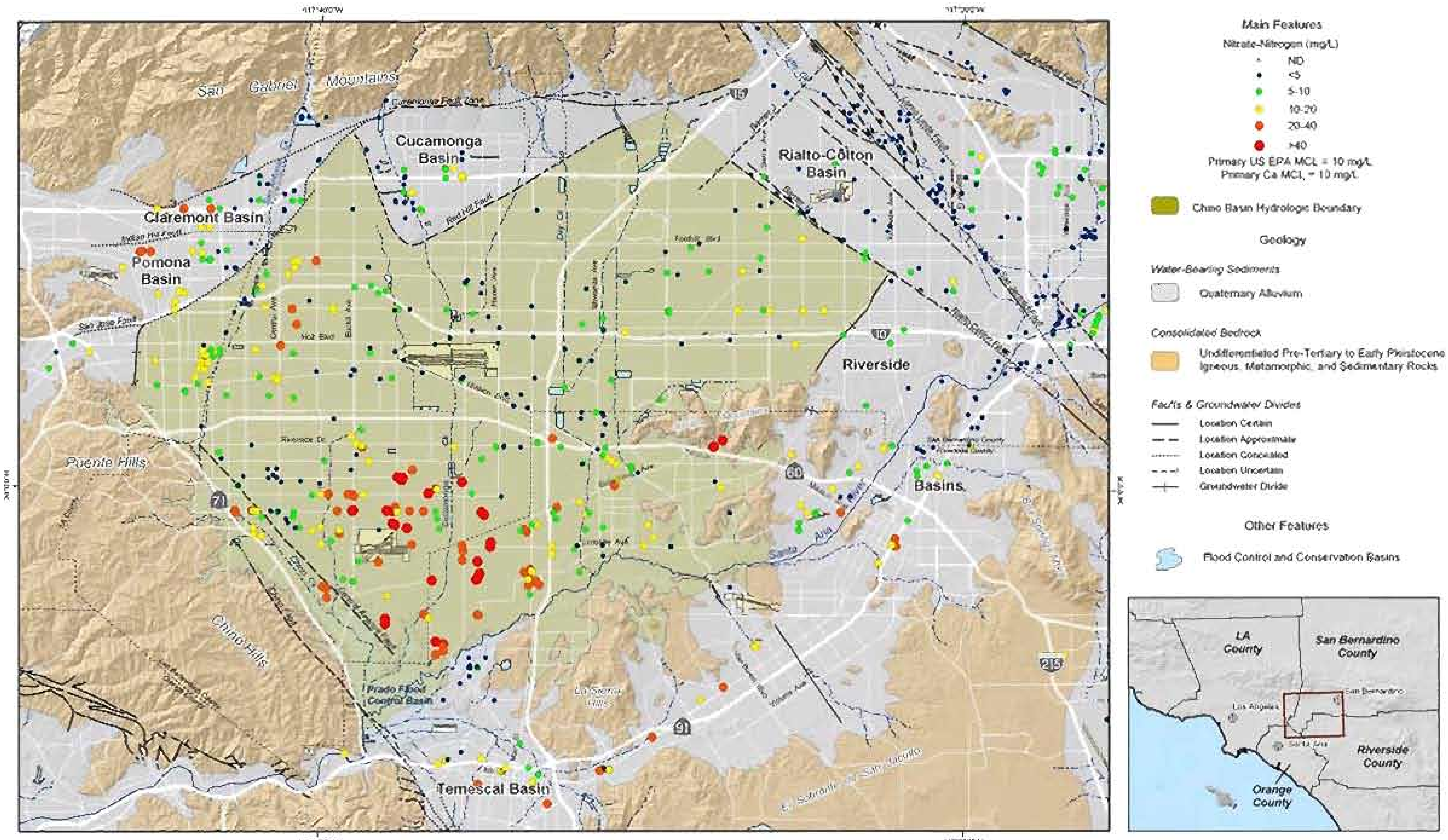
Author: BMW
Date: 20041223
File: Figure_4-5.mxd

State of the Basin Report – 2004
Groundwater Quality

Nitrate in Groundwater

Maximum Concentration (pre-1980)

Figure 4-5



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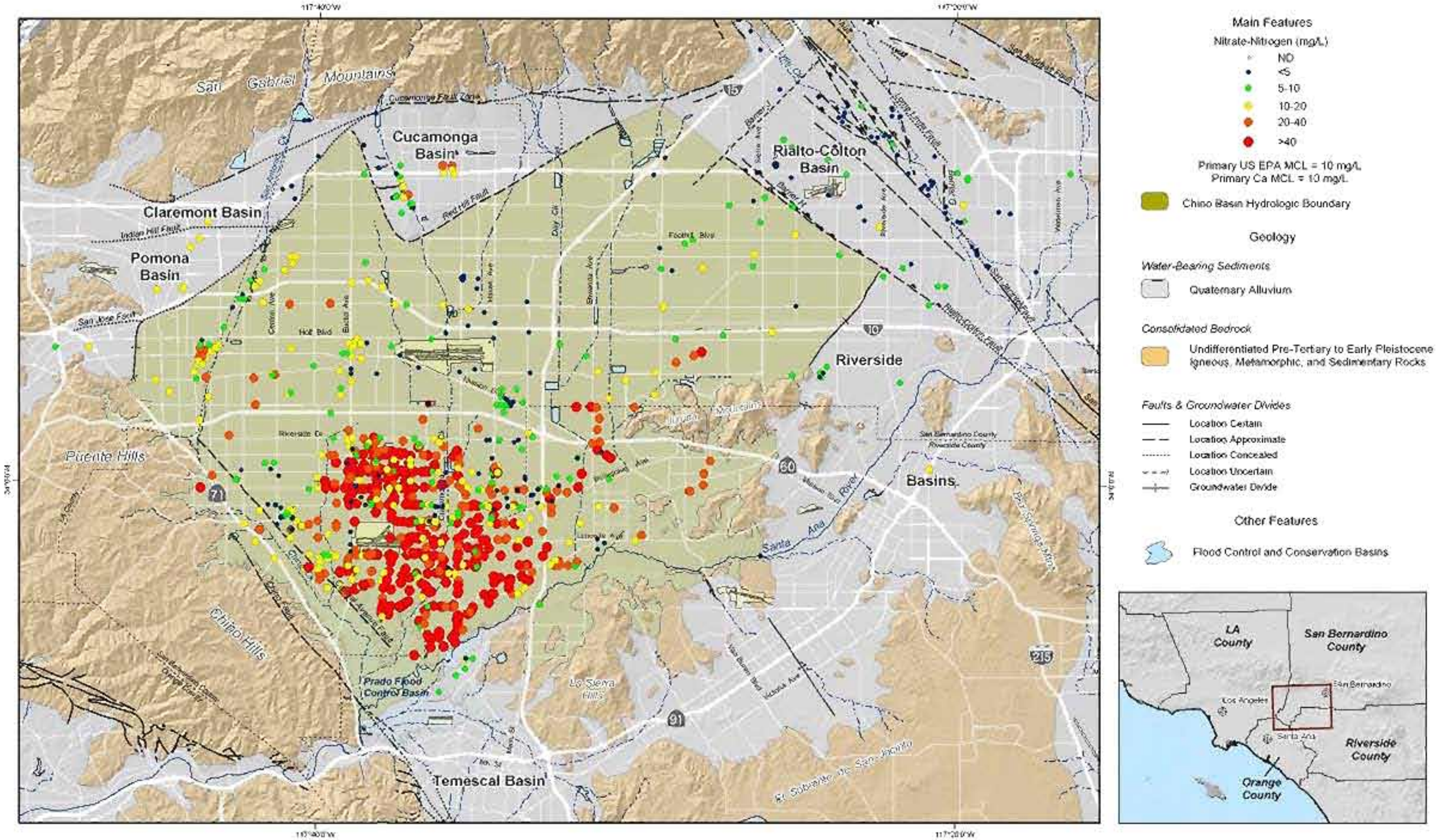
State of the Basin Report – 2004
Groundwater Quality

Nitrate in Groundwater
Maximum Concentration (1960-1998)

Figure 4-6



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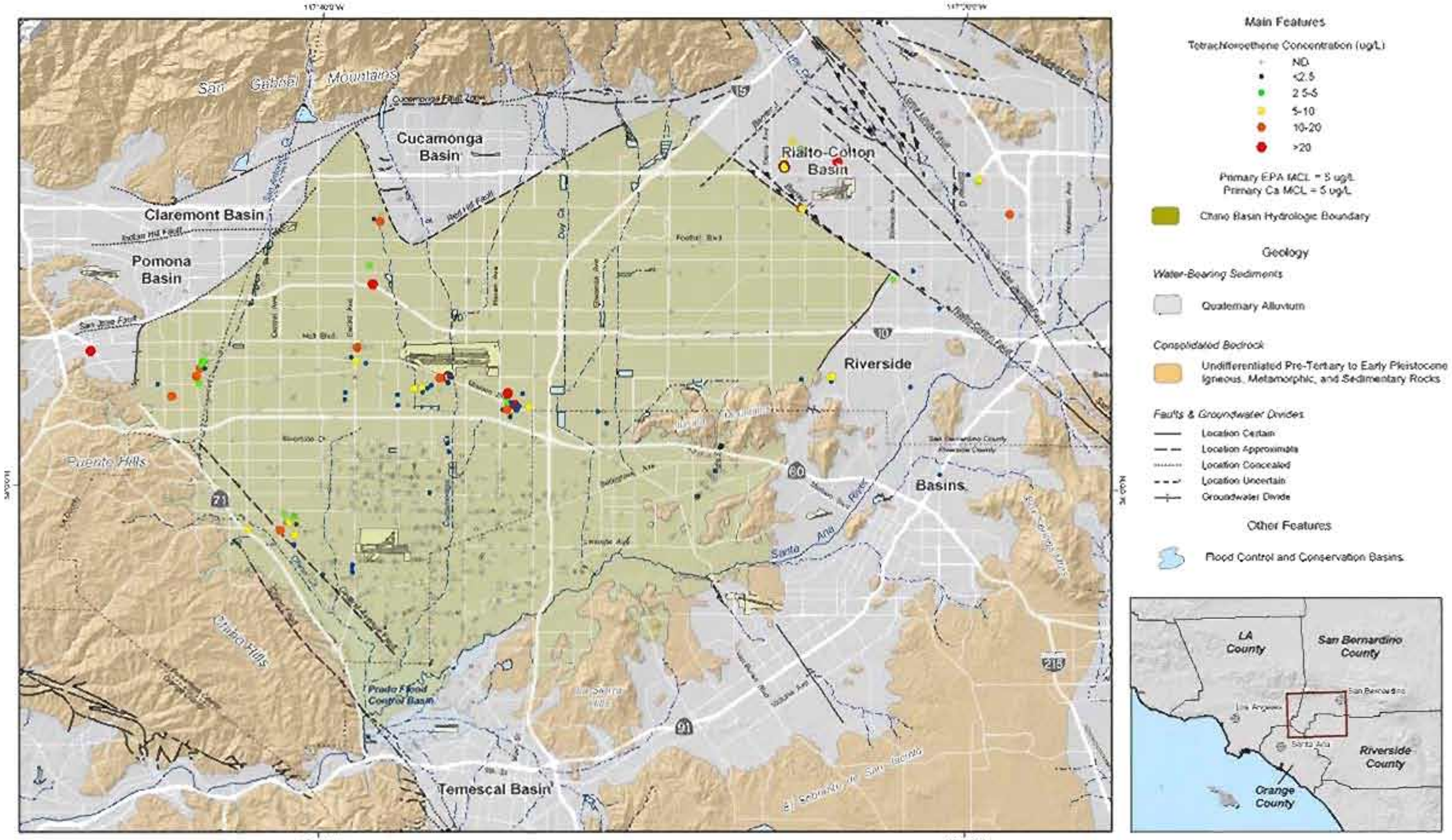
Author: BMW
Date: 20041223
File: Figure_4-7.mxd

State of the Basin Report – 2004
Groundwater Quality

Nitrate in Groundwater

Maximum Concentration (1999-2004)

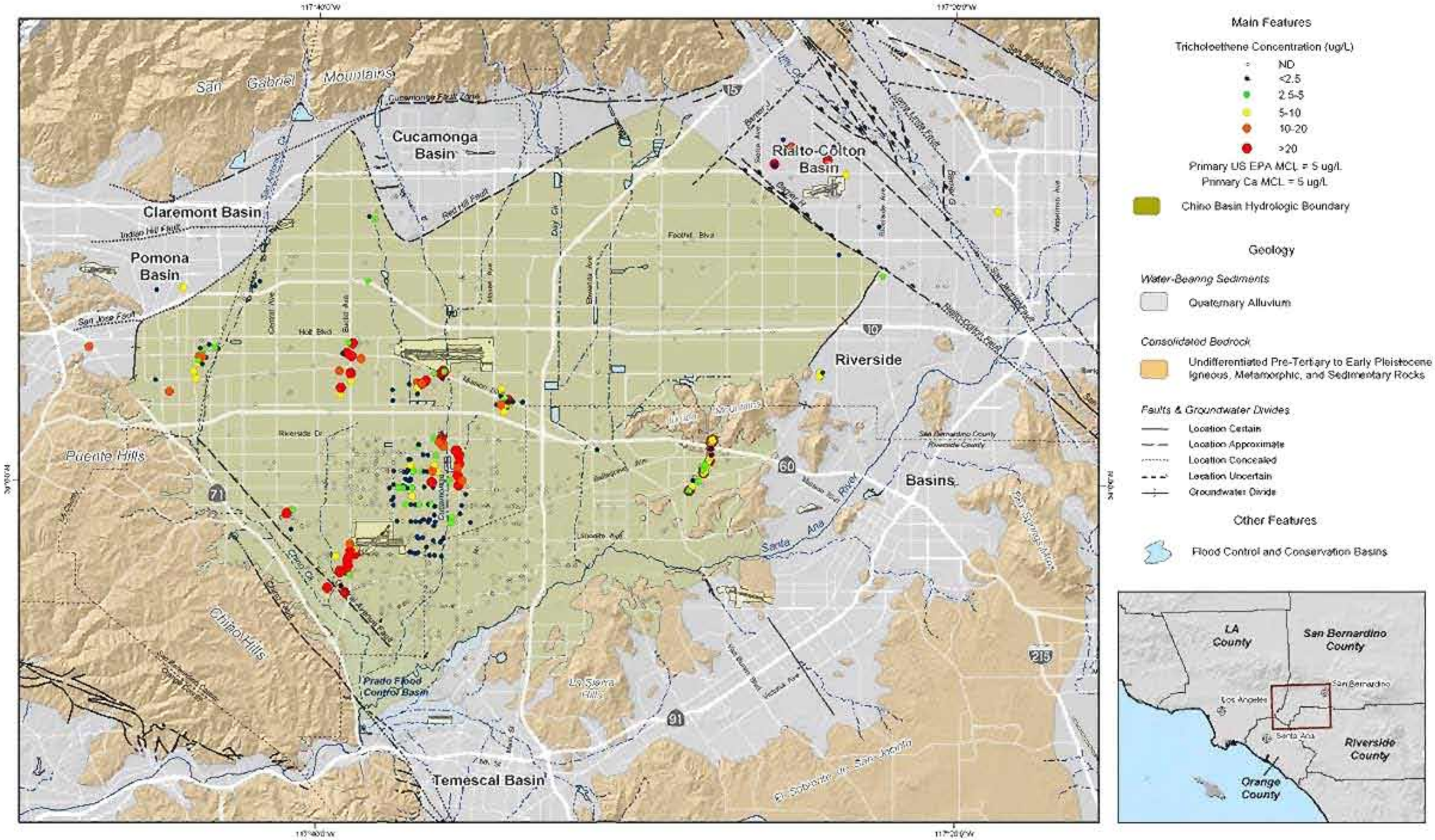
Figure 4-7



Tetrachloroethene in Groundwater

Maximum Concentration (1999-2004)

Figure 4-8



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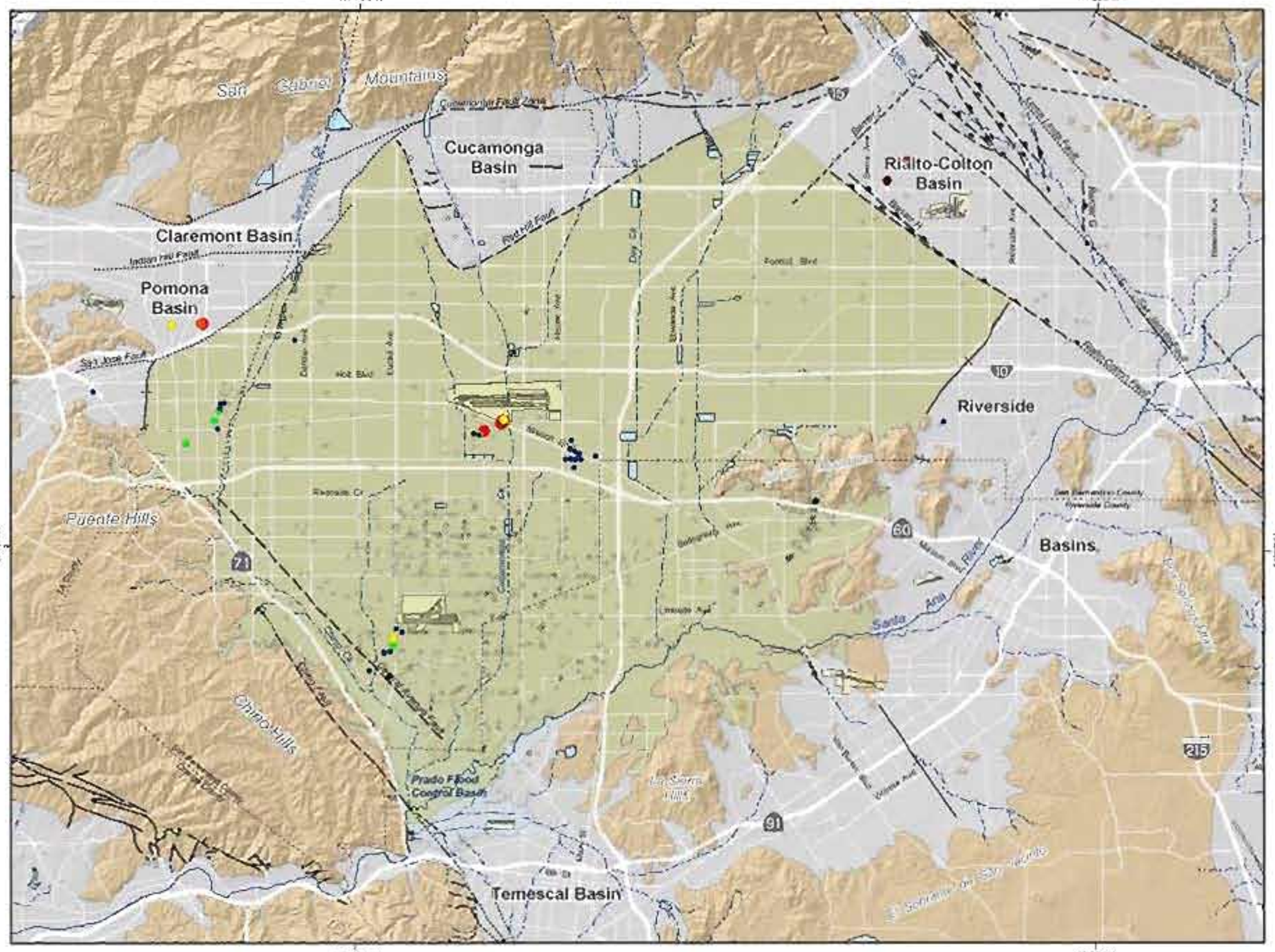
Author: EMW
Date: 20041223
File: Figure_4-9.mxd

State of the Basin Report – 2004
Groundwater Quality

Trichloroethene in Groundwater

Maximum Concentration (1999-2004)

Figure 4-9



Main Features

1,1-Dichloroethene Concentration (ug/L)

- ND
- <3
- 3-6
- 6-12
- 12-24
- >24

Primary Ca MCL = 6 ug/L

Chino Basin Hydrologic Boundary

Geology

Water-Bearing Sediments

Quaternary Alluvium

Consolidated Bedrock

Undifferentiated Pre-Tertiary to Early Pleistocene Igneous, Metamorphic, and Sedimentary Rocks

Faults & Groundwater Divides

- Location Certain
- Location Approximate
- Location Concealed
- Location Uncertain
- Groundwater Divide

Other Features

Flood Control and Conservation Basins

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0 1 2 3 4 Miles

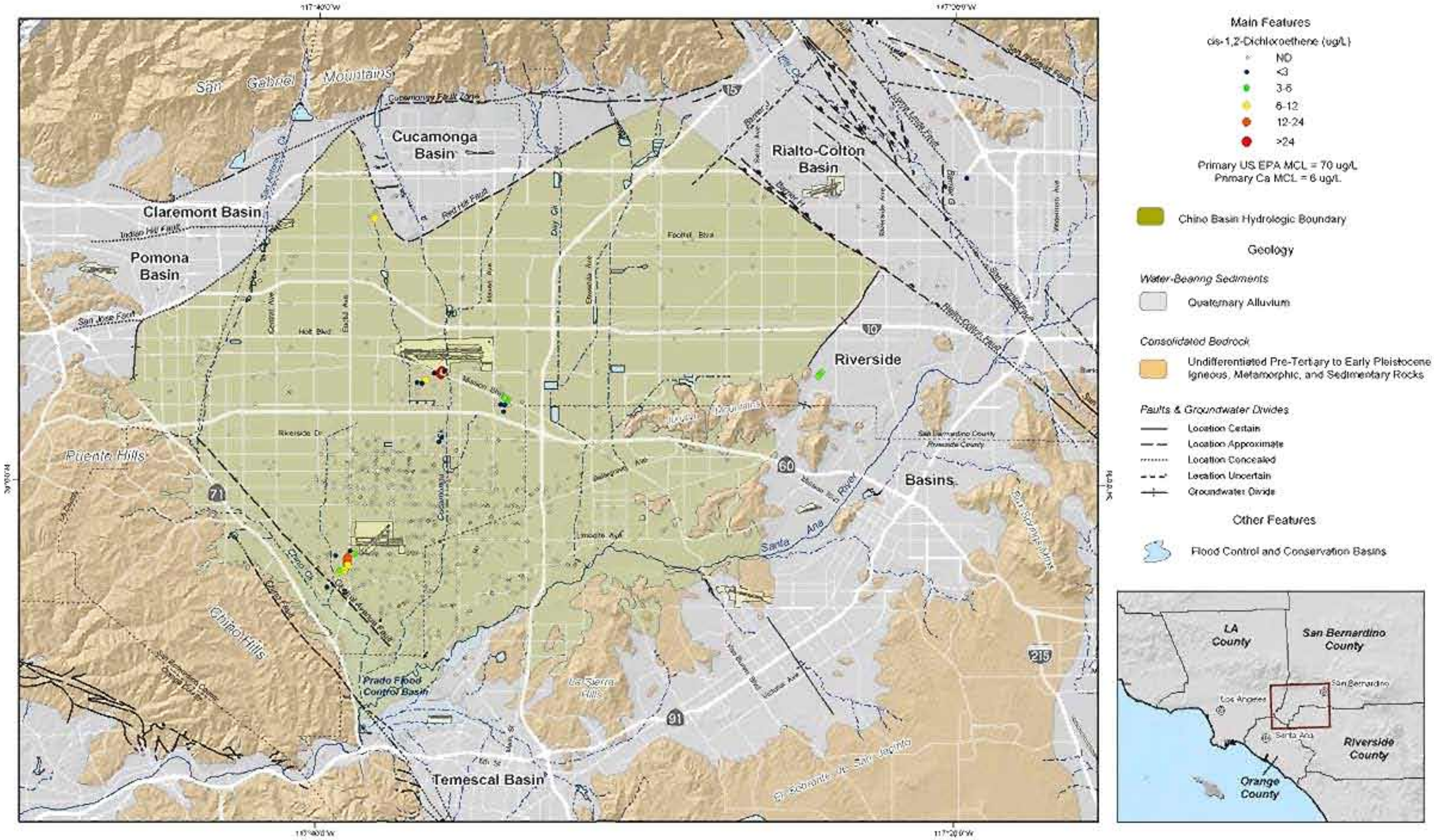
0 2 4 6 KM

State of the Basin Report – 2004
Groundwater Quality

1,1-Dichloroethene in Groundwater

Maximum Concentration (1999-2004)

Figure 4-10



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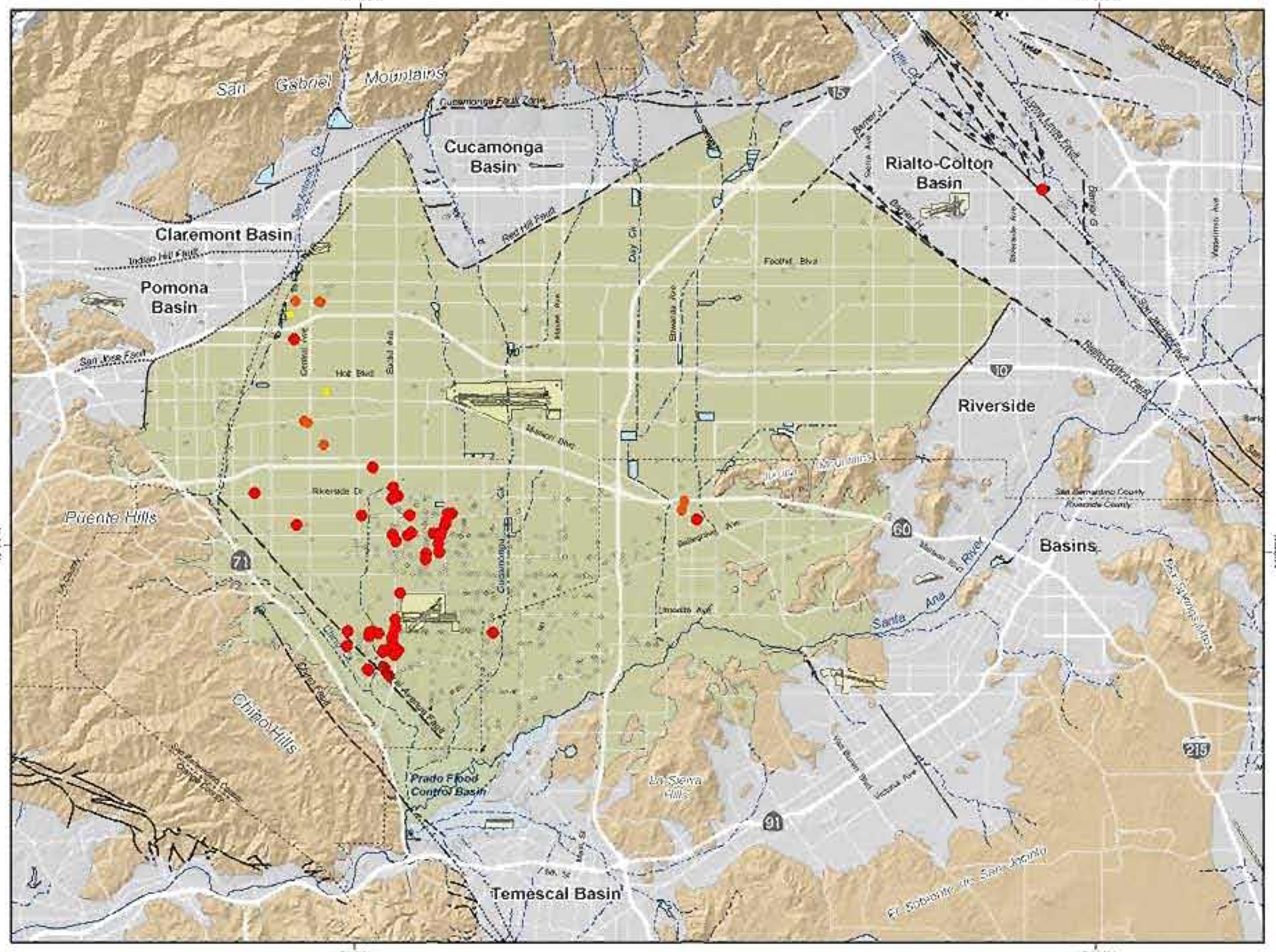
Author: BMW
Date: 20041229
File: Figure_4-11.mxd

State of the Basin Report – 2004
Groundwater Quality

cis-1,2-Dichloroethene in Groundwater

Maximum Concentration (1999-2004)

Figure 4-11



Main Features

1,2,3-Trichloropropane Concentration (ug/L)

- ND
- <0.0025
- 0.0025-0.005
- 0.005-0.01
- 0.01-0.02
- >0.02

California Notification Level = 0.005 ug/L

Chino Basin Hydrologic Boundary

Geology

Water-Bearing Sediments

Quaternary Alluvium

Consolidated Bedrock

Undifferentiated Pre-Tertiary to Early Pleistocene Igneous, Metamorphic, and Sedimentary Rocks

Faults & Groundwater Divides

- Location Certain
- Location Approximate
- Location Concealed
- Location Uncertain
- Groundwater Divide

Other Features

Flood Control and Conservation Basins

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Author: EMW
Date: 20041223
File: Figure_4-12.mxd

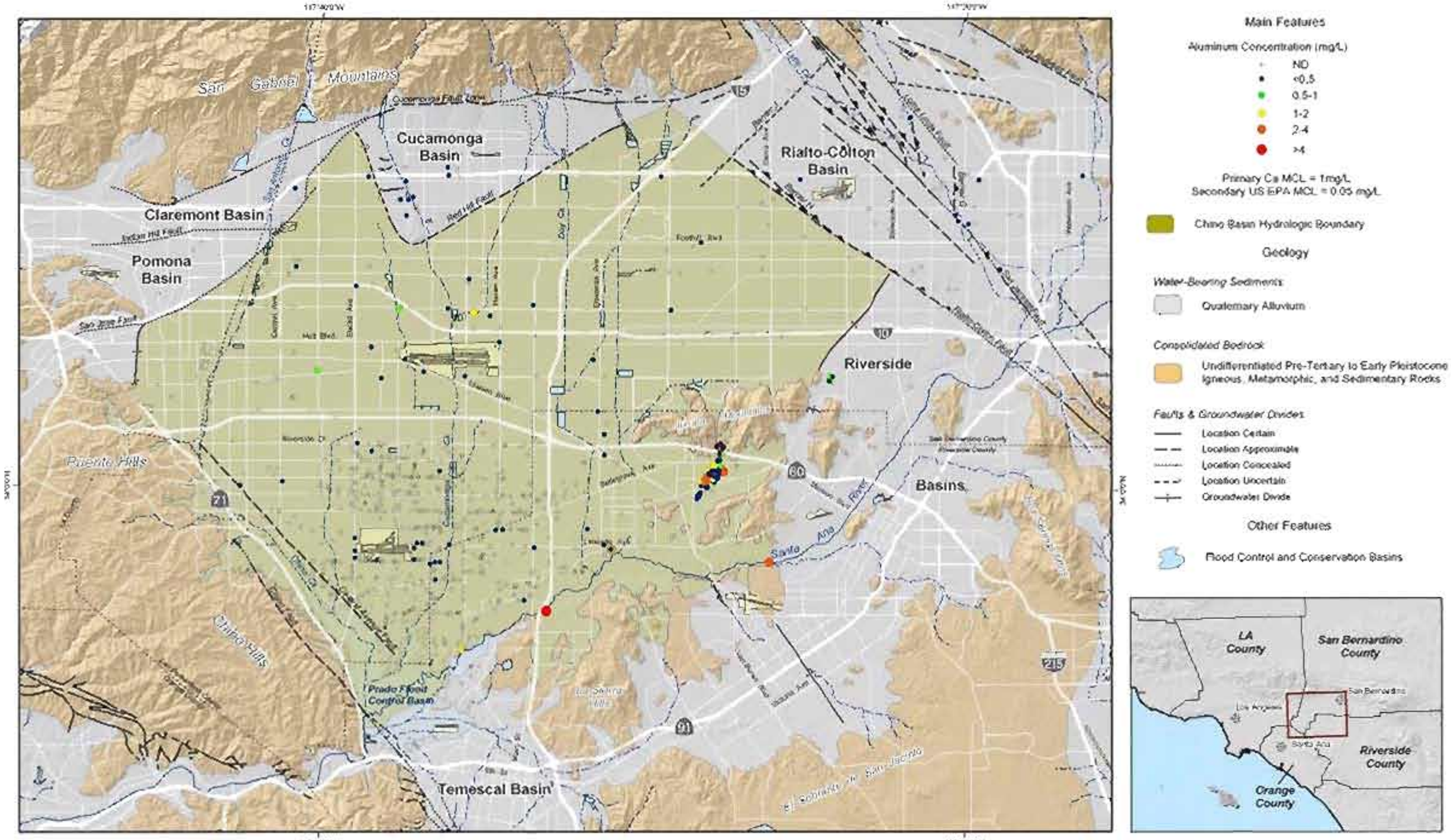
0 1 2 3 4 Miles
0 2 4 6 KM

State of the Basin Report – 2004
Groundwater Quality

1,2,3-Trichloropropane in Groundwater

Maximum Concentration (1999-2004)

Figure 4-12



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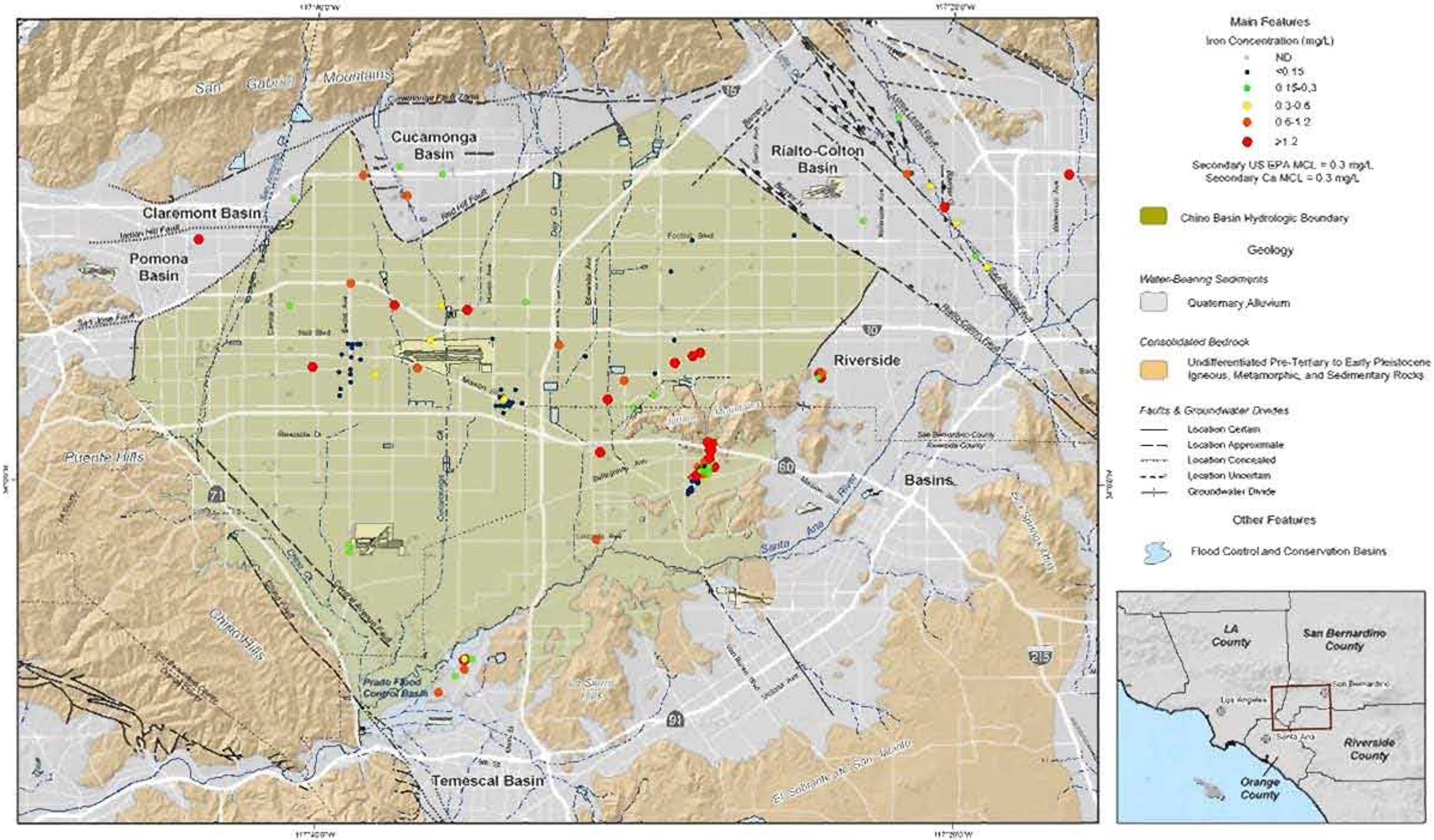
State of the Basin Report – 2004
Groundwater Quality

Aluminum in Groundwater

Maximum Concentration (1999-2004)

Figure 4-13



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State of the Basin Report – 2004
Groundwater Quality

Iron in Groundwater

Maximum Concentration (1999-2004)

Figure 4-14

Main Features
Arsenic Concentration (ug/L)

- ND
- <5
- 5-10
- 10-20
- 20-40
- >40

Proposed Primary US EPA MCL =10 ug/L
Current Primary US EPA MCL =50 ug/L
Primary Ca MCL =50 ug/L

Chino Basin Hydrologic Boundary

Geology

Water-Bearing Sediments

Quaternary Alluvium

Consolidated Bedrock

Undifferentiated Pre-Tertiary to Early Pleistocene Igneous, Metamorphic, and Sedimentary Rocks

Faults & Groundwater Divides

- Location Certain
- Location Approximate
- Location Concealed
- Location Uncertain
- Groundwater Divide

Other Features

Flood Control and Conservation Basins

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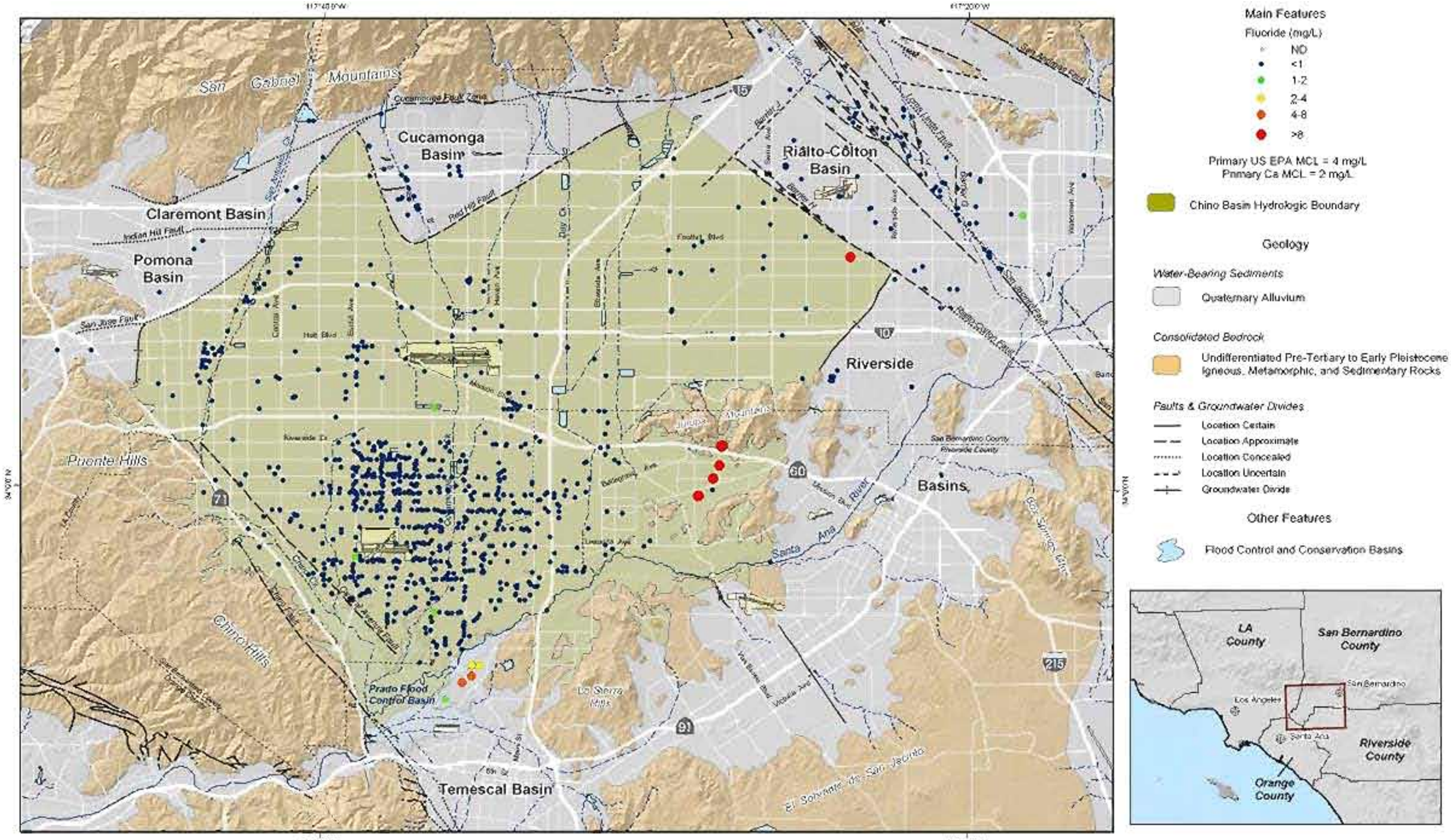
Author: EMW
Date: 20041221
File: Figure_4-15.mxd

0 1 2 3 4 Miles
0 2 4 6 KM

State of the Basin Report – 2004
Groundwater Quality

Arsenic in Groundwater
Maximum Concentration (1999-2004)

Figure 4-15



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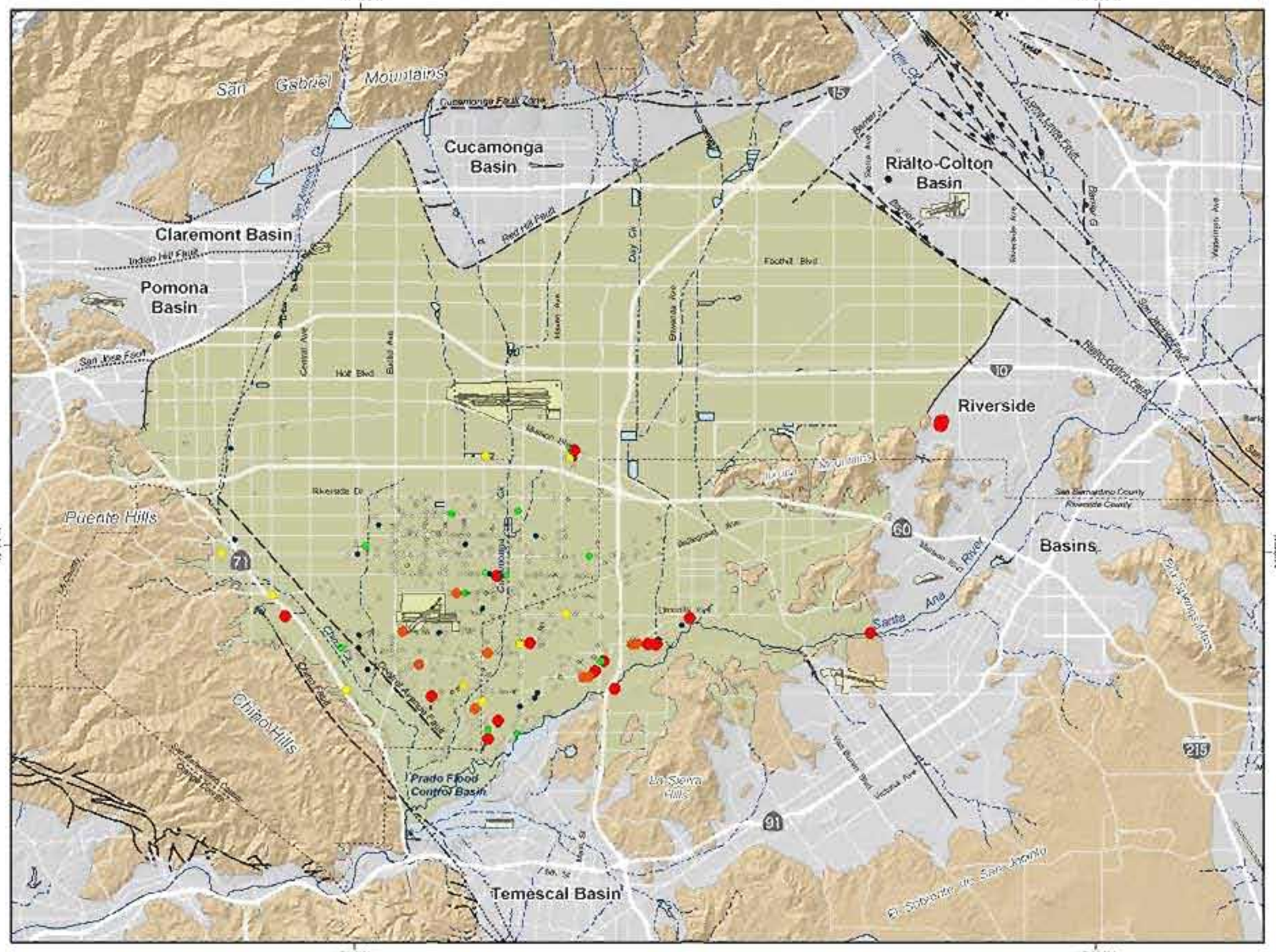
State of the Basin Report – 2004
Groundwater Quality

Fluoride in Groundwater

Maximum Concentration (1999-2004)

Figure 4-16



Main Features

Manganese (mg/L)

- ND
- <0.025
- 0.025-0.05
- 0.05-0.1
- 0.1-0.2
- >0.2

Secondary US EPA MCL = 0.05 mg/L
Secondary US CA MCL = 0.05 mg/L
Ca Notification Level = 0.5 mg/L

Chino Basin Hydrologic Boundary

Geology

Water-Bearing Sediments

Quaternary Alluvium

Consolidated Bedrock

Undifferentiated Pre-Tertiary to Early Pleistocene Igneous, Metamorphic, and Sedimentary Rocks

Faults & Groundwater Divides

- Location Certain
- Location Approximate
- Location Concealed
- Location Uncertain
- Groundwater Divide

Other Features

Flood Control and Conservation Basins

Produced by:

WILDERMUTH ENVIRONMENTAL INC.

Author: BMW
Date: 20041223
File: Figure_4-17.mxd

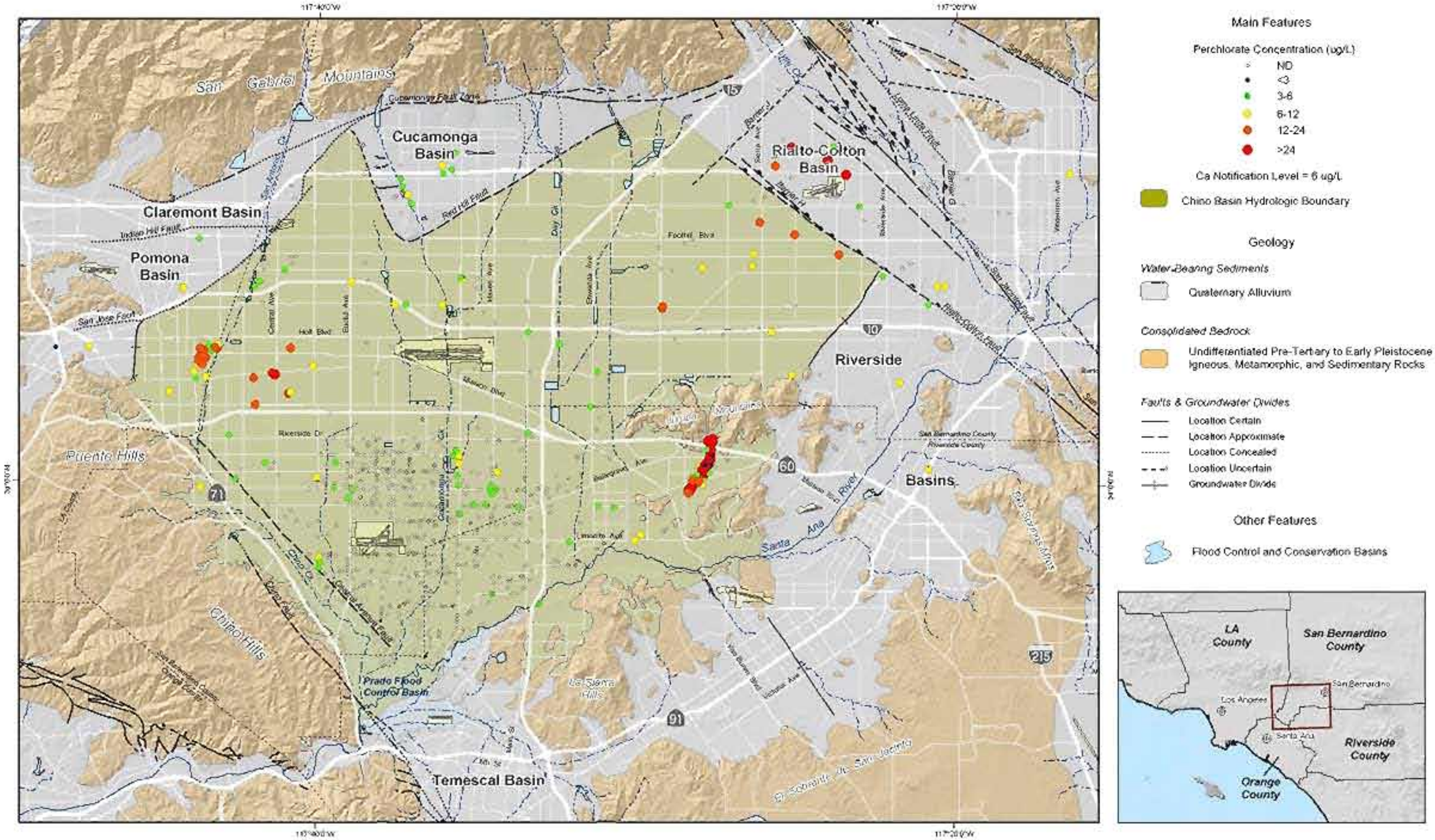
0 1 2 3 4 Miles
0 2 4 6 KM

State of the Basin Report – 2004
Groundwater Quality

Manganese in Groundwater

Maximum Concentration (1999-2004)

Figure 4-17



Produced by:

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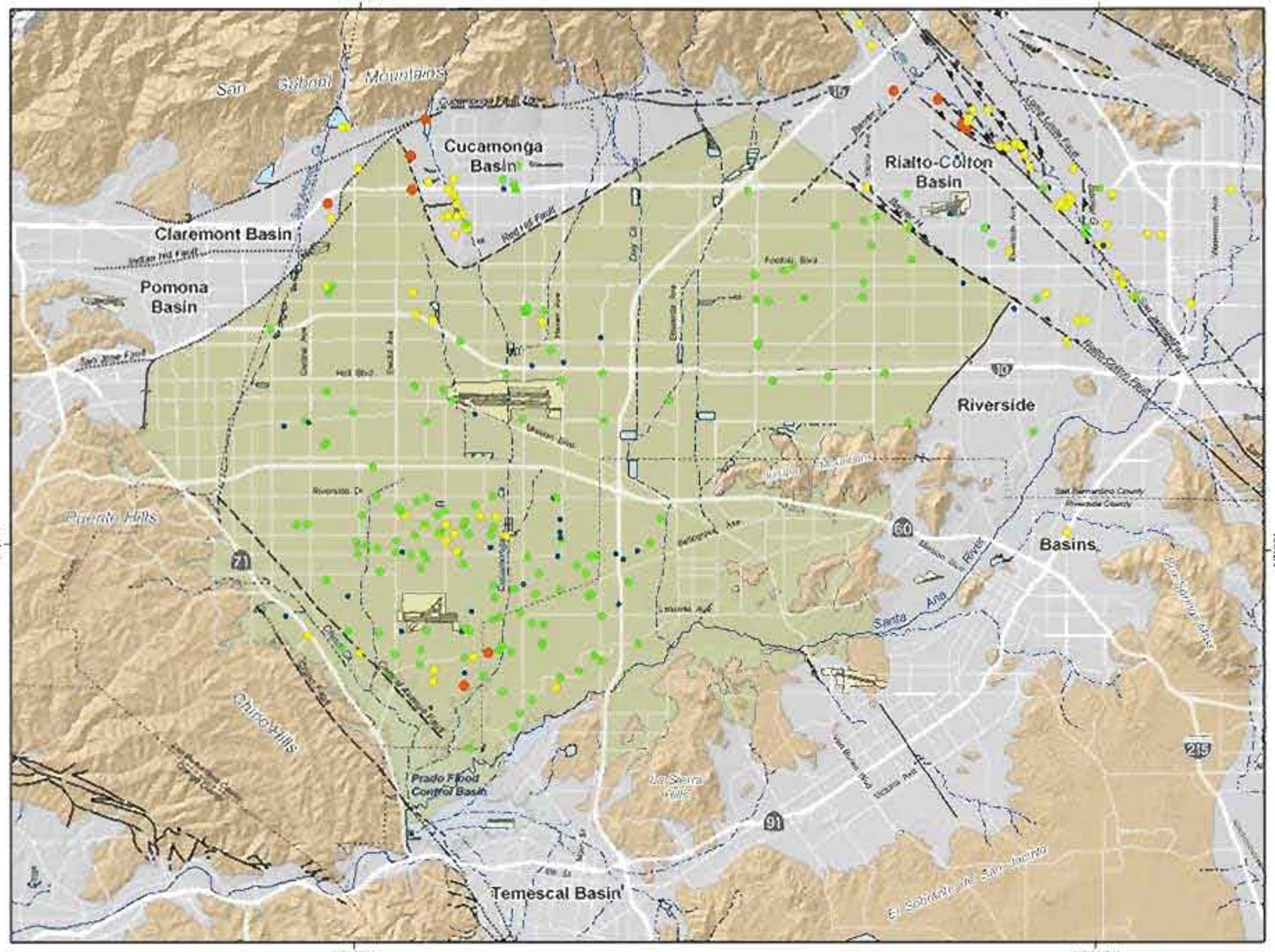
Author: BMW
Date: 20041223
File: Figure_4-18.mxd

State of the Basin Report – 2004
Groundwater Quality

Perchlorate in Groundwater

Maximum Concentration (1999-2004)

Figure 4-18



Main Features

Total Radon Concentration (PCi/L)

- ND
- <150
- 150-300
- 300-600
- 600-1200
- >1200

Primary US EPA MCL = 300 pCi/L

Chino Basin Hydrologic Boundary

Geology

Water-Bearing Sediments

Quaternary Alluvium

Consolidated Bedrock

Undifferentiated Pre-Tertiary to Early Pleistocene Igneous, Metamorphic, and Sedimentary Rocks

Faults & Groundwater Divides

- Location Certain
- Location Approximate
- Location Concealed
- Location Uncertain
- Groundwater Divide

Other Features

Flood Control and Conservation Basins

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0 1 2 3 4 Miles

0 2 4 6 KM

State of the Basin Report – 2004
Groundwater Quality

Total Radon in Groundwater

Maximum Concentration (1999-2004)

Figure 4-19

Main Features

Gross Alpha (pCi/L)

- ND
- <7.5
- 7.5-15
- 15-30
- 30-60
- >60

Primary US EPA MCL = 15 pCi/L
Primary Ca MCL = 15 pCi/L

Chino Basin Hydrologic Boundary

Geology

Water-Bearing Sediments

Quaternary Alluvium

Consolidated Bedrock

Undifferentiated Pre-Tertiary to Early Pleistocene Igneous, Metamorphic, and Sedimentary Rocks

Faults & Groundwater Divides

- Location Certain
- Location Approximate
- Location Concealed
- Location Uncertain
- Groundwater Divide

Other Features

Flood Control and Conservation Basins

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WILDERMUTH ENVIRONMENTAL INC.

Author: EMM
Date: 20041229
File: Figure_4-20.mxd

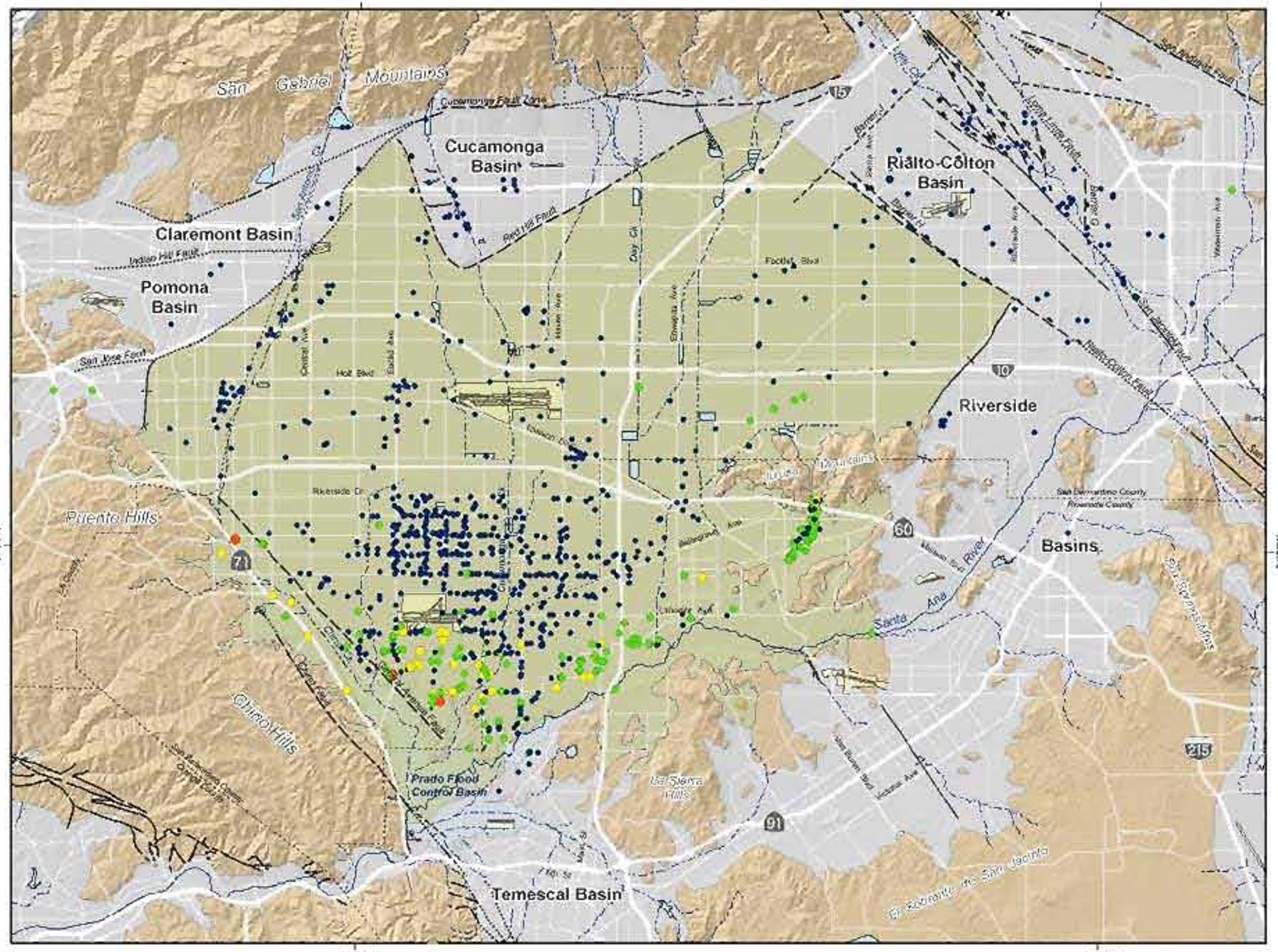
0 1 2 3 4 Miles
0 2 4 6 KM

State of the Basin Report – 2004
Groundwater Quality

Gross Alpha in Groundwater

Maximum Concentration (1999-2004)

Figure 4-20



Main Features

Sulfate Concentration (ug/L)

- NO
- <125
- 125-250
- 250-500
- 500-1000
- >1000

Secondary US EPA MCL = 250 mg/L
Secondary Ca MCL = 250 mg/L

Chino Basin Hydrologic Boundary

Geology

Water-Bearing Sediments

Quaternary Alluvium

Consolidated Bedrock

Undifferentiated Pre-Tertiary to Early Pleistocene Igneous, Metamorphic, and Sedimentary Rocks

Faults & Groundwater Divides

- Location Certain
- Location Approximate
- Location Concealed
- Location Uncertain
- Groundwater Divide

Other Features

Flood Control and Conservation Basins

Produced by:

WILDERMUTH ENVIRONMENTAL INC.

Author: BMW
Date: 20041221
File: Figure_4-21.mxd

0 1 2 3 4 Miles
0 2 4 6 KM

State of the Basin Report – 2004
Groundwater Quality

Sulfate in Groundwater

Maximum Concentration (1999-2004)

Figure 4-21

Main Features
Chloride (mg/L)
- ND
- <125
- 125-250
- 250-500
- 500-1000
- >1000

Secondary US EPA MCL = 250 mg/L
Secondary CA MCL = 250 mg/L

Chino Basin Hydrologic Boundary

Geology

Water-Bearing Sediments

Quaternary Alluvium

Consolidated Bedrock

Undifferentiated Pre-Tertiary to Early Pleistocene Igneous, Metamorphic, and Sedimentary Rocks

Faults & Groundwater Divides

- Location Certain
- Location Approximate
- Location Concealed
- Location Uncertain
- Groundwater Divide

Other Features

Flood Control and Conservation Basins

Produced by:
WILDERMUTH ENVIRONMENTAL INC.

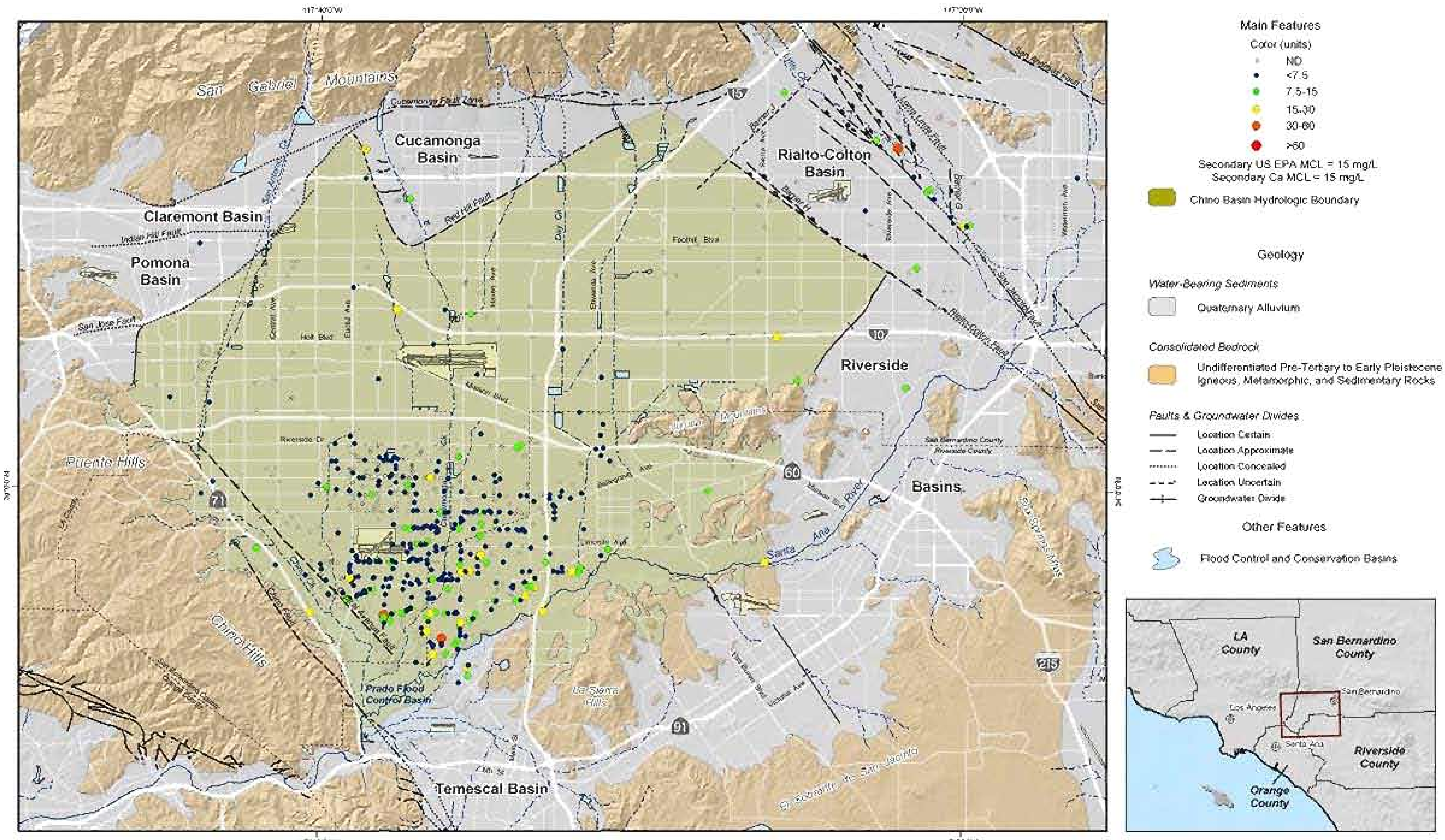
Author: EMW
Date: 2005/08/04
File: Figure_4-22.mxd

0 1 2 3 4 Miles
0 2 4 6 KM

State of the Basin Report – 2004
Groundwater Quality

Chloride in Groundwater
Maximum Concentration (1999-2004)

Figure 4-22



Produced by:

WILDERMUTH ENVIRONMENTAL INC.

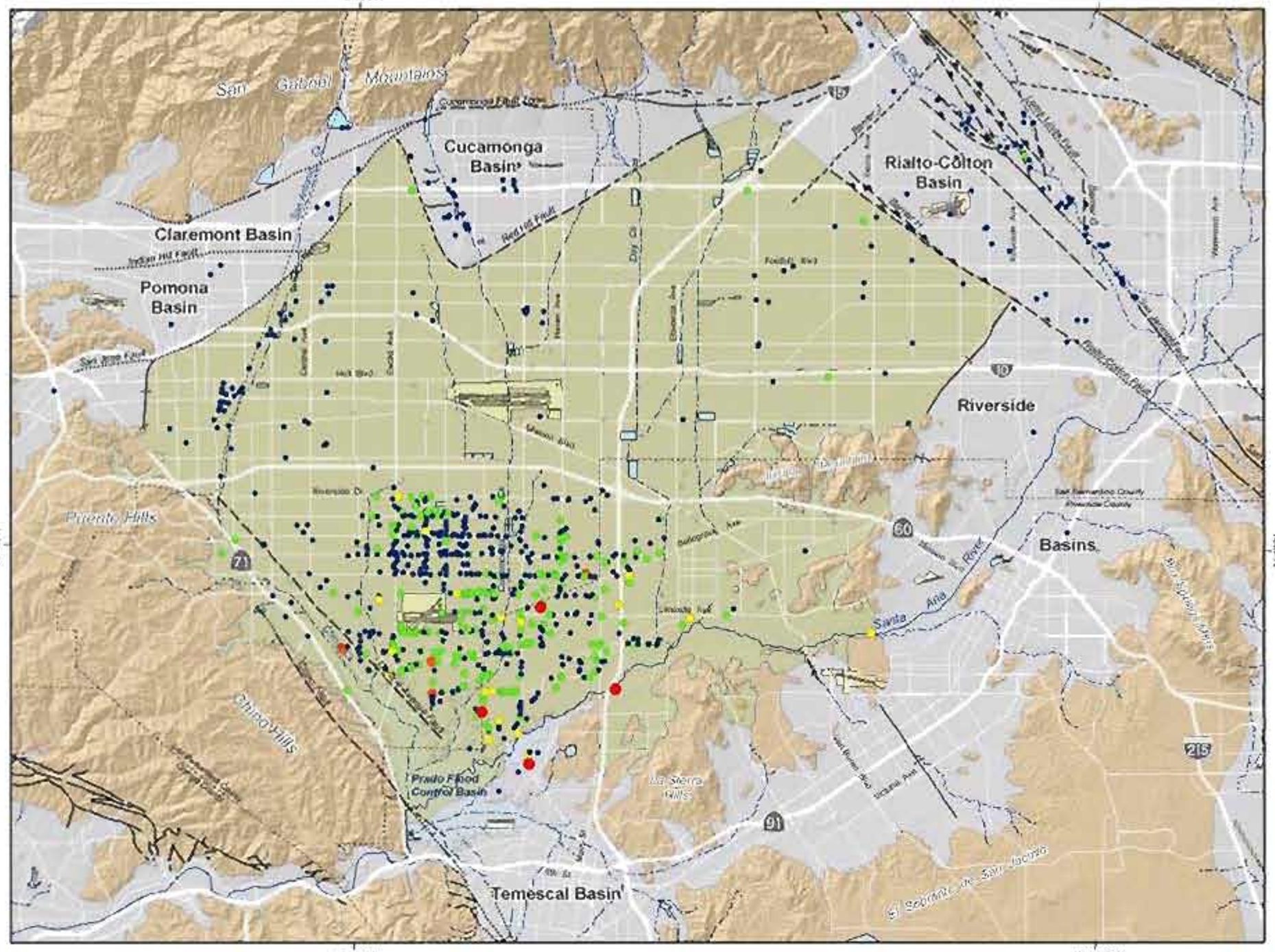
Author: EMW
Date: 20041229
File: Figure_4-23.mxd

State of the Basin Report – 2004
Groundwater Quality

Color in Groundwater

Maximum Concentration (1999-2004)

Figure 4-23



Main Features

Odor Concentration (ug/L)

- ND
- <1.5
- 1.5-3
- 3-6
- 6-12
- >12

Secondary US EPA MCL = 3 Ton
Secondary Ca MCL = 3 Ton

Chino Basin Hydrologic Boundary

Geology

Water-Bearing Sediments

Quaternary Alluvium

Consolidated Bedrock

Undifferentiated Pre-Tertiary to Early Pleistocene Igneous, Metamorphic, and Sedimentary Rocks

Faults & Groundwater Divides

- Location Certain
- Location Approximate
- Location Concealed
- Location Uncertain
- Groundwater Divide

Other Features

Flood Control and Conservation Basins

Produced by:

WILDERMUTH ENVIRONMENTAL INC

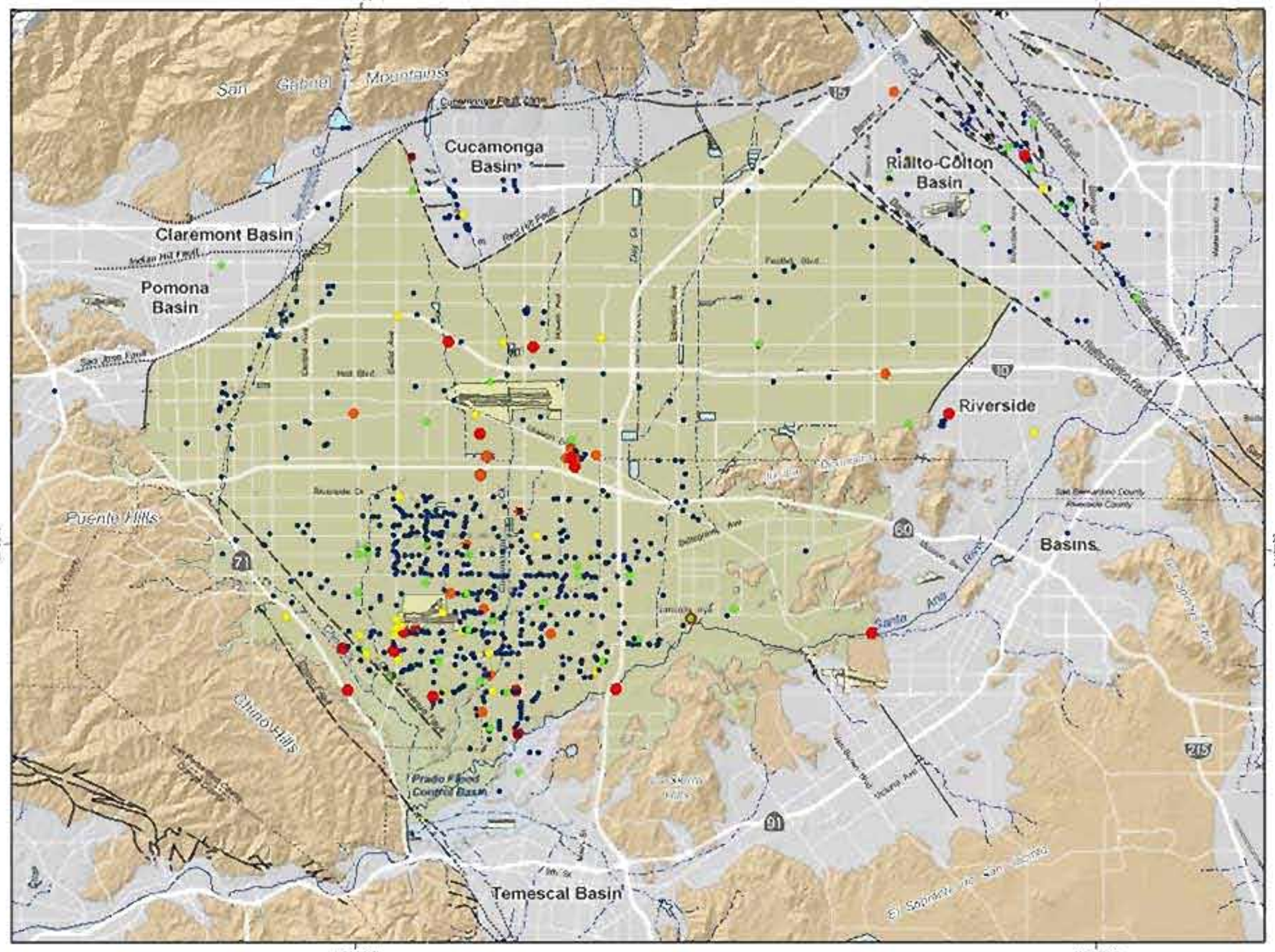
0 1 2 3 4 Miles
0 2 4 6 Km

State of the Basin Report – 2004
Groundwater Quality

Odor in Groundwater

Maximum Concentration (1999-2004)

Figure 4-24



Produced by:

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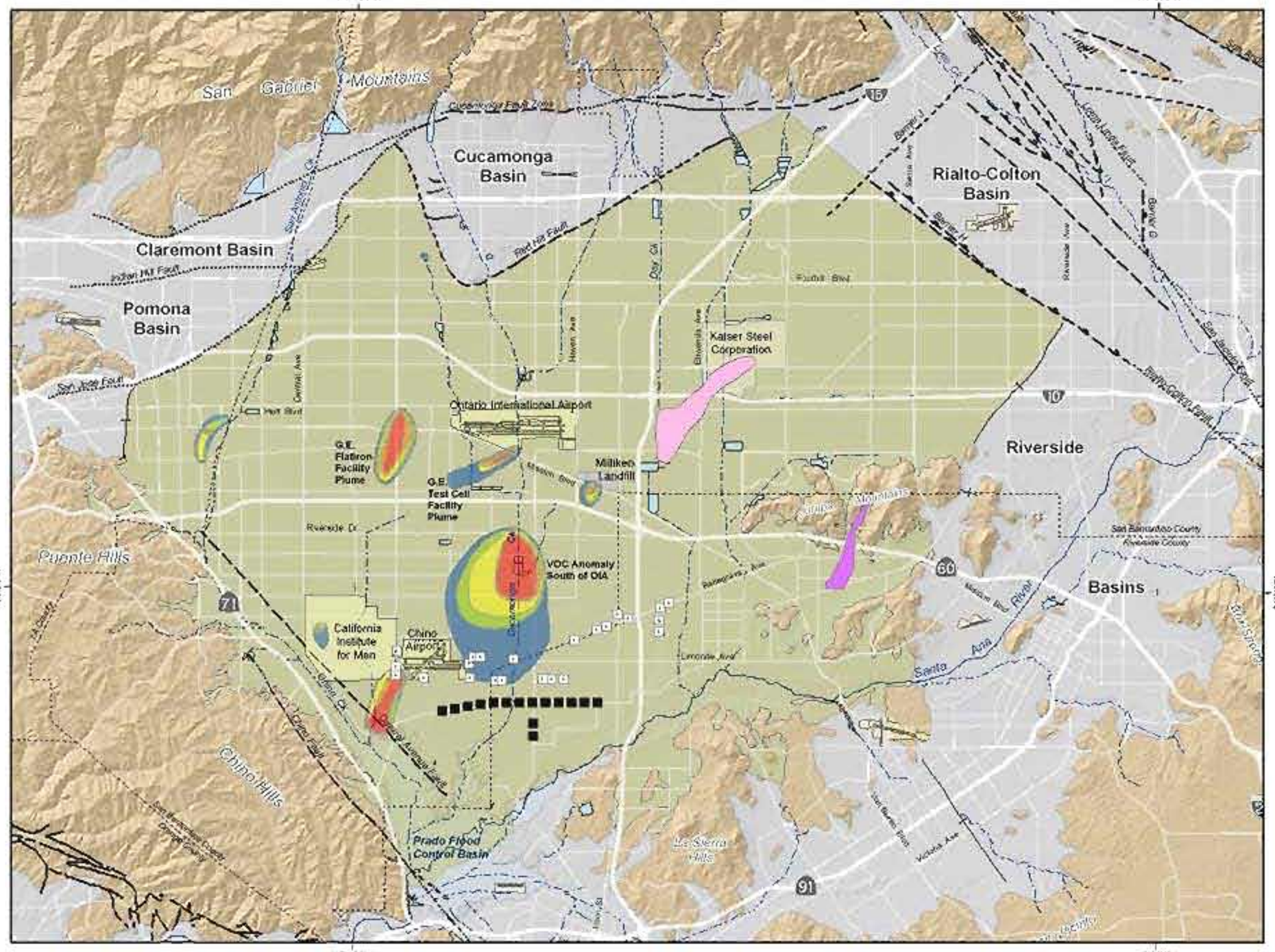
State of the Basin Report – 2004
Groundwater Quality

Turbidity in Groundwater
Maximum Concentration (1999-2004)

Figure 4-25



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Date: 20041223
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State of the Basin Report – 2004
Groundwater Quality

VOC plumes in the Chino Basin

Represented by Maximum TCE Concentration (1999-2004)

Figure 4-26

5. GROUND-LEVEL MONITORING

5.1 Background

The area underlying the City of Chino and the California Institution for Men (CIM) has experienced ground fissuring as early as 1973, but an accelerated occurrence of ground fissuring ensued after 1991. Figure 5-1 shows this area within the larger context of MZ-1.

A common cause of ground fissuring within alluvial basins is the removal of subsurface fluids resulting in compaction of poorly-consolidated aquifer materials and land subsidence (Galloway *et al.*, 1998; USGS, 1999). A number of studies have attributed this process to the ground fissuring and land subsidence that has occurred in Chino (Fife *et al.*, 1976, Kleinfelder, 1993, 1996, 1999; Geomatrix, 1994). Figure 5-1 shows the area where ground level surveys conducted within the City of Chino demonstrate that a maximum of about 2.5 ft of subsidence occurred along Central Avenue from 1987-1999 (Kleinfelder, 1993, 1996, 1999, 2001). Figure 5-2 shows a close-up view of this area.

Remote sensing studies of subsidence were conducted for the City of Chino (Peltzer, 1999a, 1999b) to further analyze subsidence in Management Zone 1 (MZ-1). These studies employed Synthetic Aperture Radar Interferometry (InSAR), which utilizes radar imagery from an Earth-orbiting spacecraft to map ground surface deformation. Figures 5-1 and 5-2 show the results of these InSAR studies that independently confirmed the location and relative magnitude of subsidence in MZ-1 as defined by the ground level surveys, and indicated the occurrence of subsidence north and northeast of Chino.

Program Element 4 (of the Optimum Basin Management Program) – *Develop and Implement a Comprehensive Groundwater Management Plan for Management Zone 1* relates specifically to ground fissuring and land subsidence in Chino Basin. This program element calls for the development and implementation of an Interim Management Plan for MZ-1 that will:

- Minimize subsidence and fissuring in the short-term
- Collect information necessary to understand the extent, rate, and mechanisms of subsidence and fissuring
- Formulate a long-term management plan to reduce to tolerable levels or abate future subsidence and fissuring

5.2 Activities and Accomplishments: 2002-2004

Since completion of the Initial State of the Basin Report in 2002, Watermaster has completed the following activities related to ground level monitoring:

1. *Formed the MZ-1 Technical Committee*. The MZ-1 Technical Committee serves as a clearing house for technical information, as well as the source for full professional discussion, input and peer review by its members, for the benefit of Watermaster. The Technical Committee provides comment and assists Watermaster in the development of recommendations for consideration and potential action by Watermaster under the Interim Management Plan. In addition, the Technical Committee provides similar assistance to Watermaster in its effort to develop a long-term plan as provided in Program Element Four. The Technical Committee consists of representatives (and their technical consultants) from those parties to the Judgment that are presently producing groundwater within MZ-1. Each of the following producers is entitled to representation on the Committee: Chino, Chino Hills, Ontario, Upland, Pomona, Monte Vista Water District, San Antonio Water Company, Southern California Water Company, CIM and the Agricultural Pool. Figure 5-1 shows the locations of wells owned by the

producers listed above. The MZ-1 Technical Committee first convened on March 6, 2002, and has continued to meet once every 1-3 months.

2. *Developed and implemented the Interim Monitoring Program*. The MZ-1 Technical Committee approved the scope and schedule for the MZ-1 Interim Monitoring Program (IMP) at the January 29, 2003 meeting. The IMP was developed and implemented to collect the information necessary to understand the extent, rate, and mechanisms of subsidence and fissuring in MZ-1. The data collected and analyzed as part of this effort are being utilized to develop effective management tools and, ultimately, a long-term management plan that will minimize or completely abate ground fissuring and subsidence in MZ-1. The IMP is described in detail in the IMP Work Plan dated January 8, 2003, but generally consists of three main elements: benchmark survey, InSAR, and aquifer-system monitoring. The benchmark surveys and the InSAR analyses monitor deformation of the land surface. Aquifer-system monitoring measures the hydraulic and mechanical changes within the aquifer-system that cause land surface deformation.

3. *Installed benchmark monument network and conducted ground level surveys*. The IMP calls for repeated benchmark surveys to measure vertical (and in some cases horizontal) ground surface deformation along selected profiles within Chino Basin – mainly in MZ-1. The benchmark surveys will (1) establish a datum from which to measure land surface deformation during the IMP period, (2) allow determination of historical subsidence at any historical benchmarks that can be recovered, (3) "ground-truth" the InSAR data, and (4) assist in the evaluation of the effectiveness of the long-term management plan.

   The IMP work plan called for the installation of a network of stable benchmark monuments to supplement an existing network of benchmarks that was installed for the City of Chino in 1987. Associated Engineers (AE) completed monument installations (see Figure 5-3) and an initial survey of all monument elevations in April 2003. Repeat surveys are planned for April of each year during the IMP period.

   The IMP work plan also calls for the deep extensometer, which is anchored in sedimentary bedrock at about 1,400 ft bgs, to be used as the "starting benchmark" for all survey loops. To accomplish this, a Class-A benchmark was constructed outside the extensometer building to serve as the practical (*i.e.* actual) starting benchmark. To link this benchmark to the deep extensometer pipe, each survey event begins by referencing the benchmark to a marked spot on one of the piers that supports the extensometer instrument platform. These piers and the instrument platform represent a stable ground surface datum that is used to measure relative vertical displacement between the ground surface and the deep extensometer pipe (recorded every 15 minutes). The vertical displacement recorded at the deep extensometer between survey events, in addition to any vertical displacement measured between the starting benchmark and the pier, is then used to calculate the elevation at the starting benchmark outside the extensometer building. Then, relative vertical displacement between benchmarks is measured across the entire network to obtain current elevations.

   A key element of the MZ-1 benchmark network is the array of closely spaced benchmarks that have been established across the historic fissure zone in the immediate vicinity of the Ayala Park extensometers (Ayala Park Array). At this array, located along Edison and Eucalyptus Avenues, both vertical and horizontal displacements are measured. These horizontal and vertical displacements are defining two-dimensional profiles of land-surface deformation that can be related to the vertical distribution of aquifer-system compaction and expansion that is being recorded continuously at the extensometers. These surveys are being repeated semi-annually during the late spring and early fall periods of highest and lowest water levels in an attempt to monitor fissure movement, if any, that may be associated with elastic and/or inelastic aquifer-system deformation. (Note: the semi-annual survey frequency of the Ayala Park Array monuments is a modification to the IMP work plan, and was agreed upon by the MZ-1 Technical Committee at the September 24, 2003 meeting).

4. *Performed "proof-of-concept" InSAR analyses to evaluate methodologies for historical analysis.* InSAR is being used to characterize ground surface deformation in Chino Basin. This analysis will be performed for a historical period (1992-2000) and on an on-going basis thereafter. The advantage of InSAR is that it provides an aerially continuous representation of land surface deformation. These data are planned to be used to: (1) characterize the time history of land surface deformation in greater spatial and temporal detail than can be accomplished from the available historical ground-level survey data, (2) calibrate computer simulation models of subsidence and groundwater flow, and (3) assist in the evaluation of the effectiveness of the long-term management plan.

   In 2004, Vexcel Corporation of Boulder, Colorado – a company that specializes in remote sensing and radar technologies – conducted a "proof of concept" study of historical SAR data that was acquired over the MZ-1 area. The objective of this study was to generate cumulative displacement maps over relatively short time steps (April to November 1993). The MZ-1 Technical Group deemed the study successful, and approved follow-up study by Vexcel to perform a comprehensive analysis of all historical SAR data (1992-2003) to characterize in detail the time history of subsidence in MZ-1.

5. *Tested and monitored the aquifer system hydraulics and mechanics*. This work involved the measuring of stresses within the aquifer-system that cause land surface deformation as measured by benchmark surveys, InSAR, and the extensometers (described below). The centerpiece of the aquifer-system monitoring program is the Ayala Park Extensometer – a highly sophisticated monitoring facility consisting of two multi-piezometers and a dual-extensometer. This facility monitors the hydraulics and mechanics of the underlying aquifer-system as the system undergoes various stresses due to groundwater production and recharge. The facility is equipped with pressure transducers to measure water levels in the piezometers, linear potentiometers to measure vertical displacement at the extensometers, and data loggers to record the data at frequent intervals (*e.g.* 15 minutes).

   Piezometer construction and instrumentation was completed in mid-November 2002, at which time collection of piezometric data commenced. Dual-extensometer construction and instrumentation was completed in mid-July 2003, at which time collection of aquifer-system deformation data commenced.

   In addition, nearby wells owned by CIM and the cities of Chino and Chino Hills have been equipped with pressure transducers and data loggers to record (1) water-level data and (2) the specific timing of pumping cycles at production wells. The IMP also called for Watermaster, with the assistance of the well owners, to conduct controlled aquifer stress tests (pumping tests) while monitoring water levels and groundwater production at nearby monitoring wells and production wells, as well as aquifer-system compaction and/or expansion at the dual-extensometer. These tests were performed in fall 2003, spring 2004, and fall 2004.

   The data collected from this monitoring effort are being used to: (1) characterize and quantify the current state of aquifer-system deformation (*i.e.* elastic vs. inelastic), (2) estimate aquifer-system parameters, such as the conductive and storage parameters of the aquifer and aquitard sediments, (3) reveal the existence of groundwater barrier(s) within the aquifer sediments, and (4) use all the above data as input to predictive computer models of compaction, subsidence, and groundwater flow to support the development of a long-term management plan.

6. *Presented interim results of IMP implementation at various professional conferences*. The preliminary results of the IMP (see Section 5.3 below) were presented by Wildermuth Environmental staff in behalf of Watermaster at three professional conferences in 2004: Inland Geological Society in Riverside CA, Groundwater Resource Association of California in Rohnert Park CA, and the American Water Resources Association in Orlando FL.

5.3 Results of Ground-Level Monitoring Program

5.3.1 Benchmark Surveys

In late April 2004, Associated Engineers (AE) performed the annual survey event across the entire network of benchmark monuments, including the measurements of horizontal displacements at the Ayala Park Array of monuments. The results of the April 2004 ground-level surveys were presented to the MZ-1 Technical Committee at its July 21, 2004 meeting. Also at this meeting, the project manager from AE, Jim Elliot, made a presentation to describe survey methodologies, accuracy, results, and challenges.

Figure 5-4 displays the vertical displacement at monuments that occurred from April 2003 to April 2004. Comparing monument elevations over the April to April time period should reveal the inelastic component of compaction, if any, that may be occurring in the region. The assumption here is that in April 2004 water levels in the region have recovered to the April 2003 levels, thus the measured vertical displacement does not include the elastic component of aquifer system deformation. Water levels measured as part of the IMP (in the vicinity of Ayala Park) support this assumption. Examination of Figure 5-4 shows that the monuments near Ayala Park experienced little to no subsidence over this time period. However, the monuments located in the northern portions of the surveyed area showed small but measurable subsidence of the land surface (on average about 0.04 feet). Maximum subsidence of about 0.08 feet was recorded at monuments located along Philadelphia Street between Pipeline and Ramona Avenues. Water level and groundwater production data have not been collected or analyzed as part of the IMP in these northern portions of the survey area; hence, it is not yet possible to classify the nature of the subsidence in this region (i.e. elastic vs inelastic).

The color-coded background in Figure 5-4 represents the subsidence that occurred in the area over the October 1993 to December 1995 period as measured by InSAR. The subsidence shown by this InSAR data has been interpreted as primarily permanent subsidence caused by inelastic aquifer-system compaction. If so, the survey data in Figure 5-4 are indicating that the distribution of inelastic compaction in 2003-04 is significantly different compared to the early 1990s. In particular, maximum subsidence of about 1 foot in 1993-95 was measured in the vicinity of Ayala Park by InSAR, whereas in 2003-04 the survey data are indicating minimal subsidence, if any, in this same area.

Figures 5-5 and 5-6 display the vertical and horizontal displacement at monuments of the Ayala Park Array that occurred from April 2003 to November 2003 and November 2003 to April 2004, respectively. The determination of horizontal displacement of monuments was accomplished through the processing of distance and angle measurements between adjacent monuments, and is based on the assumption that the southeastern monument was stable over the period of measurement.

The methods used to measure the horizontal displacement of monuments at the Ayala Park Array are currently being refined by AE. Preliminary conclusions derived from these figures provide evidence for:

- significant horizontal displacement of the ground surface over the course of the pumping and recovery seasons in the vicinity of the historic fissure zone
- the elastic nature of the land surface displacement over the course of the pumping and recovery seasons
- the apparent presence of a groundwater barrier within the deep aquifer-system (see Section 5.3.4 below).

5.3.2 Interferometer Synthetic Aperture Radar (InSAR)

In 2004, Vexcel Corporation of Boulder, Colorado – a company that specializes in remote sensing and radar technologies – conducted a "proof of concept" study of historical SAR data that was acquired over the MZ-1 area. The objective of this study was to generate cumulative displacement maps over relatively short time steps (months).

In this "proof of concept" study, four SAR images acquired from April 1993 to November 1993 were processed to create three interferograms:

- April 1993 – September 1993
- September 1993 – October 1993
- October 1993 – November 1993

These three interferograms were processed to create three cumulative displacement maps:

- April–September 1993 (Figure 5-7)
- April–October 1993 (Figure 5-8)
- April–November 1993 (Figure 5-9)

The major features to note in these cumulative displacement maps are:

1. The north-south trending trough of subsidence that extends northwest of the Ayala Park Extensometer, and depicts maximum subsidence of about 2.4 inches during the April–November 1993 period (Figure 5-9) in the vicinity of the intersection of Central Avenue and Schaefer Avenue. This pattern and magnitude of subsidence are consistent with past InSAR and ground-level survey analyses.
2. The coincidence of the north-south trending fissure zone (which was active during this general time period) and the sharp eastern edge of the trough of subsidence. This locational coincidence suggests a cause-and-effect relationship that may also be related to an underlying groundwater barrier within the deep aquifer-system sediments (see Section 5.3.4 below).
3. The slight differences between maps that depict the relatively small displacements that occurred from September to November can be recognized through this analysis. The recognition of these displacements at relatively short time steps (months) demonstrates the capability of this method to further resolve the time history of subsidence over the period of available SAR data (1992-2003).
4. The increasing number of "no data" cells as the maps progress through time. This is a result of incoherent cells in an interferogram in areas that were previously coherent in all prior interferograms. This phenomenon will progressively add "no data" cells to the cumulative displacement maps. However, in the opinion of Vexcel, the final map will still provide useful and spatially continuous data in areas typical provide coherence data (*e.g.* urban areas).
5. The large area of "no data" in the agricultural areas of Chino Basin. The analysis did not improve the coherence of the data in these agricultural areas, as was hoped.

The MZ-1 Technical Group deemed the study successful, and approved follow-up study by Vexcel to perform a comprehensive analysis of all historical SAR data (1992-2000) to characterize the historical seasonal and long-term displacements of the land surface in MZ-1.

5.3.3 Aquifer-System Monitoring

The extremely detailed monitoring of the aquifer-system (see Section 5.2) and subsequent data analyses has led to a number of key preliminary conclusions:

1. There appears to be two distinct aquifer systems in this area – a shallow, un-confined to semi-confined system from about 100-300 ft-bgs and a deep, confined system from about 400-1,200 ft-bgs.
2. Under current conditions of aquifer utilization in MZ-1, the aquifer-system deformation appears to be mainly elastic. At the Ayala Park Extensometer, 0.13 feet of elastic land subsidence and rebound were observed during the pumping and recovery seasons of 2003-04. Minor amounts (~0.02 feet) of permanent compaction and associated land subsidence apparently occurred over this same period (confirmation pending).
3. The relationships between aquifer-system stress (water level changes) and aquifer-system strain (vertical deformation of the sediment matrix) have been established by comparing piezometer data versus extensometer data. These relationships indicate the nature of the aquifer-system deformation (*i.e.* elastic vs. inelastic) and provide estimates of aquifer-system parameters for later use in aquifer-system models.
4. A deep aquifer-system pumping test in September 2004 appears to have transitioned the system from elastic to inelastic deformation (confirmation pending). This provides a "threshold" water level that when exceeded will result in inelastic compaction, but only under the same conditions imposed by the pumping test (*i.e.* same pumping wells, rates, and durations). The data derived from this test will assist in the creation of management tools for MZ-1 (*e.g.* groundwater flow and subsidence models).
5. Multiple lines of evidence suggest that a previously unknown groundwater barrier exists within the deep aquifer-system in the same location as the historic fissure zone (see Section 5.3.4 below).

A technical discussion related to the above preliminary conclusions follows:

Figure 5-10 shows the changes in thickness of the aquifer systems as recorded by the deep and shallow extensometers, completed at depths of 1,400 and 550 ft-bgs. It also shows the water-level fluctuations in two piezometers, PA-10 and PA-7, which are representative of the shallow aquifer system and the upper part of the deep aquifer system, respectively.

During periods of water-level decline in PA-7, both extensometers are recording compaction of the sediments. During periods of recovery in PA-7, both extensometers are generally recording elastic expansion. Note that for the data available, almost all of the compaction during the drawdown season is recovered as expansion during the recovery season.

During the late-spring (2004) pumping of the shallow aquifer system, while the deep system was shut down, the shallow extensometer recorded compression while the deep extensometer recorded an overall expansion. Subtracting the shallow record from the deep confirms that the deeper sediments continued a smooth expansion in response to continuing recovery of heads in the deeper parts of the aquifer system, as represented by the data from PA-7, which is screened from 438-448 ft-bgs. The shallow compression is seen to correlate closely with the drawdown recorded by PA-10, screened from 213-233 ft-bgs.

These observations clearly demonstrate the existence of the deep and shallow aquifer-systems in this region of MZ-1. Nearby pumping at wells that are screened in either the deep or shallow aquifer-systems result in distinct hydraulic and mechanical responses that are recorded at the Ayala Park piezometers and

extensometers. These observations also demonstrate the importance, for analytical purposes, of independently stressing the deep and shallow systems by pumping from only one at a time, so that the observed deformation can be more accurately attributed to production from a specific depth interval.

The relationships between water levels and aquifer-system deformation are further depicted in the stress-strain diagrams shown in Figure 5-11. In this diagram, increasing depth to water (drawdown due to pumping) is the measure of decreasing pore pressure and increasing effective intergranular stress. Increasing compression of the sediments is the resulting strain. When pumping diminishes or ceases, pore pressures recover, intergranular stress is reduced, and the aquifer systems expand.

Figure 5-11 shows that the full thickness of sediments responds linearly to extended intervals of continuous drawdown or recovery, but with a large seasonal hysteresis attributable to the time lag involved in the delayed vertical propagation of pore pressure changes from the pumped aquifers into adjacent, poorly permeable aquitards. The parallel slopes of the compression and expansion trends represent the overall elasticity of the sedimentary section. Its inverse is the skeletal storativity, in hydrologic terminology.

The parallelism of the seasonal drawdown and recovery stress-strain slopes in Figure 5-11 indicates that seasonal drawdown to 250 ft-bgs at this site is producing essentially elastic, recoverable deformation. However, the slope of the drawdown curve in 2004 begins to deviate from its elastic trend when the seasonal drawdown exceeds 250 ft-bgs indicating a transition to inelastic compaction within draining aquitard interbeds. A minor amount of non-recovered compaction (~ 0.02 ft) is indicated by the offset of the recovery curve in 2004 to the right (direction of compression), and will be confirmed if the curve remains to the right when water levels recover to pre-pumping conditions in 2004 (~105 ft-bgs at PA-7).

Brief intervals of recovery during the drawdown season, and of drawdown during the recovery season, produce steeply sloping, more-or-less tight hysteresis loops. Their much steeper slope represents the (inverse) aggregate compressibility of the permeable pumped aquifers. The longer intervals of recovery and drawdown generate the more open hysteresis loops, as the delayed responses of immediately adjacent portions of the aquitards have time to influence the extensometers.

5.3.4 Discovery of Groundwater Barrier

Controlled aquifer-system stress (pumping) tests in October 2003 and April 2004 provided piezometric response data that revealed a potential groundwater barrier within the sediments below about 300 ft-bgs and aligned with the historic fissure zone. Figure 5-12 is a map that shows the locations of a pumping well perforated in the deep aquifer system (CH-19, 340-1,000 ft-bgs) and other surrounding wells that also are perforated exclusively in the deep system. Figure 5-13 shows the water level responses in these wells during various pumping cycles at CH-19. The groundwater barrier is evidenced by a lack of water level response in CH-18 (east of the fissure zone) due to pumping at CH-19 (west of the fissure zone). Image-well analysis of pumping-test responses also indicates that this barrier approximately coincides with the location of the historic zone of ground fissuring.

Ground level survey data corroborates the water level data – also indicating the existence of the barrier and its coincident location with the fissure zone. Figure 5-5 shows that during the pumping season of 2003 (April to November) vertical displacement of the land surface (*i.e.* subsidence) was generally greater on the west side of the fissure zone where water level drawdown was greatest. Figure 5-6 shows that

during the recovery season of 2003-04 (November to April) vertical displacement of the land surface (*i.e.* rebound) was again greater on the west side of the fissure zone where water level recovery was greatest.

In other words, the groundwater barrier in the deep aquifer-system is aligned with the fissure zone and causes greater water level fluctuations on the west side of the barrier where the pumping is concentrated. These greater water level fluctuations on the west side of the barrier, in turn, cause greater deformation of the aquifer-system matrix which, in turn, causes greater vertical land surface deformation on the west side of the barrier. In addition, the pattern of horizontal displacement of benchmarks over the pumping and recovery seasons, as shown in Figures 5-5 and 5-6, likely reflects, in part, the differential compaction of the aquifer system across the fissure zone.

Similarly, the InSAR data in Figures 5-2 and 5-4 also corroborate the existence of the groundwater barrier by showing maximum subsidence west of the barrier and virtually no subsidence east of the barrier.

This spatial coincidence of the groundwater barrier and the historic fissure zone suggests a cause-and-effect relationship: the barrier causes differential water level declines, which causes differential aquifer-system compaction and a steep gradient of subsidence across the barrier, which can and likely has caused ground fissuring directly above the barrier.

5.4 On-Going and Recommended Activities

5.4.1 InSAR

The MZ-1 Technical Group deemed the "proof-of-concept" InSAR study successful (see Section 5.3.2 above), and approved a follow-up study by Vexcel to perform a comprehensive analysis of all historical SAR data (1992-2003) to characterize the historical seasonal and long-term displacements of the land surface in MZ-1. The comprehensive analysis should be completed by the first quarter of 2005. Vexcel will present the results at the following MZ-1 Technical Committee meeting. The data will be used in calibration of future groundwater flow and subsidence models (see Section 5.4.4 below).

The MZ-1 Technical Committee is recommending that on-going InSAR monitoring of land surface deformation be conducted on a semi-annual interval (spring and fall data acquisition and interferometric analysis) for the next two years. This analysis will (1) reveal seasonal and annual ground surface displacement across the entire MZ-1 area, and (2) be compared to ground-level survey data collected at the same interval (see Section 5.4.2 below) to help determine long-term monitoring strategy.

5.4.2 Ground Level Survey Lines

The next comprehensive survey event is scheduled for April 2005. These data will be compared to the April 2004 survey event to identify areas where permanent land subsidence, if any, is occurring in MZ-1. The MZ-1 Technical Committee is recommending that on-going ground-level surveys will be conducted on a semi-annual interval (spring and fall survey events) for the next two years. This analysis will (1) reveal seasonal and annual ground surface displacement across the monument network in MZ-1, and (2) be compared to InSAR results that span the same interval (see Section 5.4.1 above) to help determine long-term monitoring strategy.

Surveying of the Ayala Park Array of monuments – an exercise used to measure both vertical and horizontal displacements across the historic fissure – will also occur during the April 2005 survey event.

These data can then be compared to the previous survey data (April and November 2004), in an effort to monitor fissure movement, if any, that may be associated with elastic and/or inelastic aquifer-system deformation. The MZ-1 Technical Committee will review these data and the scope of the "fissure monitoring" efforts, and recommend changes to the scope if warranted. Anecdotal field evidence suggests that the fissure monitoring efforts should be expanded north of Edison Avenue to include the surveying of monuments along Schaefer Avenue.

It is desirable that the calibration period for future groundwater flow and subsidence modeling (see Section 5.4.4 below) begins before significant drawdown in MZ-1 (~1940). Currently available subsidence data in this region begins in 1987. If subsidence data exists prior to 1987, then it needs to be collected and linked to the post-1987 survey data if it is to be used in model calibration. Associated Engineers is currently preparing a cost estimate to conduct this data collection and processing effort.

5.4.3 Aquifer-System Monitoring

The aquifer system monitoring efforts will continue for the duration of the IMP, and will likely be recommended by the MZ-1 Technical Committee to continue, albeit at a reduced scope, as part of the long-term management plan.

The cities of Chino and Chino Hills are contemplating a pilot ASR (aquifer storage and recovery) test at inactive production wells in the region to evaluate ASR as a method to recharge the aquifer-system and manage drawdown and associated subsidence. Watermaster has committed to fund one ASR pilot test as part of the IMP, and monitor the aquifer-system responses to such a test. The cities would be responsible for conducting the test at the production well.

One of the key discoveries of the IMP has been the groundwater barrier located beneath the historic fissure zone. However, the northern and southern extent of this barrier is unknown. The MZ-1 Technical Committee is contemplating the expansion of the aquifer-system monitoring network to the north and south of its current extent to better characterize the location and effectiveness of the barrier. Further aquifer-system testing (*i.e.* pumping test) may be necessary as part of this effort.

5.4.4 Aquifer-System Modeling

The objectives of aquifer-system modeling in MZ-1 are:

- To evaluate fluid withdrawal as the mechanism of historical land subsidence (forensic tool)
- To predict the effects of potential basin management practices on groundwater levels and land subsidence (forecasting tool)

In other words, if a model can be constructed that simulates past drawdown and associated land subsidence, then the model represents an additional line of evidence that fluid withdrawal was the mechanism of historical land subsidence. In addition, the model can be used to predict future drawdown and associated land subsidence that would result from potential basin management practices.

Three distinct modeling efforts will take place in sequence:

1. *Inverse analytical modeling.* This type of modeling will use groundwater level and production data collected as part of the aquifer-system stress testing (pumping tests) that were conducted in 2003 and

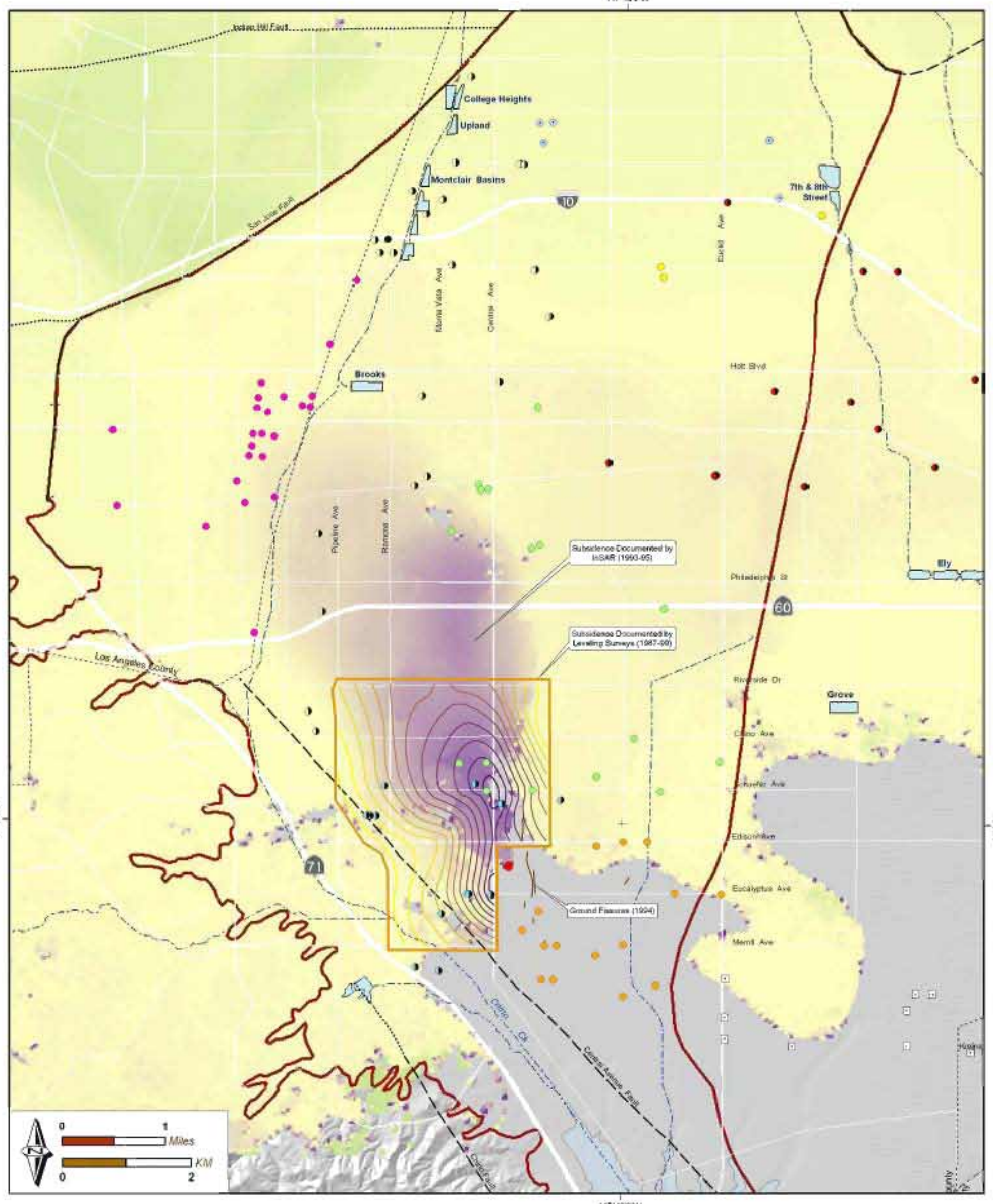
2004. The objectives are to determine the hydraulic and mechanical parameters of the aquifer-system and reveal XY-anisotropy. The results will be used in subsequent numerical modeling efforts.

2. *One-dimensional compaction modeling.* This type of modeling will use groundwater level and aquifer-system deformation data collected at the Ayala Park Extensometer facility. The objective is to determine the aquitard properties in the vicinity of Ayala Park. Aerial extrapolation of aquitard properties will be based on geology and InSAR data, and the results will be used in the three-dimensional numerical modeling efforts (below).
3. *Three-dimensional groundwater flow and subsidence modeling.* This type of modeling will use groundwater level and production data at all wells in the area and historical land subsidence data from ground level surveys and InSAR. Again, this model will serve as a forensic and forecasting tool for MZ-1.

5.4.5 Development of Long-Term Management Plan

Recall that the objective of the long-term management plan is to minimize or abate permanent land subsidence and ground fissuring in MZ-1. The modeling efforts described above will be key to the development and evaluation of this plan.

The OBMP implementation plan called for the development of the long-term management plan for MZ-1 by June 2005. Because the modeling efforts will not be completed by June 2005, the long-term management plan will not be completed by June 2005. The Special Referee has been notified, and has indicated that the IMP progress and current activities are sufficient to warrant a delay in the development of the long-term management plan for MZ-1. A workshop will be scheduled for the second quarter of 2005 to update the Special Referee on IMP progress.



Subsidence Features

- -2.2
- -2.1 - -2.0
- -1.9 - -1.6
- -1.5 - -1.4
- -1.3 - -1.2
- -1.1 - -1.0
- -0.9 - -0.8
- -0.7 - -0.6
- -0.5 - -0.4
- -0.3 - 0.0

Relative Change in Land Surface Altitude as Measured by Leveling Surveys 1987 - 1999 (feet)

+ 1.0
0.0
- 1.0

Relative Change in Land Surface Altitude as Measured by InSAR Oct 1993 - Dec 1995 (feet)

Wells in MZ-1 by Owner

- Ontario
- Pomona
- SAWC
- Upland
- SCWC
- CIM
- Chino Hills
- Chino
- MVWD

Other Features

- Ayala Park Extensometer Facility
- Chino Basin Desalter Well (Existing)
- Management Zone 1 Boundary
- No InSAR Data

Prepared by:

WILDERMUTH ENVIRONMENTAL INC.

State of the Basin Report - 2004
Ground Level Monitoring

Author: AEM
Date: 20050106
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Land Surface Deformation in Management Zone 1

Leveling Surveys and InSAR

Figure 5-1

Land Subsidence Contours as Measured by Leveling Surveys (1987-1999; in feet)

Subsidence Features

Ground Fissure (mapped in 1994)

Relative Change in Land Surface Altitude as Measured by InSAR Oct 1993 - Dec 1995 (feet)

+1.0
0.0
-1.0

Wells in MZ-1 by Owner

- Ontario
- Pomona
- SAWC
- Upland
- SCWC
- CIM
- Chino Hills
- Chino
- MVWD

Other Features

Ayala Park Extensometer Facility

Note: Air photo background flown in April 2004

Ground Fissures

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Author: ASM
Date: 20050112
File: Figure_5-2.mxd

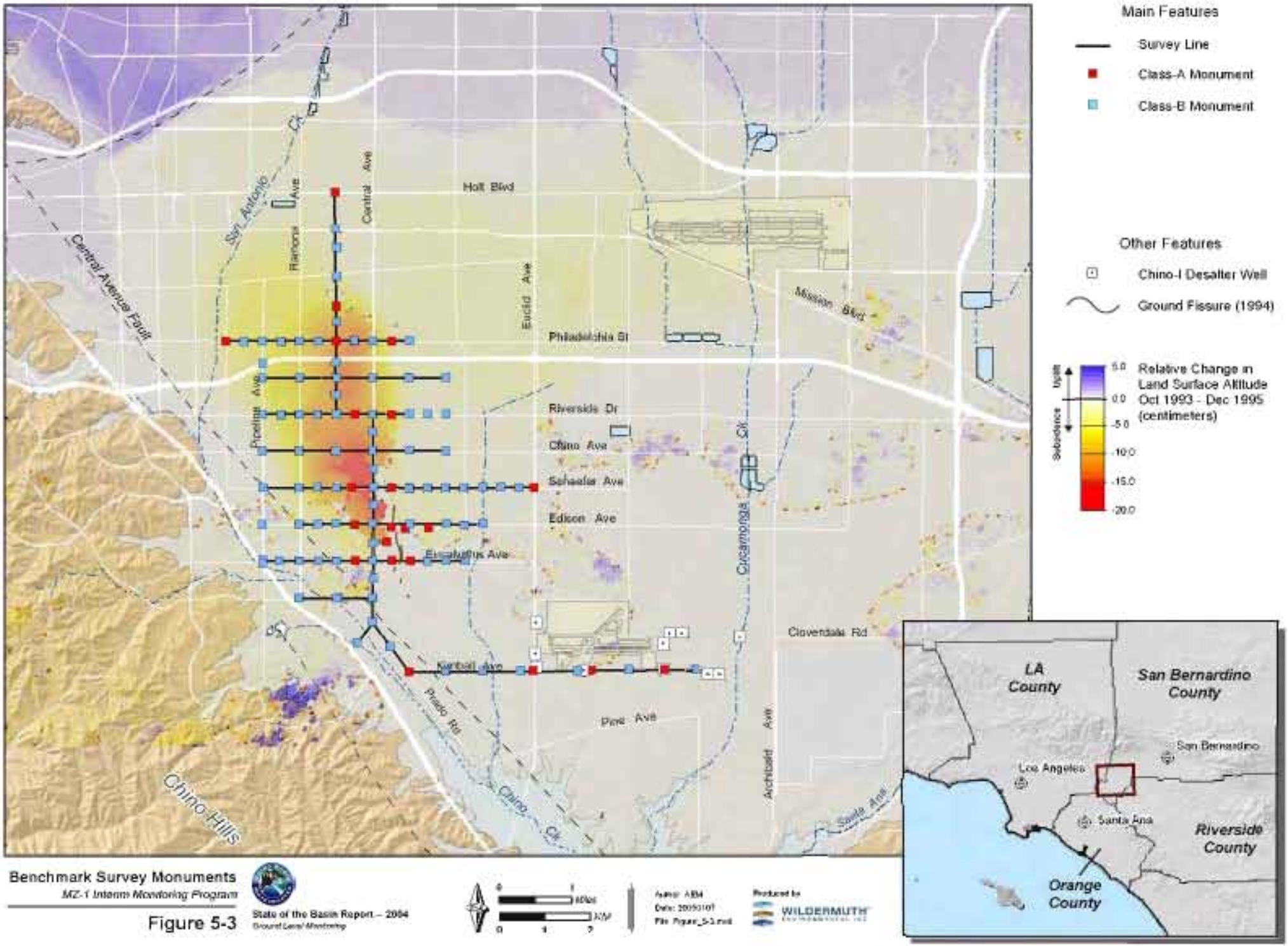
0 1,000 2,000 3,000 Feet
0 500 1,000 Meters

State of the Basin Report – 2004
Ground Level Monitoring

Land Surface Deformation in Chino, CA

Leveling Surveys and InSAR

Figure 5-2



Benchmark Survey Monuments

MZ-1 Interim Monitoring Program

Figure 5-3

State of the Basin Report – 2004

Ground Level Monitoring

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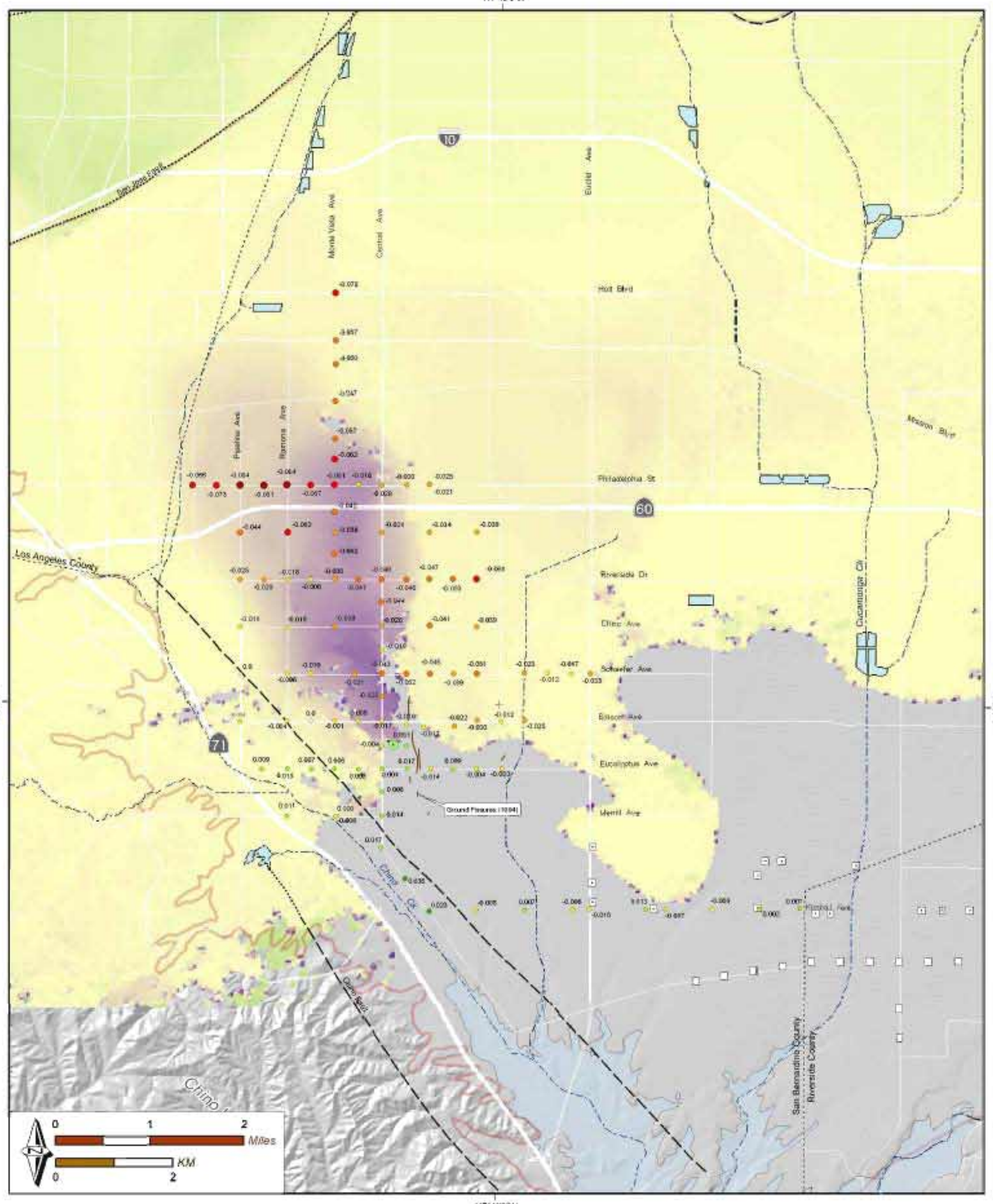


Main Features

- -0.010 to -0.050
- -0.070 to -0.080
- -0.050 to -0.040
- -0.030 to -0.020
- -0.010 to -0.001
- 0.0
- 0.001 to 0.020

Relative Change in Land Surface Altitude as Measured by Leveling Surveys April 2003 - April 2004 (feet)

+ 1.0 / 0.0 / - 1.0

Relative Change in Land Surface Altitude as Measured by InSAR Oct 1993 - Dec 1995 (feet)

Other Features

- Ayala Park Extensometer Facility
- Chino Basin Desalter Well (Existing)
- Chino Basin Desalter Well (Planned)
- Chino Basin Hydrologic Boundary

Faults & Groundwater Divides

- Location Certain
- Location Approximate
- Location Concealed
- Location Uncertain
- Groundwater Divide

Prepared by:

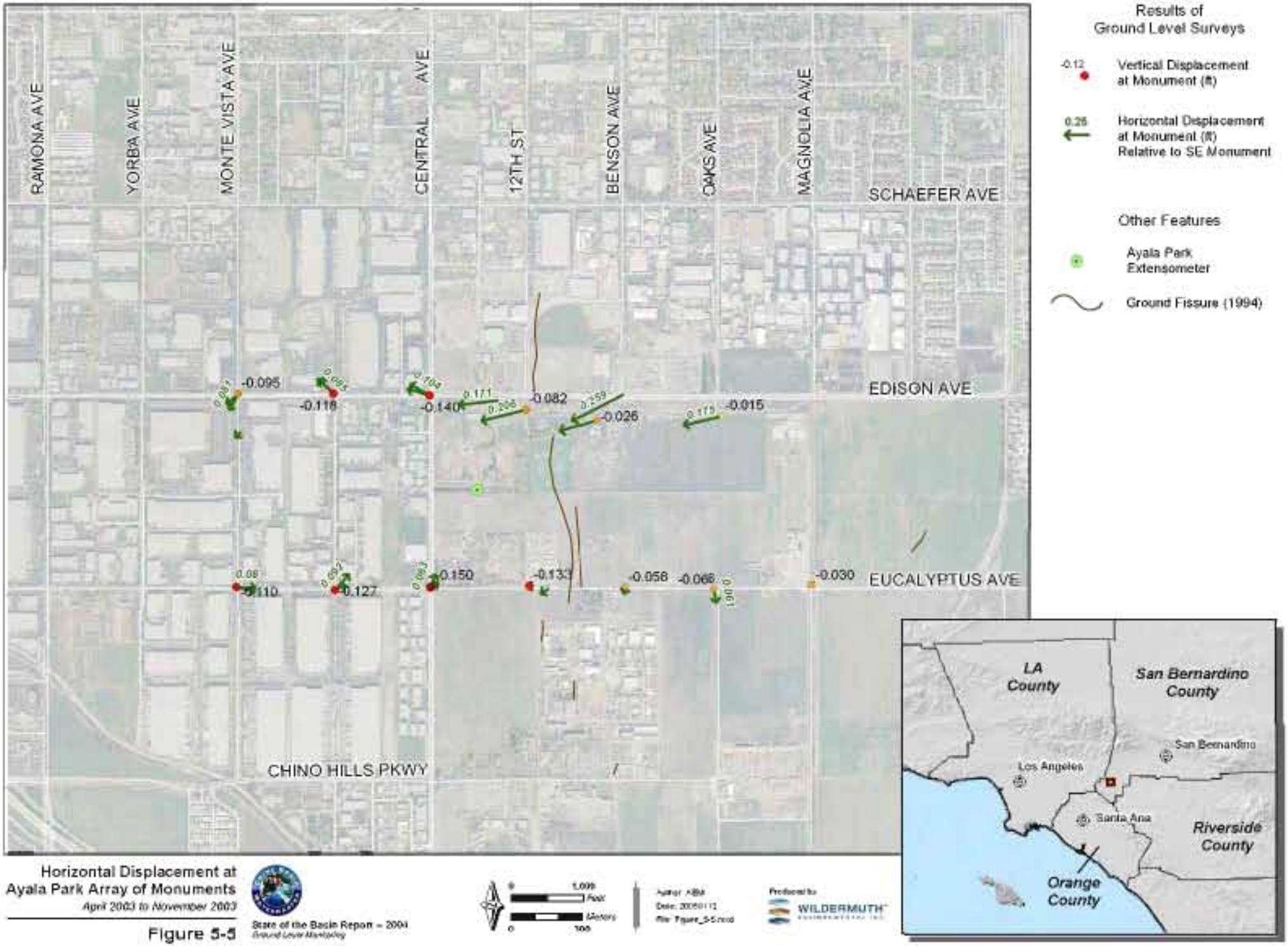
WILDERMUTH ENVIRONMENTAL INC.

State of the Basin Report 2004
Ground Level Monitoring

Author: AEM
Date: 20050112
File: Figure_5-4.mxd

Ground Level Survey Results
April 2003 to April 2004

Figure 5-4



Horizontal Displacement at
Ayala Park Array of Monuments
April 2003 to November 2003

Figure 5-5

State of the Basin Report – 2004
Ground Level Monitoring

Author: ABM
Date: 20050112
File: Figure_5-5.mxd

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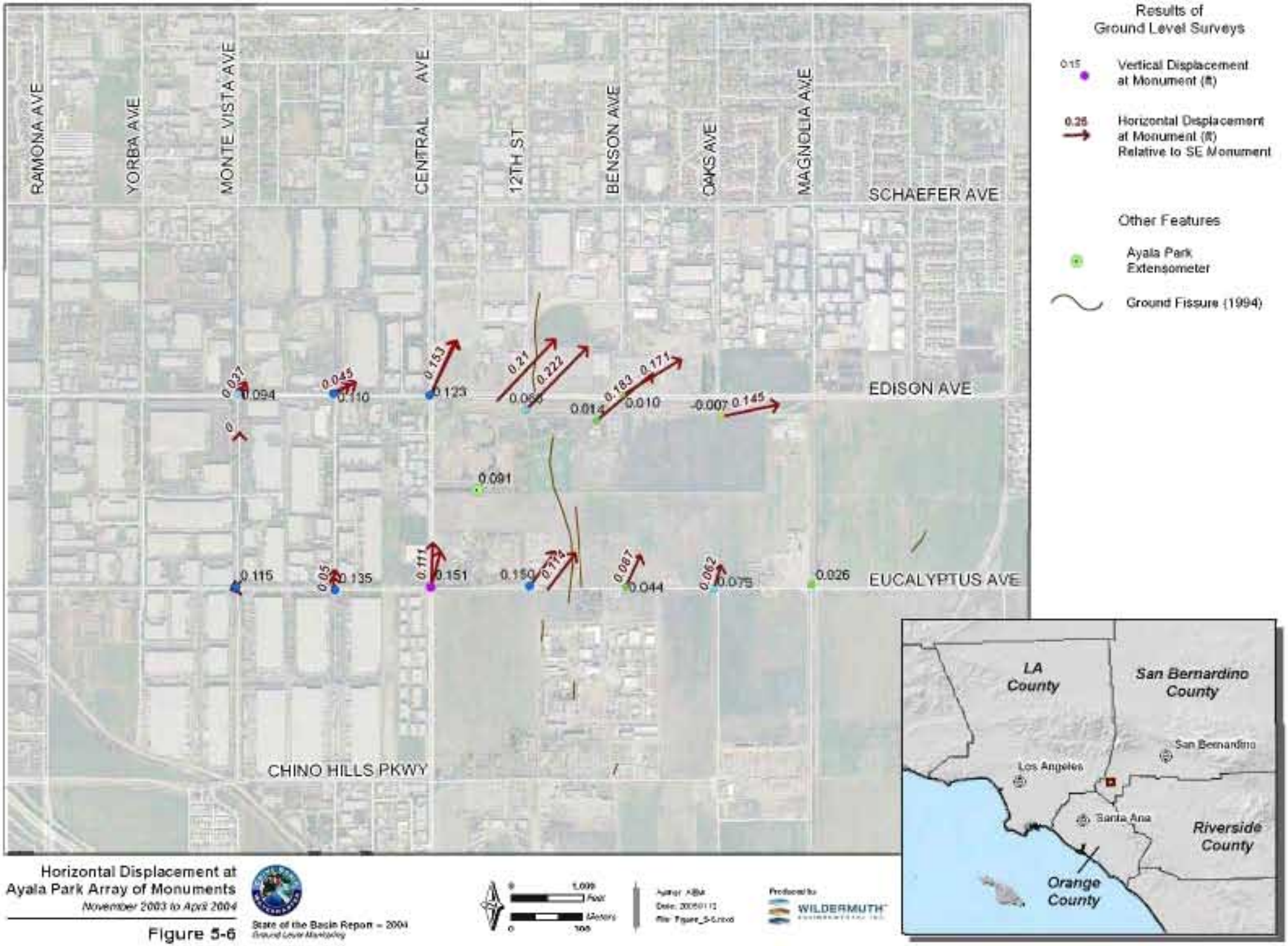

Horizontal Displacement at
Ayala Park Array of Monuments
November 2003 to April 2004

Figure 5-6

State of the Basin Report – 2004
Ground Level Monitoring

0 1,000 Feet
0 300 Meters

Author: ABM
Date: 20050112
File: Figure_5-6.mxd

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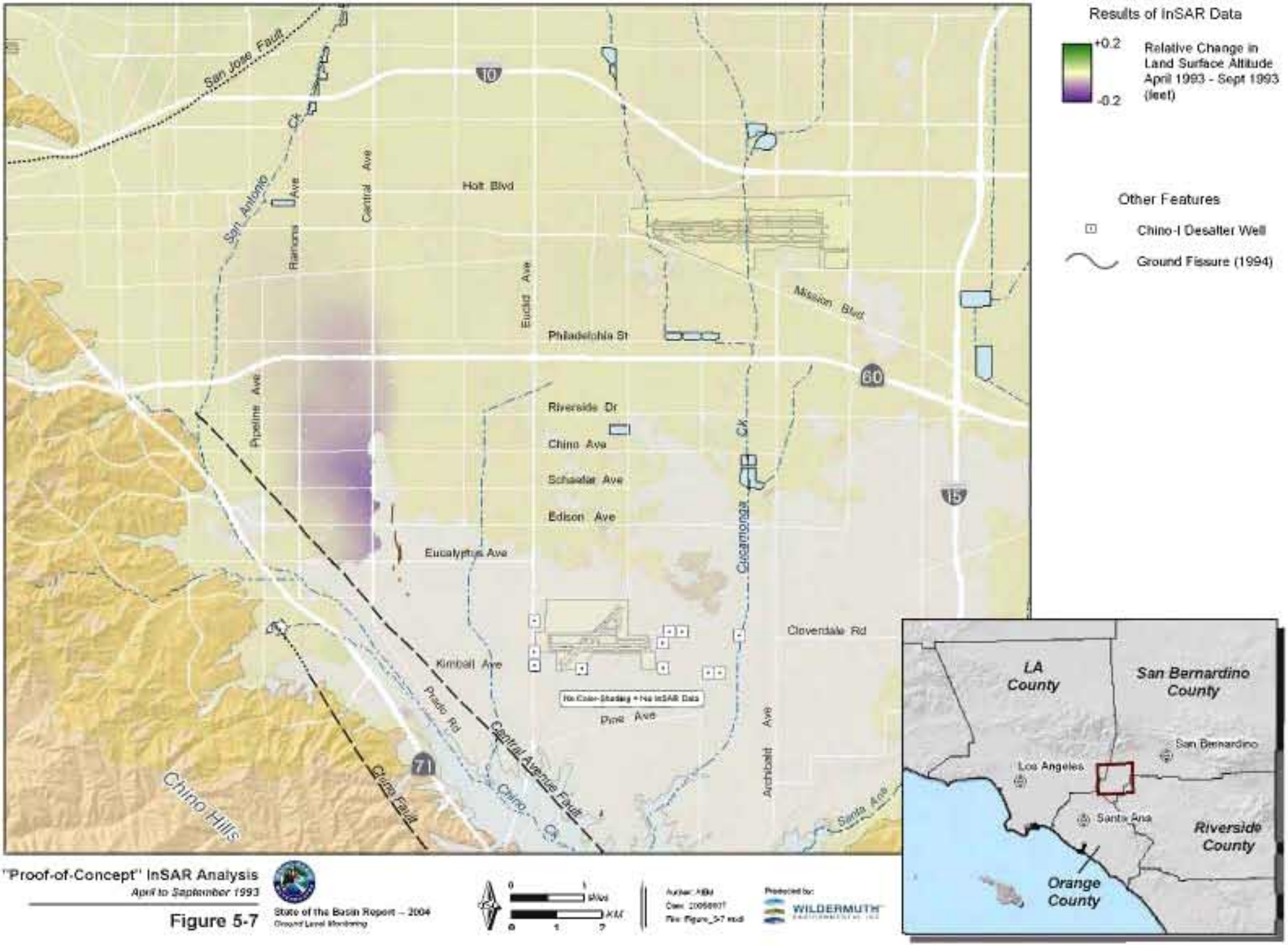

"Proof-of-Concept" InSAR Analysis
April to September 1993

Figure 5-7

State of the Basin Report – 2004
Ground Level Monitoring

Author: ABM
Date: 20050607
File: Figure_5-7.mxd

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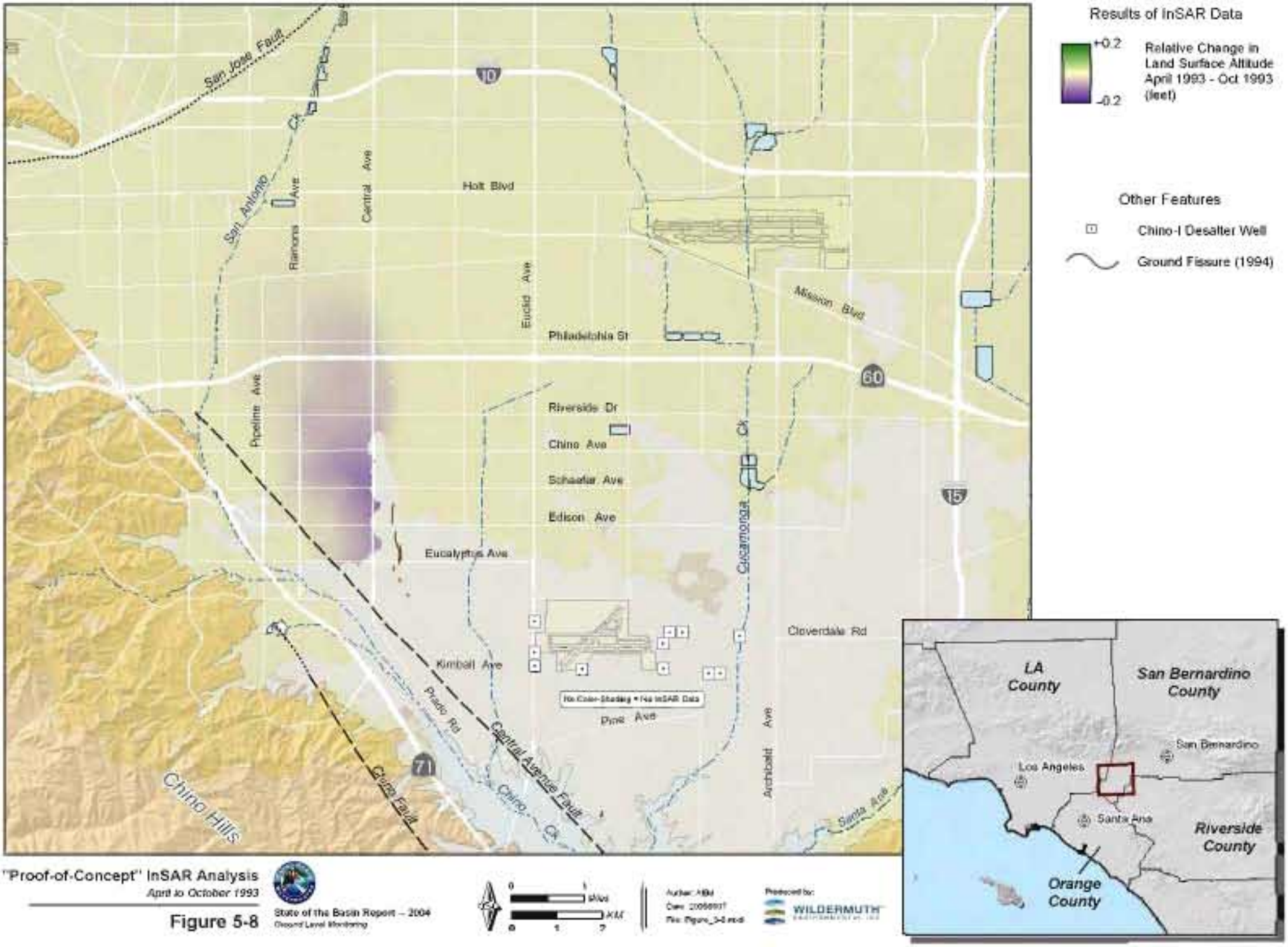
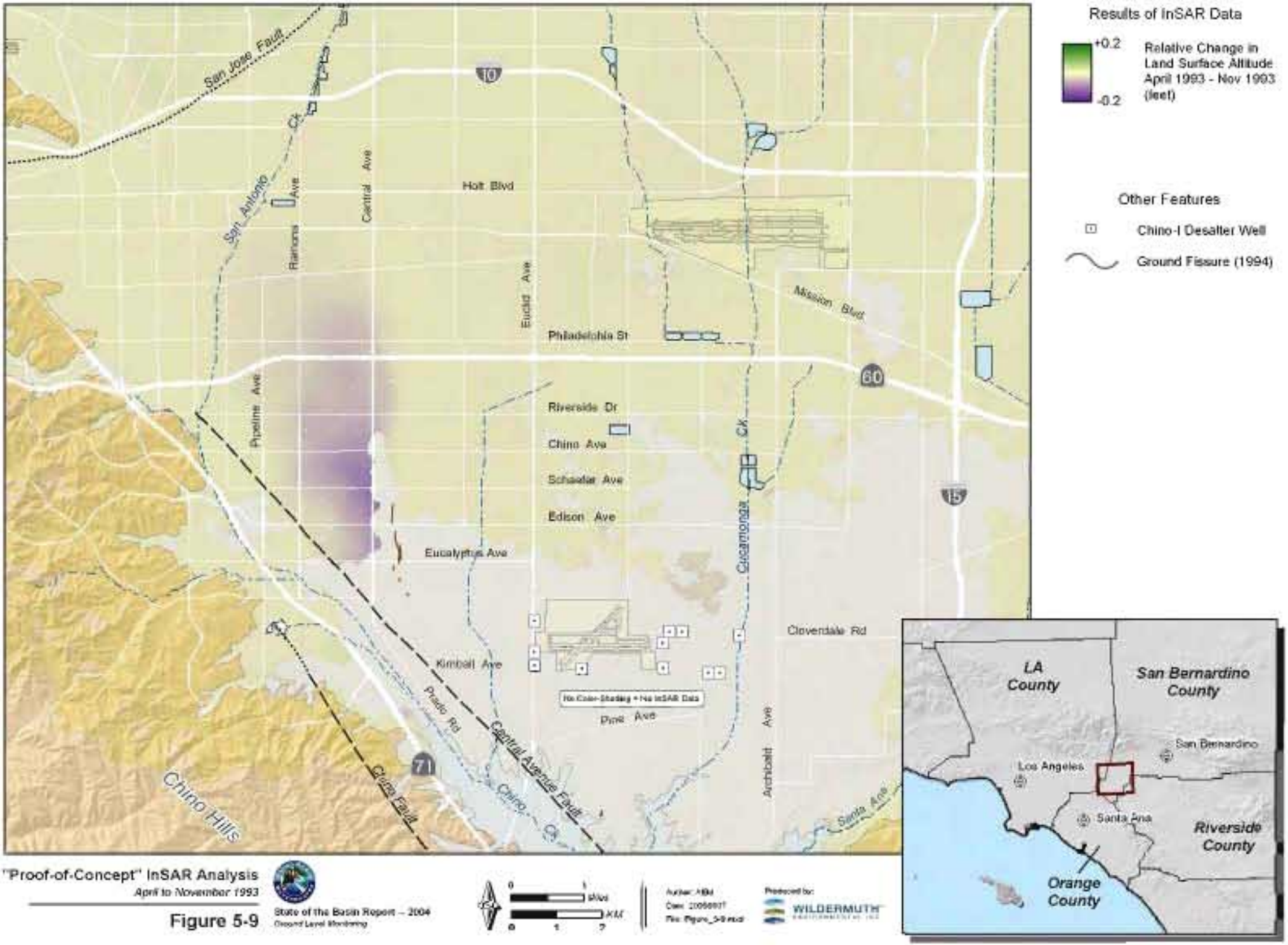


"Proof-of-Concept" InSAR Analysis
April to October 1993

Figure 5-8

State of the Basin Report – 2004
Ground Level Monitoring



"Proof-of-Concept" InSAR Analysis
April to November 1993

Figure 5-9

State of the Basin Report – 2004
Ground Level Monitoring

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Figure 5-10 - Ayala Park Dual Extensometer Facility

15July-2003 to 06Dec-2004

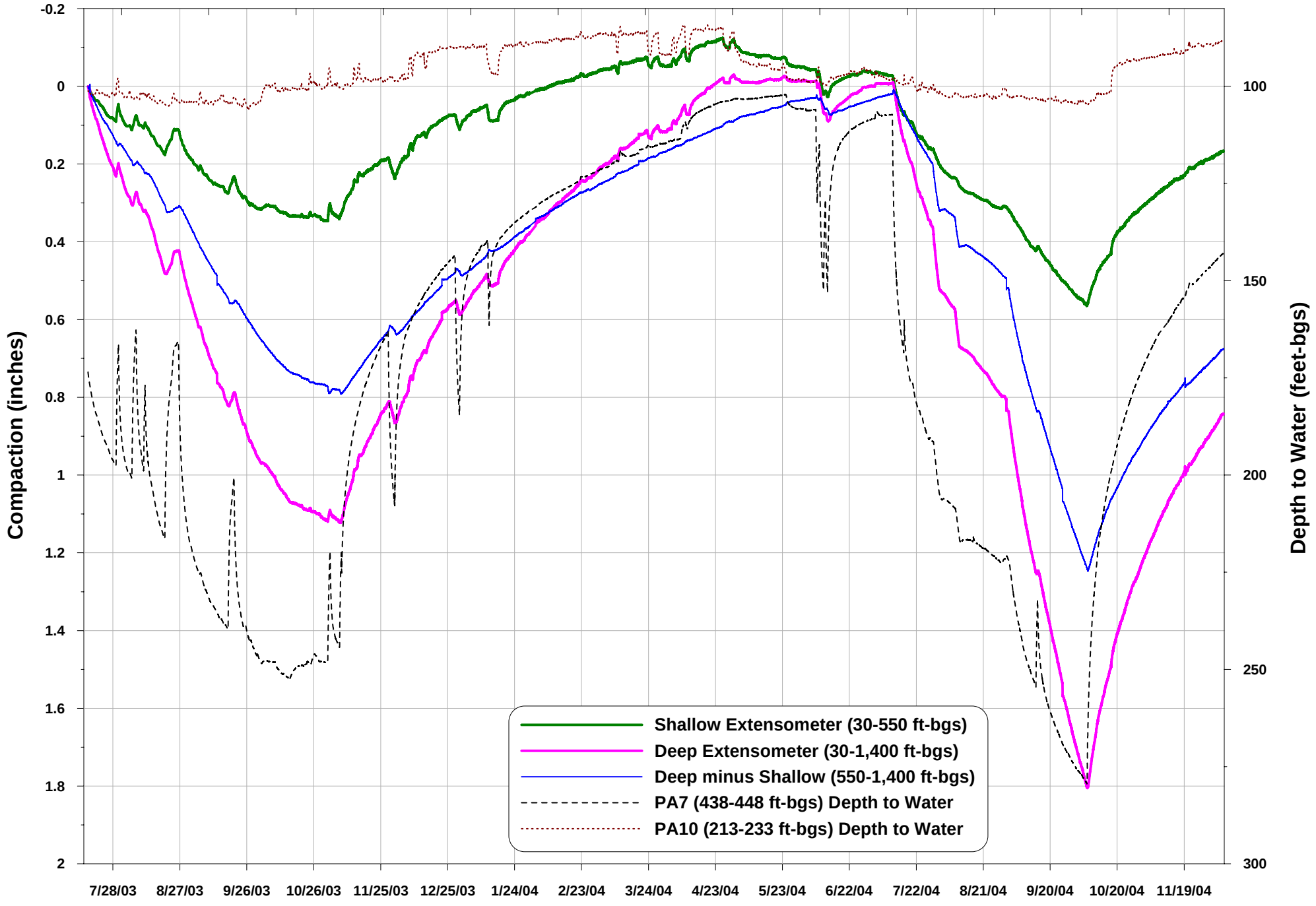
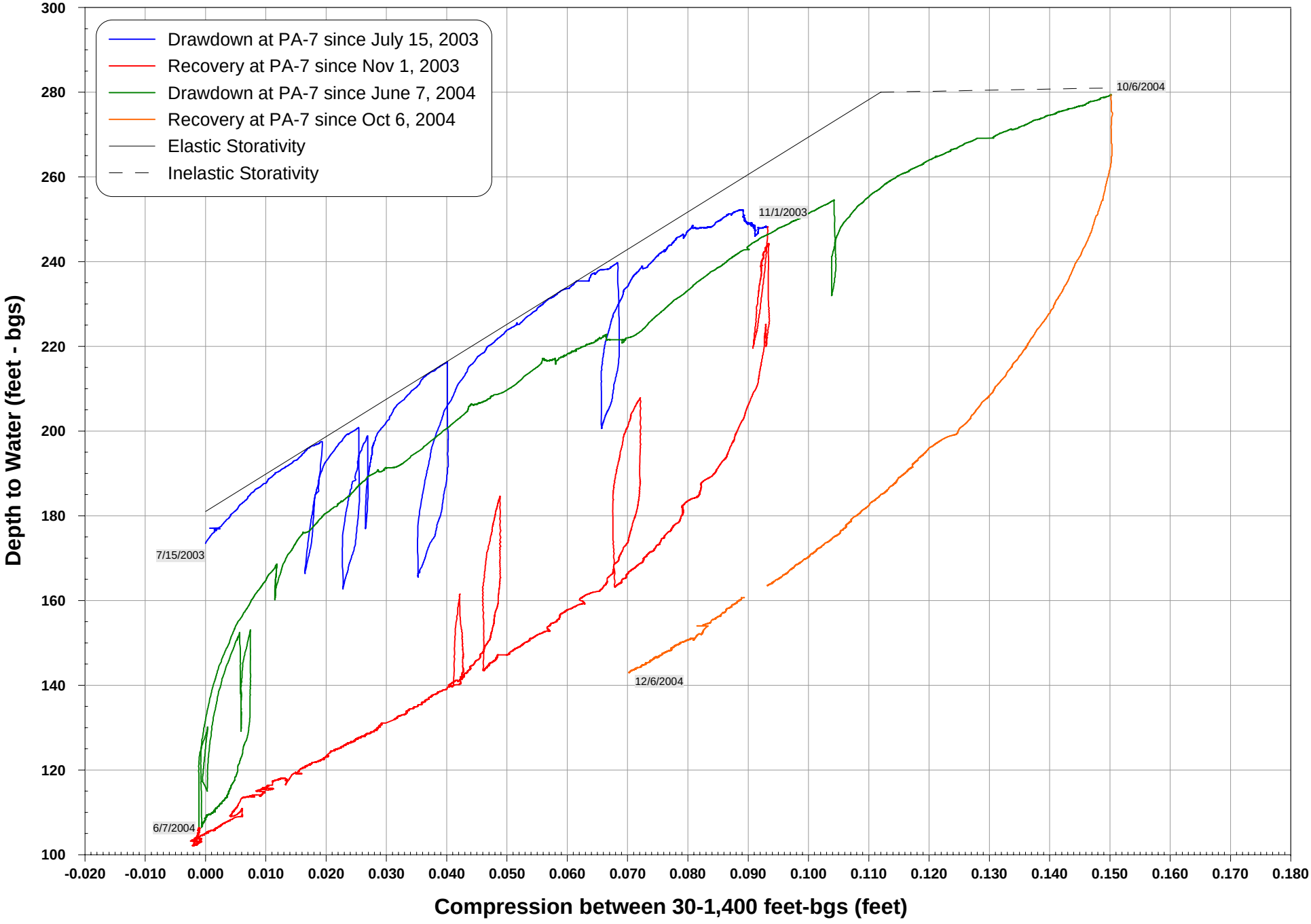
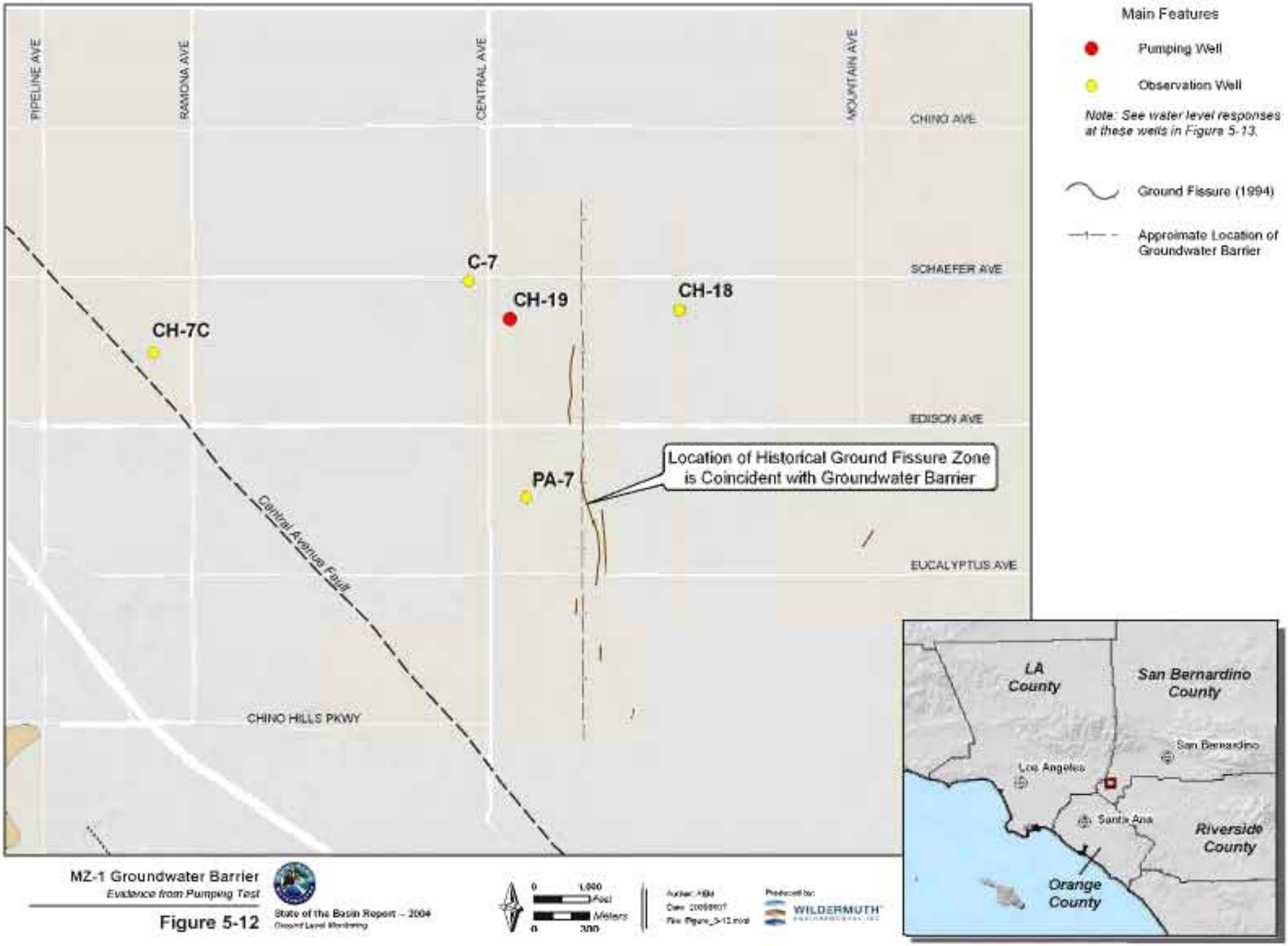


Figure 5-11 -- Stress-Strain Diagram

PA-7 vs. Deep Extensometer





MZ-1 Groundwater Barrier

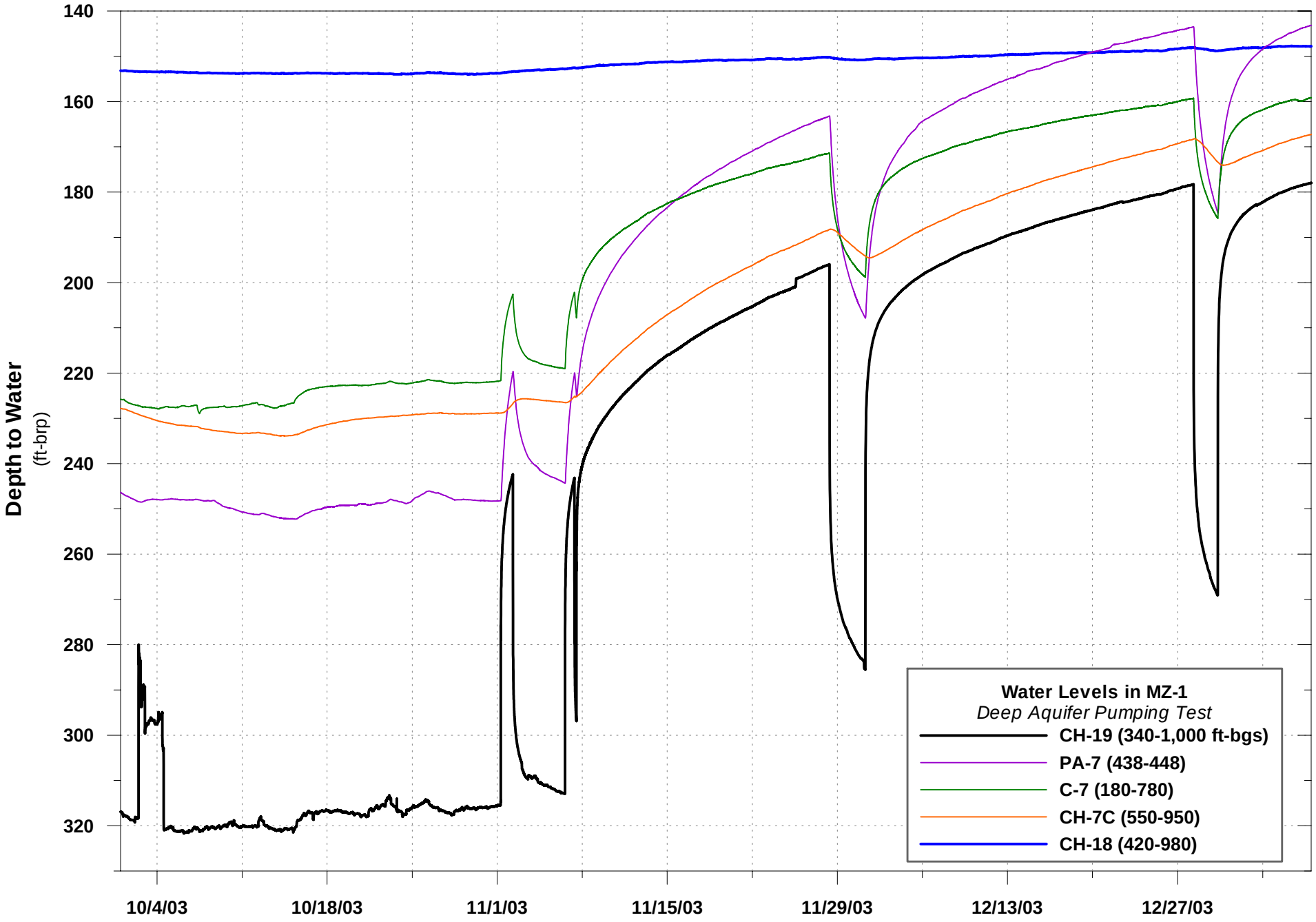
Evidence from Pumping Test

Figure 5-12

State of the Basin Report – 2004

Ground Level Monitoring

Figure 5-13 - Water Level Responses at Nearby Wells to Pumping at CH-19



6. Recharge Basin Monitoring and Future Recharge Projections

Figure 6-1 shows the location of the flood retention/recharge basins in the Chino Basin. Two types of recharge monitoring occur in the Chino Basin:

- Water level and temperature measurements are obtained and used to estimate inflow, outflow, and recharge for the Montclair Basins 1 – 4, Brooks Street Basin, Turner 1 Basin and Grove Basin.
- Storm water quality in the flood retention/conservation basins that have some level of conservation or operable storage and when possible, from basins without conservation or operable storage that temporarily contain storm water.

This recharge monitoring program is important to the Watermaster because of the new yield implications from new recharge. Per the OBMP Peace Agreement, storm water recharge above 5,600 acre-ft/yr is considered new recharge and new yield. TDS and nitrogen concentrations in stormwater collected in flood retention/conservation basins are very low, substantially below existing Basin Plan objectives and drinking water MCLs. New storm water recharge with low TDS and nitrogen concentrations will improve groundwater quality and offset the mitigation requirements from recycled water recharge. The water quality monitoring program includes all basins that are currently used for recharge and other basins that have been improved in the Chino Basin Facilities Improvement Program described below in Section 6.2.

6.1 Storm Water Recharge Calculations for 2000/01 through 2003/04

Chino Basin Water Conservation District (CBWCD) has installed integrated pressure transducers/data loggers in the Montclair Basins No. 1 through No. 4, Brooks Street Basin, Turner Basin No. 1, and the Grove Basin. The locations of these basins are shown in Figure 6-1. These instruments collect quasi-continuous water-level monitoring data in these basins. This water level data and other information make it possible to estimate:

- basin inflows by source type
  - storm water discharge
  - dry-weather discharge
  - imported water discharge
- outflows consisting of
  - groundwater recharge
  - evaporation
  - discharge by source type
- storage of water by source type

6.1.1 Methodology to Estimate Inflow and Recharge

The recharge that occurs in a spreading basin, at any time, can be estimated by solving the continuity equation:

$$\Delta S = I - O \qquad (1)$$

Where:

ΔS	is the change in storage in a basin
I	is the inflow into a basin
O	is outflow from a basin

This equation can be expanded and solved for a recharge basin with multiple inflows and outflows. Substituting individual inflow and outflow terms in Equation 1 yields:

$$S_{t+1} - S_t = (QI_{t,t+1} - QO_{t,t+1}) * \Delta t + (R_{t,t+1} - P_{t,t+1} - E_{t,t+1}) * A_{t,t+1} * \Delta t \qquad (2)$$

Where:

S_t	is the storage in the basin at time *t*
S_{t+1}	is the storage in the basin at time *t+1*
$QI_{t,t+1}$	is the rate of runoff into the basin during the period *t* to *t+1*
$QO_{t,t+1}$	is the rate of outflow from the basin during the period *t* to *t+1*
$R_{t,t+1}$	is the rate of precipitation that falls on the basin during the period *t* to *t+1*
$P_{t,t+1}$	is the rate of percolation from the basin during the period *t* to *t+1*
$E_{t,t+1}$	is the rate of evaporation from the water surface in the basin during the period *t* to *t+1*
Δt	duration of the time period *t* to *t+1*
$A_{t,t+1}$	average surface area of the water surface in the basin during the period *t* to *t+1*

The continuity equation was solved at 60-minute time steps for each day that water was observed in the spreading basins. These calculations resulted in the hourly estimates of inflow by source type, outflow by source type—including the volume of water recharged and the percolation rate, and the volume of water in storage by type. These calculations are based on the following measurements and assumptions:

Water Levels in the Basin. Water-level data for the recharge basins were provided by CBWCD. Water levels were measured with integrated pressure transducers/data loggers that were set to take readings every 60 minutes. CBWCD staff downloaded these data on a monthly basis. Water-level time history plots are provided in Appendix B.

Daily Rainfall and Evaporation. Daily rainfall ($R_{t,t+1}$) and evaporation ($E_{t,t+1}$) rates were estimated from the nearest rainfall gauging stations and Puddingstone Reservoir, respectively. The following rainfall gauging stations were used:

- 1335Auto Ontario Fire Station #3
- 1347 Monte Vista County Water District
- 1075B Guasti Park
- 1019B Upland - Water Facilities Authority
- 1137 Montclair Fire Department

Average rainfall in the urban watersheds tributary to these basins is about 16 inches per year. In contrast, the rainfall in the area in year 2001/02 was about 5.3 inches and the rainfall in 2002/03 was about 16.3 inches (based on rainfall gauges 1335 and 1347).

Basin Geometry. The storage in the basin at a specific time is estimated from the relationship between basin water level and storage (S_t). The area of inundation, or "wetted" area, ($A_{t,t+1}$) is necessary to determine the percolation rate and to compute evaporation from stored water. Elevation-area-volume rating curves were developed for each basin from topographic information provided by CBWCD.

History of Outlet Works Operations and Discharge out of Basins. Some of the basins have operable outlet works, which include gates that can be closed, opened partially, or opened

completely. To calculate outflow, the time histories of gate settings must be known. CBWCD provided these time histories. WEI developed elevation-outflow curves for each basin containing an operable outlet works. Outflow from a basin was estimated from the time history of measured basin water levels, the outlet gate setting, and the appropriate elevation-outflow curve.

Percolation and Evaporation Rates. Percolation rates ($P_{t,t+1}$) are only estimable when the gates of an operable outlet works are closed and runoff into the basin is negligible. When this occurs, there is no inflow and the only outflows are evaporation and recharge. Evaporation is accounted for by multiplying the daily evaporation rate ($E_{t,t+1}$) from Puddingstone Reservoir by the water-surface area ($A_{t,t+1}$) of the basin in question. The water-surface area ($A_{t,t+1)}$ can be calculated from the water-surface elevation and elevation-area-volume rating curves. The percolation rate is then:

$$P_{t,t+1} = \text{Rech}_{t,t+1} / [A_{t,t+1} * \Delta t] = [S_t - S_{t+1} - E_{t,t+1} * A_{t,t+1} * \Delta t\ ] / A_{t,t+1} / \Delta t \qquad (3)$$

which can be approximated as:

$$P_{t,t+1} = \Delta WL_{t+1} / \Delta t - E_{t,t+1} \qquad (4)$$

The percolation rate, as described above, is the rate at which water actually enters the soil during a short period. Its magnitude depends on many factors, including the water-level in the basin, duration of inundation, debris content of prior storm water inflows, and other conditions in the basin. To estimate the percolation rate, the water-level time history was divided to small time steps (about 6 hours) and the rate of water-level drop was calculated during each time step, as shown in Figure 6-2, with Brooks Basin data. The length of the time step was based upon the characteristics of the change in water level, which should be constant during the time-step period. Then the estimated rate of water-level change was plotted against the average water level during the time step, as shown in Figure 6-3. Note that in Figure 6-3, there are five distinctive percolation rate-elevation relationships. They are named as Fill 1 through Fill 5. They correspond to five different fill periods or fill events in the Brooks Basin. Note that the percolation rates shown on the negative y-axis by convention as they are based on falling water levels. For example, the percolation rate for the Fill 1period is about -0.92 ft/day when water level is 10 ft, which means that the water level in the basin declined about 0.92 ft/day during the first fill event when the water level in the basin was 10 feet. Review of the data in Figure 6-3, for the Brooks Basin, indicates that the percolation rate changes over time and varies with water level. The percolation rate-elevation relationship for each fill event is used to estimate the recharge of each fill event. The fill event recharge estimates are aggregated to obtain an annual recharge estimate.

Estimates of Basin Inflow. Given all the information developed above, the basin inflow hydrographs can be estimated from Equation 2. The inflow hydrograph for the Montclair Basins includes storm water and State Water Project water released from the Metropolitan Foothill Feeder. The storm flow into the Montclair Basins is estimated by subtracting the State Water Project water inflow to the Montclair Basins from the total inflow hydrograph developed from Equation 2. Figure 6-4 illustrates the State Water Project water inflow hydrograph for the Montclair Basins for fiscal years 2001/02 and 2002/03.

6.1.2 Recharge Estimates

Table 6-1 summarizes the recharge estimates by basin and source water type for years 2000/01, 2001/02 and 2002/03. During fiscal year 2000/01, Watermaster diverted 6,490 acre-ft of State Water Project water to the Montclair Basins. About 6,464 acre-ft of this water was estimated to have recharged the groundwater basin and about 26 acre-ft was estimated to have evaporated. During fiscal year 2001/02, Watermaster diverted 6,502 acre-ft of State Water Project water to the Montclair Basins. About 6,482 acre-ft of this water was estimated to have recharged the groundwater basin and about 20 acre-ft was estimated to have evaporated. During fiscal year 2002/03, Watermaster diverted about 8,492 acre-ft of imported water into the Montclair Basins; further, about 8,354 acre-ft percolated into the groundwater basin, about 40 acre-ft evaporated, and about 47 acre-ft was lost downstream. Total storm-water recharge in the Montclair Basins was about: 2,890 acre-ft in fiscal 2000/01; 773 acre-ft in fiscal year 2001/02; in fiscal year 2002/03, storm-water recharge increased to about 1,328 acre-ft.

For the Brooks Street Basin, storm-water recharge was about: 667 acre-ft in fiscal 2000/01; 104 acre-ft in fiscal year 2001/02; and 676 acre-ft in fiscal year 2002/03.

For Turner No. 1 Basin storm water recharge was at least: 22 acre-ft in fiscal 2000/01; 10 acre-ft in fiscal 2001/02; unknown in fiscal year 2002/03 due to instrument failure.

For Grove Basin, storm-water recharge was about: 76 acre-ft in fiscal year 2001/02; and 264 acre-ft in fiscal year 2002/03.

6.1.3 Recommendations for Future Basin Percolation Monitoring

Starting in 2005/06, water level and inflow monitoring will be through a SCADA system that includes these and the other recharge basins that were improved in the CBFIP. The San Sevaine Basins are not included in the SCADA system even though they are used by the Watermaster for supplemental water recharge. The San Sevaine Basins should either be included in the SCADA system in the near future or the Watermaster should install water level sensors in these basins.

For the remainder of 2004/05 the following recommendations have been made and sent to CBWCD for their consideration:

- As mentioned above, instrument failure at all basins result in a total loss of data for the instrumented basins. In 2000/01, CBWCD set the water level sampling rate at 30 minutes and for 2001/02 and 2002/03 CBWCD set the sampling rate at 60 minutes. Respectfully, the water level sampling rate should be no greater than 15 minutes. This will allow for more accurate inflow and outflow computations. The data should be downloaded and reviewed after each significant storm and at least monthly. If this were done prior to and during 2003/04, it is very likely that some or all the water level and temperature data would have been retrieved.
- Some of the basins are equipped with controllable inlets and/or outlets. Accurate records regarding the opening and closing of controllable inlets and/or outlets are essential to the accuracy of outflow and recharge calculations. WEI recommends that CBWCD develop a consistent procedure for reading and recording outlet and inlet gate settings.
- The reference elevation of the pressure transducers needs to be reestablished every time they are removed for maintenance or relocated. If they are relocated then they need to be surveyed.

6.2 The Chino Basin Facilities Improvement Project

The IEUA and the Watermaster completed the Phase II Recharge Master Plan development in August 2001 and began facility designs in December 2001. Subsequently, the IEUA began construction of recharge improvements most of which were complete in the fall of 2004 with the remaining work to be completed by June 2005. Figure 6-1 shows the basins included in the CBFIP. Table 6-2 summarizes the improvements at each basin. The cost of these improvements is about $44 million.

6.3 Baseline Estimates of Storm Water Recharge and New Yield from the CBFIP

Table 6-3 lists the recharge/storm water retention basins that are currently used or will be used for storm and supplemental water recharge purposes; and estimates of average annual storm water recharge for July 1, 2000 basin conditions and operations. Table 6-3 also contains the expected average annual recharge estimates for these basins based on Watermaster modeling studies (WEI, 2003) that incorporate most of the facility improvements included in the CBFIP. Improvements not included are the pump stations and force mains used to move supplemental and some storm water from San Sevaine Creek to Banana, RP3 and Declez Basins.

The supplemental water recharge capacity of the entire system of recharge basins is lower than anticipated during the Phase II Recharge Master Plan (Black and Veatch, 2001). The supplemental water recharge capacity was estimated to range between about 82,000 to 122,000 acre-ft/yr in the Recharge Master Plan. The current expected supplemental water recharge capacity is about 60,000 acre-ft/yr. The major reason for the reduced capacity is the deferment in the use of the College Heights and Upland Basins pending the results of hydrogeological and geotechnical investigations; and the deletion of the Etiwanda Spreading Grounds and Etiwanda Conservation Ponds from the CBFIP. This supplemental water recharge capacity is less than the estimated 63,000 acre-ft/yr required in the future.

The expected increase in stormwater recharge is about 12,000 acre-ft/yr with a total expected recharge capacity between 17,000 and 18,000 acre-ft/yr.

6.4 Storm Water Recharge Quality

Watermaster staff has been systematically collecting and analyzing surface water samples from 21 recharge basins in Chino Basin since November 1997. About 350 water quality samples from the basins were collected and analyzed from November 1997 to September 2004. The sampling frequency for each of the recharge basins over the last four wet seasons is shown graphically in Figure 6-5. Watermaster staff collects from one to four samples in each basin, depending on basin configuration and water elevation. These samples are volumetrically composited at the analytical laboratory to provide an estimate of the average water quality recharged at a given point in time at each of the basins. The vertical gridlines in Figure 6-5 represent 2-week intervals from November 1st through April 30th for each wet season.

The basins recharge water from several sources, including:

- urban dry weather flow;
- urban stormwater;
- San Gabriel Mountain stormwater;

- State Project Water;
- GE Flatiron Plant remediation water; and
- IEUA recycled water.

Table 6-4 summarizes the average TDS and nitrate-nitrogen concentrations collected from the basins. Also included in Table 6-4 is a semi-quantitative assessment of the source of recharge water; major and minor components of source waters listed in the above bullets are given in the table. Basins that recharge mostly urban stormwater have excellent water quality. For example, Brooks Basin had an average TDS of 58 mg/L and an average nitrate-nitrogen of 0.6 mg/L. Table 6-4 was developed from data derived from Watermaster's water quality database. In addition to TDS and nitrate, the surface water grab samples are also analyzed for the following constituents:

- Ammonia-N
- Anion sum
- Bicarbonate
- Boron
- Calcium
- Cation sum
- Chloride
- Color
- Electrical Conductivity
- Fluoride
- Hydroxide
- Magnesium
- MBAS
- Nitrate-N
- Nitrite-N
- Odor
- pH
- Potassium
- Sodium
- Sulfate
- Total Alkalinity
- Total Dissolved Solids
- Total Hardness
- Total Organic Carbon and Dissolved Organic Carbon
- Total Phosphorus

This database can be queried in future studies to determine the state of the basin's recharge water quality for any constituent listed above.

Table 6-1
Estimated Groundwater Recharge during
Fiscal Years 2000/01 through 2002/03

(acre-ft)

	Montclair Basins	Brooks Basin	Turner 1 Basin	Grove Basin
Fiscal Year 2000/01 - Imported Water				
Inflow	6,490			
Evaporation	26			
Percolation	6,464	667		
Outflow1				
Outflow2				
Fiscal Year 2000/01 - Storm Runoff				
Inflow				
Evaporation				
Percolation	2,890			
Outflow1				
Outflow2				
Fiscal Year 2001/02 - Imported Water				
Inflow	6,502			
Evaporation	19			
Percolation	6,482			
Outflow1	0			
Outflow2				
Fiscal Year 2001/02 - Storm Runoff				
Inflow		106	11	270
Evaporation	9	2	1	5
Percolation	773	104	10	76
Outflow1	-	-	-	190
Outflow2				
Fiscal Year 2002/03 - Imported Water				
Inflow				
Evaporation	40			
Percolation	8,354			
Outflow1	47			
Outflow2				
Fiscal Year 2002/03 - Storm Runoff				
Inflow		689		882
Evaporation	23	13		22
Percolation	1,328	676		264
Outflow1	600	-		581
Outflow2				

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Table 6-2
Improvements at Recharge Basins Included in the Chino Basin Facilities Improvement Project

Recharge Basins	New or Existing	Number of Basins	Grading				Hydraulics			New MWDSC Turnout	SCADA	Other Significant Improvement
			Enlarge	Internal Berms	Optimize Bottoms	Other Minor	New Inlet	New Outlet	Rubber Dams			
Management Zone 1												
Brooks Street Basin	Existing	1				X	X	X			X	
College Heights Basins[2]	New	2	X		X	X	X	X	X		X	
Montclair Basin 1	Existing	1									X	
Montclair Basin 2	Existing	1									X	
Montclair Basin 3	Existing	1									X	
Montclair Basin 4	Existing	1									X	
Seventh and Eighth Street Basins	Existing	2		X	X	X		X		X	X	
Upland Basin[2]	Existing	1	X					X			X	
Management Zone 2												
Ely Basins	Existing	3		X	X	X				X	X	
Hickory Basin	Existing	1		X	X	X		X	X	X	X	Pump Station and Force Main to Banana Basin
Lower Day Basin	Existing	1		X	X	X	X		X	X	X	
San Sevaine No. 1	Existing	1										
San Sevaine No. 2	Existing	1										
San Sevaine No. 3	Existing	1										
San Sevaine No.'s 4 and 5	Existing	2										
Turner Basins No. 1 and 2	Existing	2		X	X	X	X		X		X	
Turner Basins No. 3 and 4	Existing	2		X	X	X	X				X	
Victoria Basin	Existing	1		X	X	X	X	X			X	
Management Zone 3												
Banana Basin	Existing	1				X		X			X	
Jurupa Basin	Existing	0				X						Pump Station and Force Main to RP3 Ponds
Declez Basin	Existing	1		X	X	X		X			X	
IEUA RP3 Ponds	New	6	X	X	X	X	X	X	X		X	

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Table 6-3

New Storm Water Recharge and Supplemental Water Estimates at Each Basin[1]

Basin	Phase 2 Recharge Master Plan Estimates of Storm Water Conservation (acre-ft/yr)			Revised Estimates Based on CBFIP Designs and Improved Model (acre-ft/yr)			Supplemental Water Operational Plan (1=on, 0=off)												Supplemental Water Utilization	Supplemental Water Recharge Capacity (acre-ft/yr)	
	Pre-Project Estimate	Post-Project Estimate with Ultimate Land Use	Increase	Pre-Project Estimate with 1993 Land Use	Post-Project Estimate with Ultimate Land Use	Increase	J	F	M	A	M	J	J	A	S	O	N	D		Current Estimate	Future Capacity
Brooks Street Basin	850	1,800	950	1,260	1,710	450	1	1	1	1	1	0	0	0	0	1	1	1	70%	0	3,724
College Heights Basins[2]	0	100	100	0	50	50	0	0	0	0	0	0	0	0	0	0	0	0	0%	0	0
Montclair Basin 1	350	350	0	260	340	80	1	1	1	1	1	0	0	0	0	1	1	1	70%	2,331	2,331
Montclair Basin 2	780	780	0	320	370	50	1	1	1	1	1	0	0	0	0	1	1	1	70%	3,682	3,682
Montclair Basin 3	370	370	0	160	160	0	1	1	1	1	1	0	0	0	0	1	1	1	70%	1,317	1,317
Montclair Basin 4	440	440	0	220	250	30	1	1	1	1	1	0	0	0	0	1	1	1	70%	1,697	1,697
Seventh and Eighth Street Basins	0	1,550	1,550	0	1,020	1,020	1	1	1	1	1	0	0	0	0	1	1	1	70%	0	2,196
Upland Basin[2]	760	1,000	240	500	580	80	0	0	0	0	0	0	0	0	0	0	0	0	0%	0	0
Subtotal Management Zone 1	***3,550***	***6,390***	***2,840***	***2,720***	***4,480***	***1,760***														***9,027***	***14,947***
Ely Basins	1,000	2,800	1,800	1,870	1,570	-300	1	1	1	1	1	0	0	0	0	1	1	1	70%	0	3,167
Etiwanda spreading area (joint use of Etiwanda debris basin)	0	1,635	1,635	0	0	0	1	1	1	1	1	0	0	0	0	1	1	1	70%	0	0
Hickory Basin	0	840	840	0	780	780	1	1	1	1	1	0	0	0	0	1	1	1	70%	0	4,395
Lower Day Basin	0	500	500	0	2,180	2,180	1	1	1	1	1	0	0	0	0	1	1	1	70%	0	2,027
San Sevaine No. 1	610	820	210	200	930	730	1	1	1	1	1	0	0	0	0	1	1	1	70%	8,310	8,310
San Sevaine No. 2	20	20	0	20	110	90	1	1	1	1	1	0	0	0	0	1	1	1	70%	1,723	1,723
San Sevaine No. 3	380	640	260	380	770	390	1	1	1	1	1	0	0	0	0	1	1	1	70%	3,673	3,673
San Sevaine No.'s 4 and 5	60	500	440	150	630	480	1	1	1	1	1	0	0	0	0	1	1	1	70%	4,771	4,771
Turner Basins No. 1 and 2	200	860	660	160	1,240	1,080	1	1	1	1	1	0	0	0	0	1	1	1	70%	0	1,098
Turner Basins No. 3 and 4	0	1,800	1,800	0	640	640	1	1	1	1	1	0	0	0	0	1	1	1	70%	0	937
Victoria Basin	240	940	700	30	2,090	2,060	1	1	1	1	1	0	0	0	0	1	1	1	70%	0	2,365
Subtotal Management Zone 2	***2,510***	***11,355***	***8,845***	***2,810***	***10,940***	***8,130***														***18,477***	***32,465***
Banana Basin	0	800	800	0	410	410	1	1	1	1	1	0	0	0	0	1	1	1	70%	0	2,196
Declez Basin	0	260	260	0	80	80	1	1	1	1	1	0	0	0	0	1	1	1	70%	0	3,547
Etiwanda Conservation Ponds[3]	0	1,060	1,060	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	70%	0	0
IEUA RP3 Ponds	0	1,700	1,700	0	1,330	1,330	1	1	1	1	1	0	0	0	0	1	1	1	70%	0	6,562
						0															
Subtotal Management Zone 3	***0***	***3,820***	***3,820***	***0***	***1,820***	***1,820***														***0***	***12,304***
Totals	***6,060***	***21,565***	***15,505***	***5,530***	***17,240***	***11,710***														***27,505***	***59,717***

1 -- Recharge Basins not optimized for storm water recharge; actual recharge performance may be greater.
2 -- College Heights and Upland Basins will not be used for supplemental water recharge for the near future, pending resolution of geotechnical issues.
3 -- Etiwanda Conservation Ponds will not be used for recharge of either storm or supplemental water for the near future due to issues with the land owner.

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Table 6-4
Average Water Quality in Surface Water Samples Collected from Recharge Basins in Chino Basin
Samples Collected from November 1997 to August 2004

Basin	Nitrate-N		TDS		Water Source					
	(mg/L)	(# samples)	(mg/L)	(# samples)	a	b	c	d	e	f
15th Street	0.5	2	45	2	❍	●				
Banana	0.7	7	84	9	❍	●				
Brooks	0.6	21	58	21	❍	●				
Chris	1.3	6	143	7	●	●				
Church	1.2	8	159	8	●	●				
College Heights	1.0	1	47	1		●				
Declez	3.2	17	236	18	●					
Ely 1	2.1	8	113	8	❍	●			❍	
Ely 3	1.0	16	69	17	❍	●				❍
Etiwanda	2.3	1	170	1			●			
Grove	0.7	42	195	45	❍	●				
Hickory	0.8	16	102	17	❍	●				
Lower Cuca. West	0.5	1	215	1	❍	●				
Lower Day	0.5	9	70	9	❍	●	●			
Montclair 1	0.9	15	128	15	❍	●		●		
Montclair 2	0.8	13	90	13	❍	●		●		
Montclair 3	0.7	15	72	16	❍	●		●		
Montclair 4	0.8	18	76	18	❍	●		●		
Riverside	1.1	12	125	12	❍	●				
San Sevaine 1	0.9	20	120	21	❍	●	●			
San Sevaine 5	0.6	19	112	20	❍	●	●			
Turner #1	0.9	9	192	9	❍	●				
Turner #5	3.1	12	167	12	❍	●				
Upland	0.8	7	117	7	❍	●				
Victoria	0.8	22	107	23	❍	●				
Wineville	1.4	21	171	22	❍	●				

● major component of source water
❍ minor component of source water
a urban dry weather flow
b urban stormwater
c San Gabriel Mountain stormwater
d State Project Water
e GE Flatiron Plant remediation water
f IEUA recycled water

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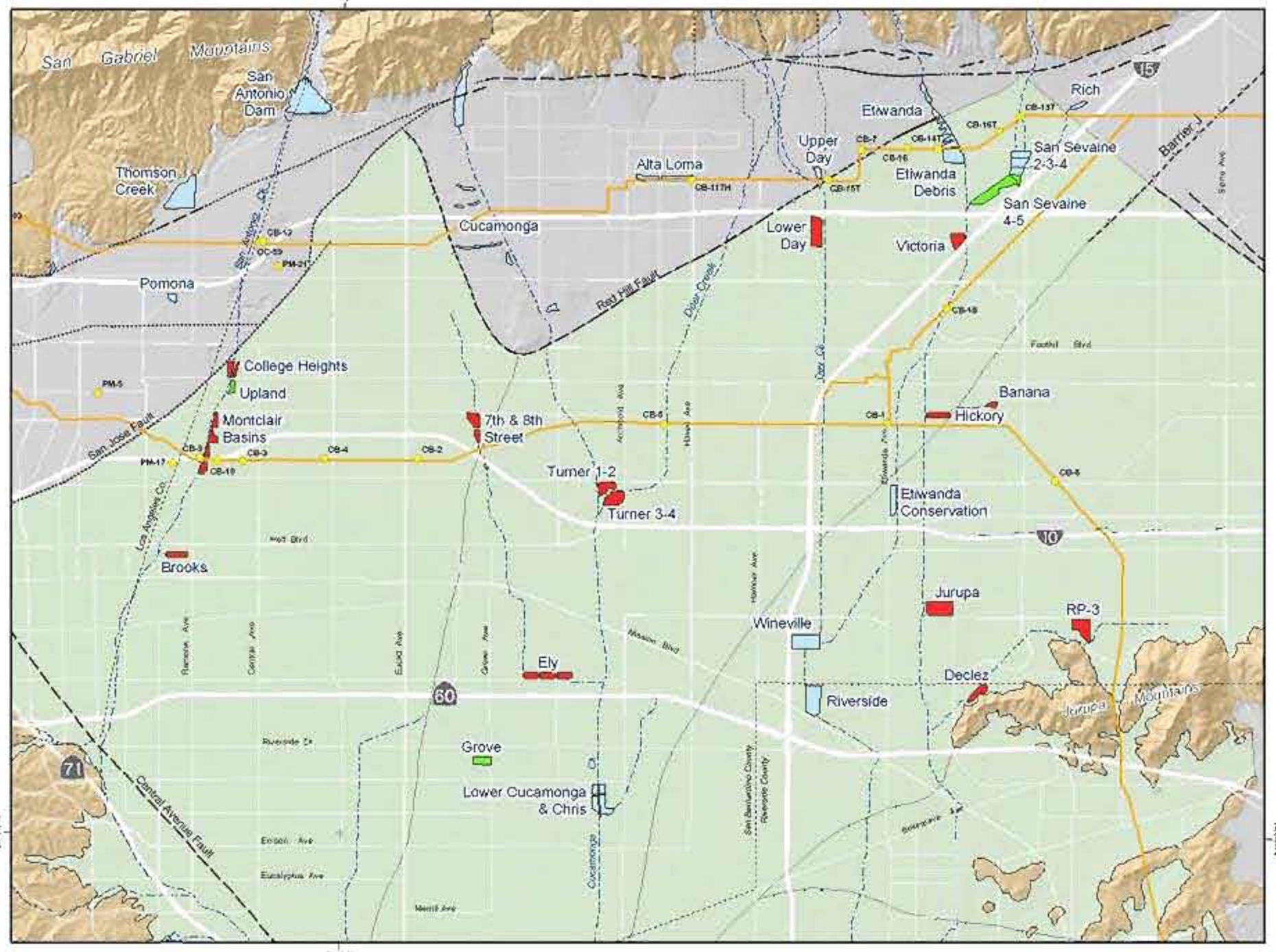

Recharge Basins (Symbolized by Improvements)

- Chino Basin Facilities Improvement Program
- Improvement By Others
- No Improvements

Imported Water Facilities

- Service Connection/Turnout
- Imported Water Pipeline

Other Features

- Rivers, Creeks, and Flood Control Channels
- Chino Basin

Geology

- Unconsolidated Water-Bearing Sediments
- Consolidated Bedrock

Faults

- Location Certain
- Location Approximate
- Location Concealed
- Location Uncertain

Produced by:

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Author: AEM
Date: 20050106
File: Figure_6-1.mxd

0 1 2 3 Miles
0 2 4 KM

State of the Basin Report – 2004
Recharge Basin Monitoring

Groundwater Recharge and Imported Water Facilities

Figure 6-1

Figure 6-2
Water-Level Time History - Brooks Basin
Fiscal Year 2002/03

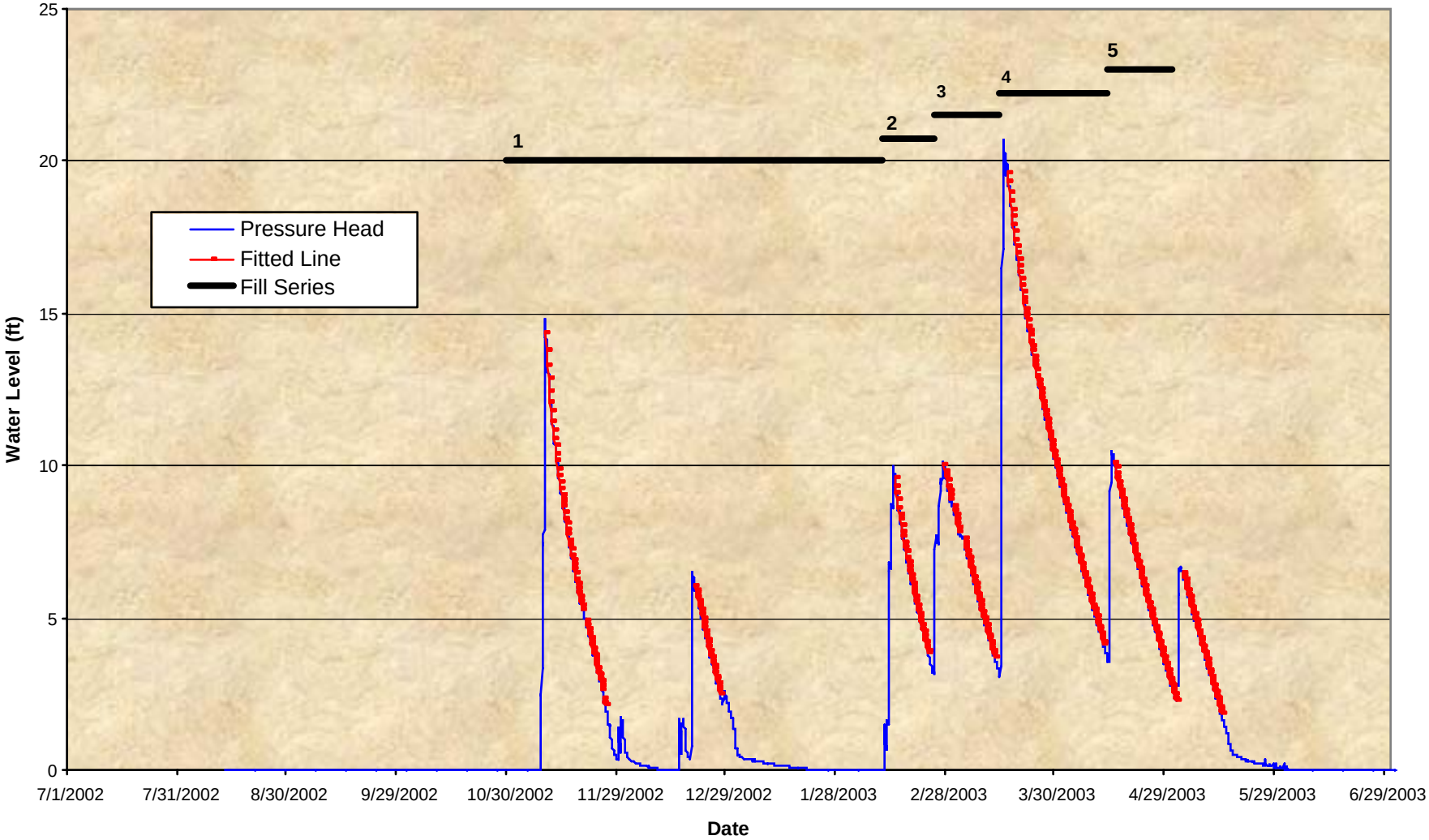

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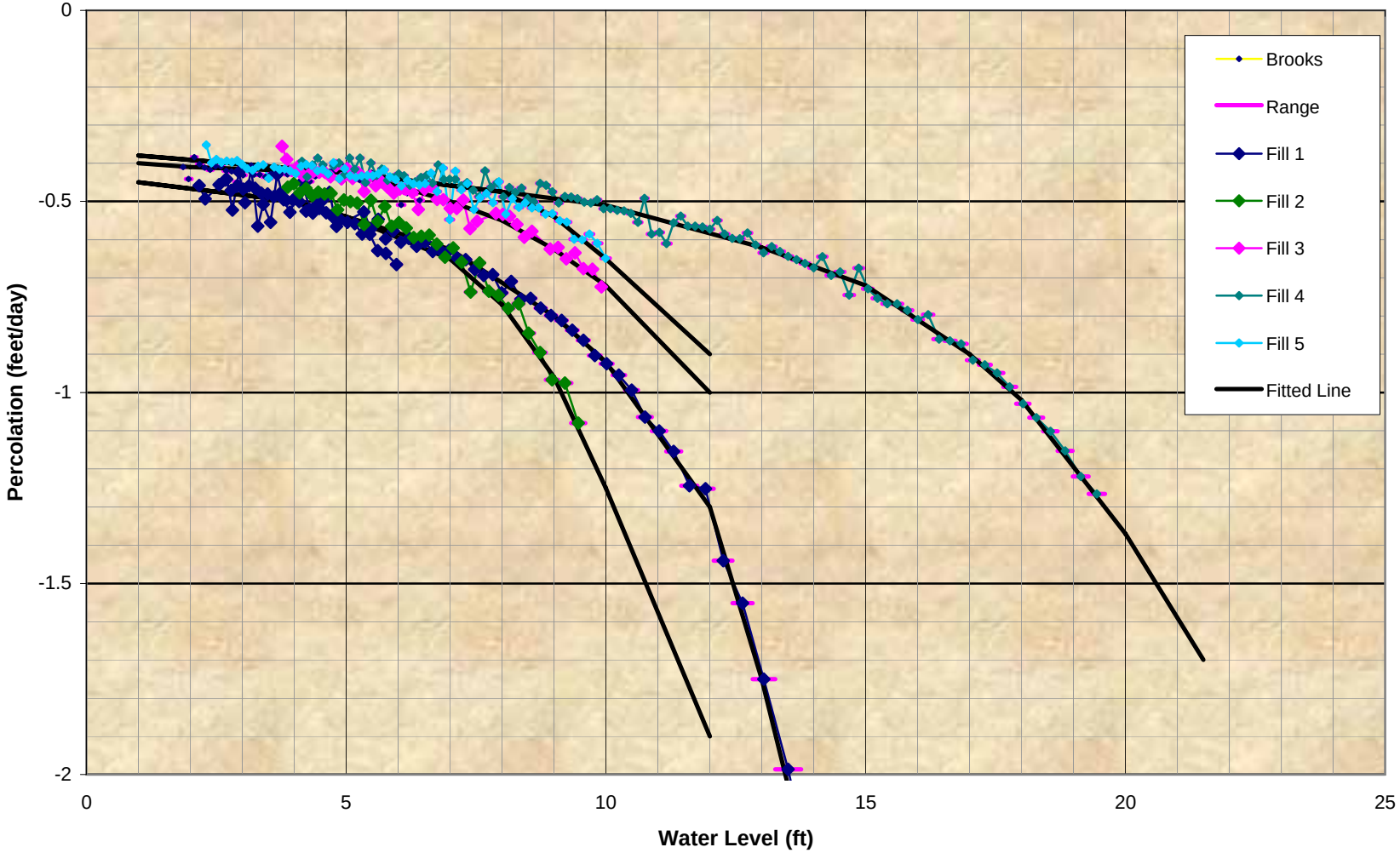
Figure 6-3
Percolation Rate - Brooks Basin
Fiscal Year 2002/03



[File] -- Figure 6-3
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Figure 6-4
Import Water Release, MWD OC-59
Fiscal Year 2001/02 and 2002/03

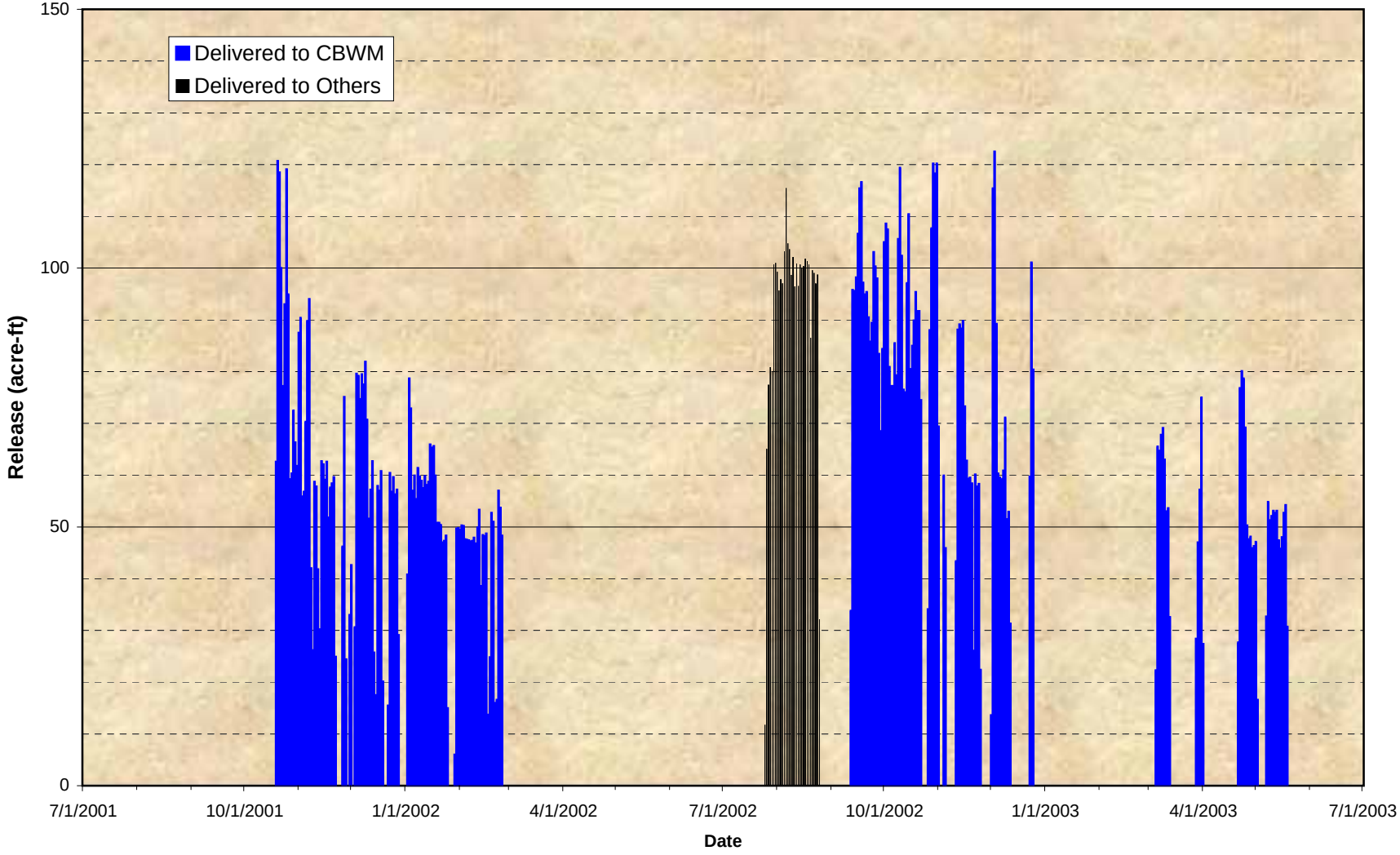

Figure_6-4.xls -- Chart6
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Figure 6-5
Surface Water Sampling Frequency for Recharge Basins in Chino Basin

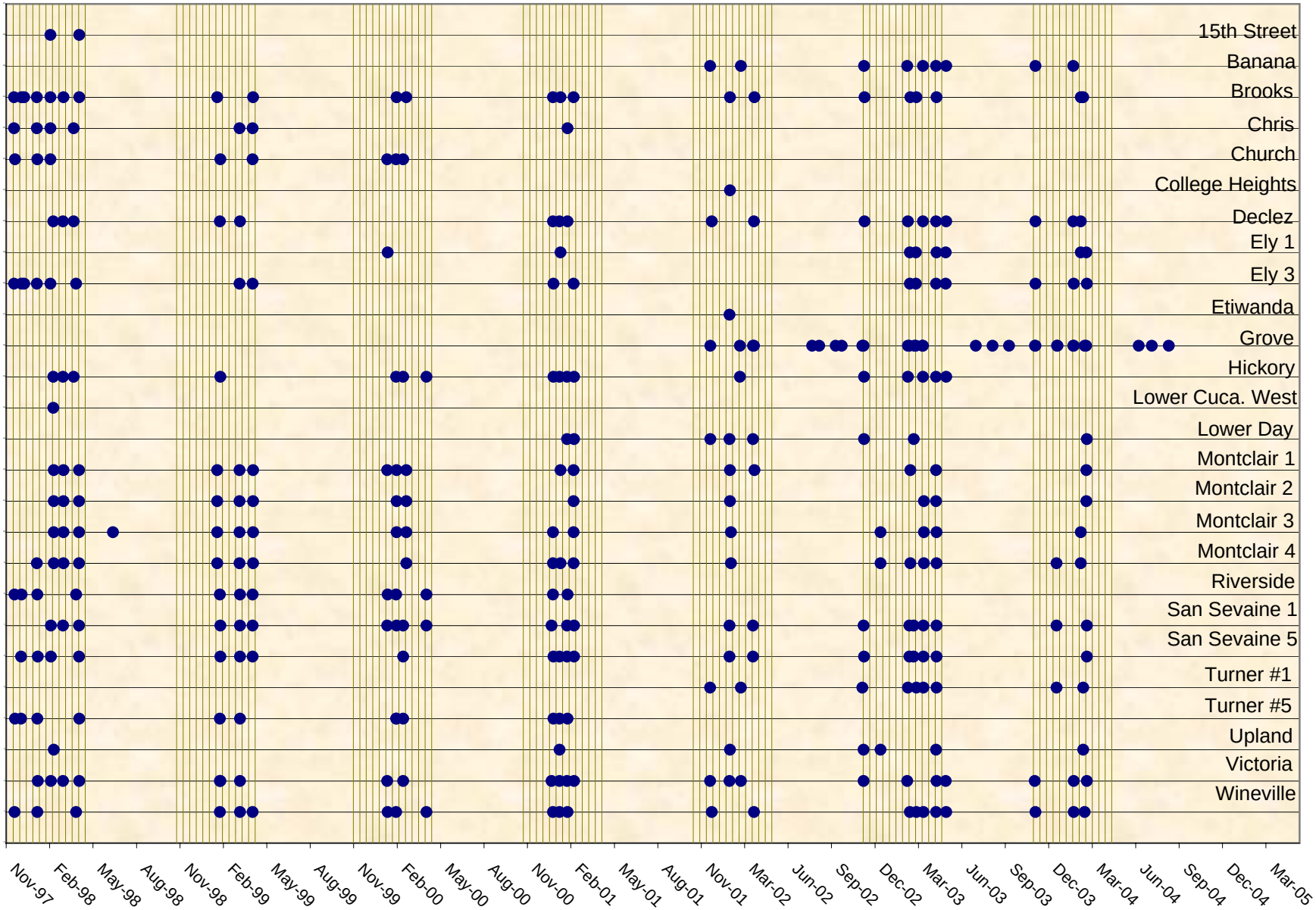

Table_6-4_Figure_6-5.xls -- Figure 6-5
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7. Basin Plan Update for the Chino Basin

7.1 Background

The TIN/TDS Task Force was formed in the mid 1990s to perform certain investigations that would lead to the establishment of new nitrate-nitrogen and total dissolved solids (TDS) objectives for groundwater basins in the Santa Ana River Watershed. The Regional Water Quality Control Board (RWQCB), Chino Basin Watermaster, water-recycling agencies, and many other entities participated in the Task Force. The RWQCB used the reports and other information developed by the Task Force to amend the Water Quality Control Plan for the Santa Ana River Watershed (Basin Plan). The Task Force initially proposed nitrate and TDS objectives based on a statistical analysis of well water quality data for the period 1954 to 1973 with the resulting well statistics volumetrically averaged to yield a new statistic for each water body. The basis for this approach is State Water Resources Control Board (SWRCB) Executive Order 68-16. The operating concept from Executive Order 68-16 is:

> "1. Whenever the existing quality of water is better than the quality established in policies as of the date on which such policies become effective, such existing high quality will be maintained until it has been demonstrated to the State that any change will be consistent with maximum benefit to the people of the State, will not unreasonably affect present and anticipated beneficial use of such water and will not result in water quality less than that prescribed in the policies."

The TIN/TDS Task Force published a report entitled *TIN/TDS Study – Phase 2A, Final Technical Memorandum* (WEI, 2000). The proposed antidegradation objectives and associated water bodies for the Chino Basin were:

Management Zone	Proposed TDS Objective (mg/L)	Nitrate-N Objective (mg/L)
Chino 1	293	4.9
Chino 2	255	2.9
Chino 3	262	3.5
Chino 4	730	10.0
Chino 5	650	4.2
Cucamonga	210	2.4

The management zones for the proposed objectives are identical to the management zones adopted by Watermaster in the OBMP and are shown in *Figure 3-12* of the *TIN/TDS Study – Phase 2A, Final Technical Memorandum*, and are shown in Figure 1-1 herein. The Task Force demonstrated with a similar statistical procedure that the current (1997) ambient TDS and nitrate concentrations exceed these objectives – that is, there is no assimilative capacity in any of these management zones for TDS or nitrate.

These objectives would, from a practical standpoint, make the large-scale use of recycled water very difficult and potentially impractical in the Chino Basin. However, the OBMP anticipates the use of about 26,000 acre-ft/yr of recycled water for direct use by 2025 and about 20,000-30,000 acre-ft/yr for recharge in 2025. Recycled water is a critical resource that the OBMP stakeholders are counting on to implement

the OBMP. If the antidegradation objectives were adopted, Watermaster, the parties to the Judgment, and IEUA, would have substantial mitigation obligations for the use of recycled water.

7.2 Watermaster's Proposal for TDS and TIN Water Quality Objectives

In December 2002, Watermaster and IEUA proposed to the RWQCB to develop new TDS and nitrate objectives based on criteria contained in California Water Code Section 13241. Section 13241 states:

> "Each regional board shall establish such water quality objectives in water quality control plans as in its judgment will ensure the reasonable protection of beneficial uses and the prevention of nuisance; however, it is recognized that it may be possible for the quality of water to be changed to some degree without unreasonably affecting beneficial uses. Factors to be considered by a regional board in establishing water quality objectives shall include, but not necessarily be limited to, all of the following:
>
> a) Past, present, and probable future beneficial uses of water.
> b) Environmental characteristics of the hydrographic unit under consideration, including the quality of water available thereto.
> c) Water quality conditions that could reasonably be achieved through the coordinated control of all factors which affect water quality in the area.
> d) Economic considerations.
> e) The need for developing housing within the region.
> f) The need to develop and use recycled water."

The Task Force modified the southern boundaries of Management Zones 1, 2, and 3, the northern end of the Temescal Management Zone, and the western boundary of Chino Basin Management Zone 5 to accommodate a new management zone that it calls the Prado Basin Management Zone. Watermaster and IEUA proposed that the remaining area in the Chino Basin be divided into the *Chino North*, *Chino East*, and *Chino South* Management Zones instead of the five management zones presented in the *TIN/TDS Study – Phase 2A, Final Technical Memorandum* (WEI, 2000a) and the OBMP (WEI, 1999). The boundary for the Cucamonga Management Zone would remain unchanged. Figure 7-1 shows the proposed management zones. *Chino North* would consist of the remaining parts of Management Zones 1, 2 and 3. *Chino East* consists of Management Zone 4 and *Chino South* consists of Management Zone 5. Watermaster and IEUA proposed that the TDS and nitrate objectives for Chino and Cucamonga management zones be:

Management Zone	TDS (mg/L)		Nitrate-N (mg/L)	
	Objective	Current	Objective	Current
Chino North	420	300	5.0	7.4
Chino East	730	760	10.0	13.3
Chino South	680	720	4.2	8.8
Cucamonga	380	260	5.0	4.4

The *current* estimate listed above is an estimate of the volume-weighted quality in 1997. It is consistent with, and uses the same data and computational methods as the current ambient concentrations listed in the *TIN/TDS Study – Phase 2A, Final Technical Memorandum* (WEI, 2000a). The proposed TDS

objectives for *Chino North* and *Cucamonga* are based on the long-term projection of the average TDS concentration in these management zones with the recycling program included in the OBMP. The proposed nitrate objective is based on values that can accommodate planned recycled water recharge in *Chino North* and *Cucamonga* without impairing beneficial uses in either management zone. The TDS and nitrate objectives for *Chino East* and *Chino South* are based on antidegradation objectives for the Chino 4 and 5 management zones. The proposed objectives for *Chino North* and *Chino South* have been adjusted slightly to account for the new Prado Basin Management Zone. Watermaster and IEUA made specific commitments to back up this proposal (see Commitments below). The Watermaster and IEUA proposal was evaluated using Water Code Section 13241 and one other criterion described below.

7.2.1 S13241 (a) Past, Present, and Probable Future Beneficial Uses of Water.

The beneficial uses in the 1995 Basin Plan for the Chino Basin subbasins I, II and III are:

> MUN – waters used for community, military, municipal, or individual water systems. These uses include, but are not limited to, drinking water supply.
>
> AGR – waters used for farming, horticulture or ranching. These uses may include, but are not limited to, irrigation, stock watering, and support of vegetation for range grazing.
>
> IND – waters used for industrial activities that do not depend primarily on water quality. These uses include, but are not limited to, mining, cooling water supply, conveyance, gravel washing, fire protection and oil well repressurization.
>
> PROC – waters are used for industrial activities that depend primarily on water quality. These uses include, but are not limited to, process water supply, and all uses of water related to product manufacturing and food preparation.

The use impairment threshold concentrations for TDS and TIN for these beneficial uses as listed or inferred from the current Basin Plan are:

Beneficial Use	TDS Threshold (mg/L)	TIN Threshold (mg/L-N)
MUN	500	10
AGR	700	>10
IND	nl	nl
PROC	nl	nl

The "nl" listed above means that the Basin Plan is silent as to the impairment threshold concentration for these uses. For the AGR use, the Basin Plan states that 700 mg/L is the beneficial use threshold for irrigation. The Basin Plan is silent regarding the TIN impairment threshold for the AGR use, however it is reasonable to assume that this impairment threshold is significantly greater than 10 mg/L – thus it is shown above as >10 mg/L. With the exception of TDS in *Chino South*, the proposed TDS and TIN objectives are protective of these beneficial uses. The protection of the MUN use in *Chino South* with regard to TDS is described below.

7.2.2 S13241 (b) Environmental characteristics of the hydrographic unit under consideration, including the quality of water available thereto.

TDS. Watermaster conducted a reconnaissance-level investigation to estimate the future TDS concentrations in *Chino North* and *Cucamonga* Management Zones. A *continuously-stirred reactor model* (CSRM) was developed to estimate the future TDS concentrations.

In a CSRM, fluid particles enter the reactor and are instantaneously dispersed throughout the reactor volume. The fluid particles leave the reactor in proportion to their statistical population. This approximation is used to study lakes and reservoirs with continuous inputs and outputs (see, for example, *Water Quality: Characteristics, Modeling and Modification,* by Tchobanoglous and Schroeder, 1987). The extension of this approach to a groundwater basin is somewhat tenuous and at best provides a first-order approximation of the time scale of TDS degradation. In words, the approach is as follows:

- Estimate the volume and volume averaged TDS concentration of the subject management zone at the start of the simulation period (initial condition).

For each time step do the following:

- Estimate the inflow and outflow volumes
- Estimate change in storage
- Estimate the TDS concentration for each inflow component
- Assume TDS in outflow is equal to the TDS concentration at the end of the previous time step
- Estimate the TDS mass in the reactor
- Estimate the TDS concentration in the reactor at the end of the time step

The initial condition for the management zones was based on the 1997 estimates from the Phase 2A report. The inflows consist of deep percolation of precipitation, deep percolation of applied water, natural and artificial recharge of storm waters, artificial recharge of supplemental water, and subsurface inflows from adjacent groundwater basins. With the exception of deep percolation of applied water, the inflow terms are independent of groundwater outflow terms, and are calculated or assumed values. The deep percolation of applied water is closely related to the total water demand and is derived from the portion of the water demand used to satisfy irrigation uses. It is calculated as follows:

$$AW_{t\ to\ t+1} = TD_{t\ to\ t+1} * FNS$$
$$DPAW_{t\ to\ t+1} = AW_{t\ to\ t+1} * (1.0 - IEFF)$$

Where:

$AW_{t\ to\ t+1}$	is the applied water
$TD_{t\ to\ t+1}$	is total demand
FNS	is the fraction of total demand that does not enter the sewer system
$DPAW_{t\ to\ t+1}$	is the deep percolation of applied water
IEFF	is the irrigation efficiency or the fraction of water consumed by the vegetation served by the applied water.

Total demands and groundwater pumping are derived from the OBMP implementation plan in the Peace Agreement. The fraction of total demand that does not enter the sewer system is based on historical data

from IEUA and future estimates from planning documents. Irrigation efficiency was assumed to be 75 percent. The planning documents used to derive total demands, fraction not sewered, and irrigation efficiency are: the Chino Basin Watermaster Optimum Basin Management Program Phase 1 Report (WEI, 1999), Peace Agreement (CBWM, 2000), and the Final Draft, Hydrologic Study of the Cucamonga Groundwater Basin (CDM, 1999).

The water volume and TDS mass balance for a groundwater basin (reactor) is simply:

$$\text{Inflow} - \text{Outflow} = \text{Change in Storage}$$

For TDS, an explicit finite-difference approximation is used and is:

$$\Sigma\,[\,I_{j,t\text{ to }t+1} * C_{j,t}\,] - \Sigma\,[O_{k,t\text{ to }t+1} * CGW_t] = VGW_{t+1}*CGW_{t+1} - VGW_t*CGW_t$$

Where:

$I_{j,t\text{ to }t+1}$	is the jth inflow during the period t to t+1
$C_{j,t}$	is the TDS concentration for the jth inflow during the period t to t+1
$O_{k,t\text{ to }t+1}$	is the kth outflow from the groundwater basin during the period t to t+1
VGW_{t+1}	is the volume of groundwater in storage at t+1
CGW_{t+1}	is the TDS concentration of groundwater at t+*1*

The TDS mass balanced is solved for CGW_{t+1} after the hydrologic or water volume mass balance is solved. The following water resources management cases were analyzed:

Case 1 100 Percent of the Replenishment Water in Chino Basin is State Project Water, Non Potable Supply is State Project Water, and No TDS Controls on Water Supply to Maintain Recycled Water below 550 mg/L. No Supplemental Water Recharge in the *Cucamonga* Management Zone.

Case 2 100 Percent of the Replenishment Water in Chino Basin is State Project Water, Non Potable Supply is State Project Water, and TDS Controls on Water Supply to Maintain Recycled Water below 550 mg/L. No Supplemental Water Recharge in the *Cucamonga* Management Zone.

Case 3 100 Percent of the Replenishment Water in Chino Basin is State Project Water, Non Potable Supply is Recycled Water, and TDS Controls on Water Supply to Maintain Recycled Water below 550 mg/L. Supplemental Water Recharge in the Cucamonga Basin consists of 5,000 acre-ft/yr of State Project Water.

Case 4 50 Percent of the Replenishment Water is State Project Water and 50 Percent is Recycled Water, Non Potable Supply is Recycled Water, and TDS Controls on Water Supply to Maintain Recycled Water below 550 mg/L. Supplemental Water Recharge in the *Cucamonga* Management Zone consists of 2,500 acre-ft/yr of State Project Water and 2,500 acre-ft/yr of Recycled Water. Case 4 represents the OBMP with additional desalting.

Each case consists of a 100-year water supply plan and an associated water and salt balance. Detailed tables were prepared that present these water supply plans for the municipal pumpers and associated water and salt balances. For Cases 2 through 4, the TDS concentration in the *Chino North* groundwater supply is equal to either the TDS concentration in the management zone or a fixed lesser value. The latter occurring when the TDS in the composite supply needs to be reduced to ensure that the TDS in recycled water is less than its permit limit. The results are summarized below:

- The Case 1 TDS projection corresponds to increasing water demands and the desalting program in the Chino Basin OBMP but excludes recycled water use. At year 2100, the average TDS concentration in groundwater will be about 470 mg/L for *Chino North* and about 430 mg/L for *Cucamonga*. This is not a feasible case because recycled water produced will exceed the permit level of 550 mg/L.
- Case 2 is identical to Case 1 except that additional desalting has been added to ensure that recycled water produced in the Chino Basin meets a TDS limitation of 550 mg/L. At year 2100, the average TDS concentration will be about 430 mg/L in *Chino North* and about 420 mg/L in *Cucamonga* – a decrease of 40 and 10 mg/L, respectively.
- Case 3 is identical to Case 2 except that the non-potable water delivered for direct use in *Chino North* and *Cucamonga* management zones is assumed to be recycled water. At year 2100, the average TDS concentration in groundwater will be about 445 mg/L for *Chino North* and about 420 mg/L for *Cucamonga* – an increase over Case 2 of 15 mg/L for *Chino North* and no change for *Cucamonga*. The increase in TDS concentration in *Chino North* over the next 100 years from the direct use of recycled water is about 15 mg/L.
- Case 4 is identical to Case 3 except that half of the replenishment water recharged in *Chino North* is assumed to be recycled water (22,000 acre-ft of recycled water recharge). Similarly for *Cucamonga*, half of the supplemental water recharge is assumed to be recycled water (2,500 acre-ft of recycled water). At year 2100, the average TDS concentration in groundwater will be about 475 mg/L in *Chino North* and about 440 mg/L in *Cucamonga* – an increase over Case 3 of 30 mg/L and 20 mg/L for *Chino North* and *Cucamonga*, respectively. The increase in TDS in *Chino North* and *Cucamonga* management zones over the next 100 years from the recharge of recycled water is about 30 mg/L and 20 mg/L, respectively. Case 4 represents the OBMP with additional desalting to ensure that the TDS concentration in recycled water is less than 550 mg/L.

Figures 7-2 and 7-3 graphically compare the TDS projections for each case for *Chino North* and *Cucamonga*, respectively.

The TDS concentration in imported water was assumed to be 290 mg/L in the preceding discussion. There may be times in the future when the TDS concentration will be much higher. Article 19 of the State Water Project contract provides that DWR "*shall take all reasonable measures*" such that the TDS concentration will not exceed 440 mg/L as a monthly average nor exceed the ten-year average of 220 mg/L. The long-term average TDS concentration of State Project water delivered to Metropolitan from DWR is about 290 mg/L or 70 mg/L above the ten-year average contract objective. The monthly average TDS levels in State Project water have exceeded the 440 mg/L objective twice and have exceeded 400 mg/L 19 times in 27 years (Metropolitan, 1999). There was a concern at Watermaster based on the actions of other Regional Boards in California that setting the TDS objectives in Chino Basin based on the anti-degradation approach would eventually result in mitigation of the recharge of State Project water when its concentration exceeds the objective. This mitigation would have no practical or economic benefit. Watermaster and IEUA asserted to the RWQCB that the TDS objective should be set high enough to recharge State Project water in the basin without mitigation as long as the recharge does not impair beneficial uses of groundwater.

At the October 22, 2002 Task Force meeting, the RWQCB and Task Force members agreed that establishing a TDS objective at 420 mg/L for *Chino North* is sufficient to promote the maximum beneficial use of water. This TDS objective is based on the Case 4 TDS projection in year 2030. The RWQCB proposed that the TDS objective in *Cucamonga* be 380 mg/L based on the Case 4 TDS projection in year 2030. These TDS objectives allows Watermaster and IEUA the greatest flexibility in conducting supplemental water recharge, and is protective of current and future beneficial uses.

Nitrate. The TIN/TDS Task Force determined that the use protection threshold for nitrate-nitrogen in groundwater was 8 mg/L. Watermaster proposes that the nitrate-nitrogen objectives for the *Chino North* and *Cucamonga* management zones be set at 5 mg/L, which will allow the direct use and recharge of recycled water without mitigation, and still protect the beneficial uses in these management zones.

7.2.3 S13241 (c) Water quality conditions that could reasonably be achieved through the coordinated control of all factors which affect water quality in the area.

The controllable factors that affect TDS and nitrate in Chino Basin groundwater include the recharge of storm water, imported water, recycled water, and Santa Ana River discharge. With OBMP implementation: the storm water recharge (TDS ~ 100mg/L and nitrate < 1 mg/L-N) will increase from 5,600 acre-ft/yr to about 17,000 acre-ft/yr, physical recharge capacity for recharge of supplemental water will increase from about 25,000 acre-ft/yr to about 60,000 acre-ft/yr, and groundwater treatment capacity (RO and ion exchange) will increase from about 9,000 acre-ft/yr to about 68,000 acre-ft/yr. Watermaster and IEUA, in implementing of the OBMP, asserted that they were taking extraordinary steps to optimize the management of the Chino Basin area by improving supply reliability and water quality. Setting the TDS and nitrate objectives per the Watermaster and IEUA proposal will reduce the cost of replenishment, which is necessary to ensure that the groundwater treatment systems are economically viable.

7.2.4 S13241 (d) Economic considerations.

There is no assimilative capacity with the TIN/TDS Task Force proposed antidegradation-based TDS and nitrate objectives. Therefore, there will be a mitigation requirement for TDS and nitrate for the recharge and direct reuse of recycled water and the recharge of imported State Project water. From the discussion in *Section 7.2.2 13241 (b) Environmental characteristics of the hydrographic unit under consideration, including the quality of water available thereto* above, it is clear that the TDS concentration in the Chino Basin will increase regardless of the TDS objective and with or without recycled water use. In 1990, the Santa Ana Watershed Project Authority Basin Plan Upgrade Task Force (SAWPA BPUTF) retained Bill Dendy and Associates to analyze the economic benefits of various management programs including:

- Managing groundwater basins to achieve Basin Plan objectives for TDS and nitrate
- Managing groundwater basins to maintain current TDS and nitrate concentrations
- Construction of groundwater treatment systems to ensure that groundwater can be put to potable uses.

The results of Dendy's work are contained in the final report *Nitrogen and TDS Studies, Upper Santa Ana Watershed* (James M. Montgomery, 1991). In summary, the SAWPA BPUTF report concluded that the cost of managing groundwater quality to achieve the Basin Plan objectives or to stop degradation were $6.5 billion and $3.2 billion (present worth, 1991 dollars), respectively. The cost of producing potable water through the construction of groundwater treatment plants was more reasonable at about $1.9 billion. The SAWPA BPUTF report concluded that groundwater treatment for potable use was the best solution to manage future TDS and nitrate degradation of groundwater. This occurs because the TDS and nitrate concentrations in agricultural and urban return flows to groundwater are not regulated and the TDS and nitrate concentrations in groundwater will asymptotically approach their volume-weighted concentrations in the recharge.

Simply put, the TIN/TDS Task Force proposed management zones and associated antidegradation objectives will cause the mitigation expenses to occur without tangible benefits to anyone in the

watershed. This economic burden will inhibit the maximum use of recycled water and recharge of imported water and reduce the scale of the groundwater treatment projects planned in the OBMP. The cost of replenishment for desalter or other groundwater treatment plants will make the use of these facilities non economical and delay or eliminate their construction thus promoting the expanded use of State Project water. Note that the expansion of Desalter 1 and construction of Desalter 2 would not be economically feasible if they had to bear the cost of full replenishment even with significant funding from Proposition 13.

Adopting the Watermaster and IEUA-proposed TDS and nitrate objectives will lower the cost of OBMP implementation and increase the amount of State Project water available throughout the state – a state wide economic and environmental benefit.

7.2.5 S13241 (e) The need for developing housing within the region; and (f) the need to develop and use recycled water.

The cities and counties in the Chino Basin area have determined a need for housing in the Chino Basin area, and have adopted general and specific plans that show substantial increases in housing in the Chino Basin as the land is converted from agricultural to urban uses. With the exception of the City of Chino, all these plans have been approved and have certified environmental documents. The water supply entities in the basin have responded to the water supply challenge posed by these plans by developing water supply plans that depend heavily on local and supplemental supplies. The OBMP is a watershed-scale program that addresses current and future demands through the development of large-scale recharge, groundwater treatment, regional conveyance, and conjunctive-use programs. The newly enacted Kuell (SB221) and Costa (SB610) bills require extensive documentation and demonstrations of water supply reliability prior to allowing new housing to occur. The direct use and recharge of recycled water are key to demonstrating and achieving reliability, and therefore to meeting the housing needs in the area. Per the OBMP, The demand for supplemental water will increase from about 70,000 acre-ft/yr in 2001 to about 122,000 acre-ft/yr in 2020 (OBMP Peace Agreement, 2000). Supplemental water consists of imported and recycled water. The imported water source is State Project water and is not a reliable source for all of the basin's supplemental water demand. Recycled water is reliable. The OBMP water supply plan includes an average direct use of recycled water in 2020 of 26,000 acre-ft/yr and recharge of recycled water of about 20,000 to 30,000 acre-ft/yr. Recycled water use in the Chino Basin area is necessary for growth. Setting the TDS and nitrate objectives as proposed by Watermaster and IEUA will maximize the use of recycled water and the capacity of groundwater treatment thereby improving the reliability of water supplies for future growth in the region.

7.3 Water Quality Impacts to the Santa Ana River from Adopting the Watermaster and IEUA Proposed TDS and TIN Objectives.

RWQCB staff expressed a concern that raising TDS objectives in the Chino Basin area will cause degradation in the Santa Ana River and subsequently impact the Orange County Basin. The OBMP will likely improve the TDS and nitrate in the River over what would occur without the OBMP. A fundamental goal of the OBMP is to eliminate groundwater outflow from the basin to the Santa Ana River. The OBMP desalters, other lower basin groundwater treatment programs, and recharge management programs are the management tools available to Watermaster and IEUA to either eliminate groundwater outflow or to control it to de minimus levels.

Watermaster, IEUA, OCWD, and RWQCB staffs worked together to develop a monitoring program to characterize the relationship of the Santa Ana River and the Chino Basin. This monitoring program, referred to as the *Hydraulic Control Monitoring Program* (WEI, 2004a) was completed in 2004. This program is discussed in Section 8 of this State of the Basin Report. Based on the results of this monitoring program Watermaster and IEUA will fine tune groundwater production and recharge in the Basin to maximize yield and prevent outflow.

7.4 Watermaster and IEUA Commitments

The RWQCB required irrevocable commitments that ensure that Watermaster and IEUA will take appropriate actions that are triggered by ambient water quality and other time-certain conditions. These commitments are contained in the 2004 Basin Plan Amendment. Watermaster and IEUA commitments are described below. Failure to meet these commitments will cause the TDS and nitrate objectives to revert back to the antidegradation objectives, and Watermaster and IEUA will be required to mitigate TDS and nitrate loadings to groundwater based on the antidegradation objectives back to 2004.

7.4.1 TDS Effluent Limitation and Salinity Management

IEUA will limit the volume-weighted average TDS concentration in its effluent to less than or equal to 550 mg/L by: using low TDS source water supply for potable uses, selective desalting of either source water and/or recycled water, and minimizing the TDS waste increment. IEUA, Watermaster and the Chino Basin producers will always attempt to serve the lowest TDS supply available for its potable supply.

When necessary, IEUA, Watermaster and the Chino Basin producers will construct desalting facilities to either reduce the TDS concentration in source water and serve this water to its customers, or to reduce the TDS concentration recycled water.

Finally, IEUA and the Chino Basin producers will use best efforts to enact ordinances and development requirements that minimize the TDS waste increment (the average TDS increase that occurs through indoor uses and numerically equal to the average TDS concentration in recycled water minus the average TDS concentration in the source water supply).

7.4.2 TIN Effluent Limitation

IEUA will reduce the TIN concentration in its recycled water such that it will produce a recycled water effluent with a 12-month average TIN of 8 mg/L or less.

7.4.3 Desalter Construction

Watermaster and IEUA will initiate planning for expansion of the Chino Basin desalting program called out in the OBMP in 2004 and have a plan completed and adopted by the Court in 2005.

7.4.4 Maintenance of Hydraulic Control

Watermaster and IEUA will monitor conditions in the southern Chino Basin to determine the state of hydraulic control and will modify recharge, production and/or treatment to ensure that hydraulic control is maintained and the effects of temporary losses of hydraulic control are mitigated.

7.4.5 Monitoring

Watermaster and IEUA commit to conducting and funding monitoring activities to enable the determination of ambient TDS and nitrate concentrations in groundwater in the Chino Basin, and to cooperate with the RWQCB in the sharing of monitoring data consistent with IEUA and Watermaster policies.

7.5 Status of Maximum Benefit Proposal and the Basin Plan Amendment

The maximum benefit proposal described above was formally incorporated into the 2004 Basin Plan Amendment and was approved by the Santa Ana Regional Board in February 2004. The State Water Resources Control Board approved this amendment in September 2004 and the Office of Administrative Law gave its approval in December 2004. The amendment was sent to the US Environmental Protection Agency for their review and approval. The EPA review and approval applies to Clean Water Act requirements and from a regulatory perspective will have no practical impact on the TDS and nitrate objectives. The Basin Plan Amendment, as it pertains to managing the Chino Basin, is now in effect.

Management Zones of the 2004 Basin Plan Update

- Chino North
- Chino East
- Chino South
- Prado Basin
- Temescal

Geology

Water-Bearing Sediments

- Quaternary Alluvium

Consolidated Bedrock

- Undifferentiated Pre-Tertiary to Early Pleistocene Igneous, Metamorphic, and Sedimentary Rocks

Faults & Groundwater Divides

- Location Certain
- Location Approximate
- Location Concealed
- Location Uncertain
- Groundwater Divide

Other Features

- Flood Control and Conservation Basins

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Author: KD
Date: 20041230
File: Figure_7-1.mxd

0 1 2 3 4 Miles
0 2 4 6 KM

State of the Basin Report – 2004

Water Quality Control Plan Management Zones

2004 Basin Plan Update

Figure 7-1

Figure 7-2
Comparison of TDS Concentration Projections
for the Chino North Management Zone

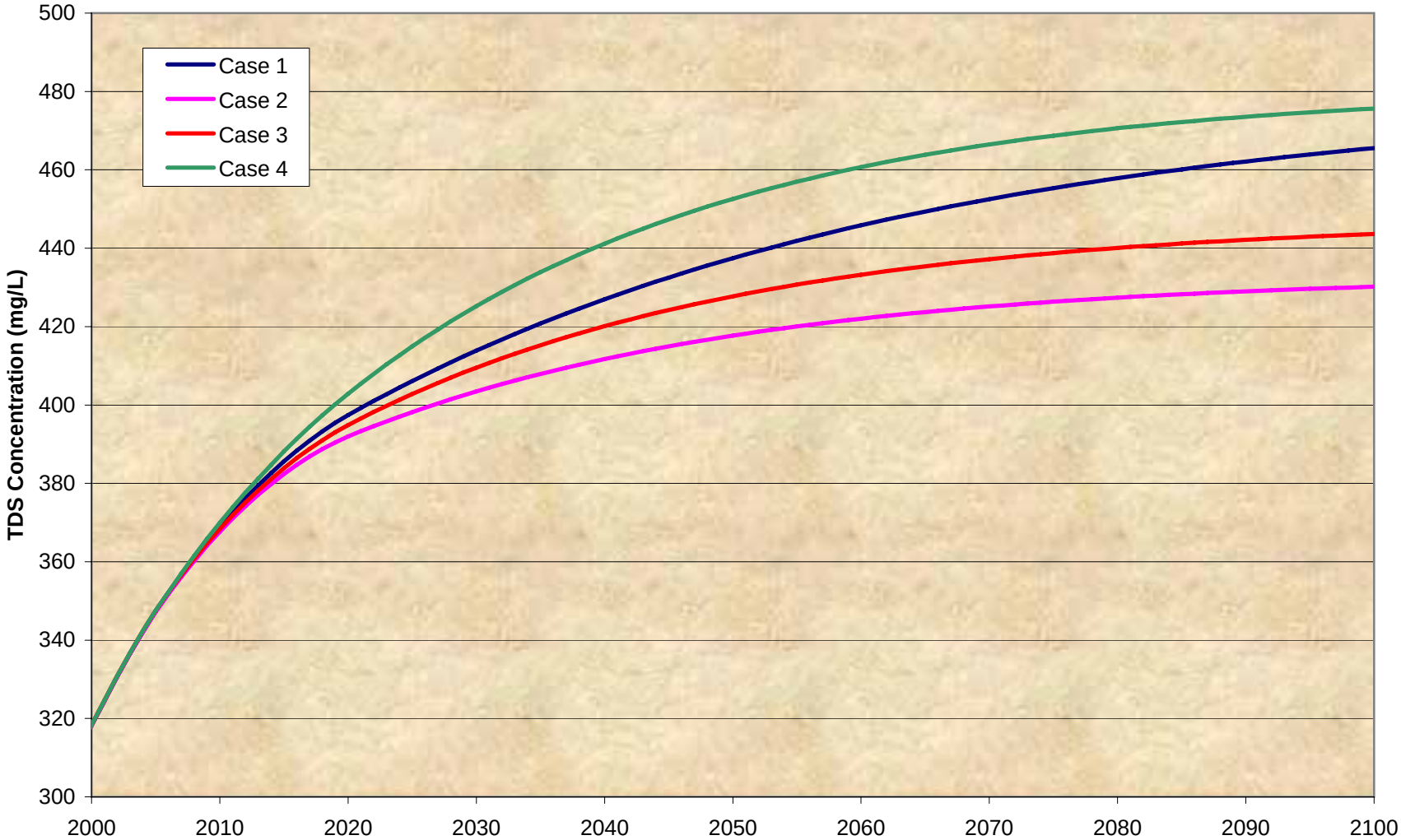

Figure_7-2_7-3.xls -- 20021017 Figure 7-2
Created on 10/17/02
Printed on 7/11/2005

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Figure 7-3
Comparison of TDS Concentration Projections
for the Cucamonga Management Zone

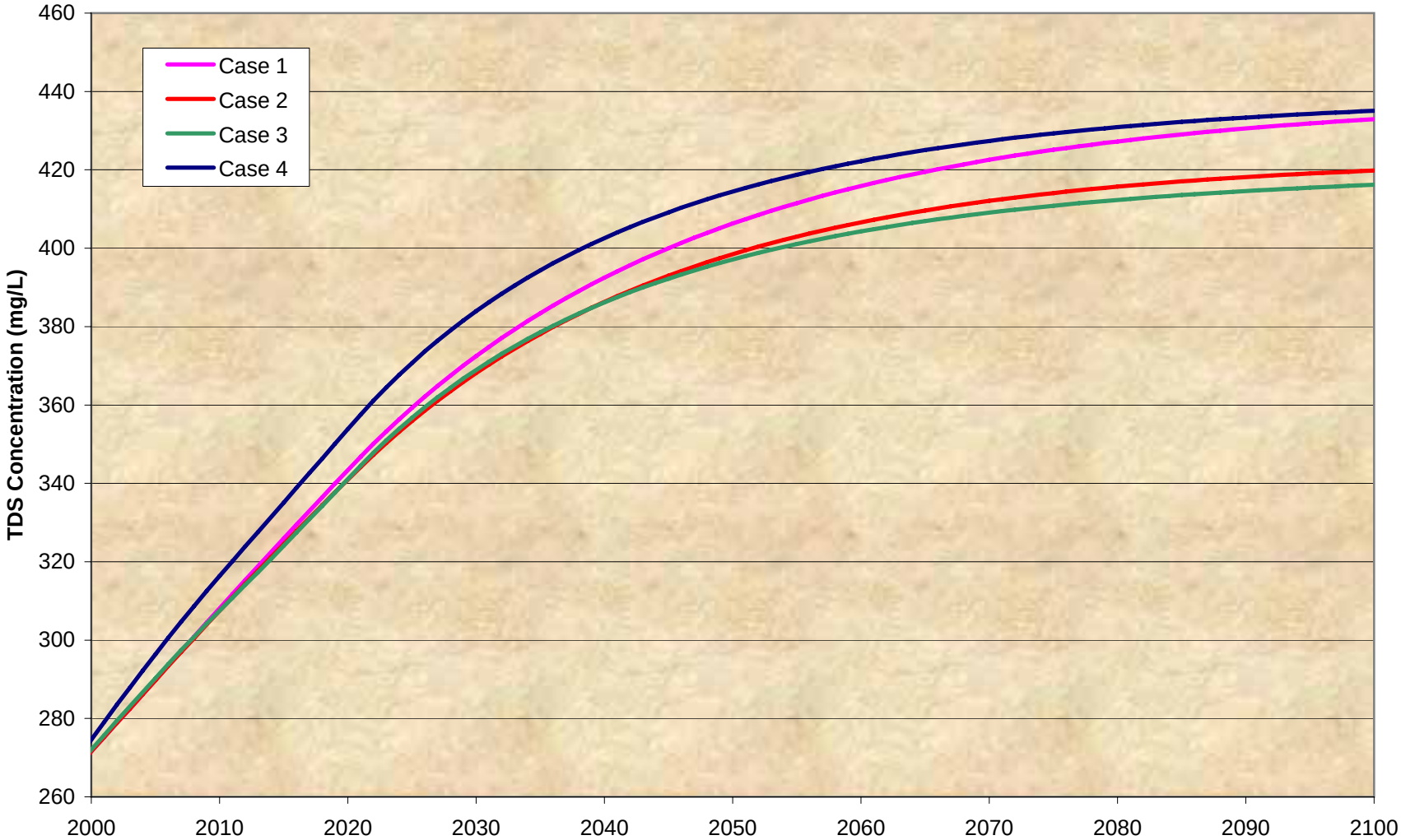

Figure_7-2_7-3.xls -- Cuc Basin Figure 7-3
Created on 10/17/02
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8. HYDRAULIC CONTROL MONITORING PROGRAM

8.1 Background

Under virgin conditions (pre- to early-1900s), groundwater flowing in a southerly direction from the northern part of the basin would rise to become surface flow in the southwestern part of the basin, ultimately discharging to the Santa Ana River. Since the onset of pumping and associated regional drawdown of groundwater-levels, this southerly flow of groundwater is thought to be intercepted by agricultural wells, and in the last few years, by desalter wells before rising as surface flow in significant quantities. Past investigations that used groundwater models to simulate flow and water quality have suggested that currently there is little or no discharge of groundwater originating in the upper part of the Chino Basin to the Santa Ana River. The condition where groundwater is intercepted before discharging to the Santa Ana River is herein referred to as "hydraulic control." Data from existing groundwater-level monitoring programs suggest hydraulic control could be occurring, but are not sufficient to conclude that hydraulic control is actually occurring. The number and location of wells available to monitor groundwater-level and quality are not sufficient to determine conclusively the state of hydraulic control.

As part of the 2004 Basin Plan update, Watermaster and IEUA have proposed that the total dissolved solids (TDS) and nitrate objectives in the Chino North management zone be established based on maximum benefit and not on antidegradation (see Section 7). One of the criteria required by the Regional Water Quality Control Board (RWQCB) that must be satisfied to establish objectives based on maximum benefit is to demonstrate that raising the TDS objective to 420 milligrams per liter (mg/L) and the nitrate-nitrogen objective to 5 mg/L will not adversely impact the quality of the Santa Ana River or downstream beneficial uses. Demonstrating hydraulic control will show that downstream beneficial uses are not impaired by management activities in the Chino North management zone.

This section describes the assessment of hydraulic control of the Chino Basin. Four engineering or scientific showings can be used to corroboratively demonstrate the state of hydraulic control in the southern portion of Chino Basin:

- water chemistry
- hydrologic balance
- piezometric levels
- groundwater modeling

While any individual demonstration may not be adequate to demonstrate complete containment, all four elements can be combined to assess the state of hydraulic control and to optimize the management of the basin to maximize yield and reduce discharge to the Santa Ana River, and subsequent outflow of poor quality groundwater at Prado Dam.

Achievement of hydraulic control, and data to demonstrate this, is important to Watermaster, IEUA, Orange County Water District (OCWD), and the RWQCB. The specific issues of each of the above entities with regard to hydraulic control are:

- **Maintain basin yield.** Watermaster included yield maximization by hydraulic control in the OBMP. The OBMP Desalter Program currently being implemented is an important element of yield maximization. The desalter wells are located at the down-gradient end of the Chino

Basin, near the Santa Ana River. The current desalter capacity of 8 mgd will be expanded to 20 mgd by 2005, and will reach 40 mgd between 2010 and 2015. One objective of the desalter program is to minimize or eliminate groundwater outflow thereby maintaining or increasing yield.

- **Minimize/eliminate loss of stored water.** Watermaster, IEUA, and Chino Basin producers either store or will store supplemental and native water in the basin. These entities want to minimize the loss of stored water from the Chino Basin to protect the investments of the producers and minimize the importation of State Project Water.
- **Protect Santa Ana River water quality.** All entities want to protect the quality and beneficial uses of the Santa Ana River through hydraulic control. Watermaster and IEUA have committed to hydraulic control in recent California Environmental Quality Act (CEQA) documents as a means to protect and prevent significant impacts to Santa Ana River water quality.

8.2 Activities and Accomplishments to Date

Watermaster, IEUA, OCWD, and the RWQCB conducted a series of meetings beginning in summer 2002 concerning this Hydraulic Control Monitoring Program (HCMP). These agencies are hereafter referred to collectively as the HCMP technical group. The HCMP technical group is implementing the activities described in this report to determine the state of hydraulic control in the lower Chino Basin. The monitoring and analytical activities described herein are phased in and modified over time as necessary to provide management-level decision support information. Once the Basin Plan Amendment is approved by the Office of Administrative Law (OAL), regular meetings will be held and quarterly progress reports will be prepared by Watermaster staff (with dissenting and supporting comments attached by the IEUA and OCWD, as warranted) for submittal to the RWQCB. These progress reports will describe the status of activities (what was scheduled to occur, what occurred, variances to the schedule, and what is expected to occur in the next quarter), data collected during the period, and analysis of the data. At some time in the future, the reporting frequency could be relaxed to once per year, if appropriate. Watermaster and IEUA will use the information produced in this effort to revise basin management activities that may include: expansion/curtailment of recycled water use, increasing/decreasing groundwater production in the southern part of the basin, expansion/reduction of storage programs, and others. The RWQCB will use this information to regulate water-recycling activities conducted by IEUA.

8.2.1 HCMP Work Plan

The HCMP Work Plan was submitted as Draft in July 2003. OCWD commented on the work plan, WEI addressed the comments, and the work plan was published as Final in May 2004. The HCMP Final Work Plan (WEI, 2004a) describes basin-wide geology/hydrogeology and groundwater quality, and discusses the proposed tasks in the HCMP. The individual tasks presented in the work plan can be used to corroboratively demonstrate hydraulic control.

8.2.2 Groundwater Elevation and Water Quality Data

8.2.2.1 Define the Study Area

The area in which monitoring is required (monitoring area) is the portion of the Chino Basin bounded by the Santa Ana River to the south, including the Prado Basin and the area of the desalters' estimated drawdown of five feet or greater (the estimated drawdown of five feet or greater is shown in Figure 4.3-18 in the Draft Subsequent Environmental Impact Report (EIR) for the Chino I Desalter Expansion and Chino II Desalter Project, prepared for the Chino Basin Desalter Authority by Tom Dodson and Associates and RBF Consulting, November 2001). The study area is shown in Figure 8-1.

8.2.2.2 Selection of Key Wells

As part of the work plan development, key wells were selected to characterize groundwater flow and quality in the southern portion of the basin, near the desalter well fields. Watermaster is implementing a key well monitoring program for water level measurements (Figure 8-2). The criteria used to select these wells were:

- Wells in the key well program require a spatial distribution such that water elevation contour maps drawn using data from only these wells are comparable to a map that used data from all wells in the following respects:
  - regional (study area) gradients are comparable, and
  - local pumping depressions are represented by the key well program.
- Wells with construction information (perforated intervals) are selected preferentially over other wells.
- The time history of water level at a well is compared to those at adjacent or nearby wells to determine if there are differences in responses to aquifer stresses over time that may indicate that the adjacent wells are perforated in different aquifer zones, especially on the southwest side of Chino Basin. In that situation, both wells would be retained in the key well program.
- The density of key wells near the desalter well fields would be greater than outlying areas, given that hydraulic gradients are expected to be steeper near the desalter well fields.
- All private wells have access ports for groundwater level sounders and that reference points are marked and well documented.

Key wells were also selected for the water quality monitoring program. The steps taken in determining the key wells (the groundwater quality key wells are shown in Figure 8-3) were:

- The basin was divided into a grid, with each cell being 2000 square meters (m^2).
- For each grid cell, the average TDS and NO_3 values were calculated (using the last five years of available data).

- The water quality of each individual well was examined. Wells most closely matching the average constituent concentrations were chosen as representative. One to two wells in each grid square were retained. Preference was given to wells with the following characteristics:
  - Known construction;
  - Choice as a groundwater level key well;
  - Likelihood of surviving the regional development.
- Basin-wide TDS and NO_3 arithmetic averages were recalculated using just the key wells and compared to the total basin arithmetic averages. New maps were made representing the water quality conditions of the key wells and qualitatively compared to the original basin maps. See Figures 4-2 through 4-7 for locations of wells with maximum concentrations of TDS and NO_3.

The USGS, as part of the National Water-Quality Assessment (NAWQA) Program, installed a series of shallow monitoring wells along Reach 3 of the Santa Ana River. These wells (shown in Figure 8-2) have been incorporated into the groundwater level and quality key well programs. Watermaster staff equipped these wells with pressure transducers in early 2004 (the transducers have data logging capabilities and the data are routinely downloaded). Monthly water quality samples are being collected for the first year the wells are included in the key well programs. This will build a robust data set to aid in the analysis of seasonal variations and trends. Some of these wells, however, have recently been destroyed as the region has been subjected to heavy rain storms and flooding since October 2004.

8.2.2.3 Collection of Groundwater Samples

Figure 4-1 shows the locations of all the wells with water quality data. The groundwater quality key wells (shown in Figure 8-3) are sampled every two years. Half of the approximate 111 key wells are sampled each year, so that each well is sampled every two years.

The field activities for this project are in general accordance with the guidelines established in California EPA (1994) and US EPA (1998). These protocols are followed to ensure the collection of high-quality and well-documented data.

Groundwater samples are tested for the following analytes:

Analytes	Method	Wells
Major cations: K, Na, Ca, Mg, Fe	EPA 200.7	All
Major anions: Cl, SO_4, NO_2, NO_3	EPA 300.0	All
Apparent Color	SM 2120B	All
ClO_4	EPA 314	All
Hardness	SM 2340B	All
HCO_3, CO_3, OH	EPA 310.1/SM 2320B	All
NH_3	EPA 350.1	All
Odor	SM 2150B	All
P	EPA 365.1	All
pH	EPA 150.1/SM 4500-HB	All

Analytes	Method	Wells
TDS	EPA 160.1/SM 2540C	All
Total Kjeldahl Nitrogen (TKN)	EPA 351.4	All
Turbidity	EPA 180.1	All
VOCs	SM 8260	Wells within or Near the Chino Airport and South of Ontario Airport Plumes

8.2.3 Surface Water Flow and Water Quality Data

Review of Santa Ana River Watermaster reports show that baseflow increases in the Santa Ana River at Prado Dam by about 80 cubic feet per second (cfs) during the winter. Recycled water and other non-tributary discharges to the River cannot account for this change in flow. The increase in baseflow discharge could be caused by a decrease in evapotranspiration by riparian vegetation in Prado Reservoir and near the river, by changes in groundwater management in either or both Chino and Temescal Basins (seasonally reduced groundwater pumping, increased recharge, changes in pumping patterns, *et cetera*) or some combination of all three. An assessment of evapotranspiration will be conducted to determine whether seasonal baseflow changes at Prado can be accounted for by evapotranspiration (Section 8.4).

8.2.3.1 Selection of Surface Water Stations

The surface water stations are listed in Table 8-1 and shown in Figure 8-4. Stations shaded in yellow are active USGS gauging stations and are included in the HCMP, along with the *ad hoc* stations, the recycled water discharge points, and the non-tributary flows.

8.2.3.2 Measurement of Flow at Stations on Routine Basis

Watermaster had contracted with the USGS to conduct the initial gauging measurements. USGS also trained Watermaster staff to conduct the stream flow measurements. Watermaster staff and its consultant conducted a site visit to the *ad hoc* stations to assess their suitability for stream gauging. The *ad hoc* stations are gauged by Watermaster staff every two weeks year-round for at least the first year, weather, and safety permitting. The permanent USGS stations are measured daily using transducers.

8.2.3.3 Grab Surface Water Samples

Watermaster staff collects grab samples at the *ad hoc* stations and at the permanent USGS stations monthly. The samples at the *ad hoc* stations are coordinated with the USGS stream gauging and occur at the same time (every other stream flow measurement).

Concurrent with USGS NAWQA monitoring well sampling, Watermaster staff collect grab samples from the Santa Ana River at stations located approximately 100 meters (310 feet) upgradient of the wells. Initially, at each station one discrete surface water sample was collected at approximately 25, 50, and 75 percent of the distance measured along a transect oriented normal to river flow (a total of 3 discrete samples at each station). The samples for each station were composited in the laboratory for chemical

analysis. Analytical results showed no significant difference in the samples collected along the transect. Therefore, all subsequent samples are collected only at 50% or half way across the river.

Surface water samples are tested for the following analytes:

Analytes	Method	Surface Water Stations
Major cations: K, Na, Ca, Mg, Fe	EPA 200.7	All
Major anions: Cl, SO_4, NO_2, NO_3	EPA 300.0	All
Apparent Color	SM 2120B	All
ClO_4	EPA 314	All
Hardness	SM 2340B	All
HCO_3, CO_3, OH	EPA 310.1/SM 2320B	All
NH_3	EPA 350.1	All
Odor	SM 2150B	All
P	EPA 365.1	All
pH	EPA 150.1/SM 4500-HB	All
TDS	EPA 160.1/SM 2540C	All
Total Kjeldahl Nitrogen (TKN)	EPA 351.4	All
Turbidity	EPA 180.1	All

8.2.3.4 Collection of Flow and Surface Water Quality Data from Cooperating Agencies

Data are collected from the permanent USGS stations routinely from the following website: http://nwis.waterdata.usgs.gov/usa/nwis/discharge. Discharge data are collected from the Publicly-Owned Treatment Works (POTW) operators on an on-going basis.

8.2.4 Characterization of Hydraulic Control near the Desalter Well Fields

Watermaster, IEUA, and OCWD concur that the hydrogeology of the lower Chino Basin needs to be better characterized for proper interpretation of groundwater monitoring data. Watermaster staff has recently revised its conceptual model of the entire Chino Basin for the Watermaster-IEUA-MWDSC dry-year yield program and has built a new three-dimensional groundwater model to simulate, among other things, the effect of groundwater storage on basin outflow.

Watermaster has committed to characterizing the state of hydraulic control near the existing and proposed Desalter well fields in the southern Chino Basin. To support this effort, a hydrogeologic characterization investigation was completed in this region (see Section 2.3.3). This investigation resulted in the creation of key well monitoring networks of existing wells for water quality and water levels, and the selection of nine (9) sites for the construction of new, nested monitoring wells. Monitoring of water quality and piezometric head at all wells in these monitoring networks will be critical to the determination of hydraulic control near the Desalter well fields.

The following tasks have been or are being completed to establish and augment the above-mentioned key well monitoring networks.

8.2.4.1 Video Logging of Private Wells South of Desalters

Groundwater levels and groundwater quality data have been collected at existing production wells within the south Chino Basin since 1999 as part of the implementation of the OBMP. Many of these wells are part of the HCMP key well monitoring networks (see Section 8.2.2). However, most of these wells are private and information pertaining to well construction and well screen depths are scarce. In August and October 2003, Watermaster video logged 10 of these wells to verify well screen depths, rendering groundwater data collected at these wells useful for hydrogeologic characterization and determination of hydraulic control. The following wells were video logged:

Well ID	Screened Interval, Approximate (Feet below top of casing)
60051	184 to 260 (perforations not clearly seen)
600197	150 to 325
600221	115 to 267
600331	130 to 327
600612	504 to 859
600637	75 to 81
600668	not able to video log
600699	no perforations observed
3600455	no perforations observed
3601410	107 to 128

8.2.4.2 Nested Monitoring Well Construction

Nine nested monitoring wells are currently being drilled and completed near the desalter well fields as part of the Hydraulic Control Monitoring Program. These wells will be used to help determine the effectiveness of the desalter wells as a hydraulic barrier. Each well will be completed in such a manner as to isolate two or three water-bearing zones encountered at depths ranging from approximately 100 to 600 feet below ground surface (bgs). The wells are designed to allow discrete analyses to be conducted on the individual water-bearing zones. Monitoring well boreholes are being drilled to final diameter in one pass, without the use of pilot boreholes, to approximately 300-600 feet bgs for lithologic logging and geophysical logging purposes.

Two nested monitoring wells are sited along a flow line that passes through the Chino-1 Desalter well field. The objective of these wells is to document the development and existence of a local “trough” or depression in the piezometric surface, for both the shallow and deep aquifer systems, as a result of Desalter pumping. The monitoring wells will be used to better characterize the hydrogeology in this area, including the hydrostratigraphy, the vertical and horizontal piezometric distribution, and the groundwater

quality. Subsequent monitoring at these wells and other nearby wells, along with groundwater modeling efforts, will determine if hydraulic control is occurring in the vicinity of the Chino-1 Desalter well field, or will determine how desalter well field production should be changed to ensure hydraulic control.

The remaining seven (of nine) nested monitoring wells are sited to the west, south, and east of the existing and proposed Desalter well fields. The objective of these wells is to document the development and existence of a regional depression in the piezometric surface, for both the shallow and deep aquifer systems, as a result of Desalter pumping. The locations of all nine nested monitoring wells are shown in Figures 8-2 and 8-3.

As of January 2005 four monitoring wells have been drilled and completed (MW-2, MW-5, MW-8 and MW-9). MW-2, MW-5 and MW-8 were the first to be installed, as the property owner, Lewis Group, requested construction occur as soon as possible so that delays in site development could be avoided. MW-9 was drilled and completed on Jurupa Unified School District Property to coincide with the winter school recess.

The five remaining wells will be drilled during the first quarter of 2005. These wells will be drilled in the following order: MW-7, MW-3, MW-6, MW-4 and MW-1.

The wells are being constructed in compliance with the latest edition or supplement of: State of California Water Well Standards, Bulletin No. 74-81 dated December 1981 and Bulletin No. 74-90 dated June 1991, local modifications to these Standards, and Sections 13800 through 13806 of the California Water Code.

8.2.4.3 Property Owners and Well Site Access

Current ownership of the monitoring well sites has been determined and the property owners contacted. Stakeholders will negotiate purchase agreements or right of entry agreements with the property owners to obtain long-term access to the sites. The following summarizes the well site property owners:

Well Identification	Property Owner
MW-1	Chino Airport
MW-2	Lewis Group
MW-3	Inland Empire Utilities Agency
MW-4	Orange County Flood Control District
MW-5	Lewis Group
MW-6	Orange County Water District
MW-7	Jurupa Community Services District
MW-8	Lewis Group
MW-9	Jurupa Unified School District

8.2.4.4 Plans and Specifications

Detailed plans and specifications were prepared for the monitoring well construction project. Following the site selection process, draft plans and specifications were completed and submitted to the stakeholders and permitting agencies for review. Review comments were incorporated into the final plans and specifications.

8.2.4.5 Selected Contractor

A bid package containing bidding instructions, contract documents, and the final plans and specifications were prepared and submitted for public bidding. Proposals were evaluated and a well drilling contractor was selected based on qualifications, experience, and best value to the stakeholders. Three bids were received for the well construction and Beylik Drilling, Inc. was selected (Beylik Drilling was subsequently acquired by Layne Environmental).

8.3 Results of the Hydraulic Control Monitoring Program

As mentioned previously, four engineering or scientific showings can be used to corroboratively demonstrate whether or not hydraulic control is occurring. The following results present two of the four lines of evidence: hydrologic balance and groundwater modeling.

8.3.1 Estimation of Hydraulic and Hydrologic Balance of the Lower Chino Basin

Two methods were used to evaluate the past and current, hydraulic and hydrologic balance in the lower end of the Chino Basin. The first of these methods is a review of available hydrologic studies that were done in support of the 1969 Judgment in OCWD *vs*. Chino *et al*. and the subsequent Santa Ana River Watermaster reports that are products of the 1969 Judgment. The second approach is based on groundwater model calibration and projection performed by Watermaster. Both of these approaches are independent of each other.

8.3.1.1 Santa Ana River Judgment Accounting

The Santa Ana River was adjudicated in the 1960s and a stipulated judgment was filed in 1969 (OCWD vs. City of Chino, *et al.* Case No. 117628, County of Orange). Since that time, the Santa Ana River Watermaster has compiled annual reports that contain estimates of all significant discharges to the Santa Ana River. Specifically, the Santa Ana Watermaster tabulates these discharges for the River near the Riverside Narrows (actually at the Metropolitan Water District of Southern California [MWDSC], Lower Feeder Crossing) and at below Prado Dam. From these tabulations, the Santa Ana River Watermaster computes the storm water, baseflow, and non-tributary discharges, and determines the obligations of the parties to the Judgment. The Santa Ana River Watermaster began submitting its reports for water year 1970/71 and has compiled annual reports since then (a total of 33).

The discharge data within the Santa Ana River Watermaster annual reports can be used to develop a hydrologic budget for the Santa Ana River between Riverside Narrows and Prado Dam. The demonstration that will be attempted will be to determine if there is a reach-wide net loss in baseflow from the Santa Ana River. Baseflow, as used herein, consists of rising groundwater, recycled water, and other non-tributary discharges to the river. Baseflow is estimated as the difference between total discharge

and storm water discharge. Figure 8-5 shows the locations of two USGS gauging stations located near the Narrows and below Prado Dam. Figure 8-5 also shows the location of recycled water facilities that discharge either directly to the Santa Ana River or to tributaries of the Santa Ana River. With the exception of the City of Corona, all discharges are directly to surface water. Historically, Corona has discharged to ponds located along Temescal Creek. After recharge, the recycled water either becomes surface water discharge at Prado or is consumed by riparian vegetation in the Prado area. Beginning in October 1998, Corona began to discharge about 7 million gallons per day (mgd) directly to Temescal Creek and eliminated the use of some of its ponds in the Prado reservoir area where the depth to water was less than 10 feet bgs.

Table 8-2 lists the storm and baseflow discharges for the Santa Ana River coming into the basin at Riverside Narrows, leaving the basin at below Prado Dam and the various discharge components in the reach between San Jacinto fault and Prado Dam. The Santa Ana Watermaster estimates the storm water component of the hydrograph and subtracts the storm water discharge from the total observed discharge to obtain a trial baseflow. In the 1969 Judgment, baseflow, by definition, consists of the rising groundwater and recycled water discharged to the Santa Ana River from dischargers in the service areas of the San Bernardino Valley Municipal Water District, Inland Empire Utilities Agency, and the Western Municipal Water District. The baseflow and storm flow contributions are plotted in Figures 8-6 and 8-7 for the Santa Ana River at Riverside Narrows and below Prado Dam, respectively.

Table 8-2 includes an accounting of the Santa Ana River discharge coming into the Chino Basin at Riverside Narrows and leaving the basin at Prado Dam. Note that the subsurface inflow into the Chino Basin at the Riverside Narrows is negligible because the Riverside Narrows is a shallow bedrock narrows that forces groundwater in the Riverside Basin to rise and become surface flow. There is negligible subsurface outflow from Chino Basin under the Santa Ana River because Prado Dam has been constructed in a similar bedrock narrows and the dam sits on a grout curtain that was constructed to eliminate underflow. Given these subsurface flow assumptions, the net rising groundwater from the Chino Basin to the Santa Ana River can be calculated from the Santa Ana River Watermaster tabulations using the following equation:

$$Q_{RW} = Q_{BF,\ Prado} - Q_{BF,\ Riverside\ Narrows} - \sum Q_{RECi} - \sum Q_{ONTDj}$$

where: Q_{RW} is the net rising water from the Chino Groundwater Basin to the Santa Ana River
$Q_{BF,\ Prado}$ is the baseflow at below Prado Dam
$Q_{BF,\ Riverside\ Narrows}$ is the baseflow at Riverside Narrows
Q_{RECi} is the ith recycled water discharge to the Santa Ana River in the Chino Basin
Q_{ONTDj} is the jth other non-tributary discharge to the Santa Ana River in the Chino Basin

Estimates of the net rising water contribution to surface discharge (column 15) are shown in Table 8-2 for the period 1970/71 to 2002/03. In all but two years (1980/81 and 1982/83), the net rising water is negative which means that the Santa Ana River recharges more baseflow into the Chino Basin than it receives as rising groundwater from the Chino Basin. The net rising groundwater ranges from a high of 20,200 acre-ft/yr to a low of –23,800 acre-ft/yr and averages about –10,600 acre-ft/yr. Over the 1970/71 to 2002/03 period the total rising groundwater was about –351,000 acre-ft. The time history of rising groundwater is presented graphically in Figure 8-8.

Table 8-3 is similar to Table 8-2 except that it shows the accounting at a monthly time step for the reach between Riverside Narrows and Prado Dam for the fourteen-year period of 1989/90 through 2002/03. The rising water values are also presented in Table 8-4 and Figure 8-9. Review of Table 8-4 and Figure 8-9 show that the net rising water is almost always negative through the year with some positive values occurring generally in the winter months January through March. Figure 8-10 is a plot of the average net rising water by month for the period 1989/90 through 2002/03 and for 1998/99 through 2002/03. This plot illustrates the average rising water pattern during the year and suggests in the short term that there may be an increasing trend in baseflow losses throughout the year including the January through March period.

In summary, this review of the Santa Ana River Watermaster data shows that the Chino Basin receives more recharge from Santa Ana River baseflow than it yields as rising groundwater to the River. This is a necessary but not sufficient condition to verify hydraulic control.

8.3.1.2 Groundwater Modeling of Current and Future Conditions

WEI developed a new groundwater model (hereafter, the 2003 Watermaster Model) for the Chino Basin in support of the Chino Basin Watermaster, Inland Empire Utility Agency (IEUA), and Metropolitan Water District of Southern California (Metropolitan) Dry-Year Yield (DYY) Program. The 2003 Watermaster Model was used to evaluate the magnitude of groundwater level and storage changes throughout Chino Basin, the change in direction and speed of specific known water quality anomalies, and the storage losses from the DYY Program. This was accomplished by first determining a baseline OBMP scenario, second by simulating the baseline OBMP and DYY scenarios, and third by comparing the model results of the baseline OBMP and DYY scenarios. The planning period used in this analysis consisted of a 25-year period ranging from October 2003 through September 2028. This period corresponds to the 25-year period of the DYY Program.

8.3.1.2.1 Baseline OBMP Scenario

The baseline scenario is based on a modified version of the water supply plan from the OBMP Implementation Plan. The water supply plan from the Implementation Plan contains future groundwater production plans for all producers in the Chino Basin. Black and Veatch modified the water supply plan for the water purveyors that are participating in the DYY Program and WEI used the water supply plan from the Implementation Plan for the remaining producers.

Table 8-5 shows the baseline groundwater production time history. Groundwater production in the basin ranges from 197,000 acre-ft/yr in 2003/2004 to about 210,000 acre-ft/yr in 2019/2020 and thereafter. Watermaster's replenishment obligation was estimated using the following assumptions pursuant to the Judgment and the Implementation Plan:

- The initial increase in stormwater recharge that is anticipated from the Chino Basin Facilities Improvement Plan is about 12,000 acre-ft/yr with a goal of about 20,000 acre-ft/yr. To be conservative, the increase in stormwater recharge was assumed to be 12,000 acre-ft/yr.
- OBMP desalter capacity is increased from the current level of 8 million gallons per day (mgd) in 2002/2003 to 40 mgd as per the water supply plan from the Implementation Plan.
- The Judgment allows a 5,000 acre-ft/yr overdraft of Chino Basin through 2017.

Table 8-5 contains the replenishment obligation pursuant to the Judgment and the Implementation Plan, which ranges from about 30,000 acre-ft/yr in 2003/2004 to about 34,000 acre-ft/yr in 2019/2020 and is

constant thereafter. An analysis of actual recent production in the Chino Basin indicates that the production and replenishment estimated in Table 8-5 may be higher than will actually occur in first few years of the baseline scenario. For consistency with the OBMP planning documents, the production and replenishment estimates in Table 8-5 were used.

The locations and magnitude of recharge shown in Table 8-5 were based on the requirements of the Peace Agreement to balance recharge and discharge in every area and sub-area. This requirement must be met over a period of time, which was assumed herein as a long-term requirement. Thus, in an individual season or year there might not be a balance between recharge and discharge in an area, sub-area, or the basin.

Balancing recharge and discharge may be critical to the management of the subsidence-prone area in the western part of the Chino Basin. Watermaster is currently involved in an investigation to develop a management program for this subsidence-prone area. Until that management program is developed, it is assumed that Watermaster replenishment and groundwater production would be managed such that groundwater levels would remain near or above current levels. Current groundwater levels were assumed to be the groundwater levels at the end of the calibration period of the 2003 Watermaster Model; the groundwater levels were from fall 2001.

8.3.1.2.2 Hydrologic Balance and Storage

The hydrologic balance for the baseline scenario is shown by management zone (Figure 7-1) in Tables 8-6a through 8-6e. The hydrologic balance includes estimates of groundwater flow between management zones. Of particular interest is the groundwater flow from Chino North, Chino South, and Temescal MZs to the PBMZ and subsequent contributions to rising water at Prado Dam. The subsurface outflow from Chino North MZ to the PBMZ decreased over time by about 5,500 acre-ft/yr. The stream recharge in the Chino South MZ increased about 12,000 acre-ft/yr from whence it flows to the desalter well field. The 2003 Watermaster Model projected that the yield of Chino Basin will increase by about 17,500 acre-ft through the recharge plan described in Table 8-5 and the construction and operation of the desalters.

Table 8-7 lists the inflow components to the PBMZ and includes a reckoning of the volumes of rising water at Prado Dam from the inflowing management zones. These estimates were made by assuming that half of the stream flow recharge in the PBMZ contributes to rising water and that remaining rising water is allocated to the inflowing management zone based on the magnitude of groundwater inflow to the PBMZ. For the baseline scenario, the average rising water contribution from the Chino North and Chino South MZs is estimated to be about 400 acre-ft/yr and 100 acre-ft/yr, respectively, or about 500 acre-ft/yr from the Chino Basin.

The total storage in the Chino Basin declined monotonically during the baseline scenario from a high of 5,940,000 acre-ft in fall 2003 to 5,730,000 acre-ft in fall 2028 – a decline of about 210,000 acre-ft. Figure 8-11 shows the estimated groundwater storage for the Chino Basin during the planning period. The modeling results suggest that the total storage in the basin appears to be asymptotically approaching a level near 5,700,000 acre-ft.

8.4 On-Going and Recommended Activities

8.4.1 Ancillary Studies

Two additional significant components of the water budget in the lower Chino Basin are groundwater pumping from private well owners and evapotranspiration losses from phreatophytes and riparian vegetation. These two studies are intended to provide additional data to help assess the state of hydraulic control.

8.4.1.1 Groundwater Production

Groundwater production from private wells and from the desalter wells is routinely collected, reviewed, and uploaded into Watermaster's relational database. These data will be used in the computation of hydrologic balance.

8.4.1.2 Vegetation Surveys

Phreatophytes are deep-rooted plants that obtain their water from the water table or the layer of soil just above it, while riparian vegetation refers to flora that are located on the bank of a natural watercourse, such as the Santa Ana River. Riparian woodlands and shrub lands occur in drainages, seepages, and riverine areas where water availability is high and is dominated by winter deciduous trees – willows, cottonwoods, alders, and sycamores. More than 95 percent of the riparian habitat historically occurring in southern California has been lost to agriculture, development, flood control, channel improvements, and other human caused impacts. Giant reed (Arundo donax) and salt cedar (Tamarix spp.) are non-indigenous plants that readily invade riparian channels in southern California, especially in areas that are disturbed. Arundo is very competitive, difficult to control, and generally does not provide either nesting or foraging habitat for native animals. It grows very quickly - up to 2 inches per day, is highly flammable, and re-sprouts rapidly after a fire. Because of these characteristics, once arundo invades a riparian area, it redirects the succession of the community towards pure stands of reed, usually through increasingly frequent fire events. Iverson (1999) states:

Not only does arundo out compete native plants, it uses about three times as much water as they do. There are no specific studies on the evapotranspiration rates of arundo. Horticulture experts, however, estimate arundo evaporates water at approximately the same rate as rice. This means that every acre of arundo uses about 5.62 acre-feet of water per year. Native species use only about two thirds this amount, 1.87 acre-feet per year. The water lost to evapotranspiration is water that would otherwise be available for groundwater recharge and ultimately drinking water supplies.

A GIS process termed "change detection" will be employed to monitor the riparian community in Prado Basin. The data utilized in change detection analysis includes (1) vegetation data collected by a botanist with a GPS receiver at various key locations in the field and (2) multi-spectral satellite imagery that covers the area of interest. These two data sets are then combined in a GIS environment to provide a map of the extent and health of the various vegetation types for a particular point in time. Same data sets from future times can be compared to the original data set to produce a map of vegetation change over the period of comparison.

These surveys will be repeated every three years for at least 15 years. This record of riparian vegetation surveys will not only allow for an accounting of water consumption, but will allow the interested parties to assess the potential impacts to the health of the riparian community from basin management activities.

8.4.2 Groundwater Monitoring

Once the nine nested monitoring wells are installed, they will be monitored as part of the HCMP along with the existing desalter wells and nearby agricultural wells. The new monitoring wells will be equipped with dedicated pressure transducers with integrated data loggers and water quality monitoring probes. Piezometric level measurements and limited water quality data will be recorded in the new monitoring wells on a continuous basis. Piezometric level data will be recorded daily in the desalter wells and every two weeks in nearby agricultural wells. The new monitoring wells also will be equipped with dedicated sampling pumps to facilitate the collection of water quality samples. The new monitoring wells will be sampled quarterly and the samples will be analyzed at a State-certified laboratory for Title 22 compliance and other analytes.

8.4.3 Recommended Activities

An estimate of hydrologic balance of surface and groundwater would be accomplished by conducting sampling events at a regular frequency at key locations on the Santa Ana River, its tributaries, points of non-tributary discharge and at wells in the lower basin. The purpose of monitoring water chemistry in surface and groundwater is to determine if groundwater from the Chino Basin is discharging as rising groundwater to the Santa Ana River. The general water chemistry of Chino Basin groundwater is different from the Santa Ana River. Native groundwater in the Chino Basin typically has a calcium-bicarbonate water character, while the Santa Ana River reflects the influence of tertiary wastewater in the baseflow of the river and has more sodium-chloride-sulfate character. The dry-weather discharge of the Santa Ana River in the basin consists of rising groundwater from the Riverside Basin, recycled water discharged by publicly-owned treatment works (POTWs), and rising groundwater from the Temescal and Chino Basins. From time to time, other waters are discharged to the Santa Ana River, including Arlington Desalter water, SWP water, and groundwater pumped from the San Bernardino area.

These discharges will be identified and their chemistries will be characterized using Piper diagrams and a modification of the Piper method for time histories known as Water Character Index (WCI). WCI is a parameter that can be used to generally characterize water in terms of rations of major cations and anions. WCI is a unitless parameter that provides a numerical estimation of water character. WCI is used to assess the ionic distribution of constituents in a water sample. WCI is analogous to a trilinear or Piper diagram, which is a graphical means of displaying the ratios of the principal ionic constituents in water (Piper, 1944; Watson and Burnett, 1995). The utility of the WCI method, compared with a Stiff or Piper/trilinear diagram, is that many data points can be plotted as time histories for a given well or surface water station. The points can also be plotted to show aerial and spatial distributions of water character.

In addition to general water chemistry, Watermaster's database of groundwater quality along with new field data in the southern Chino Basin area will be queried to see if there are other naturally occurring or introduced constituents that can potentially be used as a tracer to determine if Basin groundwater is discharging to the Santa Ana River.

Table 8-1
Surface Water Monitoring Stations for the HCMP

USGS Gauging Stations					
Status	Number	Site Name	From	To	Approximate Count
Non	11066440	Santa Ana R A Mission Blvd at Riverside CA	2/1/1971	9/30/1982	4019
Active	11066460	Santa Ana R A MWD Crossing CA	3/9/1970	Present	11529
Non	11066478	Riverside WQCP Weir No 1 CA	10/2/1972	10/28/1981	3179
Non	11066479	Riverside WQCP Weir No 2 CA	10/1/1972	10/7/1981	3201
Non	11066480	Riverside Water Quality Control Plant CA	10/1/1965	9/30/1981	5844
Non	11066500	Santa Ana R A Riverside Narrows Nr Arlington CA	10/1/1928	9/30/1973	16436
Non	11066550	Sheehan D A Rn Nr Arlington CA	10/1/1963	9/30/1968	1462
Non	11066950	Day C Div Nr Etiwanda CA	10/1/1965	10/22/1970	1201
Non	11067000	Day C Nr Etiwanda CA	10/1/1928	9/30/1972	16071
Non	11067001	Day C Nr Etiwanda CA.+ CN CA	10/1/1950	9/30/1971	7670
Non	11067890	Santa Ana R A Prado Park Nr Corona CA	3/9/1971	9/30/1980	3494
Non	11068000	Santa Ana R A Auburndale Br Nr Corona CA	10/1/1960	9/30/1968	1985
Non	11072000	Temescal C Nr Corona CA	10/1/1928	6/30/1980	18901
Active	11072100	Temescal C Above Main St A Corona CA	10/1/1980	Present	7237
Non	11072200	Temescal C A Corona CA	1/1/1968	9/30/1980	2557
Non	11073000	San Antonio C Nr Claremont CA	3/11/1901	9/30/1972	25901
Non	11073001	San Antonio C Nr Claremont + CN CA	3/11/1901	9/30/1972	26027
Non	11073200	San Antonio C Below San Antonio Dam CA	10/1/1962	9/30/1980	6575
Active	11073300	San Antonio C A Riverside Dr Nr Chino CA	12/19/1998	Present	1017
Active	11073360	Chino C A Schaefer Avenue Nr Chino CA	10/1/1969	Present	11688
Non	11073440	Chino C Nr Chino CA	1/1/1968	9/30/1969	639
Non	11073470	Cucamonga C Nr Upland CA	1/1/1929	9/30/1975	17074
Active	11073493	W Br Cucamonga Channel Above Ely Perc Basin A Ontario CA	10/1/1996	Present	1826
Active	11073495	Cucamonga C Nr Mira Loma CA	2/1/1968	Present	11788
Non	11073500	Chino C Nr Prado CA	1/1/1929	9/30/1940	4291
Active	11074000	Santa Ana R Below Prado Dam CA	10/1/1940	Present	22280
***Ad Hoc* Gauging Stations**					
Status		**Site Name**			
New		Santa Ana River at Van Buren			
New		Santa Ana River at Etiwanda			
New		Santa Ana River at Hamner			
New		Santa Ana River at River Road			
New		Hole Lake Outflow Channel near Arlington			
Recycled Water Discharge Points					
		Site Name			
		City of Corona -1			
		City of Corona -2			
		IEUA			

Table 8-1
Surface Water Monitoring Stations for the HCMP

USGS Gauging Stations					
Status	Number	Site Name	From	To	Approximate Count
		WRRWP			
		City of Riverside - 1			
		City of Riverside - 2			
		Non-Tributary Flows			
		Site Name			
		Arlington Desalter			
		OC-59 Turnout			
		Bunker Hill Groundwater			

Stations shaded in yellow are active USGS gauging stations and will be included in the HCMP, along with the *ad hoc* stations, the recycled water discharge points, and the non-tributary flows.

Table 8-2
Estimate of Net Rising Groundwater to the Santa Ana River Between San Bernardino and Prado Dam
(acre-ft/yr)

Year	Santa Ana River at Riverside Narrows								Santa Ana River below Prado Dam								
	(1) Groundwater Discharge from Bunker Hill	(2) Recycled Water Discharges	(3) Non-Tributary Discharges	(4)=(6)-(5) Non-Storm Discharge at Riverside Narrows	(5) Storm Discharge at Riverside Narrows	(6) Total Discharge at Riverside Narrows	(7)=(1)+(2)+(3) Groundwater Discharge from Bunker Hill + Recycled Water Discharge + Other Non-Tributary Discharges	(8)=(4)-(7) Net Rising Water Contribution to Surface Discharge	(9) Recycled Water Discharges	(10) Non-Tributary Discharges	(11)=(13)-(12) Non-Storm Discharge at Prado Dam	(12) Storm Discharge into Prado Dam	(13) Total Discharge into Prado Dam	(14)=(4)+(9)+(10) Non-Storm Discharge at Riverside Narrows + Recycled Water Discharge + Other Non-Tributary Discharges	(15)=(11)-(14) Net Rising Water Contribution to Surface Discharge	(16)=(13)-(6) Gain in Total Flow from Riverside Narrows to Prado Dam	(17)=(12)-(5) Gain in Storm Water Discharge between Riverside Narrows and Prado Dam
1970 - 71	0	22,650	0	35,681	7,051	42,732	22,650	13,031	21,810	0	38,402	13,462	51,864	57,491	(19,089)	9,132	6,411
1971 - 72	0	20,650	0	35,161	6,096	41,257	20,650	14,511	28,980	0	40,416	11,327	51,743	64,141	(23,725)	10,486	5,231
1972 - 73	0	23,460	11,617	17,582	15,466	33,048	35,077	(17,495)	32,780	0	49,472	28,485	77,957	50,362	(890)	44,909	13,019
1973 - 74	0	22,530	0	17,203	8,291	25,494	22,530	(5,327)	36,830	63,035	107,784	19,543	127,327	117,068	(9,284)	101,833	11,252
1974 - 75	0	21,050	0	16,771	4,199	20,970	21,050	(4,279)	40,600	27,939	81,742	11,655	93,397	85,310	(3,568)	72,427	7,456
1975 - 76	0	22,030	0	18,350	9,277	27,627	22,030	(3,680)	42,680	60,170	106,797	13,793	120,590	121,200	(14,403)	92,963	4,516
1976 - 77	0	23,240	0	19,474	5,397	24,871	23,240	(3,766)	41,800	8,350	57,603	14,675	72,278	69,624	(12,021)	47,407	9,278
1977 - 78	0	24,780	0	23,100	159,400	182,500	24,780	(1,680)	44,220	1,466	60,707	194,349	255,056	68,786	(8,079)	72,556	34,949
1978 - 79	200	25,940	0	27,208	20,708	47,916	26,140	1,068	46,570	9,897	82,572	62,646	145,218	83,675	(1,103)	97,302	41,938
1979 - 80	1,000	27,540	0	25,805	228,528	254,333	28,540	(2,735)	48,200	23,820	90,921	445,253	536,174	97,825	(6,904)	281,841	216,725
1980 - 81	3,000	27,850	0	18,915	15,783	34,698	30,850	(11,935)	52,300	0	91,377	26,923	118,300	71,215	20,162	83,602	11,140
1981 - 82	6,500	30,590	0	31,715	51,335	83,050	37,090	(5,375)	55,990	0	81,883	61,819	143,702	87,705	(5,822)	60,652	10,484
1982 - 83	11,000	31,380	0	55,884	224,103	279,987	42,380	13,504	55,960	7,720	120,566	306,519	427,085	119,564	1,002	147,098	82,416
1983 - 84	14,000	29,610	0	55,403	27,684	83,087	43,610	11,793	57,190	12,550	122,116	55,825	177,941	125,143	(3,027)	94,854	28,141
1984 - 85	12,000	31,170	0	63,968	15,145	79,113	43,170	20,798	63,440	3,883	125,358	37,889	163,247	131,291	(5,933)	84,134	22,744
1985 - 86	8,000	33,450	0	64,631	34,969	99,600	41,450	23,181	65,620	1,836	127,550	70,158	197,708	132,087	(4,537)	98,108	35,189
1986 - 87	5,000	36,330	0	57,965	20,128	78,093	41,330	16,635	68,670	0	120,182	23,343	143,525	126,635	(6,453)	65,432	3,215
1987 - 88	3,000	39,160	0	53,526	26,521	80,047	42,160	11,366	77,500	5,679	130,117	42,714	172,831	136,705	(6,588)	92,784	16,193
1988 - 89	1,700	39,470	0	50,330	12,387	62,717	41,170	9,160	85,260	6,582	126,488	33,171	159,659	142,172	(15,684)	96,942	20,784
1989 - 90	1,000	40,420	0	51,500	7,000	58,500	41,420	10,080	82,840	1,020	120,503	24,314	144,817	135,360	(14,857)	86,317	17,314
1990 - 91	500	39,530	394	43,710	30,815	74,525	40,424	3,286	84,230	8,052	119,911	75,275	195,186	135,992	(16,081)	120,661	44,460
1991 - 92	100	37,080	0	38,610	33,158	71,768	37,180	1,430	89,360	8,033	115,551	82,729	198,280	136,003	(20,452)	126,512	49,571
1992 - 93	0	38,220	0	39,714	227,670	267,384	38,220	1,494	95,570	5,273	133,438	438,563	572,001	140,557	(7,119)	304,617	210,893
1993 - 94	0	36,170	144	29,639	15,838	45,477	36,314	(6,675)	90,180	5,424	117,075	41,622	158,697	125,243	(8,168)	113,220	25,784
1994 - 95	0	38,650	2,206	45,632	199,985	245,617	40,856	4,776	95,020	18,945	144,619	284,651	429,270	159,597	(14,978)	183,653	84,666
1995 - 96	0	43,660	1,470	53,935	29,321	83,256	45,130	8,805	95,270	25,137	158,468	58,692	217,160	174,342	(15,874)	133,904	29,371
1996 - 97	0	49,960	2,762	63,285	43,995	107,280	52,722	10,563	93,760	48,473	187,911	61,783	249,694	205,518	(17,607)	142,414	17,788
1997 - 98	0	56,746	1,342	64,147	150,228	214,375	58,088	6,059	104,774	6,665	162,029	300,604	462,633	175,586	(13,557)	248,258	150,376
1998 - 99	0	54,111	0	70,912	5,382	76,294	54,111	16,801	109,300	2,684	161,321	23,673	184,994	182,896	(21,575)	108,700	18,291
1999 - 0	0	52,404	0	61,260	14,312	75,572	52,404	8,856	108,221	19,945	168,214	40,269	208,483	189,426	(21,212)	132,911	25,957
2000 - 1	0	57,753	2,760	62,366	15,725	78,091	60,513	1,853	110,852	10,686	167,305	54,621	221,926	183,904	(16,599)	143,835	38,896
2001 - 2	0	52,465	9,410	65,845	2,999	68,844	61,875	3,970	105,454	9,053	164,353	10,615	174,968	180,352	(15,999)	106,124	7,616
2002 - 3	0	53,612	3,664	59,089	33,077	92,166	57,276	1,813	111,752	8,570	158,347	97,810	256,157	179,411	(21,064)	163,991	64,733
Total	67,000	1,183,661	35,769	1,438,316	1,701,973	3,140,289	1,286,430	151,886	2,342,983	410,887	3,841,098	3,068,770	6,909,868	4,192,186	(351,088)	3,769,579	1,366,797
Average	2,030	35,869	1,084	43,585	51,575	95,160	38,983	4,603	70,999	12,451	116,397	92,993	209,390	127,036	(10,639)	114,230	41,418
Standard Dev	3,871	11,487	2,636	17,734	72,569	74,549	12,136	9,385	27,552	16,350	39,476	121,028	131,702	42,983	8,787	65,694	53,546
Coef of Var	191%	32%	243%	41%	141%	78%	31%	204%	39%	131%	34%	130%	63%	34%	-83%	58%	129%
Median	0	36,170	0	45,632	20,128	76,294	40,856	3,970	68,670	7,720	120,503	42,714	174,968	131,291	(12,021)	98,108	22,744
Max	14,000	57,753	11,617	70,912	228,528	279,987	61,875	23,181	111,752	63,035	187,911	445,253	572,001	205,518	20,162	304,617	216,725
Min	0	20,650	0	16,771	2,999	20,970	20,650	(17,495)	21,810	0	38,402	10,615	51,743	50,362	(23,725)	9,132	3,215

Source -- "Groundwater Discharge from Bunker Hill" abstracted from Table 6 of draft report *Hydrology, Description of Computer Models, and Evaluation of Selected Water-Management Alternatives in the San Bernardino Area, California* (USGS, 1997), the rest of the data from the *Annual Reports of the Santa Ana River Watermaster.*

WILDERMUTH ENVIRONMENTAL INC.

Table 8-3

Tabulation of Monthly Time Histories for Discharge Components of the Santa Ana River Between Riverside Narrows and Prado Dam -- 1989/90 to 1999/00

(acre-ft/mo)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13) =sum of (5) to (12)	(14) =(18)-(13)-(4)	(15) =(16)-(13)-(2)	(16)	(17)	(18)
Month/Yr	Riverside Narrows Discharge			Non-Tributary Reach Discharges									Reach Gains or Losses		Outflow at Prado		
	Baseflow[1]	Storm Discharge	Total	Riverside WRP	IEUA WRP's	WR WRP	Corona WRP	Arlington Desalter	Lake Elsinore	Exchange Water	State Project Water	Subtotal Non-Tributary Discharges	Total Discharge	Baseflow Discharge	Baseflow[1]	Storm Discharge	Total
10/89	4,064	242	4,306	2,768	3,374	0	762	0	0	0	0	6,903	(1,065)	(1,188)	9,779	365	10,144
11/89	4,592	198	4,790	2,768	3,374	0	762	0	0	0	0	6,903	(618)	(954)	10,541	534	11,075
12/89	4,982	0	4,982	2,768	3,374	0	762	0	0	0	0	6,903	427	87	11,972	340	12,312
1/90	5,217	1,910	7,127	2,768	3,374	0	762	0	0	0	0	6,903	2,958	350	12,470	4,518	16,988
2/90	4,611	3,055	7,666	2,768	3,374	0	762	0	0	0	0	6,903	11,821	(321)	11,193	15,197	26,390
3/90	4,988	391	5,379	2,768	3,374	0	762	0	0	0	0	6,903	8	(89)	11,802	488	12,290
4/90	4,647	863	5,510	2,768	3,374	0	762	0	0	0	0	6,903	(806)	(1,016)	10,534	1,073	11,607
5/90	4,628	317	4,945	2,768	3,374	0	762	0	0	0	0	6,903	(314)	(1,548)	9,983	1,551	11,534
6/90	3,935	24	3,959	2,768	3,374	0	762	0	0	0	0	6,903	(2,127)	(2,351)	8,487	248	8,735
7/90	3,171	0	3,171	2,768	3,374	0	762	139	0	0	0	7,042	(2,444)	(2,444)	7,769	0	7,769
8/90	3,507	0	3,507	2,768	3,374	0	762	605	0	0	0	7,508	(2,720)	(2,720)	8,295	0	8,295
9/90	3,158	0	3,158	2,768	3,374	0	762	276	0	0	0	7,179	(2,659)	(2,659)	7,678	0	7,678
10/90	3,372	0	3,372	2,682	3,578	0	759	606	0	0	0	7,625	(1,948)	(1,976)	9,021	28	9,049
11/90	3,108	218	3,326	2,682	3,578	0	759	505	0	0	0	7,524	(600)	(962)	9,670	580	10,250
12/90	4,493	0	4,493	2,682	3,578	0	759	373	0	0	0	7,392	(595)	(595)	11,290	0	11,290
1/91	4,227	1,527	5,754	2,682	3,578	0	759	529	0	0	0	7,548	3,818	306	12,081	5,039	17,120
2/91	4,588	6,502	11,090	2,682	3,578	0	759	402	0	0	0	7,421	4,848	(1,015)	10,994	12,365	23,359
3/91	4,715	22,038	26,753	2,682	3,578	0	759	0	0	0	0	7,019	34,099	(377)	11,357	56,514	67,871
4/91	4,675	530	5,205	2,682	3,578	0	759	101	0	0	0	7,120	(1,048)	(1,199)	10,596	681	11,277
5/91	3,374	0	3,374	2,682	3,578	0	759	518	0	623	0	8,160	(477)	(527)	11,007	50	11,057
6/91	3,782	0	3,782	2,682	3,578	0	759	454	0	443	0	7,916	(1,705)	(1,705)	9,993	0	9,993
7/91	2,658	0	2,658	2,682	3,578	0	759	503	0	845	0	8,367	(2,171)	(2,171)	8,854	0	8,854
8/91	2,404	0	2,404	2,682	3,578	0	759	476	0	676	0	8,171	(2,778)	(2,778)	7,797	0	7,797
9/91	2,319	0	2,319	2,682	3,578	0	759	428	0	550	0	7,997	(3,047)	(3,065)	7,251	18	7,269
10/91	2,595	239	2,834	2,722	3,974	0	751	417	0	851	0	8,715	(3,625)	(3,997)	7,313	611	7,924
11/91	3,135	23	3,158	2,722	3,974	0	751	165	0	1,369	0	8,981	(2,024)	(2,001)	10,115	0	10,115
12/91	3,699	1,043	4,742	2,722	3,974	0	751	580	0	1,860	0	9,887	666	(1,097)	12,489	2,806	15,295
1/92	3,575	2,719	6,294	2,722	3,974	0	751	224	0	0	0	7,671	5,493	(273)	10,973	8,485	19,458
2/92	3,364	17,712	21,076	2,722	3,974	0	751	176	0	210	0	7,833	19,475	(677)	10,520	37,864	48,384
3/92	3,789	10,754	14,543	2,722	3,974	0	751	199	0	147	0	7,793	20,186	(151)	11,431	31,091	42,522
4/92	3,699	514	4,213	2,722	3,974	0	751	0	0	0	0	7,447	(278)	(1,182)	9,964	1,418	11,382
5/92	3,602	79	3,681	2,722	3,974	0	751	0	0	0	0	7,447	(688)	(895)	10,154	286	10,440
6/92	2,999	0	2,999	2,722	3,974	0	751	172	0	0	0	7,619	(2,317)	(2,317)	8,301	0	8,301
7/92	3,206	73	3,279	2,722	3,974	0	751	487	0	0	0	7,934	(2,715)	(2,811)	8,329	169	8,498
8/92	2,537	0	2,537	2,722	3,974	0	751	584	0	0	0	8,031	(2,609)	(2,609)	7,959	0	7,959
9/92	2,412	0	2,412	2,722	3,974	0	751	544	0	48	0	8,039	(2,450)	(2,450)	8,001	0	8,001
10/92	2,488	656	3,144	2,842	4,323	0	800	545	0	908	0	9,417	(860)	(2,025)	9,880	1,821	11,701
11/92	2,927	161	3,088	2,842	4,323	0	800	530	0	0	0	8,494	(1,287)	(1,579)	9,842	453	10,295
12/92	3,462	11,049	14,511	2,842	4,323	0	800	237	0	0	0	8,201	11,719	(299)	11,364	23,067	34,431
1/93	3,746	109,300	113,046	2,842	4,323	0	800	66	0	0	0	8,030	99,042	1,089	12,865	207,253	220,118
2/93	3,806	42,579	46,385	2,842	4,323	0	800	0	0	0	0	7,964	92,572	374	12,144	134,777	146,921
3/93	4,658	29,646	34,304	2,842	4,323	0	800	0	0	0	0	7,964	11,531	1,151	13,773	40,026	53,799
4/93	4,481	19,757	24,238	2,842	4,323	0	800	0	0	0	0	7,964	(424)	928	13,373	18,405	31,778
5/93	4,046	11,197	15,243	2,842	4,323	0	800	0	0	0	0	7,964	(2,211)	1,543	13,553	7,443	20,996
6/93	3,240	3,327	6,567	2,842	4,323	0	800	0	0	0	0	7,964	725	(1,266)	9,938	5,318	15,256
7/93	2,721	0	2,721	2,842	4,323	0	800	603	0	221	0	8,788	(979)	(979)	10,530	0	10,530
8/93	1,991	0	1,991	2,842	4,323	0	800	605	0	869	0	9,438	(2,676)	(2,676)	8,753	0	8,753
9/93	2,144	0	2,144	2,842	4,323	0	800	325	0	364	0	8,653	(3,375)	(3,375)	7,422	0	7,422
10/93	2,404	0	2,404	2,720	4,146	0	649	245	0	0	0	7,760	(806)	(1,367)	8,797	561	9,358
11/93	1,852	280	2,132	2,720	4,146	0	649	434	0	0	0	7,949	1,517	(319)	9,482	2,116	11,598
12/93	2,232	1,122	3,354	2,720	4,146	0	649	450	0	0	0	7,965	2,927	455	10,652	3,594	14,246
1/94	3,103	689	3,792	2,720	4,146	0	649	557	0	0	0	8,072	2,003	1,017	12,192	1,675	13,867
2/94	2,807	6,335	9,142	2,720	4,146	0	649	142	0	0	0	7,657	11,977	222	10,686	18,090	28,776
3/94	3,014	5,981	8,995	2,720	4,146	0	649	306	0	0	0	7,821	7,367	1,093	11,928	12,255	24,183
4/94	2,983	786	3,769	2,720	4,146	0	649	561	0	483	0	8,559	1,688	(145)	11,397	2,619	14,016
5/94	2,659	645	3,304	2,720	4,146	0	649	551	0	379	0	8,445	282	215	11,319	712	12,031
6/94	2,216	0	2,216	2,720	4,146	0	649	545	0	0	0	8,060	(1,969)	(1,969)	8,307	0	8,307
7/94	2,208	0	2,208	2,720	4,146	0	649	0	0	0	0	7,515	(2,203)	(2,203)	7,520	0	7,520
8/94	2,132	0	2,132	2,720	4,146	0	649	232	0	0	0	7,747	(2,746)	(2,746)	7,133	0	7,133
9/94	2,029	0	2,029	2,720	4,146	0	649	548	0	137	0	8,200	(2,567)	(2,567)	7,662	0	7,662
10/94	3,434	384	3,818	2,829	4,478	0	612	546	0	0	253	8,717	(1,596)	(1,917)	10,234	705	10,939
11/94	4,399	917	5,316	2,829	4,478	0	612	512	0	0	2,062	10,492	(2,435)	(2,458)	12,433	940	13,373
12/94	4,292	1,966	6,258	2,829	4,478	0	612	143	0	0	732	8,793	(1,192)	(877)	12,208	1,651	13,859
1/95	3,812	46,772	50,584	2,829	4,478	0	612	0	48	0	0	7,966	48,292	(51)	11,727	95,115	106,842
2/95	3,395	16,698	20,093	2,829	4,478	0	612	0	1,280	0	0	9,198	4,595	(97)	12,496	21,390	33,886
3/95	4,505	106,555	111,060	2,829	4,478	0	612	0	6,908	0	0	14,826	16,550	483	19,814	122,622	142,436
4/95	4,451	12,438	16,889	2,829	4,478	0	612	0	3,624	0	0	11,542	8,933	(9)	15,984	21,380	37,364
5/95	4,365	9,331	13,696	2,829	4,478	0	612	0	2,072	0	0	9,990	1,327	(433)	13,922	11,091	25,013
6/95	3,867	4,686	8,553	2,829	4,478	0	612	0	464	0	0	8,382	3,379	(1,464)	10,785	9,529	20,314
7/95	3,363	227	3,590	2,829	4,478	0	612	0	301	0	0	8,219	(3,870)	(3,862)	7,720	219	7,939
8/95	3,078	0	3,078	2,829	4,478	0	612	0	0	0	0	7,918	(2,398)	(2,398)	8,598	0	8,598
9/95	2,671	11	2,682	2,829	4,478	0	612	0	0	0	0	7,918	(1,893)	(1,891)	8,698	9	8,707
10/95	3,495	0	3,495	2,830	4,455	0	654	0	0	0	0	7,939	(1,693)	(1,693)	9,741	0	9,741
11/95	3,539	0	3,539	2,830	4,455	0	654	0	0	0	0	7,939	(668)	(668)	10,810	0	10,810
12/95	3,726	60	3,786	2,830	4,455	0	654	379	0	0	0	8,318	1,622	332	12,376	1,350	13,726

Table 8-3

Tabulation of Monthly Time Histories for Discharge Components of the Santa Ana River Between Riverside Narrows and Prado Dam -- 1989/90 to 1999/00

(acre-ft/mo)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13) =sum of (5) to (12)	(14) =(18)-(13)-(4)	(15) =(16)-(13)-(2)	(16)	(17)	(18)
Month/Yr	Riverside Narrows Discharge			Non-Tributary Reach Discharges									Reach Gains or Losses		Outflow at Prado		
	Baseflow[1]	Storm Discharge	Total	Riverside WRP	IEUA WRP's	WR WRP	Corona WRP	Arlington Desalter	Lake Elsinore	Exchange Water	State Project Water	Subtotal Non-Tributary Discharges	Total Discharge	Baseflow Discharge	Baseflow[1]	Storm Discharge	Total
1/96	4,031	3,921	7,952	2,830	4,455	0	654	446	0	0	0	8,385	1,113	658	13,074	4,376	17,450
2/96	3,651	18,421	22,072	2,830	4,455	0	654	285	0	0	0	8,224	21,830	1,244	13,119	39,007	52,126
3/96	5,013	6,278	11,291	2,830	4,455	0	654	80	0	0	0	8,019	4,359	(483)	12,549	11,120	23,669
4/96	5,280	641	5,921	2,830	4,455	0	654	526	0	0	3,376	11,841	230	(1,968)	15,153	2,839	17,992
5/96	5,839	0	5,839	2,830	4,455	0	654	549	0	0	6,039	14,527	(1,382)	(1,382)	18,984	0	18,984
6/96	5,435	0	5,435	2,830	4,455	0	654	506	0	0	5,626	14,071	(3,003)	(3,003)	16,503	0	16,503
7/96	4,925	0	4,925	2,830	4,455	0	654	517	0	0	5,768	14,224	(3,662)	(3,662)	15,487	0	15,487
8/96	4,324	0	4,324	2,830	4,455	0	654	409	0	0	84	8,432	(2,462)	(2,462)	10,294	0	10,294
9/96	4,677	0	4,677	2,830	4,455	0	654	547	0	0	0	8,486	(2,785)	(2,785)	10,378	0	10,378
10/96	5,601	835	6,436	2,853	4,540	0	420	505	0	0	0	8,318	(1,689)	(1,905)	12,014	1,051	13,065
11/96	6,090	5,658	11,748	2,853	4,540	0	420	536	0	0	0	8,349	717	(1,782)	12,657	8,157	20,814
12/96	5,679	3,733	9,412	2,853	4,540	0	420	565	0	0	0	8,378	6,041	(333)	13,724	10,107	23,831
1/97	5,609	31,438	37,047	2,853	4,540	0	420	561	0	0	0	8,374	7,667	727	14,710	38,378	53,088
2/97	5,221	1,384	6,605	2,853	4,540	0	420	506	0	0	0	8,319	1,035	(392)	13,148	2,811	15,959
3/97	6,044	5	6,049	2,853	4,540	0	420	519	0	0	0	8,332	603	380	14,756	228	14,984
4/97	5,970	0	5,970	2,853	4,540	0	420	518	0	0	1,311	9,642	(1,321)	(1,321)	14,291	0	14,291
5/97	5,109	0	5,109	2,853	4,540	0	420	499	0	0	5,934	14,246	(1,542)	(1,542)	17,813	0	17,813
6/97	4,830	30	4,860	2,853	4,540	0	420	493	0	0	5,894	14,200	(1,951)	(2,112)	16,918	191	17,109
7/97	4,602	0	4,602	2,853	4,540	0	420	474	0	0	6,220	14,507	(3,033)	(3,033)	16,076	0	16,076
8/97	4,300	0	4,300	2,853	4,540	0	420	510	0	0	11,397	19,720	(3,515)	(3,515)	20,505	0	20,505
9/97	4,229	912	5,141	2,853	4,540	0	420	464	0	0	11,565	19,842	(2,826)	(2,773)	21,298	859	22,157
10/97	4,604	888	5,492	2,952	4,931	0	727	499	0	0	2,304	11,412	(2,377)	(2,193)	13,823	704	14,527
11/97	4,864	1,798	6,662	2,952	4,931	0	727	456	0	0	0	9,065	909	(1,993)	11,936	4,700	16,636
12/97	5,108	6,700	11,808	2,952	4,931	0	727	115	0	0	0	8,724	7,280	(1,152)	12,680	15,132	27,812
1/98	5,129	6,984	12,113	2,952	4,931	0	727	0	0	0	0	8,609	8,489	(318)	13,420	15,791	29,211
2/98	5,045	68,843	73,888	2,952	4,931	0	727	0	0	0	0	8,609	97,226	(115)	13,539	166,184	179,723
3/98	5,939	10,675	16,614	2,952	4,931	0	727	0	1,087	0	0	9,696	13,557	(98)	15,537	24,330	39,867
4/98	5,774	14,001	19,775	2,952	4,931	244	727	0	603	0	0	9,456	2,745	(231)	14,999	16,977	31,976
5/98	5,870	28,867	34,737	2,952	4,931	244	727	0	0	0	0	8,853	15,222	(169)	14,554	44,258	58,812
6/98	5,445	7,237	12,682	2,952	4,931	244	727	0	0	0	0	8,853	434	(1,603)	12,695	9,274	21,969
7/98	5,632	229	5,861	2,952	4,931	244	727	84	0	0	486	9,423	(1,492)	(1,715)	13,340	452	13,792
8/98	5,592	2,068	7,660	2,952	4,931	244	727	361	0	0	228	9,442	(2,788)	(2,145)	12,889	1,425	14,314
9/98	5,145	1,938	7,083	2,952	4,931	244	727	443	0	0	0	9,296	(2,386)	(1,825)	12,616	1,377	13,993
10/98	5,553	276	5,829	2,904	4,853	383	969	271	0	0	0	9,379	(1,261)	(1,491)	13,442	506	13,948
11/98	5,879	224	6,103	2,904	4,853	383	969	0	0	0	0	9,108	469	(1,980)	13,007	2,673	15,680
12/98	6,051	320	6,371	2,904	4,853	383	969	0	0	0	0	9,108	988	(992)	14,167	2,300	16,467
1/99	6,123	1,218	7,341	2,904	4,853	383	969	28	0	0	0	9,136	3,885	23	15,282	5,080	20,362
2/99	5,820	785	6,605	2,904	4,853	383	969	347	0	0	0	9,455	955	(1,380)	13,895	3,120	17,015
3/99	6,236	313	6,549	2,904	4,853	383	969	329	0	0	0	9,437	563	104	15,778	772	16,550
4/99	6,006	1,412	7,418	2,904	4,853	383	969	274	0	0	0	9,382	2,600	(752)	14,637	4,764	19,401
5/99	6,014	8	6,022	2,904	4,853	383	969	93	0	0	0	9,201	576	(1,711)	13,504	2,295	15,799
6/99	6,409	194	6,603	2,904	4,853	383	969	121	0	0	0	9,229	(2,638)	(3,447)	12,191	1,003	13,194
7/99	5,577	631	6,208	2,904	4,853	383	969	433	0	0	0	9,541	(2,471)	(3,000)	12,119	1,160	13,279
8/99	5,758	0	5,758	2,904	4,853	383	969	370	0	0	0	9,478	(3,561)	(3,561)	11,675	0	11,675
9/99	5,486	0	5,486	2,904	4,853	383	969	417	0	0	0	9,525	(3,387)	(3,387)	11,625	0	11,625
10/99	5,042	0	5,042	2,950	4,775	198	1,096	441	0	0	5,827	15,286	(3,159)	(3,159)	17,169	0	17,169
11/99	4,832	16	4,848	2,950	4,775	198	1,096	348	0	0	0	9,366	(1,831)	(1,965)	12,233	150	12,383
12/99	5,270	14	5,284	2,950	4,775	198	1,096	494	0	0	2,935	12,447	(1,127)	(1,224)	16,493	111	16,604
1/00	5,379	607	5,986	2,950	4,775	198	1,096	425	0	0	3,750	13,193	1,013	(407)	18,165	2,027	20,192
2/00	5,068	7,674	12,742	2,950	4,775	198	1,096	382	0	0	2,057	11,457	15,824	(838)	15,687	24,336	40,023
3/00	5,863	4,239	10,102	2,950	4,775	198	1,096	277	0	0	0	9,295	4,197	(950)	14,208	9,386	23,594
4/00	6,288	1,729	8,017	2,950	4,775	198	1,096	497	0	0	0	9,515	1,251	(914)	14,889	3,894	18,783
5/00	5,215	0	5,215	2,950	4,775	198	1,096	444	0	0	0	9,462	(1,283)	(1,283)	13,394	0	13,394
6/00	4,867	0	4,867	2,950	4,775	198	1,096	485	0	0	0	9,503	(2,172)	(2,172)	12,198	0	12,198
7/00	4,491	0	4,491	2,950	4,775	198	1,096	529	0	0	0	9,547	(2,510)	(2,510)	11,528	0	11,528
8/00	4,366	0	4,366	2,950	4,775	198	1,096	537	0	0	0	9,555	(2,710)	(2,710)	11,211	0	11,211
9/00	4,580	34	4,614	2,950	4,775	198	1,096	516	0	0	0	9,534	(2,745)	(3,075)	11,039	364	11,403
10/00	5,696	153	5,849	2,972	4,990	184	1,092	489	0	0	2,106	11,833	(991)	(2,053)	15,476	1,215	16,691
11/00	5,931	4	5,935	2,972	4,990	184	1,092	517	0	0	3,888	13,643	(984)	(1,162)	18,412	182	18,594
12/00	6,188	0	6,188	2,972	4,990	184	1,092	537	0	0	0	9,775	(533)	(723)	15,240	190	15,430
1/01	5,571	5,205	10,776	2,972	4,990	184	1,092	183	0	0	0	9,421	8,063	(849)	14,143	14,117	28,260
2/01	5,079	7,024	12,103	2,972	4,990	184	1,092	117	0	0	0	9,355	22,736	(781)	13,653	30,541	44,194
3/01	5,806	1,931	7,737	2,972	4,990	184	1,092	88	0	0	0	9,326	3,753	1,160	16,292	4,524	20,816
4/01	5,479	1,358	6,837	2,972	4,990	184	1,092	553	0	0	0	9,791	1,420	(863)	14,407	3,641	18,048
5/01	4,701	0	4,701	2,972	4,990	184	1,092	585	0	0	0	9,823	(997)	(997)	13,527	0	13,527
6/01	4,542	0	4,542	2,972	4,990	184	1,092	527	0	0	0	9,765	(2,394)	(2,394)	11,913	0	11,913
7/01	4,423	50	4,473	2,972	4,990	184	1,092	343	0	0	0	9,581	(2,486)	(2,647)	11,357	211	11,568
8/01	4,485	0	4,485	2,972	4,990	184	1,092	306	0	0	0	9,544	(2,957)	(2,957)	11,072	0	11,072
9/01	4,465	0	4,465	2,972	4,990	184	1,092	447	0	0	0	9,685	(2,337)	(2,337)	11,813	0	11,813
10/01	5,008	0	5,008	2,966	4,593	198	1,032	548	0	0	0	9,336	(870)	(870)	13,474	0	13,474
11/01	5,389	2,037	7,426	2,966	4,593	198	1,032	570	0	0	0	9,358	899	(689)	14,058	3,625	17,683
12/01	5,989	382	6,371	2,966	4,593	198	1,032	581	0	0	0	9,369	2,216	133	15,491	2,465	17,956
1/02	5,980	90	6,070	2,966	4,593	198	1,032	498	0	0	0	9,286	1,268	(2)	15,264	1,360	16,624
2/02	4,876	3	4,879	2,966	4,593	198	1,032	379	0	0	0	9,167	(281)	(612)	13,431	334	13,765
3/02	5,944	383	6,327	2,966	4,593	198	1,032	515	0	0	0	9,303	1,295	(52)	15,195	1,730	16,925

Table 8-3

Tabulation of Monthly Time Histories for Discharge Components of the Santa Ana River Between Riverside Narrows and Prado Dam -- 1989/90 to 1999/00

(acre-ft/mo)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13) =sum of (5) to (12)	(14) =(18)-(13)-(4)	(15) =(16)-(13)-(2)	(16)	(17)	(18)
Month/Yr	Riverside Narrows Discharge			Non-Tributary Reach Discharges									Reach Gains or Losses		Outflow at Prado		
	Baseflow[1]	Storm Discharge	Total	Riverside WRP	IEUA WRP's	WR WRP	Corona WRP	Arlington Desalter	Lake Elsinore	Exchange Water	State Project Water	Subtotal Non-Tributary Discharges	Total Discharge	Baseflow Discharge	Baseflow[1]	Storm Discharge	Total
4/02	6,416	104	6,520	2,966	4,593	198	1,032	551	0	0	0	9,339	246	(585)	15,170	935	16,105
5/02	6,819	0	6,819	2,966	4,593	198	1,032	560	0	0	0	9,348	(1,726)	(1,892)	14,275	166	14,441
6/02	5,490	0	5,490	2,966	4,593	198	1,032	521	0	0	0	9,309	(2,472)	(2,472)	12,327	0	12,327
7/02	5,050	0	5,050	2,966	4,593	198	1,032	521	0	0	441	9,750	(3,126)	(3,126)	11,674	0	11,674
8/02	4,570	0	4,570	2,966	4,593	198	1,032	438	0	0	2,412	11,638	(2,603)	(2,603)	13,605	0	13,605
9/02	4,314	0	4,314	2,966	4,593	198	1,032	518	0	0	0	9,306	(3,231)	(3,231)	10,389	0	10,389
10/02	4,485	0	4,485	3,025	5,085	201	1,002	542	0	0	0	9,855	(1,892)	(1,892)	12,448	0	12,448
11/02	4,724	3,682	8,406	3,025	5,085	201	1,002	522	0	0	0	9,835	1,963	(2,793)	11,766	8,438	20,204
12/02	4,887	4,168	9,055	3,025	5,085	201	1,002	482	0	0	0	9,795	8,085	(1,227)	13,455	13,480	26,935
1/03	4,994	52	5,046	3,025	5,085	201	1,002	435	0	0	0	9,748	(907)	(914)	13,828	59	13,887
2/03	4,729	11,974	16,703	3,025	5,085	201	1,002	455	0	0	0	9,768	19,685	(1,030)	13,467	32,689	46,156
3/03	5,304	10,264	15,568	3,025	5,085	201	1,002	456	5	0	0	9,774	21,972	33	15,111	32,203	47,314
4/03	5,042	2,646	7,688	3,025	5,085	201	1,002	468	1,165	0	0	10,946	3,738	(2,015)	13,973	8,399	22,372
5/03	4,999	291	5,290	3,025	5,085	201	1,002	82	854	0	0	10,249	1,062	(1,051)	14,197	2,404	16,601
6/03	5,018	0	5,018	3,025	5,085	201	1,002	0	0	0	0	9,313	(1,519)	(1,519)	12,812	0	12,812
7/03	5,008	0	5,008	3,025	5,085	201	1,002	156	0	0	0	9,469	(1,606)	(1,744)	12,733	138	12,871
8/03	5,119	0	5,119	3,025	5,085	201	1,002	632	0	0	667	10,612	(3,622)	(3,622)	12,109	0	12,109
9/03	4,780	0	4,780	3,025	5,085	201	1,002	652	0	0	997	10,962	(3,294)	(3,294)	12,448	0	12,448
Average	4,462	4,818	9,281	2,858	4,435	92	809	323	110	65	562	9,254	3,336	(1,341)	12,375	9,495	21,871
Standard Deviation	1,165	14,367	14,419	104	500	123	195	222	641	240	1,785	2,057	14,437	1,244	2,743	26,710	27,246
Coefficient of Variation	26%	298%	155%	4%	11%	134%	24%	69%	585%	367%	318%	22%	433%	-93%	22%	281%	125%
Max	6,819	109,300	113,046	3,025	5,085	383	1,096	652	6,908	1,860	11,565	19,842	99,042	1,543	21,298	207,253	220,118
Min	1,852	0	1,991	2,682	3,374	0	420	0	0	0	0	6,903	(3,870)	(3,997)	7,133	0	7,133

Source -- Raw data obtained from the Annual Reports of the Santa Ana Watermaster

1 -- Baseflow, as used herein, is the difference between total discharge as measured at USGS gaging stations, and storm water discharge as estimated by the Santa Ana River Watermaster

Table 8-4
Monthly Distribution of Gains (+) and Losses (-) to Baseflow in the Santa Ana River Between the Riverside Narrows and Prado Dam

(acre-ft/mo)

Month	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	Average	Standard Deviation	Coeficient of Variation	Maximum	Minimum
October	-1,188	-1,976	-3,997	-2,025	-1,367	-1,917	-1,693	-1,905	-2,193	-1,491	-3,159	-2,053	-870	-1,892	-1,980	789	40%	-870	-3,997
November	-954	-962	-2,001	-1,579	-319	-2,458	-668	-1,782	-1,993	-1,980	-1,965	-1,162	-689	-2,793	-1,522	737	48%	-319	-2,793
December	87	-595	-1,097	-299	455	-877	332	-333	-1,152	-992	-1,224	-723	133	-1,227	-537	600	112%	455	-1,227
January	350	306	-273	1,089	1,017	-51	658	727	-318	23	-407	-849	-2	-914	97	630	651%	1,089	-914
February	-321	-1,015	-677	374	222	-97	1,244	-392	-115	-1,380	-838	-781	-612	-1,030	-387	683	176%	1,244	-1,380
March	-89	-377	-151	1,151	1,093	483	-483	380	-98	104	-950	1,160	-52	33	157	634	403%	1,160	-950
April	-1,016	-1,199	-1,182	928	-145	-9	-1,968	-1,321	-231	-752	-914	-863	-585	-2,015	-805	779	97%	928	-2,015
May	-1,548	-527	-895	1,543	215	-433	-1,382	-1,542	-169	-1,711	-1,283	-997	-1,892	-1,051	-834	917	110%	1,543	-1,892
June	-2,351	-1,705	-2,317	-1,266	-1,969	-1,464	-3,003	-2,112	-1,603	-3,447	-2,172	-2,394	-2,472	-1,519	-2,128	609	29%	-1,266	-3,447
July	-2,444	-2,171	-2,811	-979	-2,203	-3,862	-3,662	-3,033	-1,715	-3,000	-2,510	-2,647	-3,126	-1,744	-2,565	779	30%	-979	-3,862
August	-2,720	-2,778	-2,609	-2,676	-2,746	-2,398	-2,462	-3,515	-2,145	-3,561	-2,710	-2,957	-2,603	-3,622	-2,822	447	16%	-2,145	-3,622
September	-2,659	-3,065	-2,450	-3,375	-2,567	-1,891	-2,785	-2,773	-1,825	-3,387	-3,075	-2,337	-3,231	-3,294	-2,765	513	19%	-1,825	-3,387
Total	-14,857	-16,066	-20,456	-7,116	-8,314	-14,978	-15,874	-17,605	-13,559	-21,574	-21,212	-16,599	-15,999	-21,064	-16,091	4,411	27%	-7,116	-21,574
Average	-1,238	-1,339	-1,705	-593	-693	-1,248	-1,323	-1,467	-1,130	-1,798	-1,768	-1,383	-1,333	-1,755	-1,341				
Max	350	306	-151	1,543	1,093	483	1,244	727	-98	104	-407	1,160	133	33	466				
Min	-2,720	-3,065	-3,997	-3,375	-2,746	-3,862	-3,662	-3,515	-2,193	-3,561	-3,159	-2,957	-3,231	-3,622	-3,262				

Source -- Basic data from the Santa Ana River Watermaster Annual Reports

Table 8-5
Total Chino Basin Production, Watermaster Replenishment Requirement and Replenishment Plan that Balances Recharge and Discharge for Baseline Scenario

(1)	(2)	(3)	(4)	(5)	(6) = (2) - (3) - (4) - (5)	(7)	(8)	(9)	(10)	(11)	(12) = Σ(7) to (11)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20) = Σ(13) to (18	(21) = (12) + (20)
Fiscal Year	Production	Operating Yield	New Stormwater	Other Basin Inflow	Replenishment Obligation	MZ1 Recharge Basins						Supplemental Water Recharge Plan								Total
						MZ1 Goal	Montclair 1-4 0.25	Upland 0.15	College Hts 0.15	Brooks 0.15	Subtotal	MZ2 and MZ3 Recharge Basins								
												San Sevaine 0.25	Victoria	Banana + Hickory	Etiwanda Cons	Etiwanda Perc	RP3 0.05	Declez	Subtotal	
2004	196,577	145,000	12,000	9,989	29,588	20,712	20,712	0	0	0	20,712	8,876	0	0	0	0	0	0	8,876	29,588
2005	197,542	145,000	12,000	10,710	29,832	20,882	7,458	4,475	4,475	4,475	20,882	7,458	0	0	0	0	1,492	0	8,949	29,832
2006	195,715	145,000	12,000	10,888	27,827	19,479	6,957	4,174	4,174	4,174	19,479	6,957	0	0	0	0	1,391	0	8,348	27,827
2007	197,912	145,000	12,000	13,053	27,858	19,501	6,965	4,179	4,179	4,179	19,501	6,965	0	0	0	0	1,393	0	8,358	27,858
2008	196,068	145,000	12,000	13,231	25,837	18,086	6,459	3,876	3,876	3,876	18,086	6,459	0	0	0	0	1,292	0	7,751	25,837
2009	194,245	145,000	12,000	13,408	23,837	16,686	5,959	3,576	3,576	3,576	16,686	5,959	0	0	0	0	1,192	0	7,151	23,837
2010	206,871	145,000	12,000	20,744	29,127	20,389	7,282	4,369	4,369	4,369	20,389	7,282	0	0	0	0	1,456	0	8,738	29,127
2011	207,484	145,000	12,000	21,130	29,355	20,548	7,339	4,403	4,403	4,403	20,548	7,339	0	0	0	0	1,468	0	8,806	29,355
2012	208,089	145,000	12,000	21,515	29,574	20,702	7,393	4,436	4,436	4,436	20,702	7,393	0	0	0	0	1,479	0	8,872	29,574
2013	208,704	145,000	12,000	21,900	29,804	20,863	7,451	4,471	4,471	4,471	20,863	7,451	0	0	0	0	1,490	0	8,941	29,804
2014	209,311	145,000	12,000	22,285	30,026	21,018	7,507	4,504	4,504	4,504	21,018	7,507	0	0	0	0	1,501	0	9,008	30,026
2015	209,917	145,000	12,000	22,670	30,247	21,173	7,562	4,537	4,537	4,537	21,173	7,562	0	0	0	0	1,512	0	9,074	30,247
2016	210,015	145,000	12,000	23,057	29,958	20,971	7,490	4,494	4,494	4,494	20,971	7,490	0	0	0	0	1,498	0	8,987	29,958
2017	210,126	145,000	12,000	23,443	29,683	20,778	7,421	4,452	4,452	4,452	20,778	7,421	0	0	0	0	1,484	0	8,905	29,683
2018	210,229	140,000	12,000	23,830	34,399	24,079	8,600	5,160	5,160	5,160	24,079	8,600	0	0	0	0	1,720	0	10,320	34,399
2019	210,328	140,000	12,000	24,216	34,112	23,879	8,528	5,117	5,117	5,117	23,879	8,528	0	0	0	0	1,706	0	10,234	34,112
2020	210,423	140,000	12,000	24,602	33,821	23,675	8,455	5,073	5,073	5,073	23,675	8,455	0	0	0	0	1,691	0	10,146	33,821
2021	210,427	140,000	12,000	24,602	33,825	23,677	8,456	5,074	5,074	5,074	23,677	8,456	0	0	0	0	1,691	0	10,147	33,825
2022	210,427	140,000	12,000	24,602	33,825	23,677	8,456	5,074	5,074	5,074	23,677	8,456	0	0	0	0	1,691	0	10,147	33,825
2023	210,427	140,000	12,000	24,602	33,825	23,677	8,456	5,074	5,074	5,074	23,677	8,456	0	0	0	0	1,691	0	10,147	33,825
2024	210,423	140,000	12,000	24,602	33,821	23,675	8,455	5,073	5,073	5,073	23,675	8,455	0	0	0	0	1,691	0	10,146	33,821
2025	210,427	140,000	12,000	24,602	33,825	23,677	8,456	5,074	5,074	5,074	23,677	8,456	0	0	0	0	1,691	0	10,147	33,825
2026	210,427	140,000	12,000	24,602	33,825	23,677	8,456	5,074	5,074	5,074	23,677	8,456	0	0	0	0	1,691	0	10,147	33,825
2027	210,427	140,000	12,000	24,602	33,825	23,677	8,456	5,074	5,074	5,074	23,677	8,456	0	0	0	0	1,691	0	10,147	33,825
2028	210,423	140,000	12,000	24,602	33,821	23,675	8,455	5,073	5,073	5,073	23,675	8,455	0	0	0	0	1,691	0	10,146	33,821

Note -- recharge allocated to facilities that are assured of being on line in 2004

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Table 8-6a
Estimated Hydrologic Budget for the Chino Basin by RWQCB Management Zone – Chino North, Baseline Period 2004/05 to 2028/29

(acre-ft)

Period	Inflow										Outflows							Inflow-Outflow
		Inter-basin Flow			Deep Percolation			Artificial Recharge		Subtotal	Pumping	Inter-basin Flow			ET	Rising	Subtotal	
	Boundary Inflow	Chino South	Chino East	PBMZ	Precipitation	Applied Water	Stream Recharge	Storm	Imported and Recycled Water	Inflows		Chino South	Chino East	PBMZ		Groundwater	Outflow	
1	16,711	6,137	403	0	58,235	35,299	191	20,409	29,588	166,974	174,680	0	32	8,440	68	0	183,220	-16,246
2	16,711	7,081	124	0	57,224	36,634	339	20,409	29,832	168,353	174,330	0	134	7,865	68	0	182,397	-14,043
3	16,711	7,649	123	0	56,212	37,969	373	20,409	27,827	167,273	172,710	0	97	7,432	68	0	180,307	-13,034
4	16,711	8,400	86	0	55,200	39,303	377	20,409	27,858	168,345	175,270	0	314	7,014	68	0	182,667	-14,322
5	16,711	8,810	141	0	54,188	40,638	383	20,409	25,837	167,117	172,660	0	105	6,724	68	0	179,558	-12,440
6	16,711	8,997	511	0	53,176	41,973	384	20,409	23,837	165,999	170,440	0	0	6,567	68	0	177,075	-11,077
7	16,711	10,762	850	0	52,164	43,308	387	20,409	29,127	173,718	180,830	0	0	4,434	68	0	185,333	-11,614
8	16,711	12,287	960	0	51,153	44,643	391	20,409	29,355	175,907	181,590	0	0	3,117	68	0	184,776	-8,869
9	16,711	12,917	1,002	0	50,141	45,977	395	20,409	29,574	177,126	182,110	0	0	2,632	68	0	184,810	-7,684
10	16,711	13,103	976	0	49,129	47,312	396	20,409	29,804	177,841	182,450	0	0	2,351	68	0	184,869	-7,028
11	16,711	13,293	1,017	0	48,117	48,647	399	20,409	30,026	178,619	183,160	0	0	2,201	68	0	185,429	-6,810
12	16,711	13,398	1,043	0	47,105	49,982	402	20,409	30,247	179,297	183,910	0	0	2,124	68	0	186,102	-6,805
13	16,711	13,450	1,062	0	46,094	51,317	407	20,409	29,958	179,407	184,240	0	0	2,128	68	0	186,436	-7,029
14	16,711	13,398	1,110	0	45,082	52,651	408	20,409	29,683	179,451	184,590	0	0	2,154	68	0	186,813	-7,362
15	16,711	13,352	1,262	0	44,070	53,986	410	20,409	34,399	184,599	184,930	0	0	2,228	68	0	187,226	-2,627
16	16,711	13,259	1,253	0	43,058	55,321	413	20,409	34,112	184,536	185,260	0	0	2,337	68	0	187,666	-3,129
17	16,711	13,150	1,230	0	42,046	56,656	417	20,409	33,821	184,440	185,580	0	0	2,493	68	0	188,142	-3,701
18	16,711	12,987	1,212	0	42,046	56,656	415	20,409	33,825	184,261	185,590	0	0	2,618	68	0	188,277	-4,016
19	16,711	12,895	1,153	0	42,046	56,656	415	20,409	33,825	184,109	185,590	0	0	2,719	68	0	188,377	-4,268
20	16,711	12,880	855	0	42,046	56,656	415	20,409	33,825	183,797	186,430	0	0	2,793	68	0	189,291	-5,494
21	16,711	12,945	834	0	42,046	56,656	417	20,409	33,821	183,839	186,060	0	0	2,853	68	0	188,981	-5,142
22	16,711	12,808	1,231	0	42,046	56,656	415	20,409	33,825	184,101	185,600	0	0	2,858	68	0	188,527	-4,426
23	16,711	12,807	1,258	0	42,046	56,656	415	20,409	33,825	184,127	185,600	0	0	2,881	68	0	188,549	-4,422
24	16,711	12,790	1,271	0	42,046	56,656	415	20,409	33,825	184,123	185,600	0	0	2,899	68	0	188,567	-4,444
25	16,711	12,792	1,287	0	42,046	56,656	417	20,409	33,821	184,139	185,590	0	0	2,933	68	0	188,592	-4,453
Total	417,775	292,347	22,254	0	1,188,764	1,234,864	9,796	510,225	775,474	4,451,499	4,544,800	0	682	94,794	1,711	0	4,641,986	-190,487
Average	16,711	11,694	890	0	47,551	49,395	392	20,409	31,019	178,060	181,792	0	27	3,792	68	0	185,679	-7,619
Maximum	16,711	13,450	1,287	0	58,235	56,656	417	20,409	34,399	184,599	186,430	0	314	8,440	68	0	189,291	-2,627
Minimum	16,711	6,137	86	0	42,046	35,299	191	20,409	23,837	165,999	170,440	0	0	2,124	68	0	177,075	-16,246

WILDERMUTH™ ENVIRONMENTAL INC.

Table 8-6b
Estimated Hydrologic Budget for the Chino Basin by RWQCB Management Zone – Chino East, Baseline Period 2004/05 to 2028/29

(acre-ft)

Period	Inflow										Outflows						Inflow-Outflow
		Inter-basin Flow		Deep Percolation			Artificial Recharge			Subtotal	Pumping	Inter-basin Flow		ET	Rising	Subtotal	
	Boundary Inflow	Chino North	Chino South	Precipitation	Applied Water	Stream Recharge	Storm	State Project	Recycled	Inflows		Chino North	Chino South		Groundwater	Outflow	
1	887	32	1,902	1,139	1,247	0	0	0	0	5,207	6,260	403	0	0	0	6,663	-1,456
2	887	134	2,594	1,126	1,274	0	0	0	0	6,014	6,539	124	0	0	0	6,663	-649
3	887	97	2,972	1,112	1,300	0	0	0	0	6,368	6,579	123	0	0	0	6,702	-334
4	887	314	3,509	1,099	1,327	0	0	0	0	7,136	7,570	86	0	0	0	7,656	-520
5	887	105	3,739	1,085	1,353	0	0	0	0	7,170	7,230	141	0	0	0	7,371	-202
6	887	0	3,632	1,072	1,380	0	0	0	0	6,971	6,523	511	0	0	0	7,034	-63
7	887	0	3,554	1,058	1,406	0	0	0	0	6,906	5,980	850	0	0	0	6,830	76
8	887	0	3,534	1,045	1,433	0	0	0	0	6,899	6,018	960	0	0	0	6,978	-79
9	887	0	3,620	1,031	1,460	0	0	0	0	6,998	6,057	1,002	0	0	0	7,059	-61
10	887	0	3,676	1,018	1,486	0	0	0	0	7,067	6,094	976	0	0	0	7,070	-3
11	887	0	3,751	1,004	1,513	0	0	0	0	7,154	6,133	1,017	0	0	0	7,150	5
12	887	0	3,816	991	1,539	0	0	0	0	7,233	6,171	1,043	0	0	0	7,214	19
13	887	0	3,869	977	1,566	0	0	0	0	7,299	6,195	1,062	0	0	0	7,257	43
14	887	0	3,839	964	1,592	0	0	0	0	7,282	6,030	1,110	0	0	0	7,140	143
15	887	0	3,664	951	1,619	0	0	0	0	7,120	5,682	1,262	0	0	0	6,944	176
16	887	0	3,618	937	1,645	0	0	0	0	7,087	5,697	1,253	0	0	0	6,950	137
17	887	0	3,591	924	1,672	0	0	0	0	7,074	5,712	1,230	0	0	0	6,942	132
18	887	0	3,559	924	1,672	0	0	0	0	7,041	5,712	1,212	0	0	0	6,924	117
19	887	0	3,603	924	1,672	0	0	0	0	7,085	5,909	1,153	0	0	0	7,062	23
20	887	0	3,949	924	1,672	0	0	0	0	7,431	6,703	855	0	0	0	7,558	-127
21	887	0	4,172	924	1,672	0	0	0	0	7,654	6,732	834	0	0	0	7,566	88
22	887	0	3,702	924	1,672	0	0	0	0	7,184	5,712	1,231	0	0	0	6,943	241
23	887	0	3,639	924	1,672	0	0	0	0	7,121	5,712	1,258	0	0	0	6,970	151
24	887	0	3,612	924	1,672	0	0	0	0	7,094	5,712	1,271	0	0	0	6,983	111
25	887	0	3,609	924	1,672	0	0	0	0	7,091	5,712	1,287	0	0	0	6,999	92
Total	22,176	682	88,723	24,922	38,185	0	0	0	0	174,687	154,373	22,254	0	0	0	176,627	-1,940
Average	887	27	3,549	997	1,527	0	0	0	0	6,987	6,175	890	0	0	0	7,065	-78
Maximum	887	314	4,172	1,139	1,672	0	0	0	0	7,654	7,570	1,287	0	0	0	7,656	241
Minimum	887	0	1,902	924	1,247	0	0	0	0	5,207	5,682	86	0	0	0	6,663	-1,456

WILDERMUTH™ ENVIRONMENTAL INC.

Table 8-6c
Estimated Hydrologic Budget for the Chino Basin by RWQCB Management Zone – Chino South, Baseline Period 2004/05 to 2028/29

(acre-ft)

Period	Inflows											Outflows							Inflow-Outflow
		Inter-basin Flow			Deep Percolation		Stream	Artificial Recharge			Subtotal	Pumping	Inter-basin Flow			ET	Rising	Subtotal	
	Boundary	Chino North	PBMZ	Chino East	Precipitation	Applied Water	Recharge	Storm	State Project	Recycled	Inflows		Chino North	PBMZ	Chino East		Groundwater	Outflow	
1	125	0	0	0	2,836	2,670	16,094	0	0	0	21,725	7,658	6,137	2,638	1,902	6,434	794	25,563	-3,838
2	125	0	0	0	2,793	2,707	18,928	0	0	0	24,553	7,640	7,081	2,522	2,594	6,427	244	26,508	-1,955
3	125	0	0	0	2,749	2,744	20,418	0	0	0	26,036	7,473	7,649	2,456	2,972	6,427	74	27,050	-1,014
4	125	0	0	0	2,706	2,781	21,573	0	0	0	27,185	7,686	8,400	2,408	3,509	6,427	29	28,459	-1,273
5	125	0	0	0	2,663	2,819	22,656	0	0	0	28,262	7,519	8,810	2,374	3,739	6,434	21	28,896	-634
6	125	0	0	0	2,619	2,856	22,921	0	0	0	28,521	7,352	8,997	2,352	3,632	6,427	20	28,780	-259
7	125	0	0	0	2,576	2,893	25,303	0	0	0	30,897	10,390	10,762	2,036	3,554	6,427	20	33,189	-2,292
8	125	0	0	0	2,533	2,930	27,638	0	0	0	33,226	10,287	12,287	1,796	3,534	6,427	20	34,351	-1,125
9	125	0	0	0	2,489	2,968	28,677	0	0	0	34,259	10,184	12,917	1,726	3,620	6,434	21	34,901	-642
10	125	0	0	0	2,446	3,005	29,047	0	0	0	34,623	10,081	13,103	1,686	3,676	6,427	20	34,994	-371
11	125	0	0	0	2,403	3,042	29,253	0	0	0	34,823	9,977	13,293	1,669	3,751	6,427	20	35,137	-314
12	125	0	0	0	2,359	3,079	29,369	0	0	0	34,933	9,875	13,398	1,661	3,816	6,427	21	35,197	-264
13	125	0	0	0	2,316	3,117	29,430	0	0	0	34,988	9,724	13,450	1,666	3,869	6,434	21	35,164	-176
14	125	0	0	0	2,273	3,154	29,279	0	0	0	34,831	9,573	13,398	1,665	3,839	6,427	21	34,923	-92
15	125	0	0	0	2,230	3,191	29,012	0	0	0	34,558	9,423	13,352	1,673	3,664	6,427	22	34,560	-3
16	125	0	0	0	2,186	3,228	28,715	0	0	0	34,255	9,272	13,259	1,685	3,618	6,427	22	34,283	-28
17	125	0	0	0	2,143	3,266	28,500	0	0	0	34,033	9,121	13,150	1,706	3,591	6,434	22	34,024	9
18	125	0	0	0	2,143	3,266	28,226	0	0	0	33,759	9,121	12,987	1,712	3,559	6,427	23	33,828	-69
19	125	0	0	0	2,143	3,266	28,091	0	0	0	33,624	9,121	12,895	1,721	3,603	6,427	23	33,789	-165
20	125	0	0	0	2,143	3,266	28,149	0	0	0	33,682	9,121	12,880	1,726	3,949	6,427	23	34,126	-443
21	125	0	0	0	2,143	3,266	28,561	0	0	0	34,094	9,121	12,945	1,731	4,172	6,434	23	34,425	-331
22	125	0	0	0	2,143	3,266	28,377	0	0	0	33,910	9,121	12,808	1,724	3,702	6,427	23	33,804	106
23	125	0	0	0	2,143	3,266	28,136	0	0	0	33,669	9,121	12,807	1,727	3,639	6,427	24	33,744	-74
24	125	0	0	0	2,143	3,266	28,015	0	0	0	33,548	9,121	12,790	1,728	3,612	6,427	24	33,702	-154
25	125	0	0	0	2,143	3,266	28,009	0	0	0	33,542	9,121	12,792	1,735	3,609	6,434	24	33,715	-172
Total	3,125	0	0	0	59,464	76,574	662,377	0	0	0	801,540	226,203	292,347	47,522	88,723	160,718	1,601	817,113	-15,573
Average	125	0	0	0	2,379	3,063	26,495	0	0	0	32,062	9,048	11,694	1,901	3,549	6,429	64	32,685	-623
Maximum	125	0	0	0	2,836	3,266	29,430	0	0	0	34,988	10,390	13,450	2,638	4,172	6,434	794	35,197	106
Minimum	125	0	0	0	2,143	2,670	16,094	0	0	0	21,725	7,352	6,137	1,661	1,902	6,427	20	25,563	-3,838

WILDERMUTH™ ENVIRONMENTAL INC.

Table 8-6d
Estimated Hydrologic Budget for the Chino Basin by RWQCB Management Zone – Prado Basin, Baseline Period 2004/05 to 2028/29

(acre-ft)

Period	Inflow											Outflows							Inflow-Outflow
		Inter-basin Flow			Deep Percolation		Stream	Artificial Recharge			Subtotal	Pumping	Inter-basin Flow			ET	Rising	Subtotal	
	Boundary	Chino North	Chino South	Temescal	Precipitation	Applied Water	Recharge	Storm	State Project	Recycled	Inflows		Chino North	Chino South	Temescal		Groundwater	Outflow	
1	0	8,440	2,638	1,360	2,168	1,193	10,759	0	0	4,500	31,058	4,771	0	0	0	16,134	11,232	32,137	-1,079
2	0	7,865	2,522	889	2,138	1,164	11,639	0	0	4,500	30,716	4,657	0	0	0	16,117	10,492	31,266	-550
3	0	7,432	2,456	927	2,107	1,136	12,270	0	0	4,500	30,828	4,542	0	0	0	16,117	10,157	30,816	12
4	0	7,014	2,408	956	2,077	1,107	12,629	0	0	4,500	30,691	4,428	0	0	0	16,117	10,007	30,552	139
5	0	6,724	2,374	964	2,047	1,078	12,861	0	0	4,500	30,547	4,312	0	0	0	16,134	9,904	30,350	198
6	0	6,567	2,352	952	2,016	1,050	12,967	0	0	4,500	30,404	4,198	0	0	0	16,117	9,800	30,115	289
7	0	4,434	2,036	934	1,986	1,021	13,596	0	0	4,500	28,507	4,082	0	0	0	16,117	9,332	29,531	-1,025
8	0	3,117	1,796	920	1,956	992	14,717	0	0	4,500	27,997	3,966	0	0	0	16,117	8,482	28,565	-568
9	0	2,632	1,726	898	1,925	962	15,338	0	0	4,500	27,982	3,849	0	0	0	16,134	8,078	28,061	-80
10	0	2,351	1,686	867	1,895	934	15,591	0	0	4,500	27,823	3,734	0	0	0	16,117	7,843	27,694	129
11	0	2,201	1,669	831	1,864	904	15,761	0	0	4,500	27,731	3,618	0	0	0	16,117	7,742	27,477	255
12	0	2,124	1,661	794	1,834	875	15,864	0	0	4,500	27,652	3,501	0	0	0	16,117	7,704	27,322	330
13	0	2,128	1,666	758	1,804	838	15,941	0	0	4,500	27,635	3,354	0	0	0	16,134	7,749	27,237	398
14	0	2,154	1,665	721	1,773	802	15,921	0	0	4,500	27,536	3,206	0	0	0	16,117	7,780	27,103	433
15	0	2,228	1,673	682	1,743	765	15,909	0	0	4,500	27,499	3,058	0	0	0	16,117	7,865	27,040	458
16	0	2,337	1,685	642	1,713	728	15,878	0	0	4,500	27,483	2,911	0	0	0	16,117	7,973	27,001	482
17	0	2,493	1,706	605	1,682	691	15,861	0	0	4,500	27,538	2,763	0	0	0	16,134	8,134	27,031	507
18	0	2,618	1,712	570	1,682	691	15,776	0	0	4,500	27,549	2,763	0	0	0	16,117	8,221	27,101	448
19	0	2,719	1,721	535	1,682	691	15,757	0	0	4,500	27,605	2,763	0	0	0	16,117	8,300	27,180	425
20	0	2,793	1,726	505	1,682	691	15,751	0	0	4,500	27,647	2,763	0	0	0	16,117	8,358	27,238	409
21	0	2,853	1,731	478	1,682	691	15,780	0	0	4,500	27,714	2,763	0	0	0	16,134	8,431	27,328	386
22	0	2,858	1,724	477	1,682	691	15,767	0	0	4,500	27,699	2,763	0	0	0	16,117	8,426	27,306	393
23	0	2,881	1,727	808	1,682	691	15,703	0	0	4,500	27,991	2,763	0	0	0	16,117	8,449	27,329	662
24	0	2,899	1,728	1,199	1,682	691	15,447	0	0	4,500	28,147	2,763	0	0	0	16,117	8,494	27,374	773
25	0	2,933	1,735	1,489	1,682	691	15,169	0	0	4,500	28,199	2,763	0	0	0	16,134	8,581	27,478	721
Total	0	94,794	47,522	20,761	46,187	21,763	368,652	0	0	112,500	712,179	87,054	0	0	0	403,044	217,534	707,632	4,548
Average	0	3,792	1,901	830	1,847	871	14,746	0	0	4,500	28,487	3,482	0	0	0	16,122	8,701	28,305	182
Maximum	0	8,440	2,638	1,489	2,168	1,193	15,941	0	0	4,500	31,058	4,771	0	0	0	16,134	11,232	32,137	773
Minimum	0	2,124	1,661	477	1,682	691	10,759	0	0	4,500	27,483	2,763	0	0	0	16,117	7,704	27,001	-1,079

WILDERMUTH™ ENVIRONMENTAL INC.

Table 8-6e
Estimated Hydrologic Budget for the Chino Basin by RWQCB Management Zone – Temescal, Baseline Period 2004/05 to 2028/29

(acre-ft)

Period	Inflows										Outflows						Inflow-Outflow
	Inter-basin Flow			Deep Percolation		Stream	Artificial Recharge			Subtotal	Pumping	Inter-basin Flow		ET	Rising	Subtotal	
	Boundary	PBMZ	Chino South	Precipitation	Applied Water	Recharge	Storm	State Project	Recycled	Inflows		PBMZ	Chino South		Groundwater	Outflow	
1	2,520	0	0	1,902	1,761	1,067	0	0	4,500	11,750	19,346	1,360	0	0	0	20,706	-8,955
2	2,520	0	0	1,869	1,754	1,063	0	0	4,500	11,706	10,458	889	0	0	0	11,347	359
3	2,520	0	0	1,836	1,747	1,063	0	0	4,500	11,666	10,458	927	0	0	0	11,385	280
4	2,520	0	0	1,802	1,740	1,063	0	0	4,500	11,625	10,458	956	0	0	0	11,414	211
5	2,520	0	0	1,769	1,732	1,067	0	0	4,500	11,588	10,458	964	0	0	0	11,422	166
6	2,520	0	0	1,736	1,725	1,063	0	0	4,500	11,544	10,458	952	0	0	0	11,410	134
7	2,520	0	0	1,703	1,718	1,063	0	0	4,500	11,503	10,458	934	0	0	0	11,392	112
8	2,520	0	0	1,669	1,711	1,063	0	0	4,500	11,463	10,458	920	0	0	0	11,378	85
9	2,520	0	0	1,636	1,703	1,067	0	0	4,500	11,426	10,458	898	0	0	0	11,356	70
10	2,520	0	0	1,603	1,696	1,063	0	0	4,500	11,382	10,458	867	0	0	0	11,325	57
11	2,520	0	0	1,570	1,689	1,063	0	0	4,500	11,341	10,458	831	0	0	0	11,289	52
12	2,520	0	0	1,536	1,681	1,063	0	0	4,500	11,301	10,458	794	0	0	0	11,252	49
13	2,520	0	0	1,503	1,674	1,067	0	0	4,500	11,264	10,458	758	0	0	0	11,216	48
14	2,520	0	0	1,470	1,667	1,063	0	0	4,500	11,220	10,458	721	0	0	0	11,179	41
15	2,520	0	0	1,436	1,660	1,063	0	0	4,500	11,179	10,458	682	0	0	0	11,140	40
16	2,520	0	0	1,403	1,652	1,063	0	0	4,500	11,139	10,458	642	0	0	0	11,100	38
17	2,520	0	0	1,370	1,645	1,067	0	0	4,500	11,102	10,458	605	0	0	0	11,063	39
18	2,520	0	0	1,370	1,645	1,067	0	0	4,500	11,102	10,458	570	0	0	0	11,028	74
19	2,520	0	0	1,370	1,645	1,067	0	0	4,500	11,102	10,458	535	0	0	0	10,993	109
20	2,520	0	0	1,370	1,645	1,067	0	0	4,500	11,102	10,458	505	0	0	0	10,963	139
21	2,520	0	0	1,370	1,645	1,067	0	0	4,500	11,102	10,458	478	0	0	0	10,936	166
22	2,520	0	0	1,370	1,645	1,067	0	0	4,500	11,102	9,366	477	0	0	0	9,843	1,259
23	2,520	0	0	1,370	1,645	1,067	0	0	4,500	11,102	7,260	808	0	0	0	8,068	3,034
24	2,520	0	0	1,370	1,645	1,067	0	0	4,500	11,102	7,260	1,199	0	0	0	8,459	2,643
26	2,520	0	0	1,370	1,645	1,067	0	0	4,500	11,102	7,260	1,489	0	0	0	8,749	2,353
Total	63,000	0	0	38,773	42,116	26,627	0	0	112,500	283,016	259,652	20,761	0	0	0	280,413	2,602
Average	2,520	0	0	1,551	1,685	1,065	0	0	4,500	11,321	10,386	830	0	0	0	11,217	104
Maximum	2,520	0	0	1,902	1,761	1,067	0	0	4,500	11,750	19,346	1,489	0	0	0	20,706	3,034
Minimum	2,520	0	0	1,370	1,645	1,063	0	0	4,500	11,102	7,260	477	0	0	0	8,068	-8,955

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Table 8-7
Model-Estimated Inflows, Outflows and Rising Water Contributions to the Santa Ana River for the Prado Basin Management Zone
Baseline Scenario 2004/05 to 2028/29

(acre-ft)

Period	Inflow								Outflows				Rising Water Attributed to Inflows from Upgradient Management Zones				
	Inter-basin Flow			Deep Percolation		Stream	ficial Recha	Subtotal	Pumping	Uptake by	Rising	Subtotal					
	Chino North	Chino South	Temescal	Precipitation	Applied Water	Recharge	Recycled	Inflows		Riparian Vegetation	Groundwater	Outflow	Chino North	Chino South	Temescal	PBMZ	Total
1	8,440	2,638	1,360	2,168	1,193	10,759	4,500	31,058	4,771	16,134	11,232	32,137	1,924	601	310	8,397	11,232
2	7,865	2,522	889	2,138	1,164	11,639	4,500	30,716	4,657	16,117	10,492	31,266	1,476	473	167	8,376	10,492
3	7,432	2,456	927	2,107	1,136	12,270	4,500	30,828	4,542	16,117	10,157	30,816	1,211	400	151	8,395	10,157
4	7,014	2,408	956	2,077	1,107	12,629	4,500	30,691	4,428	16,117	10,007	30,552	1,062	365	145	8,435	10,007
5	6,724	2,374	964	2,047	1,078	12,861	4,500	30,547	4,312	16,134	9,904	30,350	968	342	139	8,455	9,904
6	6,567	2,352	952	2,016	1,050	12,967	4,500	30,404	4,198	16,117	9,800	30,115	910	326	132	8,431	9,800
7	4,434	2,036	934	1,986	1,021	13,596	4,500	28,507	4,082	16,117	9,332	29,531	518	238	109	8,468	9,332
8	3,117	1,796	920	1,956	992	14,717	4,500	27,997	3,966	16,117	8,482	28,565	170	98	50	8,164	8,482
9	2,632	1,726	898	1,925	962	15,338	4,500	27,982	3,849	16,134	8,078	28,061	53	35	18	7,972	8,078
10	2,351	1,686	867	1,895	934	15,591	4,500	27,823	3,734	16,117	7,843	27,694	6	4	2	7,831	7,843
11	2,201	1,669	831	1,864	904	15,761	4,500	27,731	3,618	16,117	7,742	27,477	0	0	0	7,742	7,742
12	2,124	1,661	794	1,834	875	15,864	4,500	27,652	3,501	16,117	7,704	27,322	0	0	0	7,704	7,704
13	2,128	1,666	758	1,804	838	15,941	4,500	27,635	3,354	16,134	7,749	27,237	0	0	0	7,749	7,749
14	2,154	1,665	721	1,773	802	15,921	4,500	27,536	3,206	16,117	7,780	27,103	0	0	0	7,780	7,780
15	2,228	1,673	682	1,743	765	15,909	4,500	27,499	3,058	16,117	7,865	27,040	0	0	0	7,865	7,865
16	2,337	1,685	642	1,713	728	15,878	4,500	27,483	2,911	16,117	7,973	27,001	4	3	1	7,965	7,973
17	2,493	1,706	605	1,682	691	15,861	4,500	27,538	2,763	16,134	8,134	27,031	26	18	6	8,084	8,134
18	2,618	1,712	570	1,682	691	15,776	4,500	27,549	2,763	16,117	8,221	27,101	44	29	10	8,138	8,221
19	2,719	1,721	535	1,682	691	15,757	4,500	27,605	2,763	16,117	8,300	27,180	58	37	11	8,194	8,300
20	2,793	1,726	505	1,682	691	15,751	4,500	27,647	2,763	16,117	8,358	27,238	68	42	12	8,235	8,358
21	2,853	1,731	478	1,682	691	15,780	4,500	27,714	2,763	16,134	8,431	27,328	78	47	13	8,293	8,431
22	2,858	1,724	477	1,682	691	15,767	4,500	27,699	2,763	16,117	8,426	27,306	78	47	13	8,287	8,426
23	2,881	1,727	808	1,682	691	15,703	4,500	27,991	2,763	16,117	8,449	27,329	85	51	24	8,288	8,449
24	2,899	1,728	1,199	1,682	691	15,447	4,500	28,147	2,763	16,117	8,494	27,374	109	65	45	8,274	8,494
25	2,933	1,735	1,489	1,682	691	15,169	4,500	28,199	2,763	16,134	8,581	27,478	142	84	72	8,283	8,581
Total	94,794	47,522	20,761	46,187	21,763	368,652	112,500	712,179	87,054	403,044	217,534	707,632	8,991	3,305	1,431	203,808	217,534
Average	3,792	1,901	830	1,847	871	14,746	4,500	28,487	3,482	16,122	8,701	28,305	360	132	57	8,152	8,701
Maximum	8,440	2,638	1,489	2,168	1,193	15,941	4,500	31,058	4,771	16,134	11,232	32,137	1,924	601	310	8,468	11,232
Minimum	2,124	1,661	477	1,682	691	10,759	4,500	27,483	2,763	16,117	7,704	27,001	0	0	0	7,704	7,704

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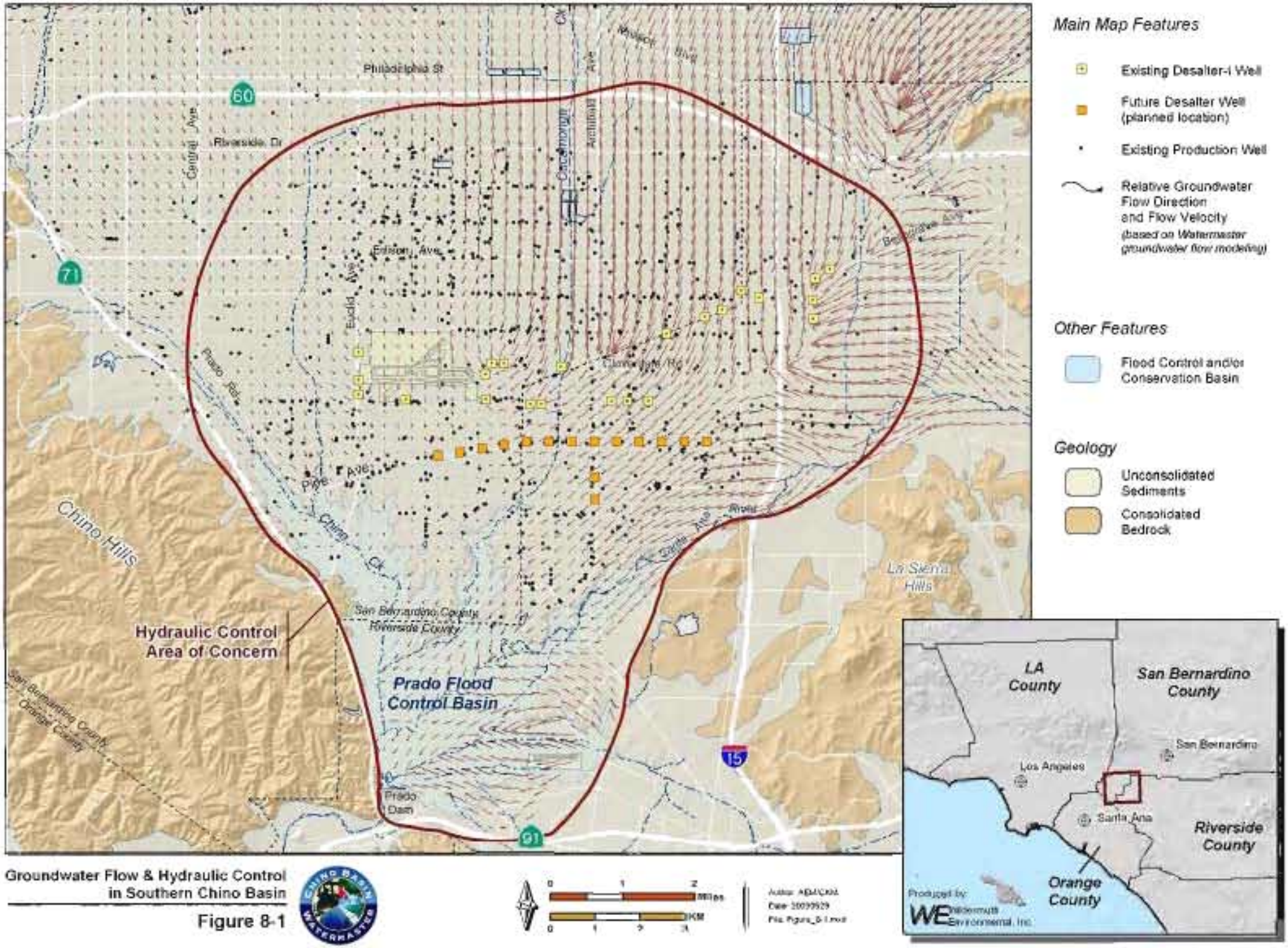

Groundwater Flow & Hydraulic Control in Southern Chino Basin

Figure 8-1

Proposed HCMP Nested Monitoring Well

HCMP Key Well -- Water Level Monitoring

- Agricultural Pool
- Overlying Non-Ag Pool
- Appropriative Pool
- State of California Well
- USGS NAWQA Monitoring Well

Other Features

- Chino-1 Desalter Well (Existing)
- Chino Desalter Well (Proposed)
- Phreatophytes

Geology

Water-Bearing Sediments

- Quaternary Alluvium

Consolidated Bedrock

- Plio-Pleistocene Sedimentary Rocks
- Cretaceous to Miocene Sedimentary Rocks
- Pre-Terbary Igneous and Metamorphic Rocks

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Date: 2004/06/30
File: Figure_8-2.mxd

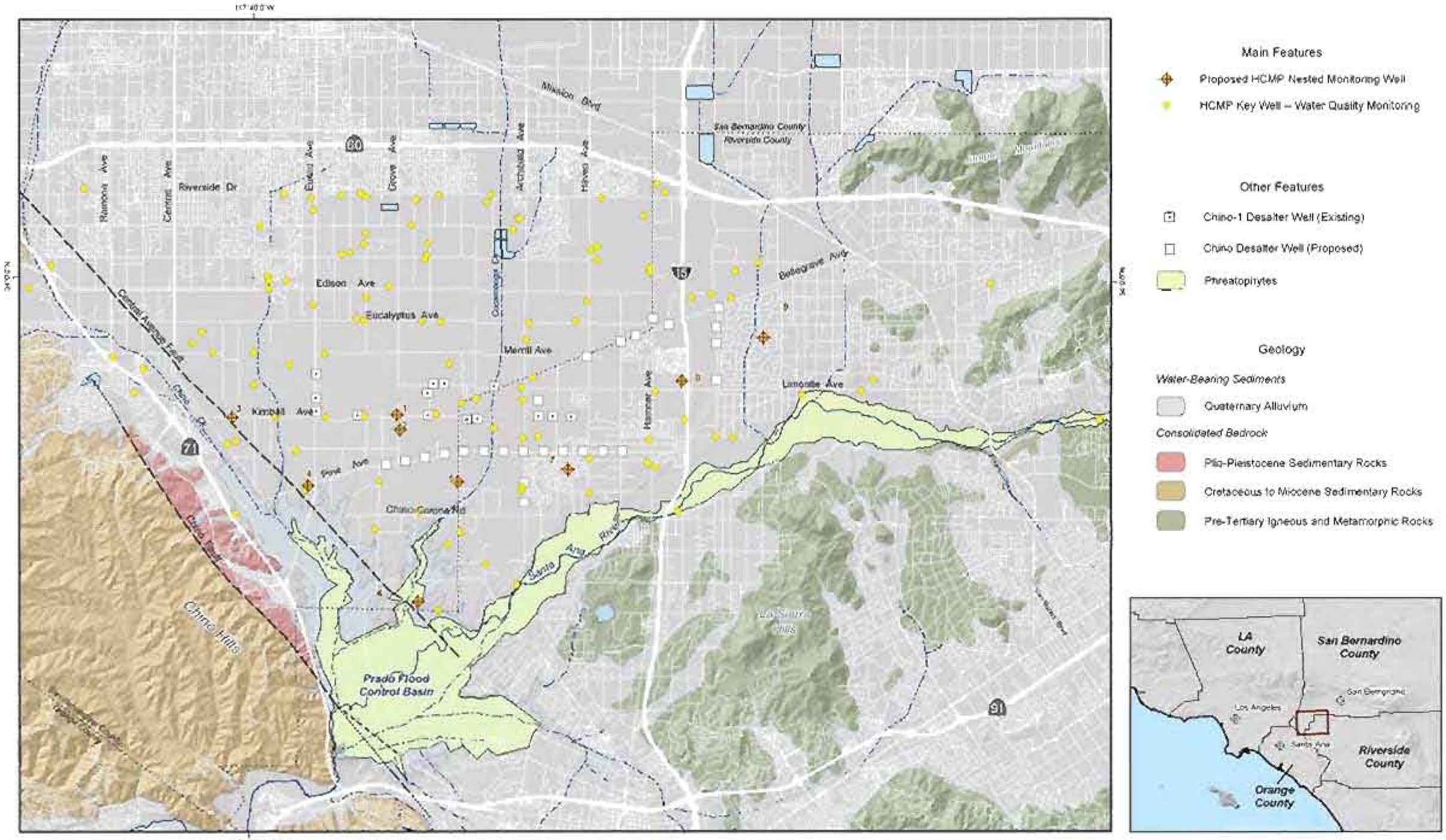
0 1 2 Miles
0 2 4 KM

State of the Basin Report -- 2004
Hydraulic Control

HCMP Key Well Network

Groundwater Levels

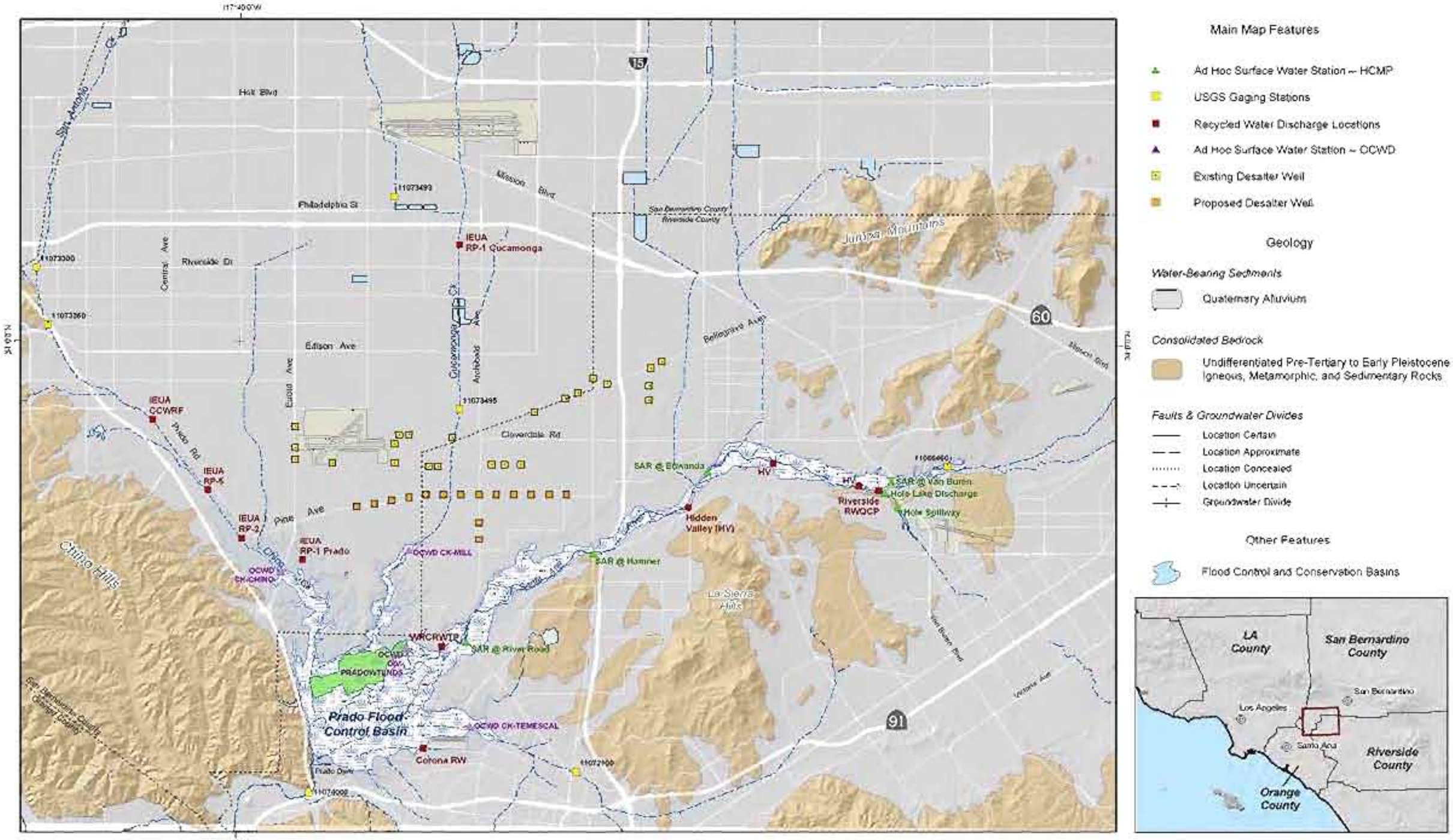
Figure 8-2



HCMP Key Well Network

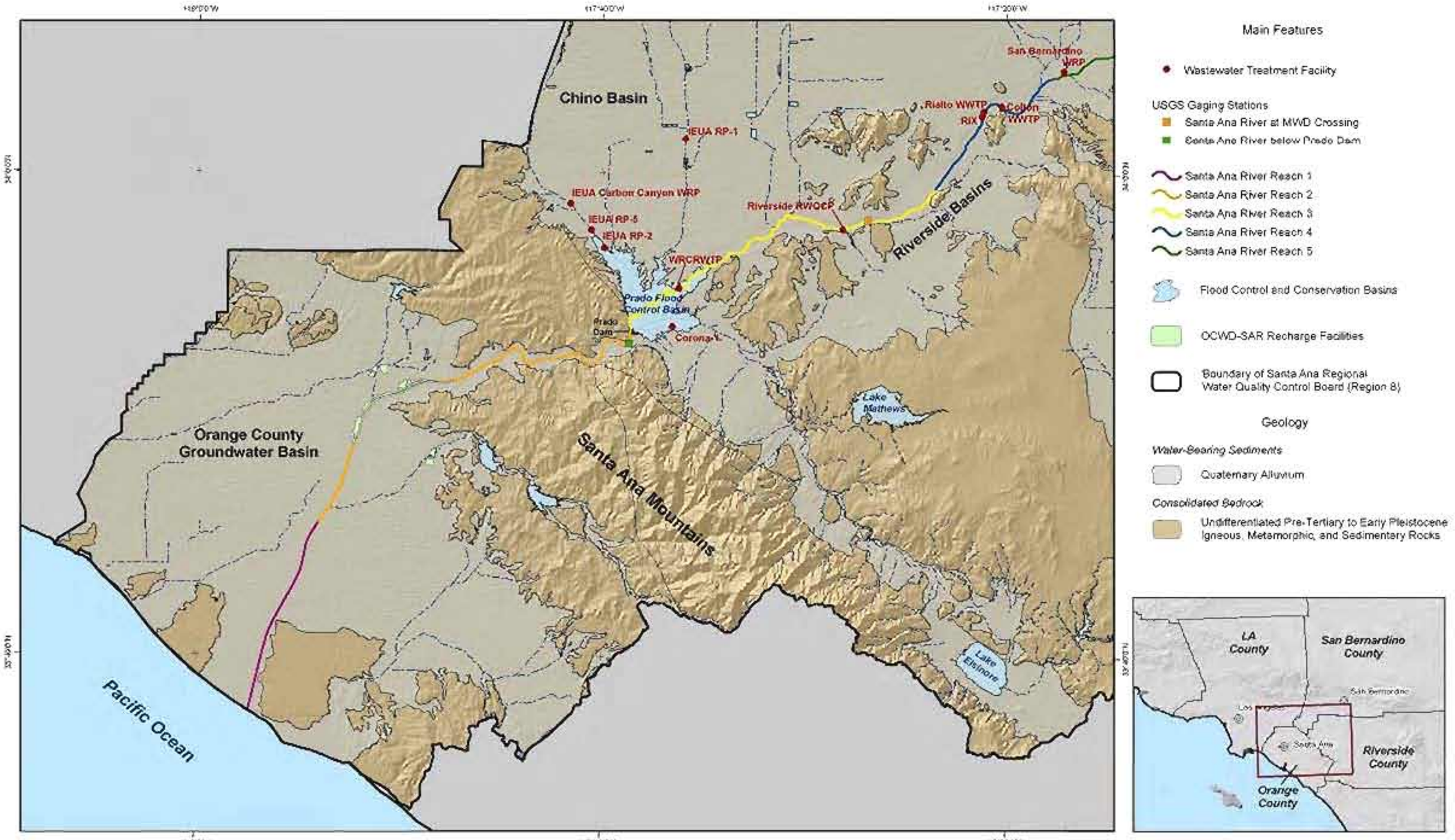
Groundwater Quality

Figure 8-3



Location of Surface Water Stations in the HCMP

Figure 8-4



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State of the Basin Report – 2004
Hydraulic Control

Location of Stream Gages and Points of Recycled Water Discharge to the Santa Ana River Watershed

Figure 8-5

Figure 8-6
Surface Water Discharge Hydrograph for Santa Ana River at MWD Crossing

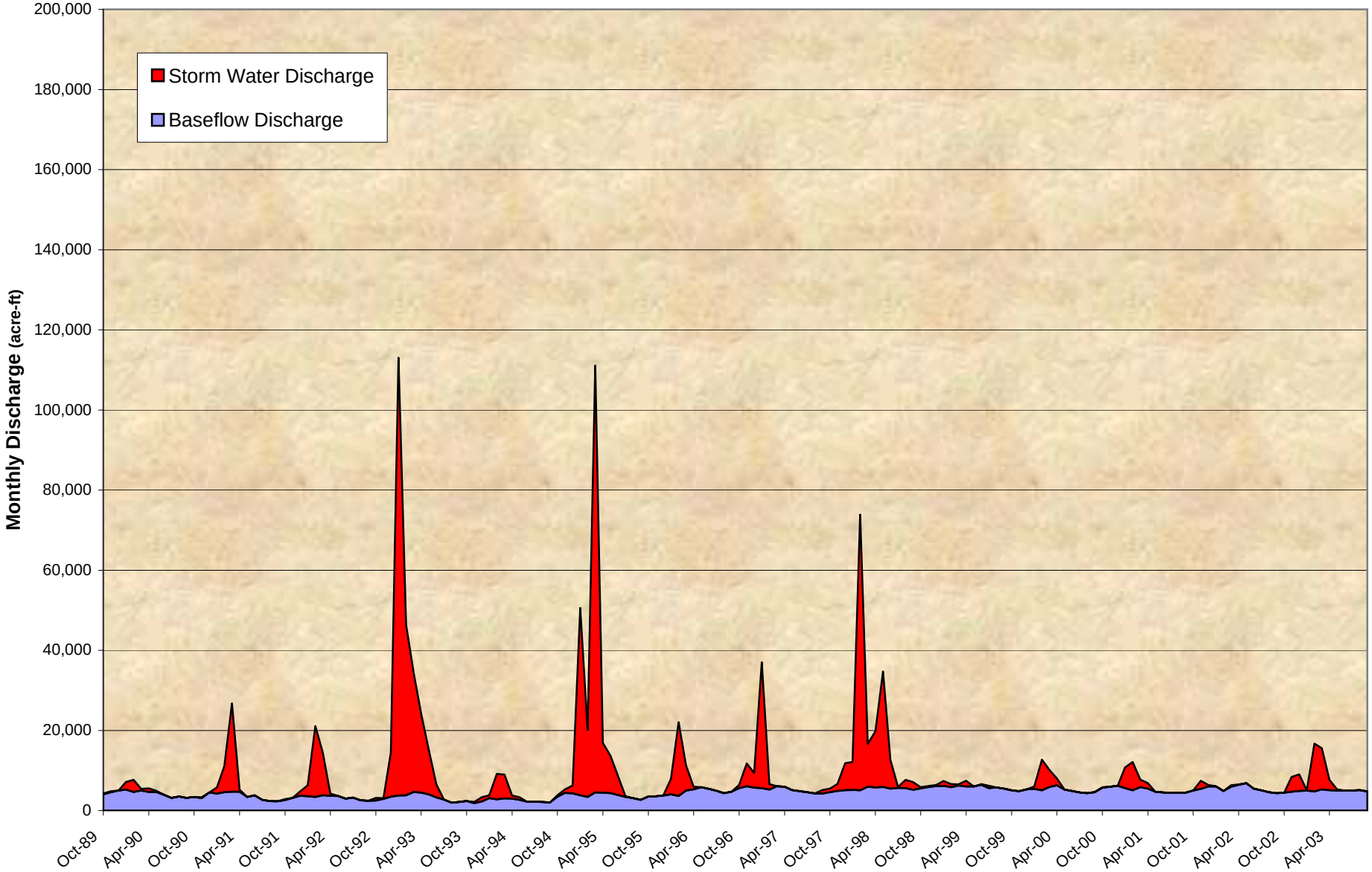

Figure_8-6_8-10.xls -- Fig 8-6 Baseflow and Stor (2)
7/11/2005

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Figure 8-7
Surface Water Discharge Hydrograph for Santa Ana River at Below Prado

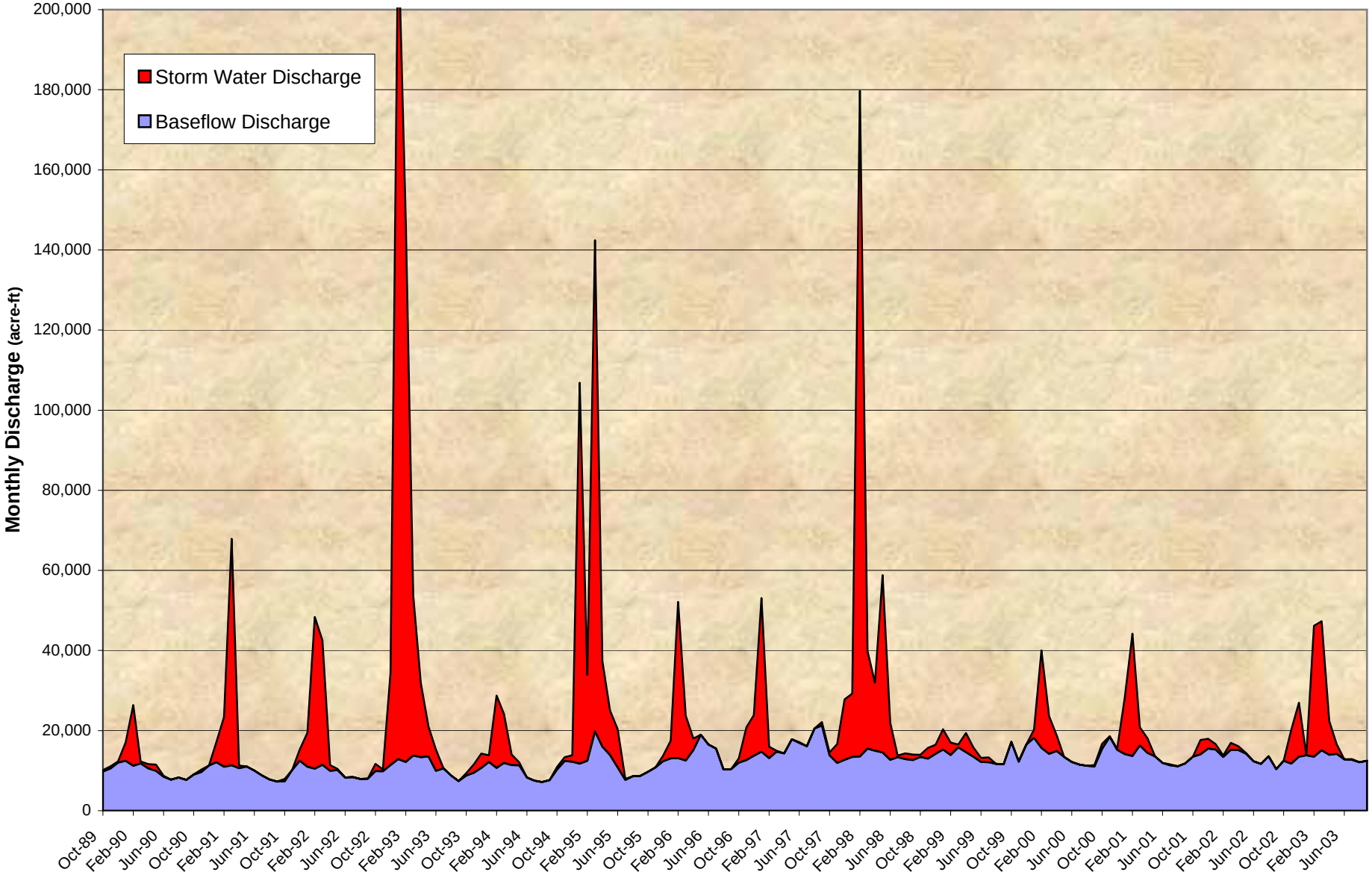

Figure_8-6_8-10.xls -- Figure 8-7 Prado Hydrograph
7/11/2005

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Figure 8-8
Net Annual Rising Groundwater Time History in the Chino Basin 1970/71 through 2002/03

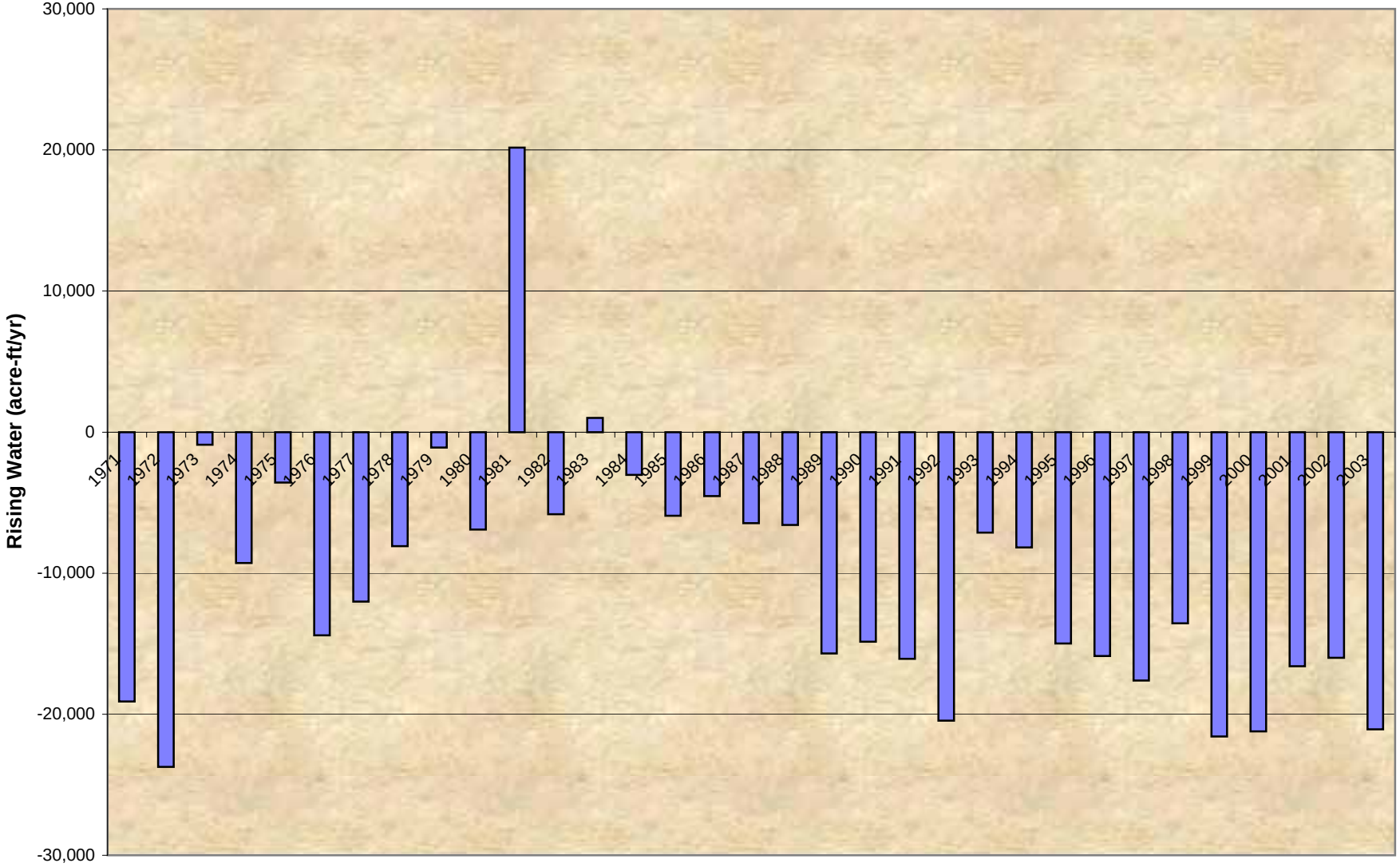

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Figure 8-9 Monthly
Time History of Baseflow Gains and Losses in the Santa Ana River
between Riverside Narrows and Prado Dam -- 1989/90 to 2002/03

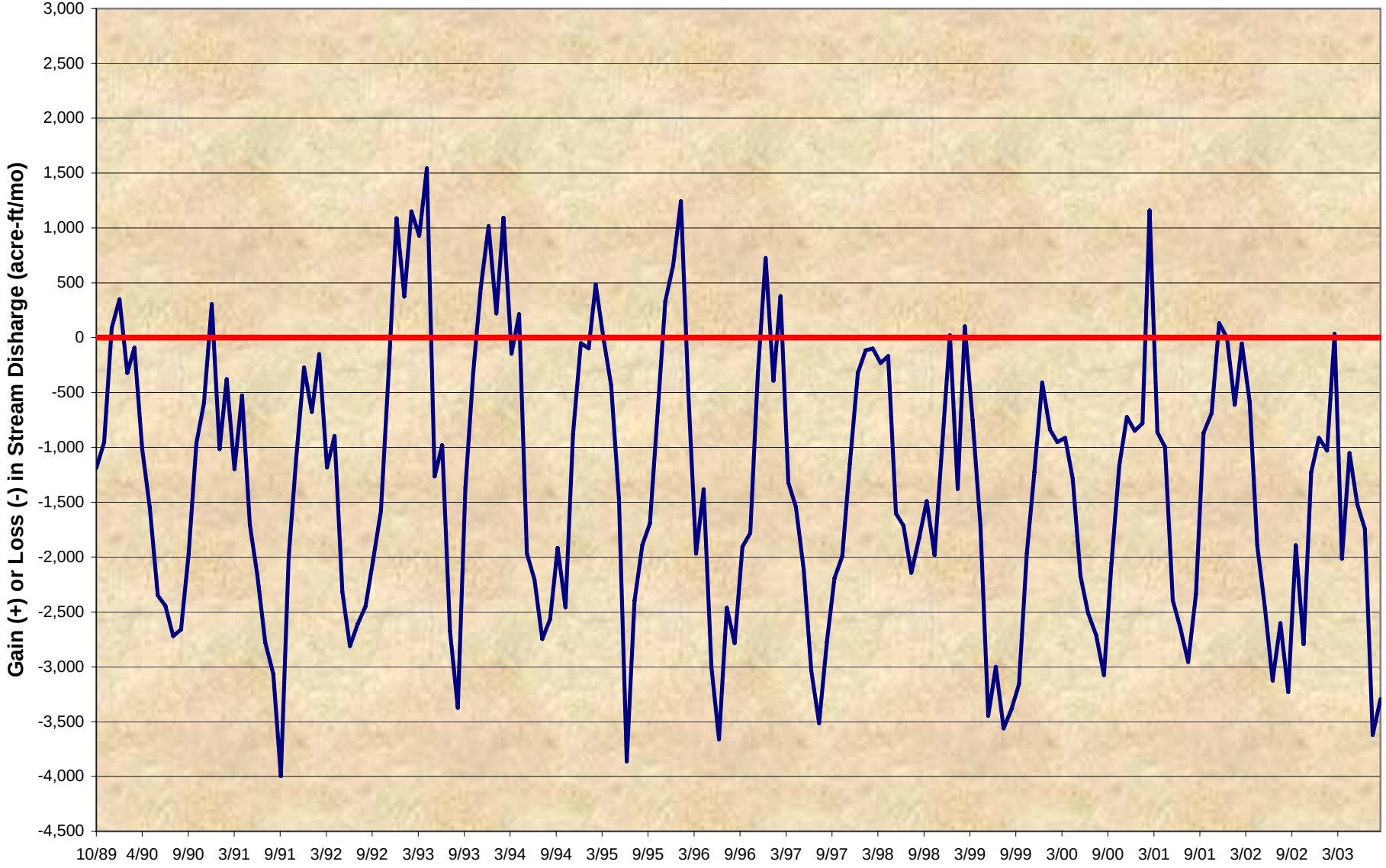

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Figure 8-10
Monthly Distribution of Gains and Losses in Santa Ana River Baseflow between Riverside Narrows and Prado Dam -- 1989/90 to 2002/03

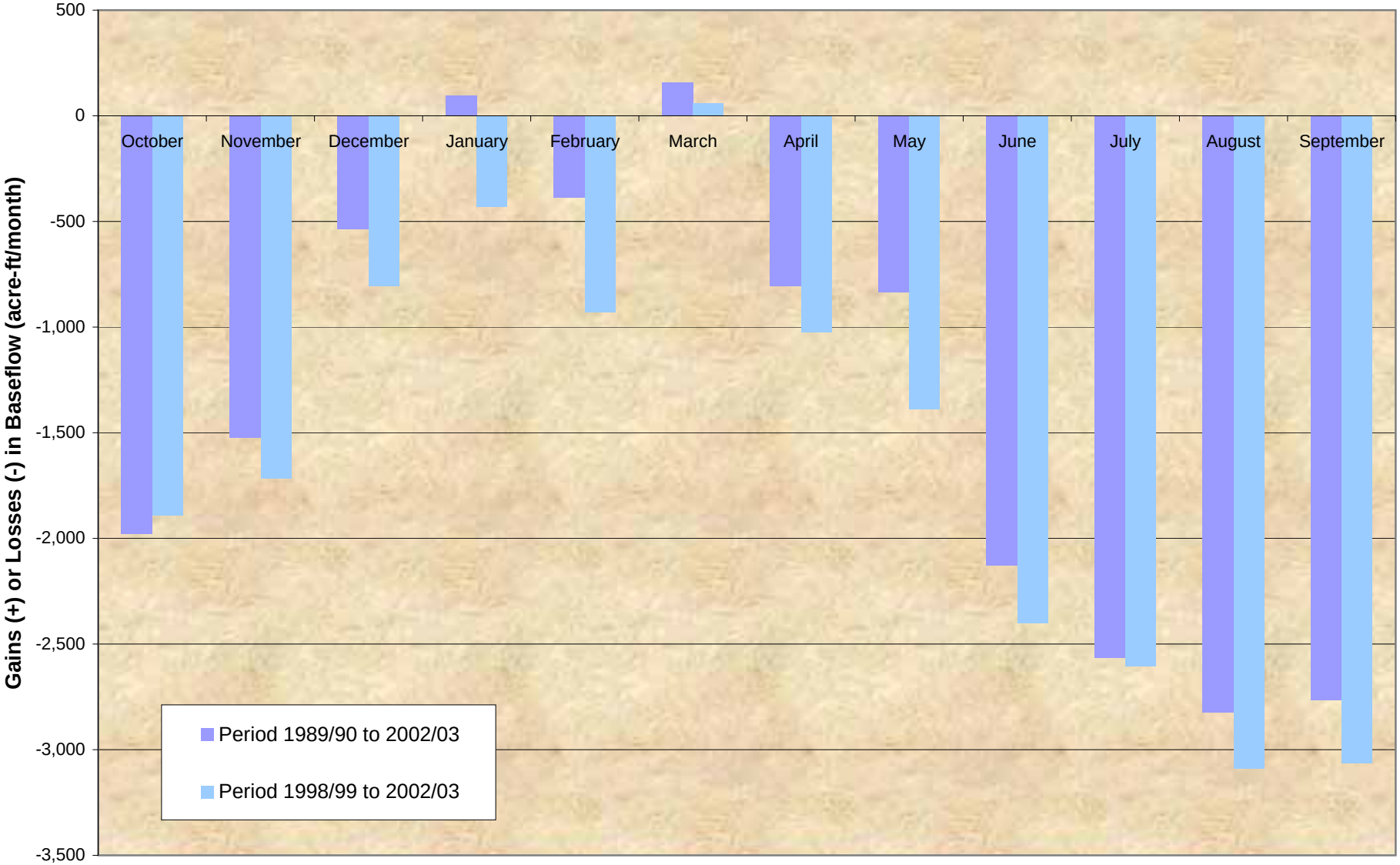

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Figure 8-11
Projected Time History of Total Storage in the Chino Basin for Baseline and Dry-Year Yield Scenarios

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9. Summary of Other OBMP Activities

9.1 Meter Installation Program

The Watermaster Rules and Regulations require that producers of groundwater in excess of ten (10) acre-feet per year shall install and maintain in good operating condition meters on their well(s). Many Agricultural Pool wells did not have properly functioning in-line meters installed on their discharge pipes when the OBMP was adopted. Watermaster initiated a meter installation program for Agricultural Pool wells without properly functioning in-line meters. As of mid-2004, Watermaster equipped 403 of the 517 existing Agricultural Pool wells with operating in-line meters. The other 114 wells have or will become inactive within 18-24 months because of urban development in the southern portion of Chino Basin.

Watermaster staff reads the meters on Agricultural Pool wells quarterly. A "water duty" method is used to estimate production at agricultural wells that do not have meters.

9.2 Chino Desalter Projects

The following status report for the Chino Desalter Authority (CDA) activities are based on the April 2005 Progress Report, prepared by CDA staff.

The CDA Chino I Desalter Expansion and Chino II Desalter Project (Project) includes the construction of the facilities required to expand the existing Chino I Desalter by 5 mgd and the construction of a new 10-mgd Chino II Desalter. The Project began in June 2002 and is estimated to be complete by February 2006. The progress of the major construction activities is described in the following paragraphs.

The treatment processes of the Chino I Desalter (post expansion) and Chino II Desalter are shown diagrammatically in Figures 9-1 and 9-2, respectively.

9.2.1 Chino I Desalter Expansion Facilities

9.2.1.1 Wells

The expansion project well facilities include three new extraction wells and one monitoring well. To date, the construction of the three extraction wells has been completed and the monitoring well has not been drilled. Equipping of the extraction wells is approximately 90 percent complete.

9.2.1.2 On-Site Improvements/Facilities

On-site improvements include bypass piping, a sodium hypochlorite station, a volatile organic compound (VOC) treatment system, expansion of the existing product water pump stations, and installation of ion exchange (IX) facilities. Construction of all on-site facilities, excluding the IX equipment, is approximately 98 percent complete. Construction of the IX treatment facilities are approximately 75 percent complete.

9.2.1.3 Off-Site Improvements/Facilities

The following list summarizes the status of the off-site improvements and facilities for the Chino I Desalter Expansion:

- The raw water pipeline from the new extraction wells to the existing raw water pipeline is complete.
- Design of the Archibald Product Water Pipeline from the Chino I Desalter to the City of Ontario is approximately 90 percent complete.
- The Archibald Product Water Pump Station will deliver water to the City of Ontario service connection. Design of this facility will be complete this month and is currently in the bid phase.
- Construction of the Chino Hills Product Water Pipeline, required to deliver water to the City of Chino Hills, is complete.
- The Chino Hills Pump Station will lift water into the City of Chino Hills water system. Construction of the pump station is approximately 95 percent complete.
- The Chino I Desalter storm drain and Santa Ana Regional Interceptor (SARI) meter facilities include construction of a storm drain within the plant, connecting to the existing City of Chino Storm Drain, air gap structure and replacement of the SARI flow meter system. Construction of these facilities is approximately 35 percent complete.
- The City of Chino Turnout facility includes a connection to the City of Chino water system from the existing CDA/Jurupa Community Services District product water pipeline. Design of this facility is approximately 75 percent complete.

9.2.2 Chino II Desalter Facilities

9.2.2.1 Wells

The Chino II Desalter Project well facilities include the construction of eight new extraction wells, which was split into three drilling construction packages and two equipping packages. Construction of five of the extraction wells is complete and construction of the remaining three is approximately 95 percent complete. Well equipping is currently in progress.

9.2.2.2 On-Site Improvements/Facilities

On-site improvements include site grading and development, yard piping, buildings, roads, and process equipment. Construction of all improvements excluding the IX facilities is approximately 97 percent complete. Construction of the IX facilities is approximately 88 percent complete.

9.2.2.3 Off-Site Improvements/Facilities

The following list summarizes the status of the off-site improvements and facilities for the Chino II Desalter:

- Construction of Phase 1 of the raw water pipeline from the extraction wells to the Chino II Desalter site is approximately 80 percent complete.

- Phase 2 of the raw water pipeline is currently in the bid phase, which will be advertised next month.
- Construction of Phase 3 of the raw water pipeline is approximately 75 percent complete.
- Construction of the Santa Ana River Water Company product water pipeline is complete.
- Construction of the Ontario product water pipeline for connection to the City of Ontario water system is approximately 5 percent complete.
- Construction of the Ontario Pump Station just began. This facility will lift water into the City's water system.
- Construction of the brine line from the Chino II Desalter site to the SARI system is complete.

9.2.3 Comparison of Salt Removal Projection from the Desalter Program as Implemented to OBMP Projection

Table 9-1 contains the projection of desalter production and salt removal capacity for the desalters as envisioned during the development of the OBMP and as contained in Table 3 of Exhibit B in the Peace Agreement. Table 9-1 also contains a projection of desalter production and salt removal capacity from Desalters I and II and the potential future Desalter III. The salt removal capacity is shown graphically in Figure 9-3. The OBMP Peace Agreement projection is fairly comparable to the salt removal capacity projection for the existing desalters if Desalter III is actually built. The slight differences in the projections are due to timing of desalter startup, desalter and ion-exchange recovery rates, and source water quality assumptions in 1999 versus actual water quality.

If Desalter III is not built, the salt removal capacity will be about half of that projected in the OBMP. The southern appropriators are currently planning not to build Desalter III and, instead, to construct new wells north of the high TDS and nitrate areas. All appropriative pool producers are currently engaged in the Peace II process where discussions are being held that will determine if Desalter III will be constructed.

9.3 Storage and Recovery and DYY Programs

9.3.1 Storage and Recovery Programs

Watermaster staff and its Consultants and Attorneys are continuing to pursue potential storage and recovery programs to supplement the Metropolitan Water District of Southern California (Metropolitan) Dry-Year Yield Program (DYY Program). Preliminary discussions have been held with Castaic Lake Water Agency, Western Municipal Water District, and San Diego County Water Authority for potential storage programs.

As determined during the development of the Metropolitan DYY Program, Chino Basin Appropriators have a fixed in-lieu capacity due to their current imported water purchase capacities. Therefore, the storage and recovery programs being considered are mainly "export" type projects where water is stored within the Chino Basin and exported from the basin upon demand. Additional mechanisms available to store water in the Chino Basin include wet water recharge and groundwater injection. If possible, water could also be stored in the Chino Basin using any available in-lieu capacity above and beyond the requirements of the DYY Program.

9.3.2 Dry-Year Yield Program

The DYY Program is the first step in a phased plan to develop and implement a comprehensive conjunctive use program to allow maximum use of imported water available during wet years and stored groundwater during dry years. The DYY Program is a conjunctive use program between Metropolitan and eight basin appropriators, which would develop a maximum of 100,000 acre-feet (AF) of storage. Participants in the DYY Program will be required to reduce (shift) their imported water usage by a predetermined amount during a dry year. Each participating agency has a specific shift obligation that, when added together, will provide Metropolitan with a total of 33,000 AF of dry year yield. The shifts for the participating agencies are listed in Table 9-2.

9.3.3 Final Design of DYY Facilities

The designs for the facilities outlined in the DYY Program Preliminary Design Report (July 2003) are either currently underway, completed, or will commence shortly. Final Plans and Specifications for the facilities are scheduled to be completed by the end of September 2005 with the exception of Chino Hills, which will be completed in August of 2006 (an extension to the Metropolitan-imposed design deadline should be processed). The DYY facilities are required to be constructed by March 8, 2008 to qualify for funding by Metropolitan. The status of each appropriator's DYY facilities is summarized in Table 9-3.

9.4 Data Exchange (DataX)

IEUA and Watermaster maintain information related to local surface water diversion and use, recycled water production and use, groundwater production, recharge of supplemental and storm water, water quality data associated with all forms of water, groundwater level, and monitoring station data independently in their own formats and for their own purposes. Each entity uses their data to generate reports at regular frequencies for internal management, internal accounting, and regulatory and planning purposes. The use of different formats for storing and maintaining these data makes the current sharing of these data expensive and leads to errors in the analyses of these data and duplicate efforts in collecting, managing, and storing data. Watermaster and IEUA recognized the issues described above and desired to formalize a data collection and sharing process to minimize the cost of acquiring certain water resources data, to share these data with all interested entities, and to increase the integrity of the data. Watermaster and IEUA are proceeding with the development of the Data Exchange System (DataX).

At completion in June 2005, the implementation of DataX will consist of these five main elements:

- DataX security to allow only permitted users access to information
- IEUA database including data for recycled water, imported water, and supplemental water
- Watermaster database including data for water quality, water level, and water production
- DataX user interface using an off-the-shelf, web-enabled product called Mapplet.NET by DCSE
- User's guide and documentation

The DataX security element will define the security and access rules as outlined by both IEUA and Watermaster. The development of the IEUA and Watermaster databases will provide the core elements of DataX. The Mapplet.NET user interface will provide seamless access to DataX for both IEUA and Watermaster users. The user's guide and documentation will facilitate the use of DataX by end users at both agencies.

Currently, the recycled water data maintained by IEUA can be accessed through an MS-Access based user interface. Imported water data, including the ability to collaborate data with MWD bills, are currently being implemented. Water quality, level, and production data maintained by Watermaster can be accessed through its own MS-Access based user interface. The ability to exchange water quality data from IEUA's laboratory information management system (LIMS) to DataX is being tested. The Mapplet.NET user interface has been successfully implemented with more customized data viewing and extraction capabilities developed daily. One of the main features of DataX will be the ability to enter data securely through web forms which are scheduled to be developed in the coming months.

9.5 Cooperative Agreement between Watermaster and IEUA

Implementation of the program elements of the OBMP requires that hydraulic control be maintained in the southerly portion of the Chino Groundwater Basin. Hydraulic control is achieved if groundwater levels are kept at a low level, by desalter and agricultural pumping, to minimize groundwater flow into the Prado Basin. Maintaining hydraulic control enables the use of the Chino Basin for conjunctive use and allows IEUA to recharge recycled water.

Watermaster and IEUA jointly proposed to the Regional Water Quality Control Board to substantially increase the TDS and nitrogen objectives in the northern part of the Chino Basin to encourage the maximum beneficial use of imported and recycled water. This request was granted and was included in the Basin Plan update, which was adopted in December 2004. One of the conditions included in this proposal was that Watermaster and IEUA would implement the OBMP and achieve hydraulic control.

IEUA entered into an agreement with Orange County Water District in October 2002, for mitigation measures associated with IEUA's planned recycled water program, which includes recycled water recharge. A significant mitigation measure is monitoring to assure hydraulic control is maintained. IEUA and Watermaster are co-permitees for the recharge of recycled water and have extensive groundwater and surface water monitoring requirements.

Watermaster staff has developed a hydraulic control monitoring program consisting of nine hydraulic control monitoring wells. The cost of the installation of the nine wells was estimated at $1,500,000. IEUA has obtained funding from the Bureau of Reclamation ($400,000) and the Department of Water Resources ($250,000). The balance of the cost is be funded equally by IEUA and CBWM.

Watermaster and IEUA staff determined that they had mutual monitoring needs. Watermaster and IEUA staff developed an agreement to share in the monitoring efforts in the basin with the intent of minimizing the cost of data acquisition, laboratory services, and data management. Every year, Watermaster and IEUA will develop a monitoring plan for the following year and develop a cost allocation. Currently, Watermaster and IEUA are completing the first year (fiscal 2004/05) under the cooperative agreement and have developed a plan for the second year (fiscal 2005/06)

The types of data being collected in the cooperative program include surface water quality at recharge basins, surface water quality in the Santa Ana River, soil water samples from lysimeters at recharge basins, groundwater quality, groundwater level, and surface water discharge measurements in the Santa Ana River. Watermaster staff will complete most of the fieldwork and IEUA will do most of the analytical work at their laboratory. Data from other agencies that collect similar data is collected and

entered into the joint Watermaster and IEUA database (DataX). The estimated cost of monitoring for the first year, exclusive of HCMP well construction expenses, is summarized below:

Monitoring Program Element	Watermaster Share	IEUA Share
Groundwater Quality Monitoring	$42,000	$42,000
Hydraulic Control Monitoring	$100,000	$100,000
Recharge Basin Water Quality Monitoring	$144,000	$247,000
Total	$286,000	$389,000

9.6 Balance of Recharge & Discharge

9.6.1 Background

In 2003, Watermaster staff prepared an analysis of the Balance of Recharge and Discharge pursuant to the Peace Agreement and documented this effort in September 2003. This Section contains the September 2003 report in its entirety.

Section 5.1 (e) of the Peace Agreement contains the Watermaster commitments regarding the recharge of supplemental water in the Chino Basin. This analysis focuses on Watermaster's implementation of the Peace Agreement Section 5.1 (e), items (i), (iii), (v), (vii), and (viii), that are as follows (see Peace Agreement, pages 20 and 21):

"Watermaster shall exercise Best Efforts to:

(i) protect and enhance the safe yield of the Chino Basin through Replenishment and Recharge; …

(iii) direct Recharge relative to Production in each area and sub-area of the Basin to achieve long term balance and to promote the goal of equal access to groundwater in all areas and sub-areas of the Chino Basin; …

(v) establish and periodically update criteria for the use of water from different sources for Replenishment purposes; …

(vii) recharge the Chino Basin with water in any area where groundwater levels have declined to such an extent that there is an imminent threat of Material Physical Injury to any party to the Judgment;

(viii) maintain long-term hydrologic balance between total Recharge and discharge in all areas and sub-areas;"

Maximization of the recharge of storm water is occurring and the related requirements of the Peace Agreement and Watermaster Rules and Regulations are being satisfied.

The *OBMP Implementation Plan* (Exhibit B of the Peace Agreement) contains identical language to the Peace Agreement Section 5.1 (e), but is mostly silent as to the schedule for implementation of the specific commitments listed above (see Exhibit B, paragraph 11 on page 20 and the implementation schedule on pages 22 and 23). Paragraph 9 on page 20 of the *OBMP Implementation Plan* includes additional recharge guidelines that Watermaster must consider regarding recharge:

> "9. When locating and directing physical recharge, Watermaster shall consider the following guidelines:
> (i) provide long term hydrologic balance within the areas and sub-areas of the basin
> (ii) protect and enhance water quality
> (iii) improve water levels
> (iv) the cost of recharge water
> (v) any other relevant factors"

Section 7 of the Rules and Regulations repeats the commitments of Section 5.1 (e) of the Peace Agreement and adds (see Rules and Regulations, page 37, 7.1 (b) (iv)):

"(b) Watermaster shall exercise Best Efforts to: …

> (iv) Make its initial report on the then existing state of Hydrologic Balance by July 1, 2003, including any recommendations on Recharge actions which may be necessary under the OBMP. Thereafter, Watermaster shall make written reports on the long term Balance in the Chino Basin every two years; …"

This technical memorandum was prepared pursuant to the requirements of the Peace Agreement and the Watermaster Rules and Regulations cited above.

9.6.2 Analysis

WEI developed a new groundwater model (hereafter, the 2003 Watermaster Model) for the Chino Basin in support of the Chino Basin Watermaster, Inland Empire Utility Agency (IEUA), and Metropolitan Water District of Southern California (Metropolitan) Dry-Year Yield (DYY) Program. The 2003 Watermaster Model was used to evaluate the magnitude of groundwater level and storage changes throughout Chino Basin, the change in direction and speed of specific known water quality anomalies, and the storage losses from the DYY Program. This was accomplished by first determining a baseline OBMP scenario, second by simulating the baseline OBMP and DYY scenarios, and third by comparing the model results of the baseline OBMP and DYY scenarios. The planning period used in this analysis consisted of a 25-year period ranging from October 2003 through September 2028. This period corresponds to the 25-year period of the DYY Program. The impacts listed above were estimated by:

- Preparing maps that show the maximum differences in groundwater levels at the point of peak storage and at the end of a DYY extraction period. Time histories at the same wells used in the calibration were plotted to show local impacts at each of these wells.
- Preparing maps that show the plume migration tracks for the baseline and DYY scenarios over the planning period. Each plume was modeled as though the contaminant of concern was a conservative (non-sorbing, non-degrading) constituent using MODPATH.
- Preparing time histories of Santa Ana River discharge for the baseline and DYY scenarios and comparing these time histories for the planning period. The total water lost from storage was estimated by subtracting the baseline time history from the DYY time history.

9.6.2.1 Baseline OBMP Scenario

The baseline scenario is based on a modified version of the water supply plan from the *OBMP Implementation Plan* (Table 2 of Exhibit B of the Peace Agreement). The water supply plan from the Implementation Plan contains future groundwater production plans for all producers in the Chino Basin. Black and Veatch modified the water supply plan for the water purveyors that are participating in the DYY Program and WEI used the water supply plan from the Implementation Plan for the remaining producers.

Table 9-4 shows the baseline groundwater production time history. Groundwater production in the basin ranges from 197,000 acre-ft/yr in 2003/2004 to about 210,000 acre-ft/yr in 2019/2020 and thereafter. Watermaster's replenishment obligation was estimated using the following assumptions pursuant to the Judgment and the Implementation Plan:

- The initial increase in stormwater recharge that is anticipated from the Chino Basin Facilities Improvement Plan is about 12,000 acre-ft/yr with a goal of about 20,000 acre-ft/yr. To be conservative, the increase in stormwater recharge was assumed to be 12,000 acre-ft/yr.
- OBMP desalter capacity is increased from the current level of 8 million gallons per day (mgd) in 2002/2003 to 40 mgd as per the water supply plan from the Implementation Plan. Half of the production from the desalters will come from decreased rising water and new induced recharge from the Santa Ana River.
- The Judgment allows a 5,000 acre-ft/yr overdraft of Chino Basin through 2017.

Table 9-4 contains the replenishment obligation pursuant to the Judgment and the Implementation Plan, which ranges from about 30,000 acre-ft/yr in 2003/2004 to about 34,000 acre-ft/yr in 2019/2020 and is constant thereafter. An analysis of actual recent production in the Chino Basin indicates that the production and replenishment estimated in Table 9-4 may be higher than will actually occur in first few years of the baseline scenario. For consistency with the OBMP planning documents, the production and replenishment estimates in Table 9-4 were used.

The locations and magnitude of recharge shown in Table 9-4 were based on the requirements of the Peace Agreement to balance recharge and discharge in every area and sub-area. This requirement must be met over a period of time, which was assumed herein as a long-term requirement. Thus, in an individual season or year there might not be a balance between recharge and discharge in an area, sub-area, or the basin.

Balancing recharge and discharge may be critical to the management of the subsidence-prone area in MZ1. Watermaster is currently involved in an investigation to develop a management program for this subsidence-prone area. Until that management program is developed, it is assumed that Watermaster replenishment and groundwater production would be managed such that groundwater levels would remain near or above current levels in the southern part of MZ1. Current groundwater levels were assumed to be the groundwater levels at the end of the calibration period of the 2003 Watermaster Model; the groundwater levels were from fall 2001. In the rest of the basin, replenishment would be managed to maximize desalter replenishment from a combination of reduced rising water to the Santa Ana River and increased streambed recharge from the Santa Ana River.

The 2003 Watermaster Model was used to investigate the recharge requirements for managing groundwater levels in MZ1 and determine the theoretical potential of induced recharge from the Santa Ana River. The results of this work are summarized in Table 9-4, which shows the location and magnitude of supplemental water recharge. Approximately 75 percent of the recharge will be needed in the College Heights, Upland, Montclair, and Brooks spreading basins to manage groundwater levels in the western part of the basin. The locations of these recharge facilities are shown in Figure 9-4. The remaining 25 percent is shown to occur in the San Sevaine and RP3 spreading facilities; however, there is some flexibility in the selection of facilities that could be used in the eastern part of the basin. Figures 9-5a, 9-5b, and 9-5c illustrate the model-estimated change in groundwater levels over the 25-year planning period for the baseline scenario. Throughout the duration of the baseline scenario, groundwater levels in the western part of the Chino Basin remain near or above the fall 2001 groundwater levels. Groundwater levels in the other parts of Chino Basin declined over the planning period to levels that support decreased rising water to the Santa Ana River and increased streambed recharge from the Santa Ana River. Groundwater levels declined the most in the Fontana area—as much as 30 to 40 feet near the far eastern edge of the Fontana area. In the subsidence-prone area in MZ1, there was almost no change in groundwater levels. In the area north of the subsidence-prone area, there was a slight increase in groundwater levels due to the shifting of Watermaster's replenishment to this area as shown in Table 9-4. The effect of the desalters is evident in the south-central part of Chino Basin where groundwater levels declined in excess of 25 feet.

The total storage in the Chino Basin declined monotonically during the baseline scenario from a high of 5,940,000 acre-ft in fall 2003 to 5,730,000 acre-ft in fall 2028—a decline of about 210,000 acre-ft. Figure 9-6 shows the estimated groundwater storage for the Chino Basin during the planning period. The modeling results suggest that the total storage in the basin appears to be asymptotically approaching a level near 5,700,000 acre-ft. This decline in storage is necessary to induce the recharge of the Santa Ana River.

9.6.2.2 Analysis of Material Physical Injury

Based on the analysis described above, there is no projected material physical injury to a Party to the Judgment or to the Chino Basin from the proposed recharge program in the baseline OBMP scenario.

The only location where significant increases in groundwater levels occur is in the vicinity of the recharge basins in Upland and Montclair (College Heights, Upland, Montclair, and Brooks Street Basins) where the depth to water is 300 feet or greater. Under the baseline scenario, groundwater levels are projected to remain almost unchanged in the western third of the basin. In the center of Chino Basin, groundwater levels are projected to decrease by about 15 to 20 feet, and at the far eastern edge of the basin, north of the Jurupa Hills, groundwater levels are projected to decrease by as much as 40 feet. In addition, groundwater levels are projected to decline 25 feet or more in the vicinity of the OBMP desalter well fields with most of this drawdown caused by desalter operation. Slight increases in production costs will occur and slight decreases in production capacity might occur in these areas of groundwater level decline. For the members of the Appropriative Pool, the added cost of production will be more than offset by the savings provided by the avoided purchase of supplemental water for desalter replenishment. Production costs could increase about $3.50 per acre-ft (assuming $0.10 per kilowatt-hour, 60 percent pumping efficiency, and an average additional lift of 20 feet). The producers that will be impacted by operating the basin at about 20 feet lower under the baseline scenario are the City of Ontario, Cucamonga County Water

District, Fontana Water Company, and Jurupa Community Water District whose combined production averages about 80,000 acre-ft during the baseline scenario. The increased power cost totals about $240,000 per year. Operating the basin at this lower level avoids the cost of purchasing about 24,600 acre-ft/yr of supplemental water at a cost of about $6,000,000 if the replenishment water consists of State Water Project water and about $2,000,000 if it consists of recycled water.

A similar analysis was done for the Agricultural Pool producers (see Appendix A). The results of this analysis suggest that the average increase in power cost to agricultural producers is about $1.50 per acre-ft over the planning period and that the estimated cumulative increase in power cost over the planning period for all agricultural production is about $340,000 or about $14,000 per year.

Under the baseline scenario, the groundwater levels in the subsidence-prone part of MZ1 are projected to remain near or above current levels. This occurs because of the recharge program described in Table 9-4 and deep groundwater pumping in the subsidence-prone area were adjusted to maintain groundwater levels near or above current levels. This is a minimum, necessary condition to minimize subsidence and ground fissuring in this area. Groundwater levels in this area should be managed using this criterion until Watermaster can implement a long-term management program for subsidence; after which, groundwater levels in this area would be managed according to the long-term management program.

9.6.2.3 Limitations of this Analysis

Significant amounts of new information regarding the hydrogeology of the MZ1 area have been developed since the 2003 Watermaster Model was developed and calibrated. This new information seems to suggest that the deeper water bearing units that underlie the subsidence area are recharged much slower than predicted by the model. If this is true, it would imply that the model may exaggerate the benefits from the spreading of water in the northern part of MZ1 on piezometric levels in the subsidence-prone area. By extension, this implies that the management of piezometric levels in the subsidence-prone area in MZ1 will likely be done by reducing groundwater production from the deeper aquifer units, recharge by injection, or a combination of both. Given the limitations of the model and the uncertainty in the contents of the long-term MZ1 management program, the results of this analysis should be used as guidelines for planning recharge activities until the long term management plan for MZ1 is implemented. It is likely in the long term that significant quantities of future replenishment by Watermaster will need to occur in MZ1. However, the location and magnitude of future recharge should depend on the actual production by producers in MZ1, which could be different than was assumed in the OBMP and this analysis.

9.6.3 Recommended Supplemental Recharge Program for the Next Five Years

We recommend the following actions by Watermaster regarding the recharge of supplemental water:

- Continue supplemental water recharge in MZ1 as is currently done (6,500 acre-ft/yr) for two more years. The need to continue this recharge should be reevaluated in the spring of 2005.

- Should Watermaster need to replenish over-production, the replenishment should be done in MZ1, if possible, up to the amount shown in Table 9-4. Watermaster should monitor groundwater levels in MZ1 to ensure that this level of recharge is sufficient to maintain groundwater levels throughout MZ1 in the short term until the long-term MZ1 management program is implemented.

- The 2003 Watermaster model should be recalibrated prior to the completion of the long-term MZ1 management program. The revised model should be used to assess the viability of the management program and the need for supplemental water recharge in the program.

- For the next five years Watermaster should assume that half of the desalter replenishment obligation will come from reduced rising water outflow to the Santa Ana River and induced inflow from the Santa Ana River. The 2003 Watermaster Model should be recalibrated at the end of this five-year period to verify recharge assumptions regarding the Santa Ana River. This, of course, requires that Watermaster continue to monitor groundwater levels throughout the basin.

- Per the requirements of the Peace Agreement, Watermaster should review the applicability of these recommendations in the spring of 2005 and make revisions as appropriate.

Table 9-1
Comparison of Chino Basin Salt Removal Projections from the OBMP Peace Agreement and Current Forecast

Year	Projected OBMP Desalter Production and Salt Removal from Exhibit B of the Peace Agreement, Table 3							Projected Desalter Production and Basin Salt Removal from Existing Desalters I and II and Potential Future Desalter III								
	Product Water Capacity				Salt Removal			Product Water Capacity					Salt Removal			
	Desalter I (mgd)	Desalter II (mgd)	Total (mgd)	Total (acre-ft)	Desalter I (tons)	Desalter II (tons)	Total (tons)	Desalter I (mgd)	Desalter II (mgd)	Desalter III (mgd)	Total (mgd)	Total (acre-ft)	Desalter I (tons)	Desalter II (tons)	Desalter III (tons)	Total (tons)
2000	4.7	0.0	4.7	5,265	5,436	0	5,436	0.0	0.0	0.0	0.0	0	0	0	0	0
2001	8.0	0.0	8.0	8,961	9,205	0	9,205	0.0	0.0	0.0	0.0	0	0	0	0	0
2002	8.0	0.0	8.0	8,961	9,250	0	9,250	8.4	0.0	0.0	8.4	4,705	7,476	0	0	7,476
2003	10.0	10.0	20.0	22,403	12,881	22,697	35,578	8.4	0.0	0.0	8.4	9,409	14,951	0	0	14,951
2004	10.0	12.0	22.0	24,643	12,881	27,176	40,057	8.4	0.0	0.0	8.4	9,409	14,951	0	0	14,951
2005	10.0	12.0	22.0	24,643	12,881	27,176	40,057	8.4	0.0	0.0	8.4	9,409	14,951	0	0	14,951
2006	12.0	12.0	24.0	26,884	14,134	27,176	41,310	13.3	10.0	0.0	23.3	26,099	23,673	16,890	0	40,563
2007	12.0	12.0	24.0	26,884	14,134	27,176	41,310	13.3	10.0	0.0	23.3	26,099	23,673	16,890	0	40,563
2008	12.0	14.0	26.0	29,124	14,134	30,755	44,889	13.3	10.0	0.0	23.3	26,099	23,673	16,890	0	40,563
2009	12.0	14.0	26.0	29,124	14,134	30,755	44,889	13.3	10.0	0.0	23.3	26,099	23,673	16,890	0	40,563
2010	12.0	14.0	26.0	29,124	14,134	30,755	44,889	13.3	10.0	10.0	33.3	37,301	23,673	16,890	25,473	66,036
2011	12.0	14.0	26.0	29,124	14,134	30,755	44,889	13.3	10.0	10.0	33.3	37,301	23,673	16,890	25,473	66,036
2012	12.0	14.0	26.0	29,124	14,134	30,755	44,889	13.3	10.0	10.0	33.3	37,301	23,673	16,890	25,473	66,036
2013	12.0	20.0	32.0	35,845	14,134	45,215	59,349	13.3	10.0	10.0	33.3	37,301	23,673	16,890	25,473	66,036
2014	12.0	20.0	32.0	35,845	14,134	45,215	59,349	13.3	10.0	16.7	40.0	44,806	23,673	16,890	42,539	83,102
2015	12.0	20.0	32.0	35,845	14,134	45,215	59,349	13.3	10.0	16.7	40.0	44,806	23,673	16,890	42,539	83,102
2016	14.0	20.0	34.0	38,085	16,651	60,573	77,224	13.3	10.0	16.7	40.0	44,806	23,673	16,890	42,539	83,102
2017	14.0	26.0	40.0	44,806	16,651	60,573	77,224	13.3	10.0	16.7	40.0	44,806	23,673	16,890	42,539	83,102
2018	14.0	26.0	40.0	44,806	16,651	60,573	77,224	13.3	10.0	16.7	40.0	44,806	23,673	16,890	42,539	83,102
2019	14.0	26.0	40.0	44,806	16,651	60,573	77,224	13.3	10.0	16.7	40.0	44,806	23,673	16,890	42,539	83,102
2020	14.0	26.0	40.0	44,806	16,651	60,573	77,224	13.3	10.0	16.7	40.0	44,806	23,673	16,890	42,539	83,102

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Table 9-2

Participating Agencies DYY Shift Obligations

Local Retail Agency	DYY Program Shift Obligation (AFY)
City of Chino	1,159
City of Chino Hills	1,448
Cucamonga Valley Water District	11,353
Jurupa Community Services District	2,000
Monte Vista Water District	3,963
City of Ontario	8,076
City of Pomona	2,000
City of Upland	3,001
Total	**33,000**

Note:

(1) Fontana Water Company is no longer a participant in the DYY Program. Cucamonga Valley Water District has assumed FWC's shift obligation.

Table 9-3

Status of DYY Program Facilities by Agency

Agency	Facility Name	Final Plans and Specs Completion	Construction Completion
City of Chino	Northwest B IX	Jun-05	Dec-07
City of Chino Hills	Southwest IX	Aug-06	Aug-07
CVWD	North Central IX	Mar-05	Mar-06
	Well No. 39, 40, 41 & 42	Completed	Underway
MVWD	Northwest B IX	Jun-05	Dec-07
	Richton Monte Vista Well	Jun-05	Jun-06
	Plant No. 9 ASR Well	Aug-04	May-05
City of Ontario	Central IX	Sep-05	Jan-07
	Well No. 1, 2, 3, 4, & 5	Sep-05	Jan-07
City of Pomona	West IX	Completed	Jun-05
City of Upland	Northwest IX	Completed	Jan-06
JCSD	Teagarden IX Expansion	Completed	Feb-05

Table 9-4
Total Chino Basin Production, Watermaster Replenishment Requirement and Replenishment Plan that Balances Recharge and Discharge for Baseline Scenario

(1)	(2)	(3)	(4)	(5)	(6) = (2) - (3) - (4) - (5)	(7)	(8)	(9)	(10)	(11)	(12) = Σ(7) to (11)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20) = Σ(13) to (18	(21) = (12) + (20)
						Supplemental Water Recharge Plan														
						MZ1 Recharge Basins						MZ2 and MZ3 Recharge Basins								Total
Fiscal Year	Production	Operating Yield	New Stormwater	SAR Inflow	Replenishment Obligation	MZ1 Goal	Montclair 1-4 0.25	Upland 0.15	College Hts 0.15	Brooks 0.15	Subtotal	San Sevaine 0.25	Victoria	Banana + Hickory	Etiwanda Cons	Etiwanda Perc	RP3 0.05	Declez	Subtotal	
2004	196,577	145,000	12,000	9,989	29,588	20,712	20,712	0	0	0	20,712	8,876	0	0	0	0	0	0	**8,876**	**29,588**
2005	197,542	145,000	12,000	10,710	29,832	20,882	7,458	4,475	4,475	4,475	20,882	7,458	0	0	0	0	1,492	0	8,949	29,832
2006	195,715	145,000	12,000	10,888	27,827	19,479	6,957	4,174	4,174	4,174	19,479	6,957	0	0	0	0	1,391	0	8,348	27,827
2007	197,912	145,000	12,000	13,053	27,858	19,501	6,965	4,179	4,179	4,179	19,501	6,965	0	0	0	0	1,393	0	8,358	27,858
2008	196,068	145,000	12,000	13,231	25,837	18,086	6,459	3,876	3,876	3,876	18,086	6,459	0	0	0	0	1,292	0	7,751	25,837
2009	194,245	145,000	12,000	13,408	23,837	16,686	5,959	3,576	3,576	3,576	16,686	5,959	0	0	0	0	1,192	0	7,151	23,837
2010	206,871	145,000	12,000	20,744	29,127	20,389	7,282	4,369	4,369	4,369	20,389	7,282	0	0	0	0	1,456	0	8,738	29,127
2011	207,484	145,000	12,000	21,130	29,355	20,548	7,339	4,403	4,403	4,403	20,548	7,339	0	0	0	0	1,468	0	8,806	29,355
2012	208,089	145,000	12,000	21,515	29,574	20,702	7,393	4,436	4,436	4,436	20,702	7,393	0	0	0	0	1,479	0	8,872	29,574
2013	208,704	145,000	12,000	21,900	29,804	20,863	7,451	4,471	4,471	4,471	20,863	7,451	0	0	0	0	1,490	0	8,941	29,804
2014	209,311	145,000	12,000	22,285	30,026	21,018	7,507	4,504	4,504	4,504	21,018	7,507	0	0	0	0	1,501	0	9,008	30,026
2015	209,917	145,000	12,000	22,670	30,247	21,173	7,562	4,537	4,537	4,537	21,173	7,562	0	0	0	0	1,512	0	9,074	30,247
2016	210,015	145,000	12,000	23,057	29,958	20,971	7,490	4,494	4,494	4,494	20,971	7,490	0	0	0	0	1,498	0	8,987	29,958
2017	210,126	145,000	12,000	23,443	29,683	20,778	7,421	4,452	4,452	4,452	20,778	7,421	0	0	0	0	1,484	0	8,905	29,683
2018	210,229	140,000	12,000	23,830	34,399	24,079	8,600	5,160	5,160	5,160	24,079	8,600	0	0	0	0	1,720	0	10,320	34,399
2019	210,328	140,000	12,000	24,216	34,112	23,879	8,528	5,117	5,117	5,117	23,879	8,528	0	0	0	0	1,706	0	10,234	34,112
2020	210,423	140,000	12,000	24,602	33,821	23,675	8,455	5,073	5,073	5,073	23,675	8,455	0	0	0	0	1,691	0	10,146	33,821
2021	210,427	140,000	12,000	24,602	33,825	23,677	8,456	5,074	5,074	5,074	23,677	8,456	0	0	0	0	1,691	0	10,147	33,825
2022	210,427	140,000	12,000	24,602	33,825	23,677	8,456	5,074	5,074	5,074	23,677	8,456	0	0	0	0	1,691	0	10,147	33,825
2023	210,427	140,000	12,000	24,602	33,825	23,677	8,456	5,074	5,074	5,074	23,677	8,456	0	0	0	0	1,691	0	10,147	33,825
2024	210,423	140,000	12,000	24,602	33,821	23,675	8,455	5,073	5,073	5,073	23,675	8,455	0	0	0	0	1,691	0	10,146	33,821
2025	210,427	140,000	12,000	24,602	33,825	23,677	8,456	5,074	5,074	5,074	23,677	8,456	0	0	0	0	1,691	0	10,147	33,825
2026	210,427	140,000	12,000	24,602	33,825	23,677	8,456	5,074	5,074	5,074	23,677	8,456	0	0	0	0	1,691	0	10,147	33,825
2027	210,427	140,000	12,000	24,602	33,825	23,677	8,456	5,074	5,074	5,074	23,677	8,456	0	0	0	0	1,691	0	10,147	33,825
2028	210,423	140,000	12,000	24,602	33,821	23,675	8,455	5,073	5,073	5,073	23,675	8,455	0	0	0	0	1,691	0	10,146	33,821

Note -- recharge allocated to facilities that are assured of being on line in 2004

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Figure 9-1
Desalter I Post Expansion Process Diagram

0 = OFF
2 = ON

	Wells	Nitrates	TDS	GPM
2	1	16	230	600
2	2	14	230	300
0	3	20.4	260	0
2	4	66	360	300
0	5	120	1200	0
2	6	170	820	800
2	7	140	680	1200
2	8	241	980	900
0	9	170	1200	0
2	10	100	810	1200
2	11	100	560	1200
2	12	140	900	2000
2	13	90	900	2200
2	14	140	900	2000

RO Trains in service	4

System 1 (Non-treated)

Wells	Nitrates	TDS	GPM		
1	16	230	600	9600	138000
2	14	230	300	4200	69000
3	20.4	260	0	0	0
4	66	360	300	19800	108000
				33600	315000

Blend	Nitrates	**28**	GPM	**1200**
	TDS	**263**	MGD	**1.73**

System 2 (Treated)

Wells	Nitrates	TDS	GPM		
5	120	1200	0	0	0
6	170	820	800	136000	656000
7	140	680	1200	168000	816000
8	241	980	900	216900	882000
9	170	1200	0	0	0
10	100	810	1200	120000	972000
11	100	560	1200	120000	672000
12	140	900	2000	280000	1800000
13	90	900	2200	198000	1980000
14	140	900	2000	280000	1800000
				1518900	9578000

Blend	Nitrates	**160**	GPM	**9500**
	TDS	**1008**	MGD	**13.68**

Final Blend

Nitrates	TDS	GPM		
28	263	1200	33600	315000
22	20	4640	103861	93562
20	931	3394	67887	3158709
		9234	205348	3567270

RO Facility

Nitrates	TDS	GPM Out	GPM In
22	20	4640	5800
86%	98%	80%	
	MGD	**6.68**	**8.35**

Final Blend

Nitrates	TDS	GPM	MGD
22	**386**	**9234**	**13.30**

Current Contracts 9,200 AF
Future Contracts 5,000 AF
Total Sales 14,200 AF

IX Facility

Nitrates	TDS	GPM Out	GPM In
20	931	3394	3573
	MGD	**4.89**	**5.15**

	AF Year	AF Month	GPM
100%	14,895	1,241	9,234
95%	14,150	1,179	8,773
90%	13,406	1,117	8,311

Waste

	RO	IX
GPM	**1160**	**179**
MGD	**1.67**	**0.26**
	1.93	

Prepared By Tom O'Neill / JCSD

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Figure 9-2
Chino II Desalter Process Diagram

0 = OFF
2 = ON

	Wells	Nitrates	TDS	GPM
2	1	150	900	1200
2	2	150	900	1200
2	3	150	900	1200
2	4	150	900	1200
2	5	150	900	950
0	6	150	900	0
2	7	150	900	1200
0	8	150	900	0
2	9	150	900	1200
2	10	150	900	1200

RO Trains in service	4

System 2 (Treated)

Wells	Nitrates	TDS	GPM		
1	150	900	1200	180000	1080000
2	150	900	1200	180000	1080000
3	150	900	1200	180000	1080000
4	150	900	1200	180000	1080000
5	150	900	950	142500	855000
6	150	900	0	0	0
7	150	900	1200	180000	1080000
8	150	900	0	0	0
9	150	900	1200	180000	1080000
10	25	300	1200	30000	360000
				1252500	7695000

Blend	Nitrates	**154**	GPM	**8150**	
	TDS	**944**	MGD	**11.74**	

Final Blend

Nitrates	TDS	GPM		
22	19	4333	93217	81814
20	871	2784	55670	2425738
		7116	148887	2507553

RO Facility

Nitrates	TDS	GPM Out	GPM In
22	19	4333	5220
86%	98%	83%	
	MGD	**6.24**	**7.52**

Final Blend

Nitrates	TDS	GPM	MGD
21	**352**	**7116**	**10.25**

IX Facility

Nitrates	TDS	GPM Out	GPM In
20	871	2784	2930
	MGD	**4.01**	**4.22**

	AF Year	AF Month	GPM
100%	11,478	957	7,116
95%	10,904	909	6,760
90%	10,330	861	6,404

Waste

	RO	IX
GPM	**887**	**147**
MGD	**1.28**	**0.21**
	1.49	

Prepared By Tom O'Neill / JCSD

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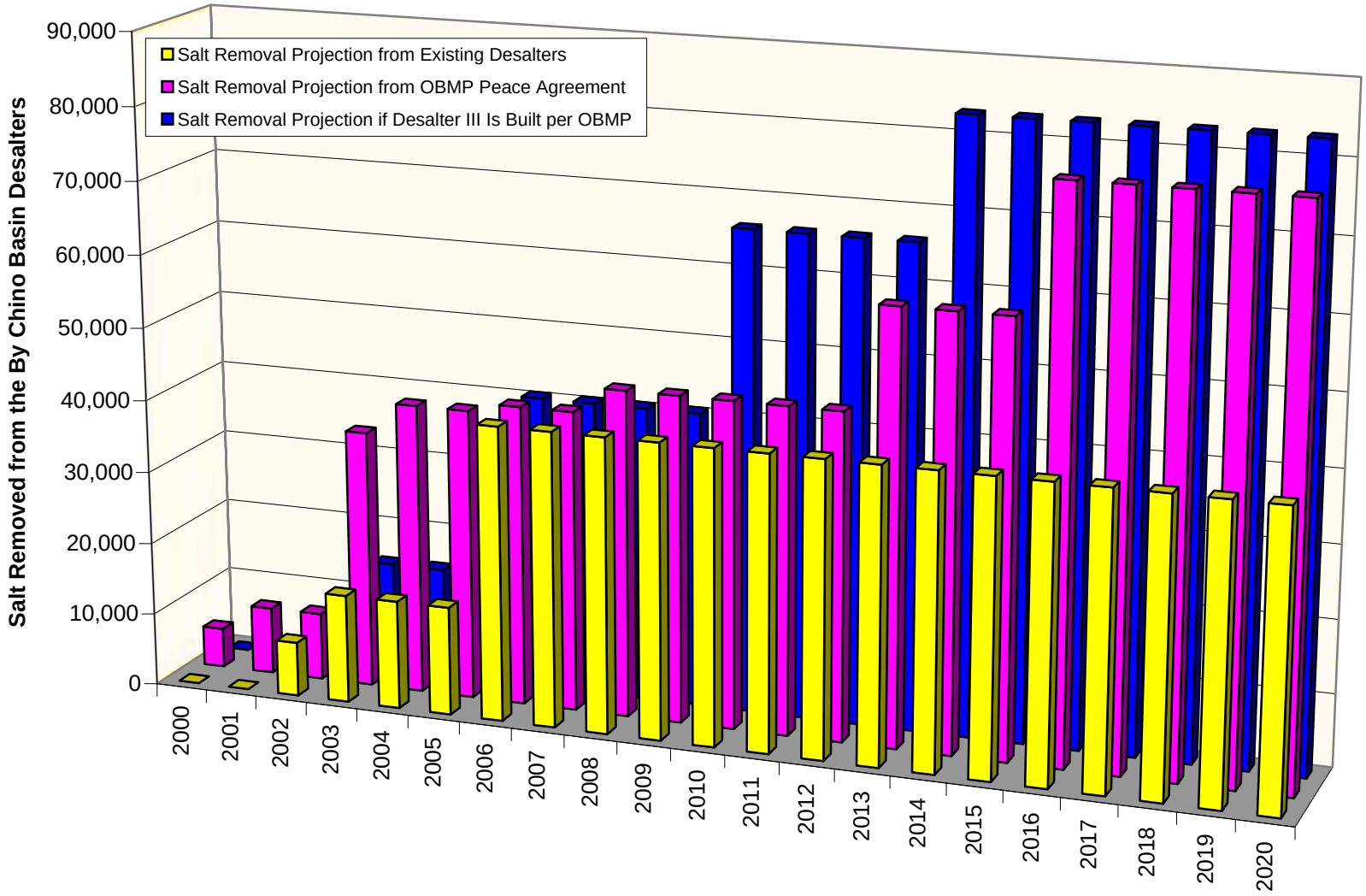
Figure 9-3
Comparison of Chino Basin Salt Removal Projections from the OBMP Peace Agreement and Current Forecast



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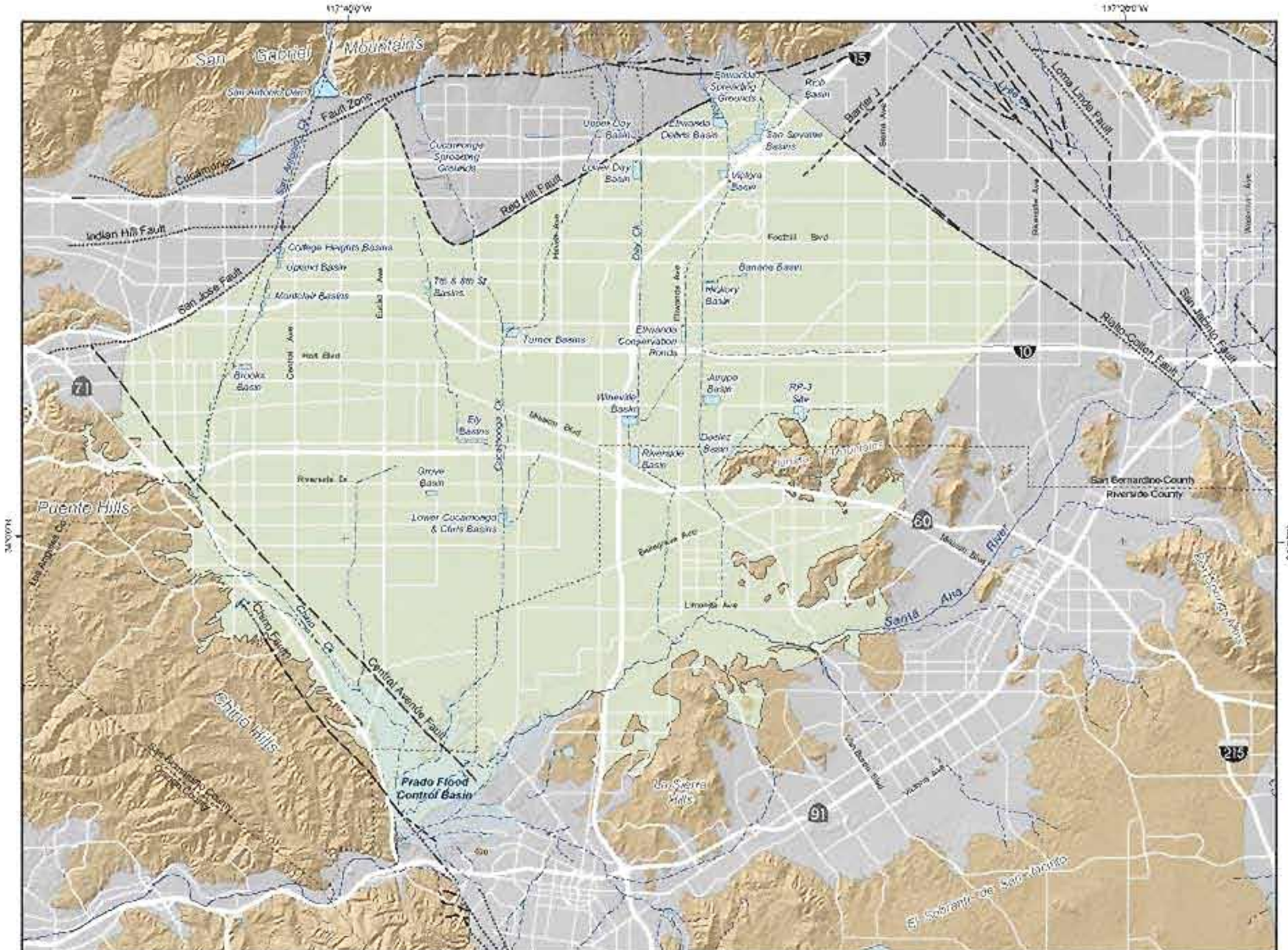

Main Features

Flood Control and Conservation Basins

Chino Basin

Geology

Water-Bearing Sediments

Quaternary Alluvium

Consolidated Bedrock

Cretaceous to Miocene Sedimentary Rocks

Faults

Location Certain

Location Approximate

Location Concealed

Location Uncertain

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www.wildermuthenvironmental.com

Author: AEM
Date: 20050627
File: Figure_9-4.mxd

0 1 2 3 4 Miles

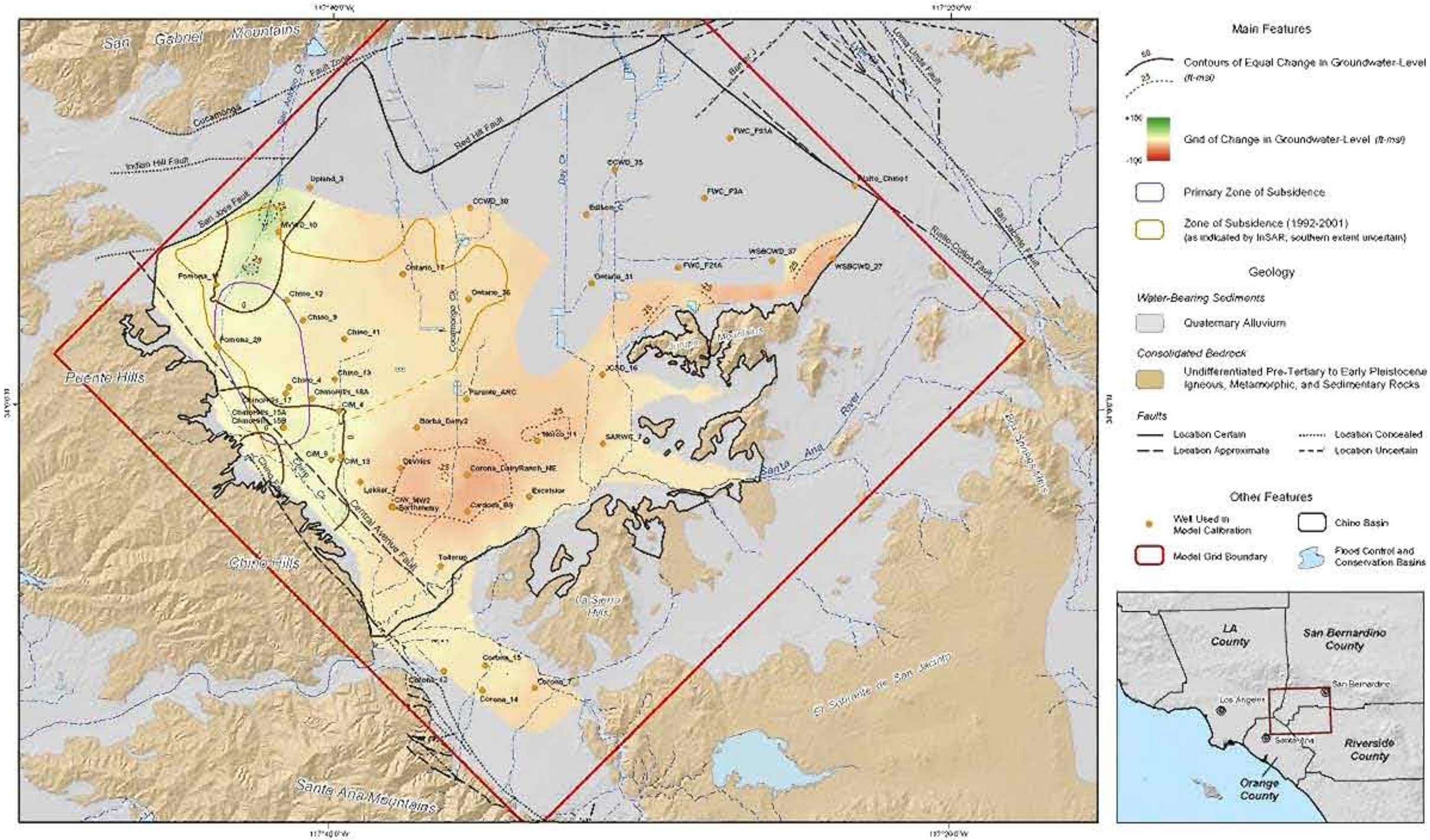
0 2 4 6 KM

State of the Basin Report – 2004
Summary of Other OBMP Activities

Inland Empire

Chino Groundwater Basin and Surface Water Spreading Facilities

Figure 9-4



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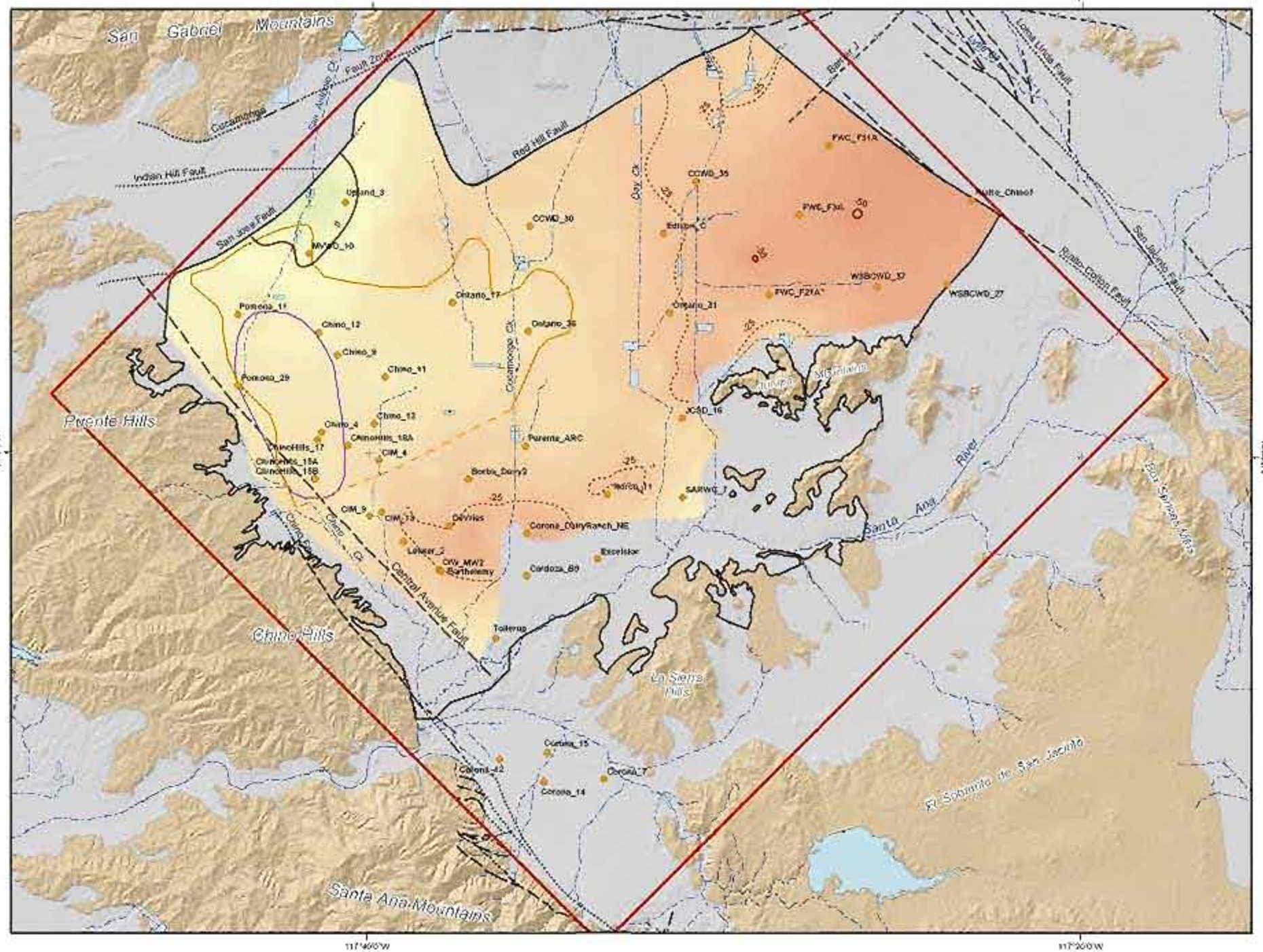
State of the Basin Report – 2004
Summary of Other OBMP Activities

Change in Groundwater Level from Start to End of Baseline Scenario for Layer 1
2004-2028

Figure 9-5a



Main Features

Contours of Equal Change in Groundwater-Level (ft-msl)

Grid of Change in Groundwater-Level (ft-msl)

Primary Zone of Subsidence

Zone of Subsidence (1992-2001) (as indicated by InSAR; southern extent uncertain)

Geology

Water-Bearing Sediments

Quaternary Alluvium

Consolidated Bedrock

Undifferentiated Pre-Tertiary to Early Pleistocene Igneous, Metamorphic, and Sedimentary Rocks

Faults

Location Certain — Location Concealed

Location Approximate — Location Uncertain

Other Features

Well Used in Model Calibration

Chino Basin

Model Grid Boundary

Flood Control and Conservation Basins

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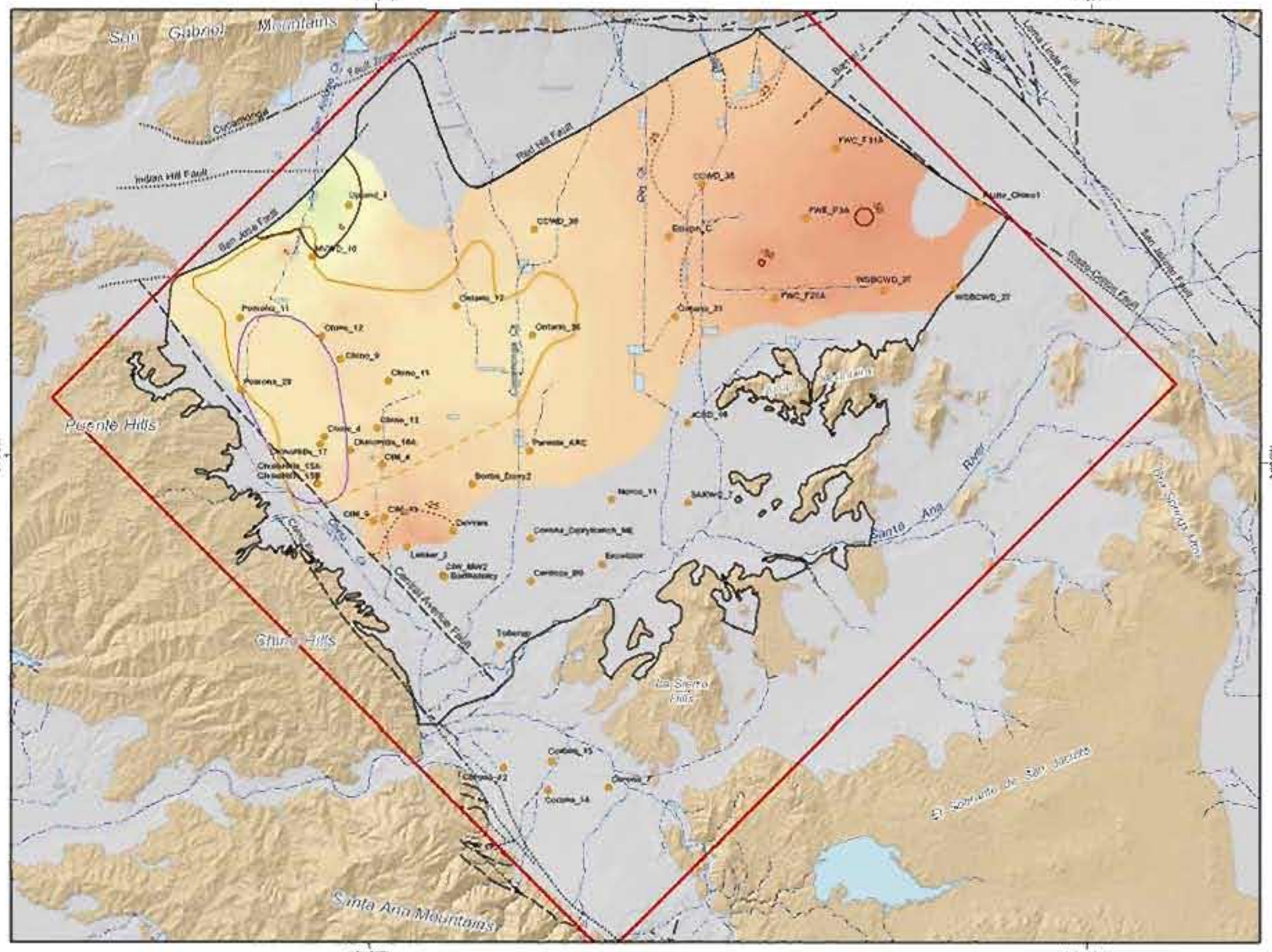
0 1 2 3 4 Miles
0 2 4 6 KM

State of the Basin Report – 2004
Summary of Other OBMP Activities

Change in Groundwater Level from Start to End of Baseline Scenario for Layer 2

2004-2028

Figure 9-5b



Main Features

Contours of Equal Change in Groundwater-Level (ft-msl)

Grid of Change in Groundwater-Level (ft-msl)

Primary Zone of Subsidence

Zone of Subsidence (1992-2001) (as indicated by InSAR; southern extent uncertain)

Geology

Water-Bearing Sediments

Quaternary Alluvium

Consolidated Bedrock

Undifferentiated Pre-Tertiary to Early Pleistocene Igneous, Metamorphic, and Sedimentary Rocks

Faults

Location Certain

Location Approximate

Location Concealed

Location Uncertain

Other Features

Well Used in Model Calibration

Chino Basin

Model Grid Boundary

Flood Control and Conservation Basins

Produced by:

WILDERMUTH

0 1 2 3 4 Miles

0 2 4 6 KM

Inland Empire

Chino Basin Dry-Year Yield Program
Geology and Hydrogeology

Change in Groundwater Level from Start to End of Baseline Scenario for Layer 3

2004-2028

Figure 9-5c

Figure 9-6
Projected Time History of Total Storage in the Chino Basin for Baseline and Dry-Year Yield Scenarios

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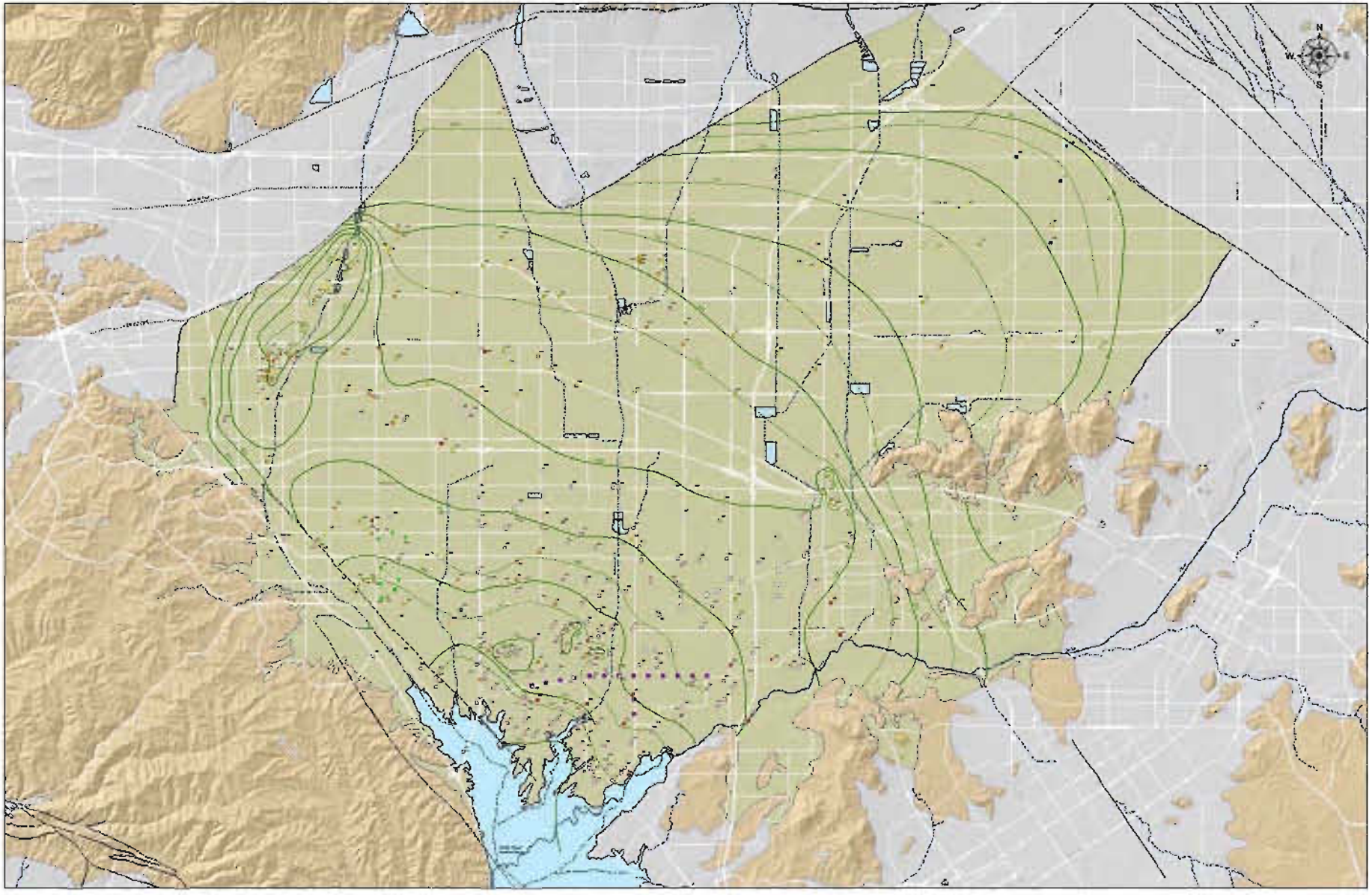
APPENDIX A

GROUNDWATER ELEVATION FOR FALL 2003 CHINO BASIN



State of the Basin Report – 2004
Groundwater Levels

WILDERMUTH

Water-Level Quadification
Symbol Code

Water-Level Label Key

Depth Classification
Color Code

Other Map Features

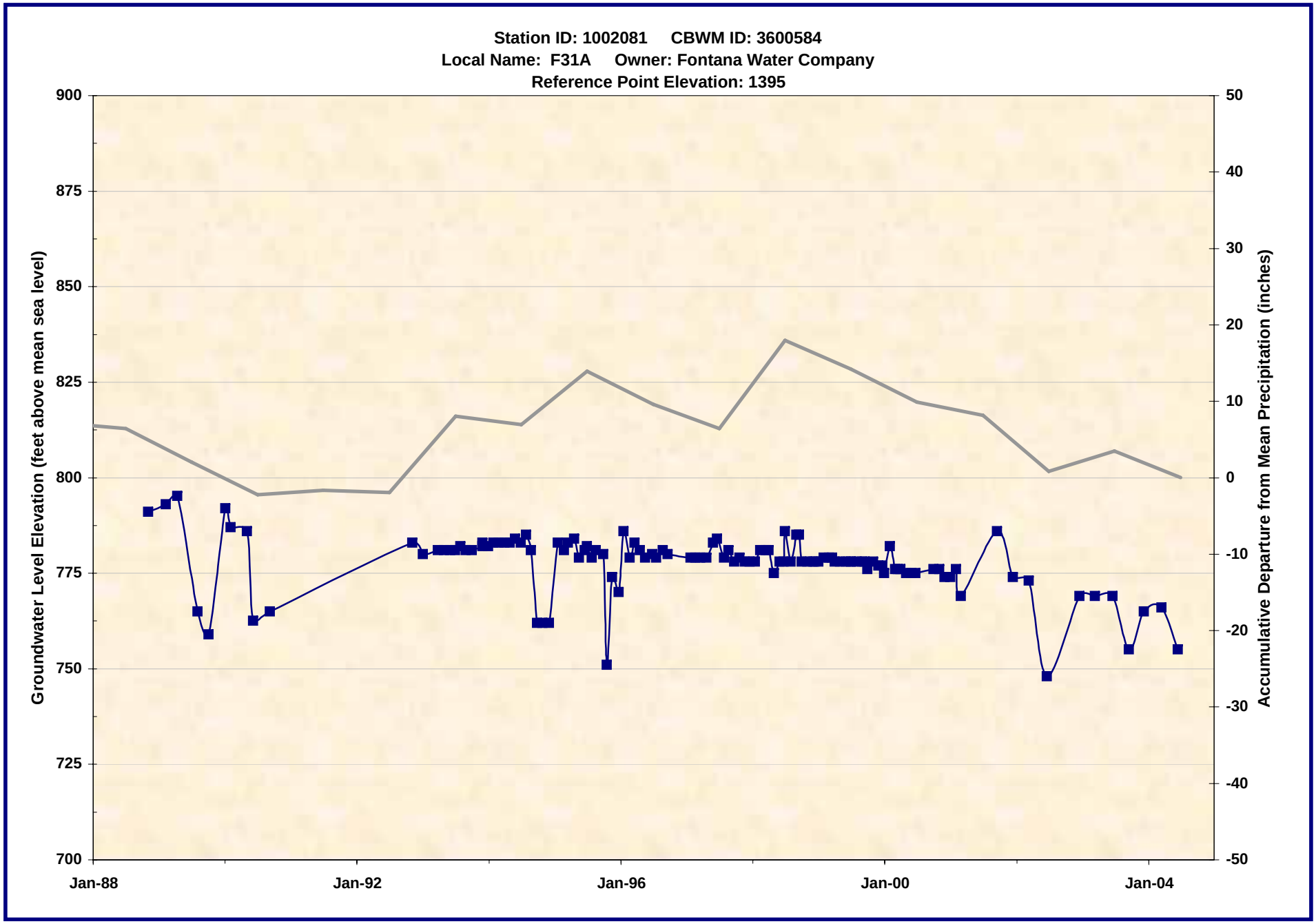
0 0.5 1 2 3 4
Miles

Appendix A
Groundwater Elevation for Fall 2003
Chino Basin
Shallow Aquifer System

All Values in Feet Above Mean Sea-Level

APPENDIX B

GROUNDWATER LEVEL TIME HISTORIES



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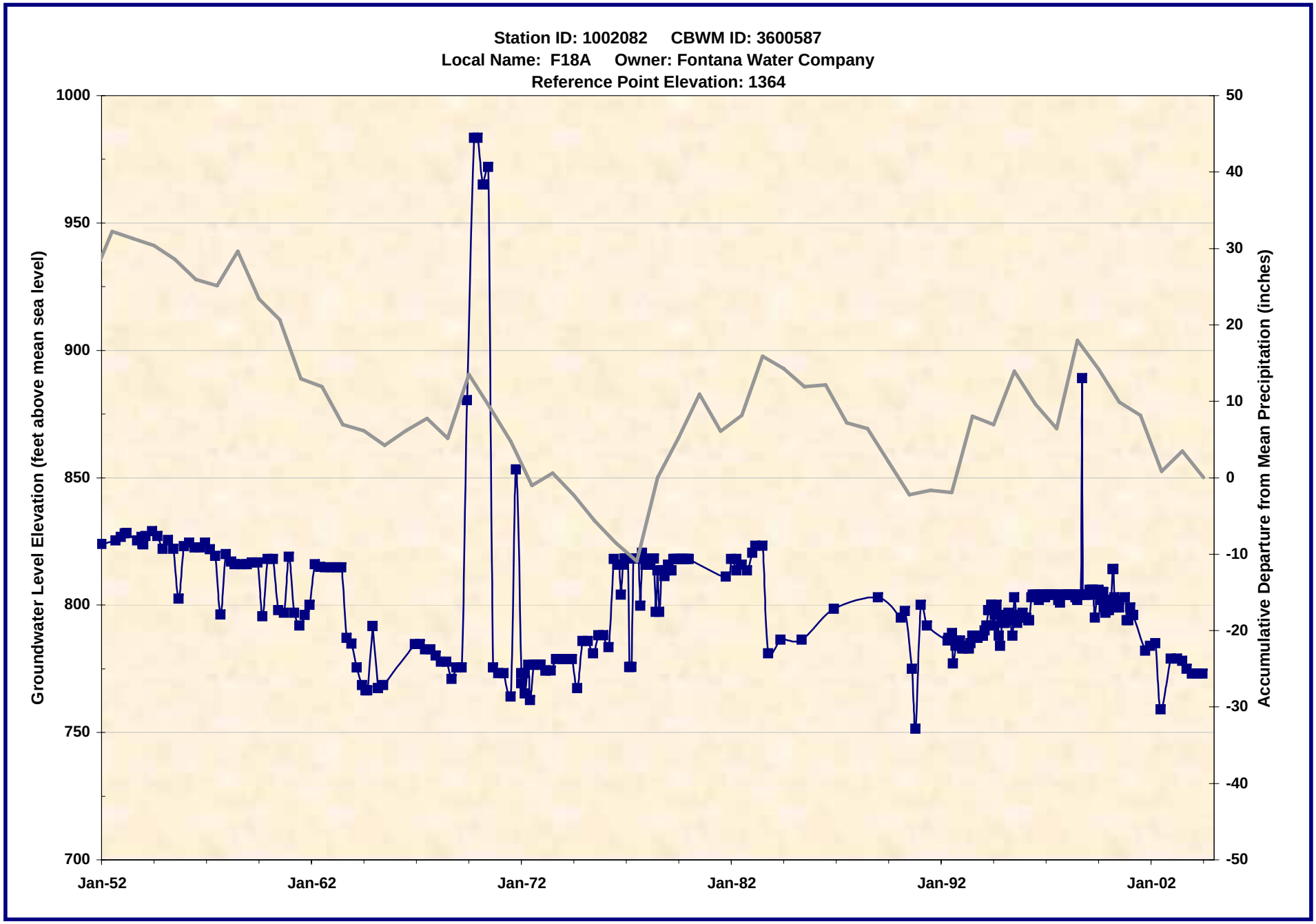

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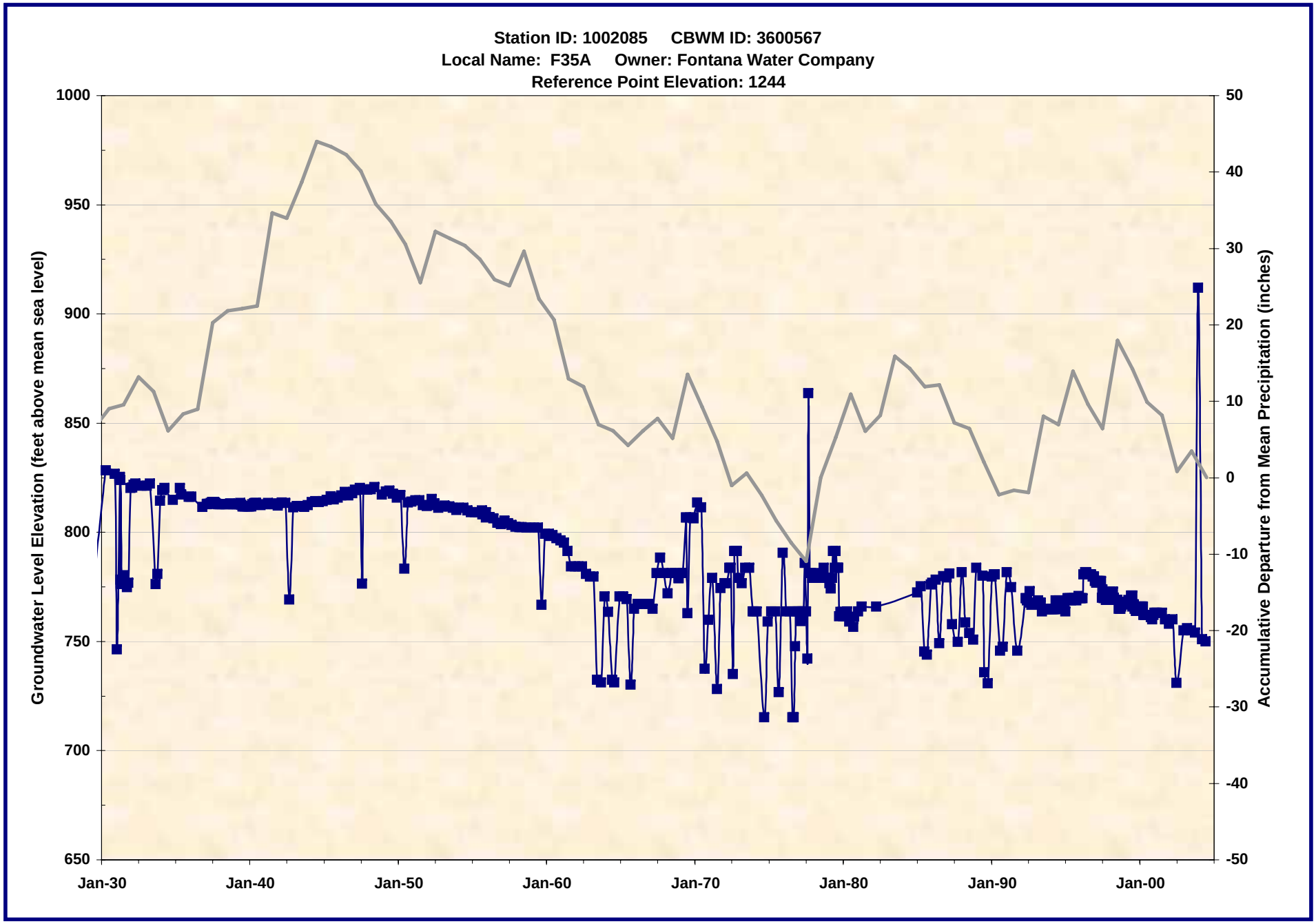

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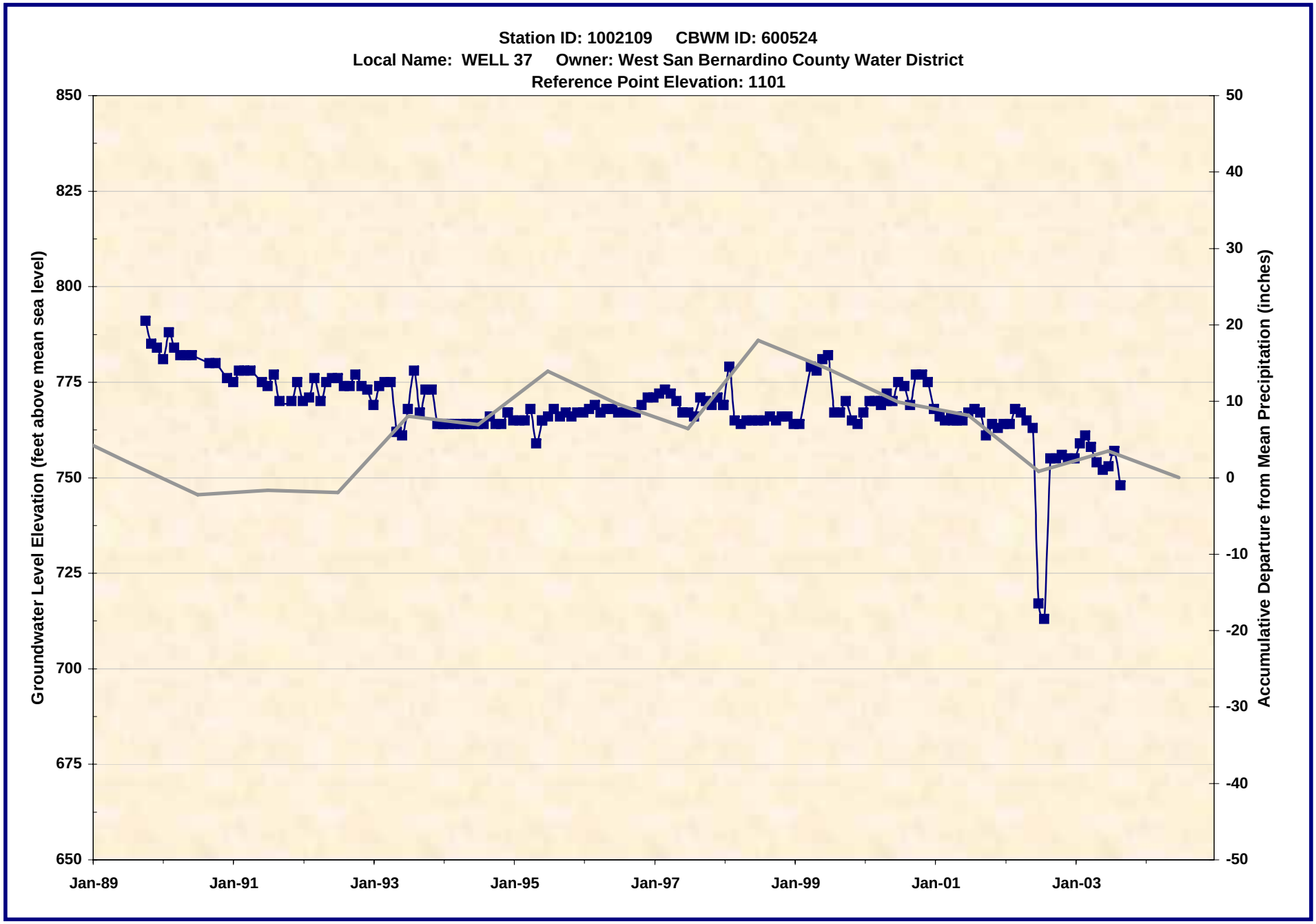

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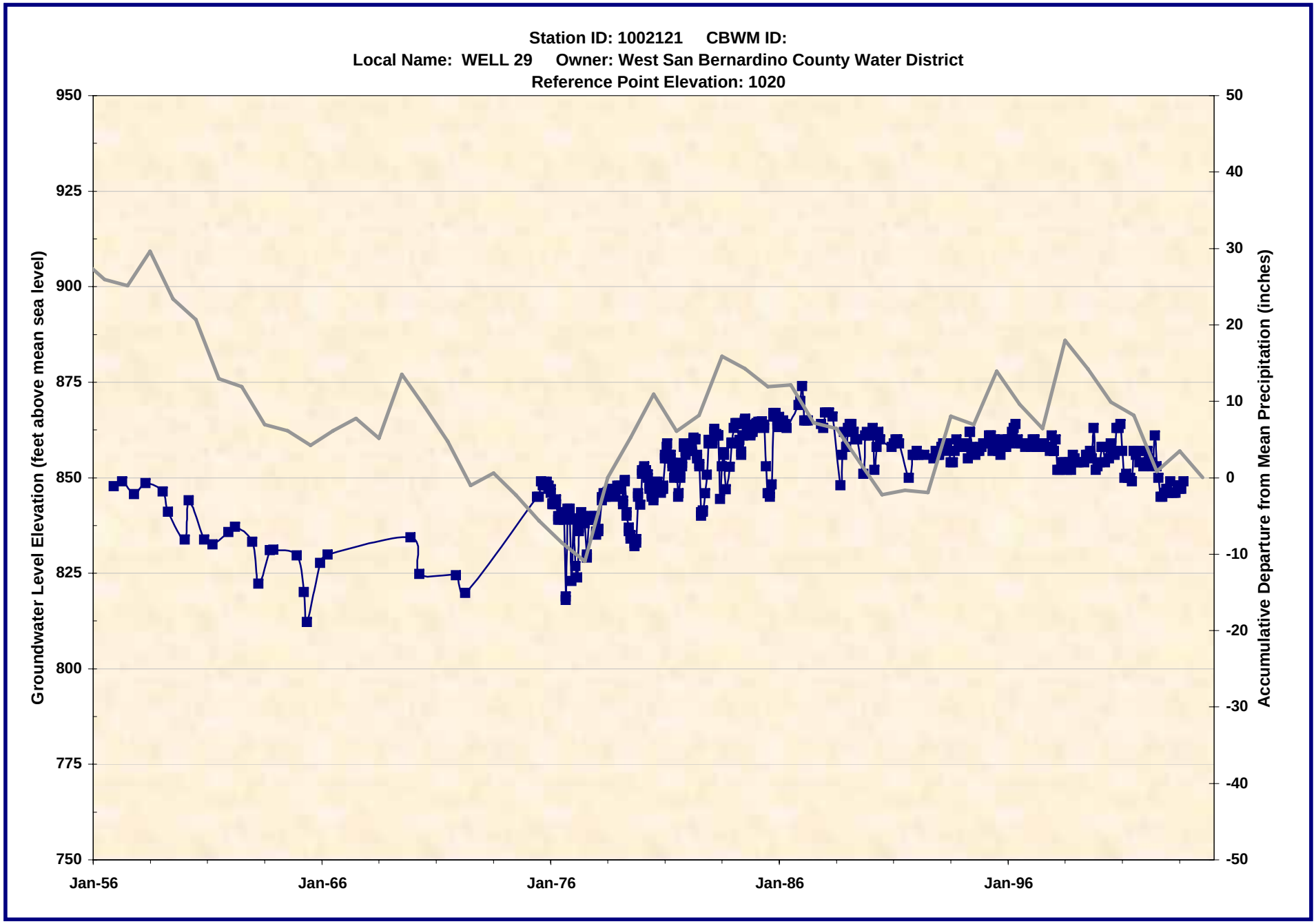

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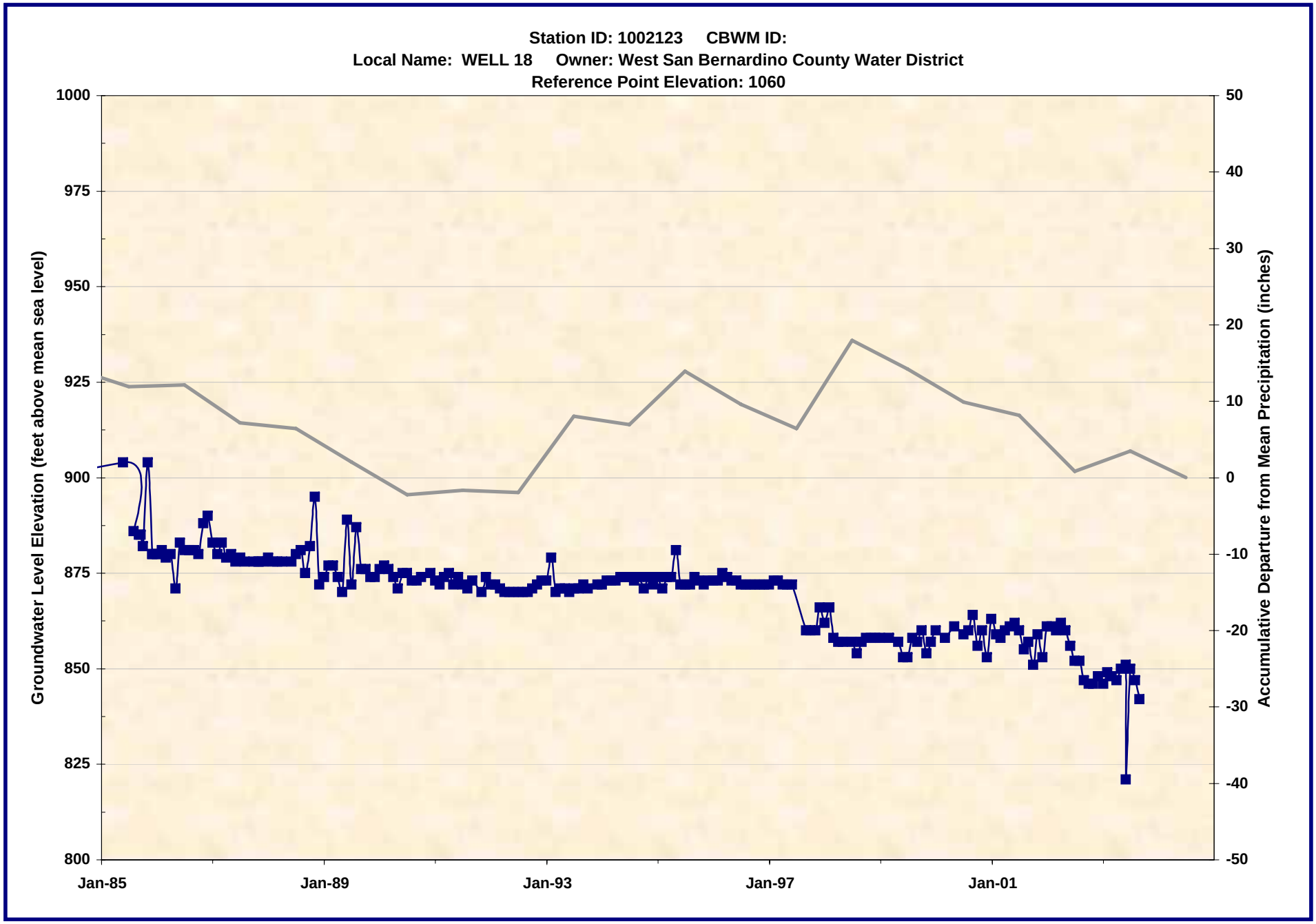

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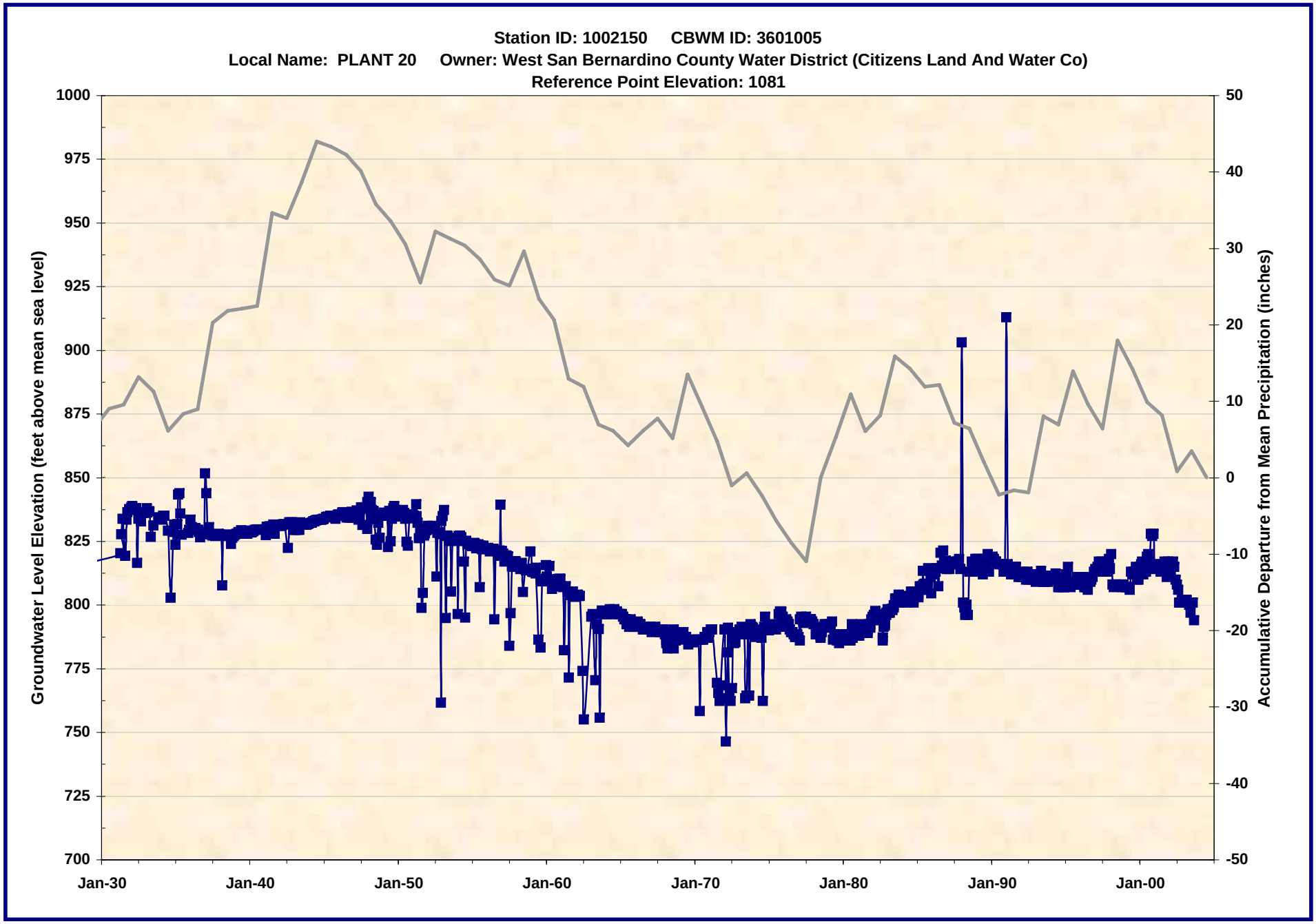

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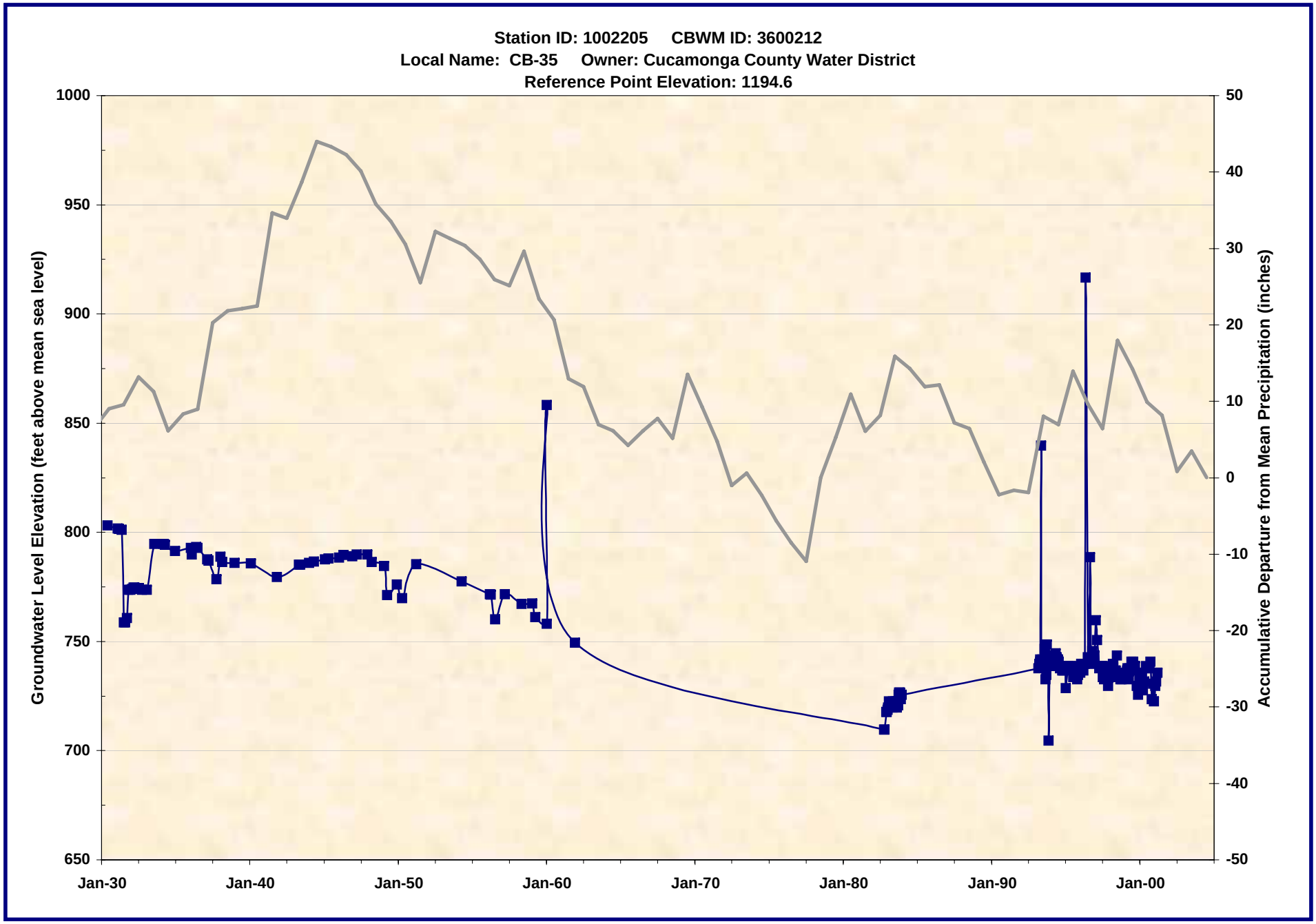

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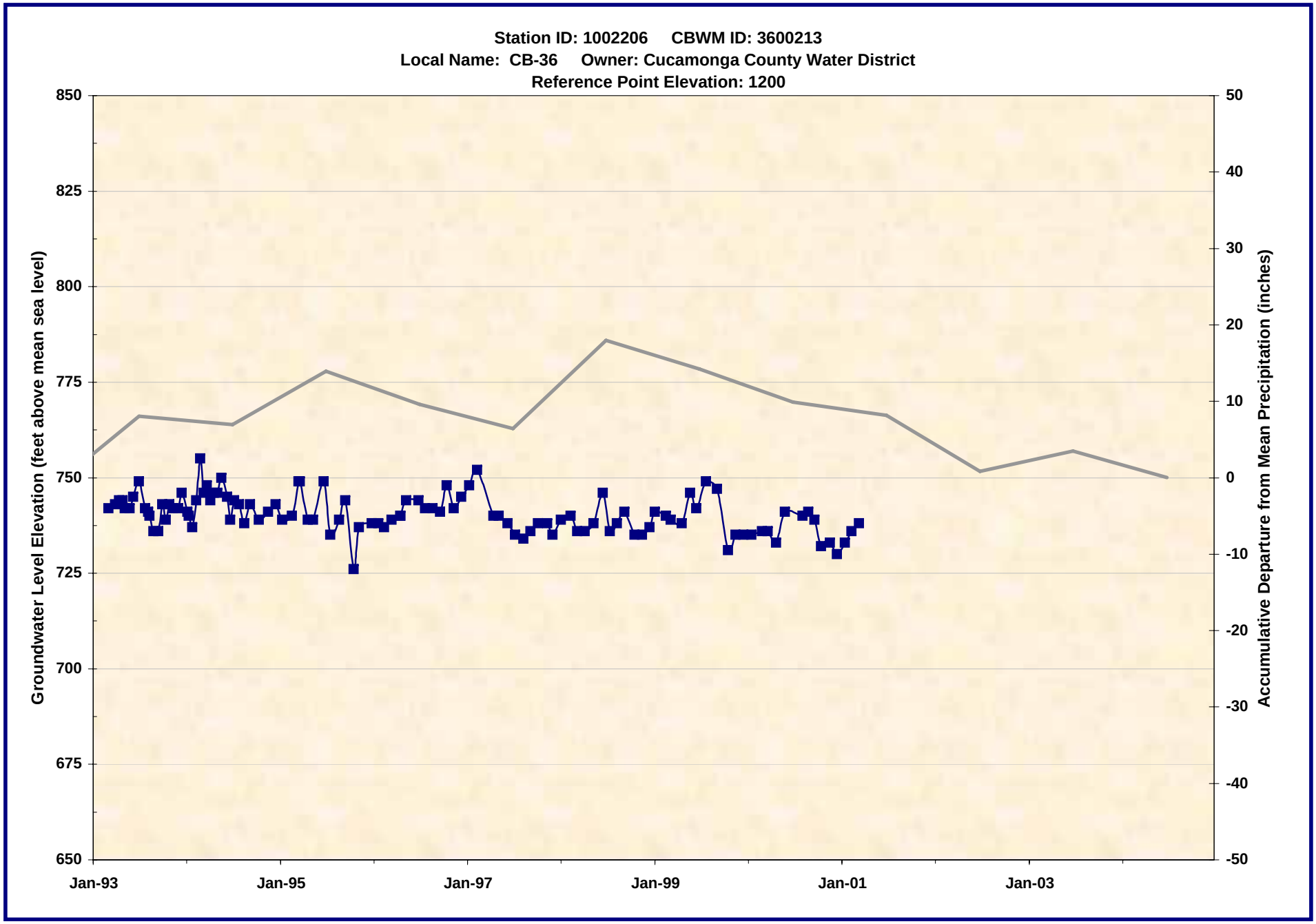

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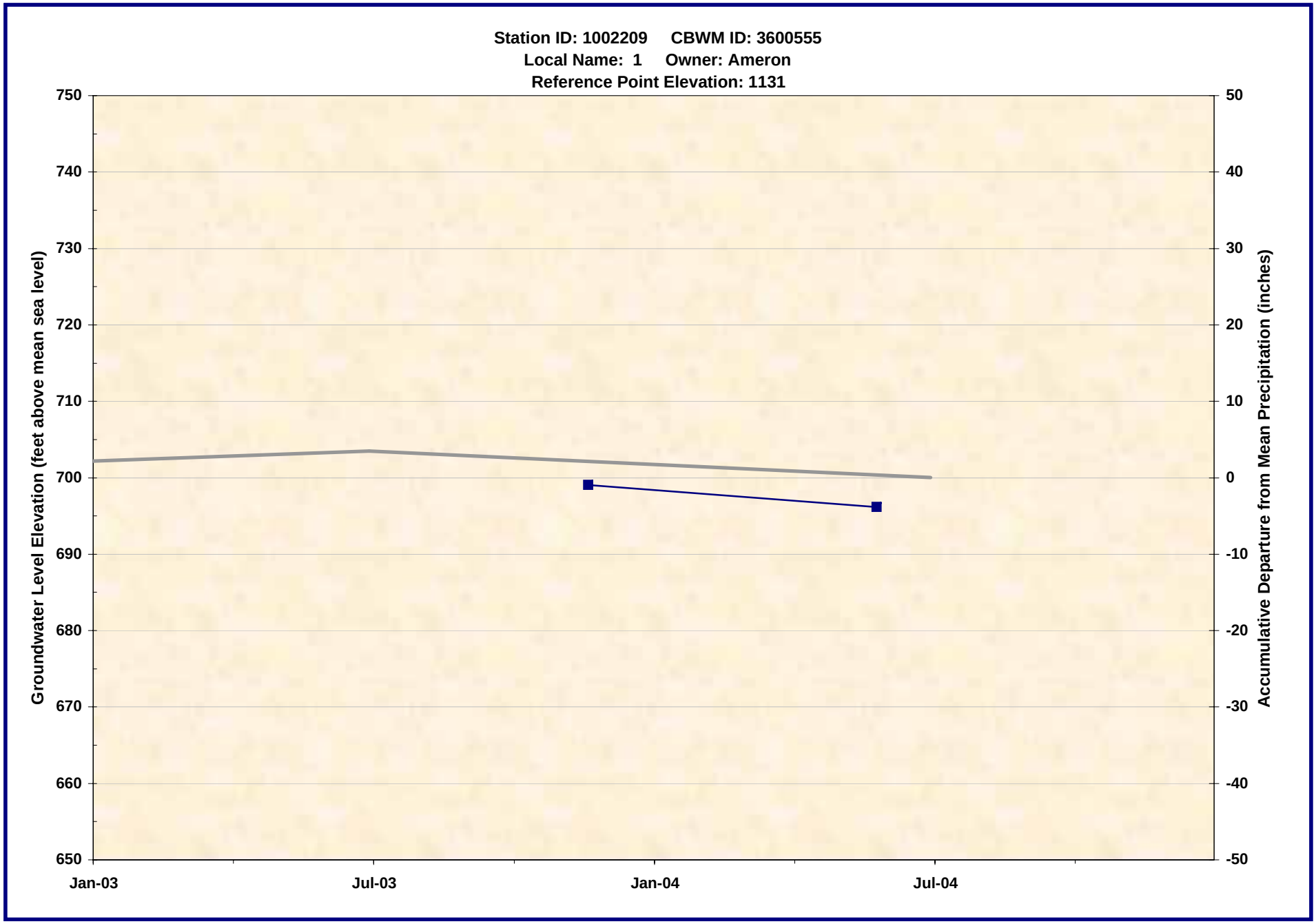

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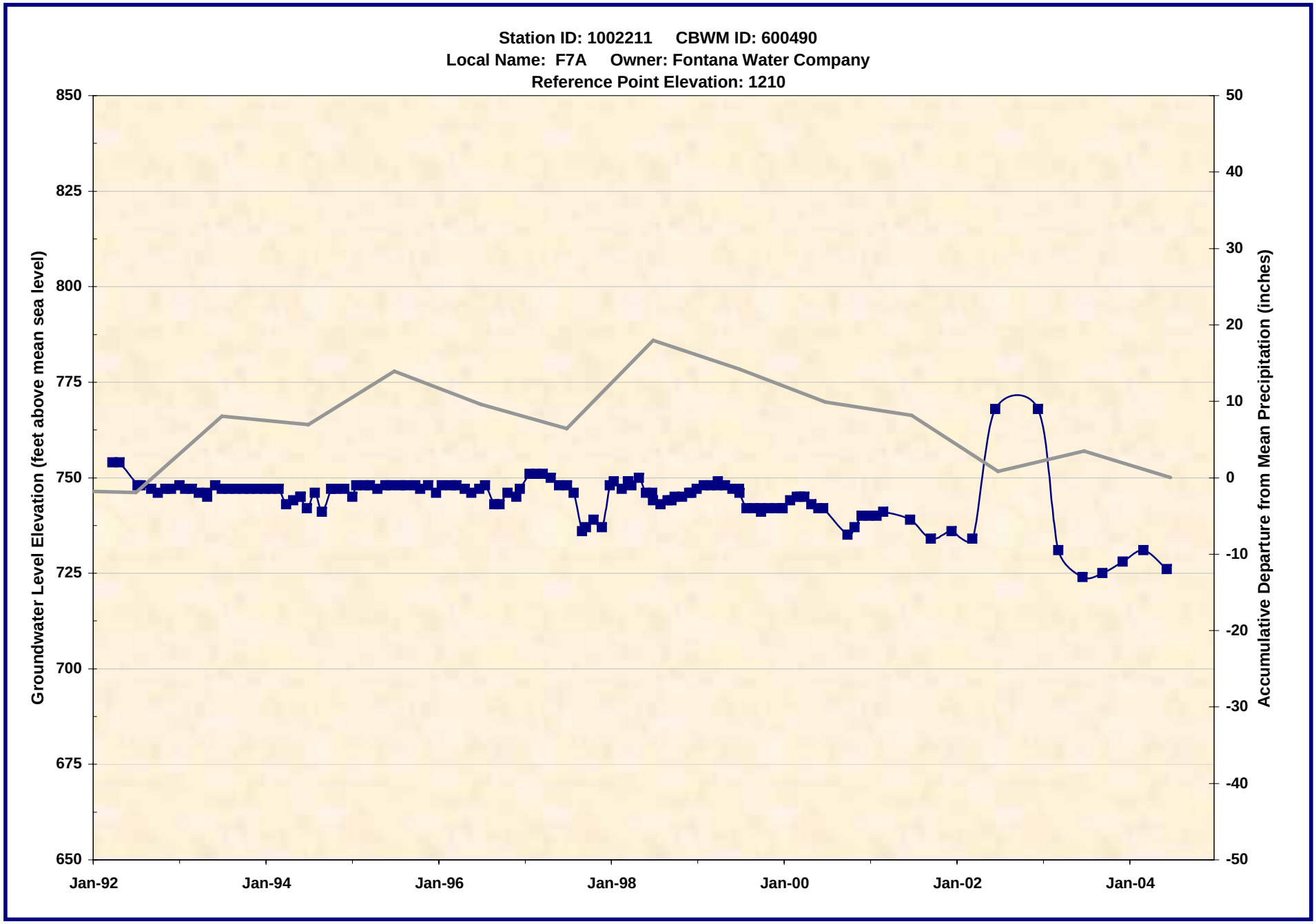

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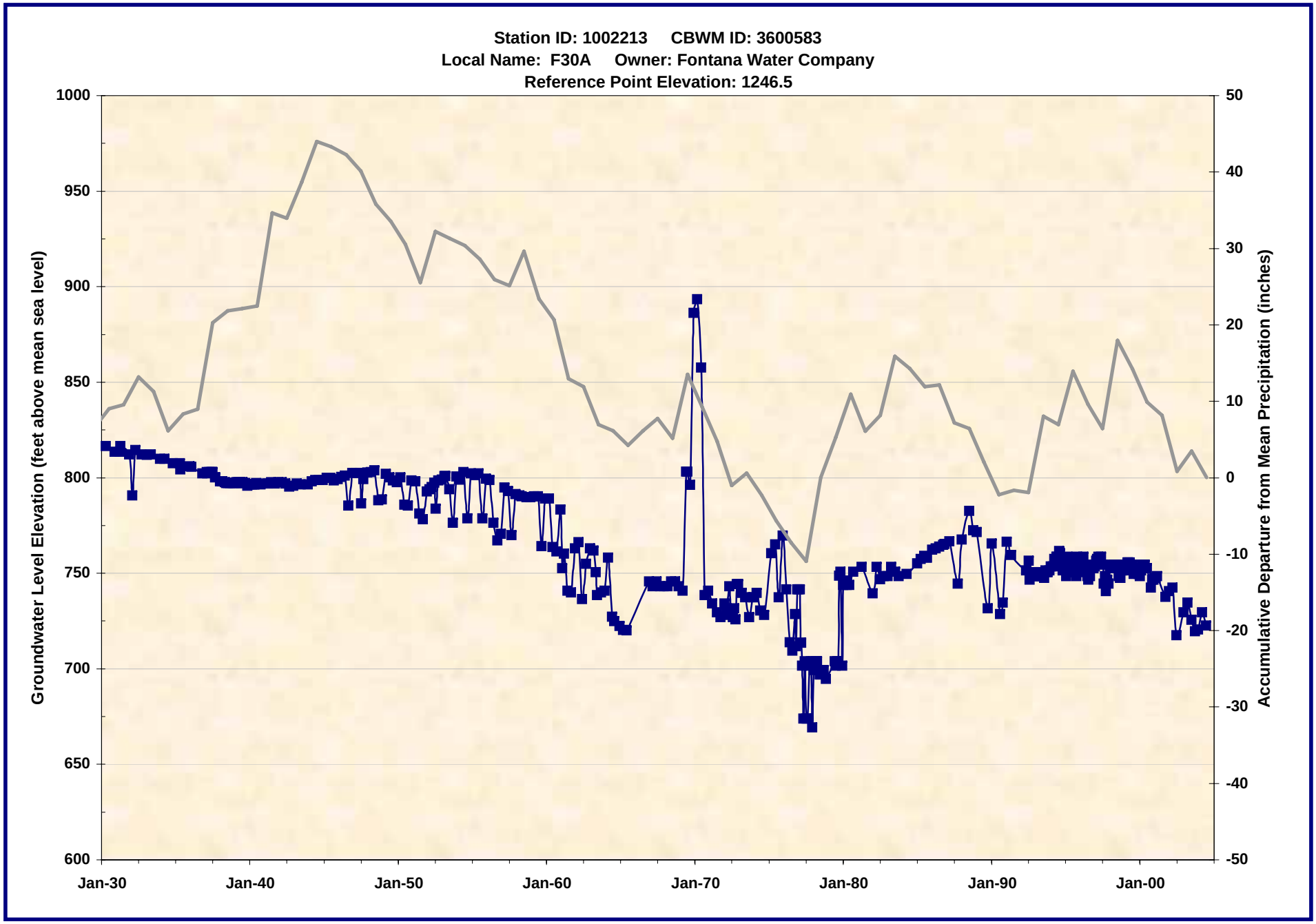

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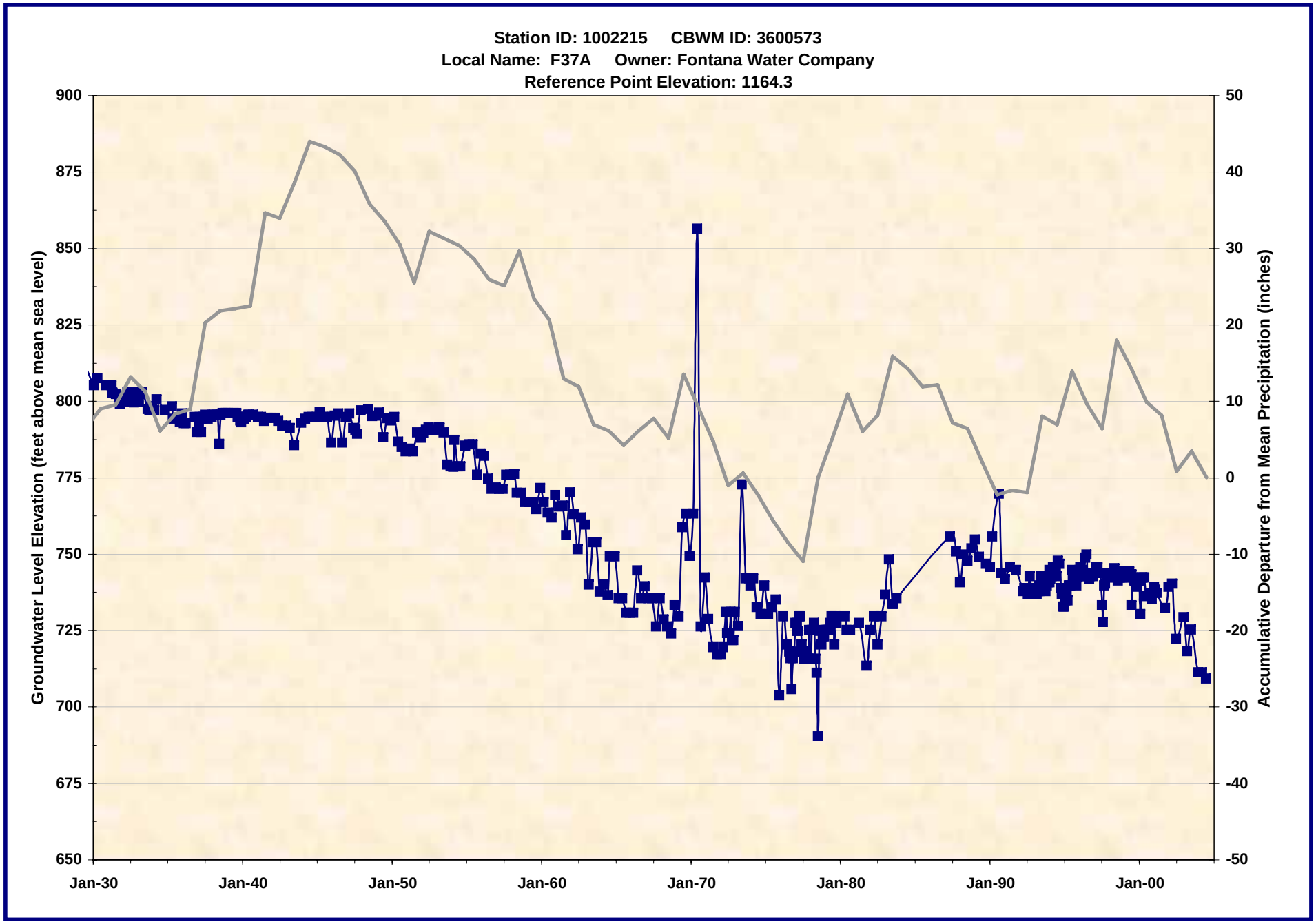

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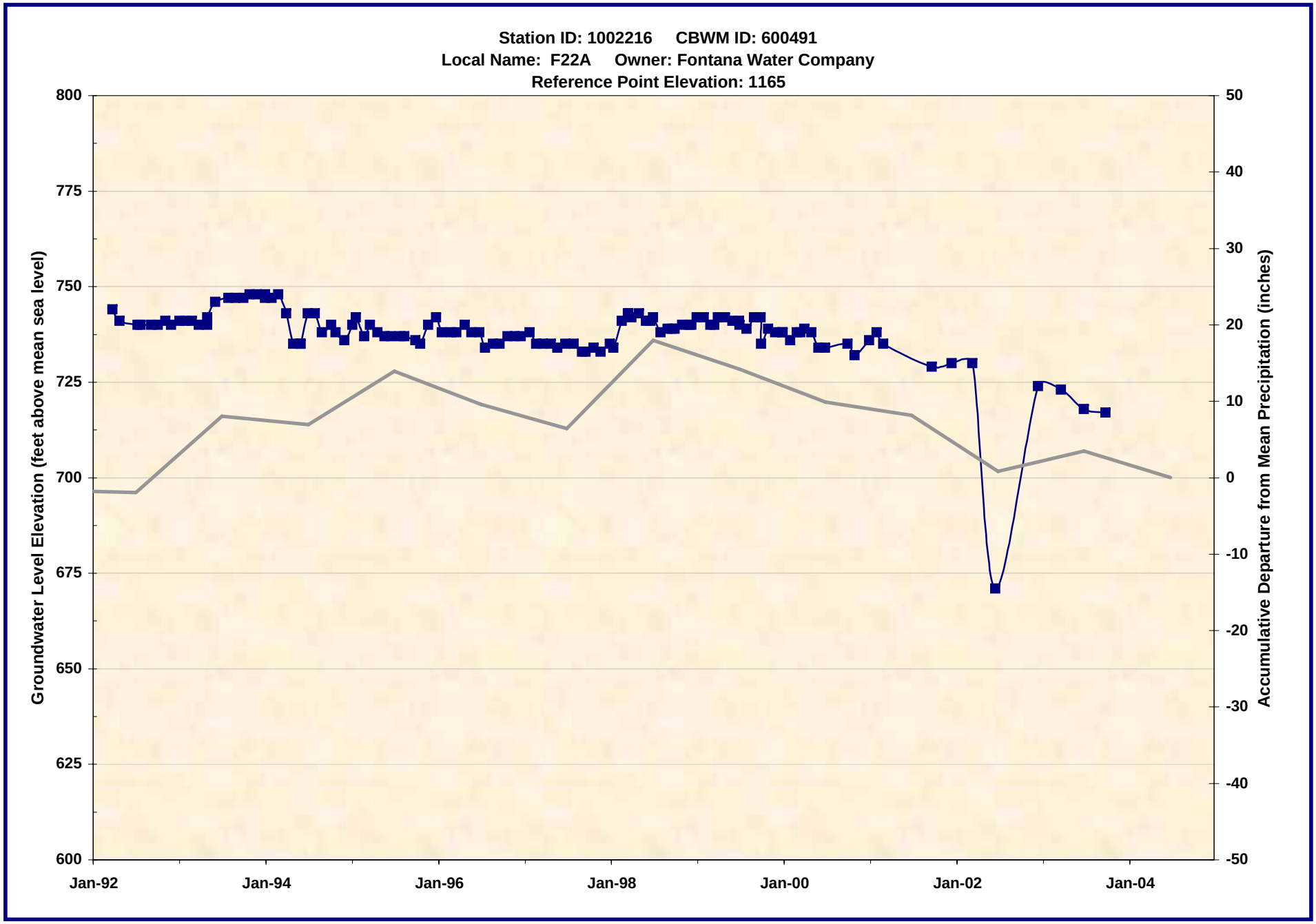

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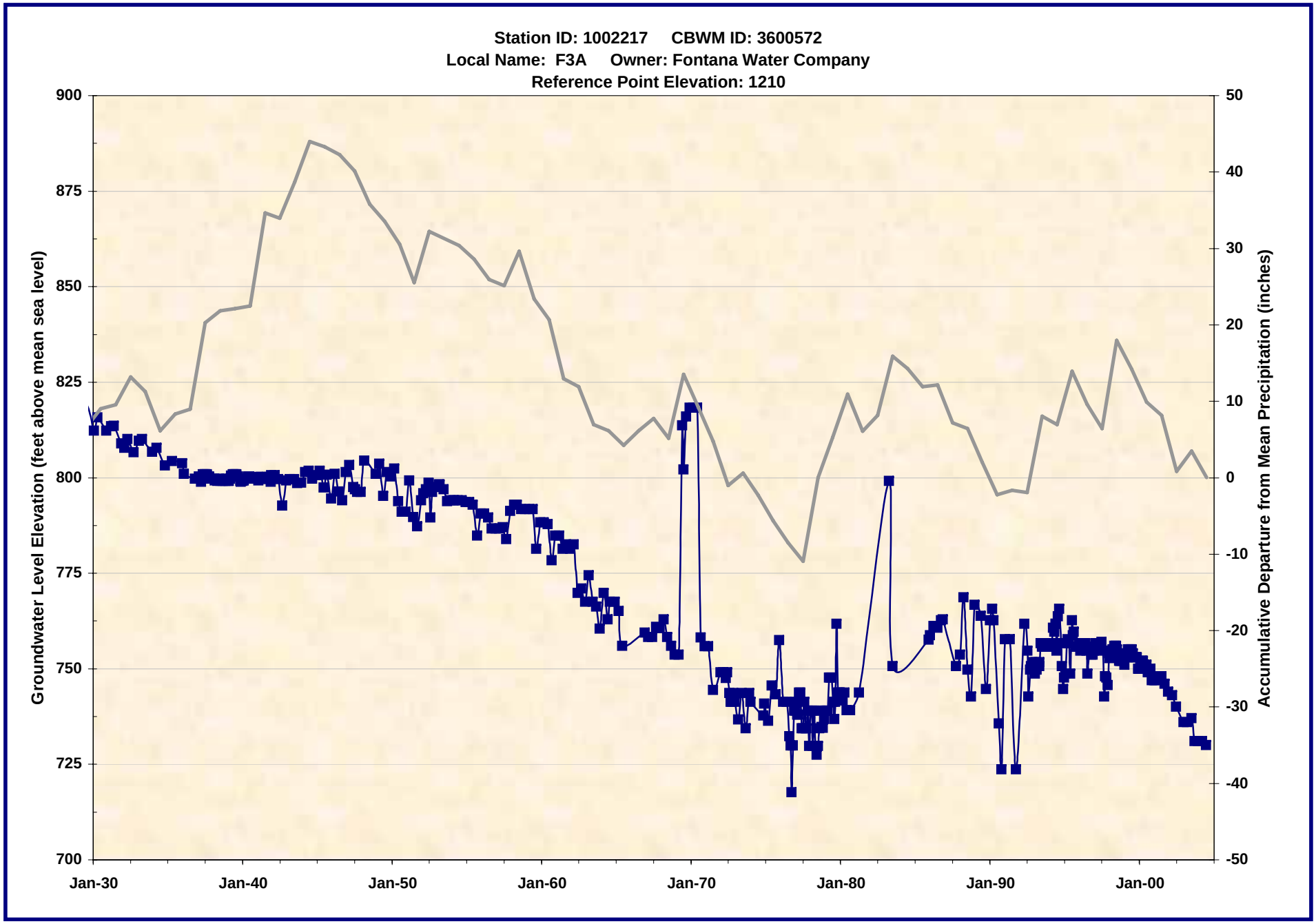

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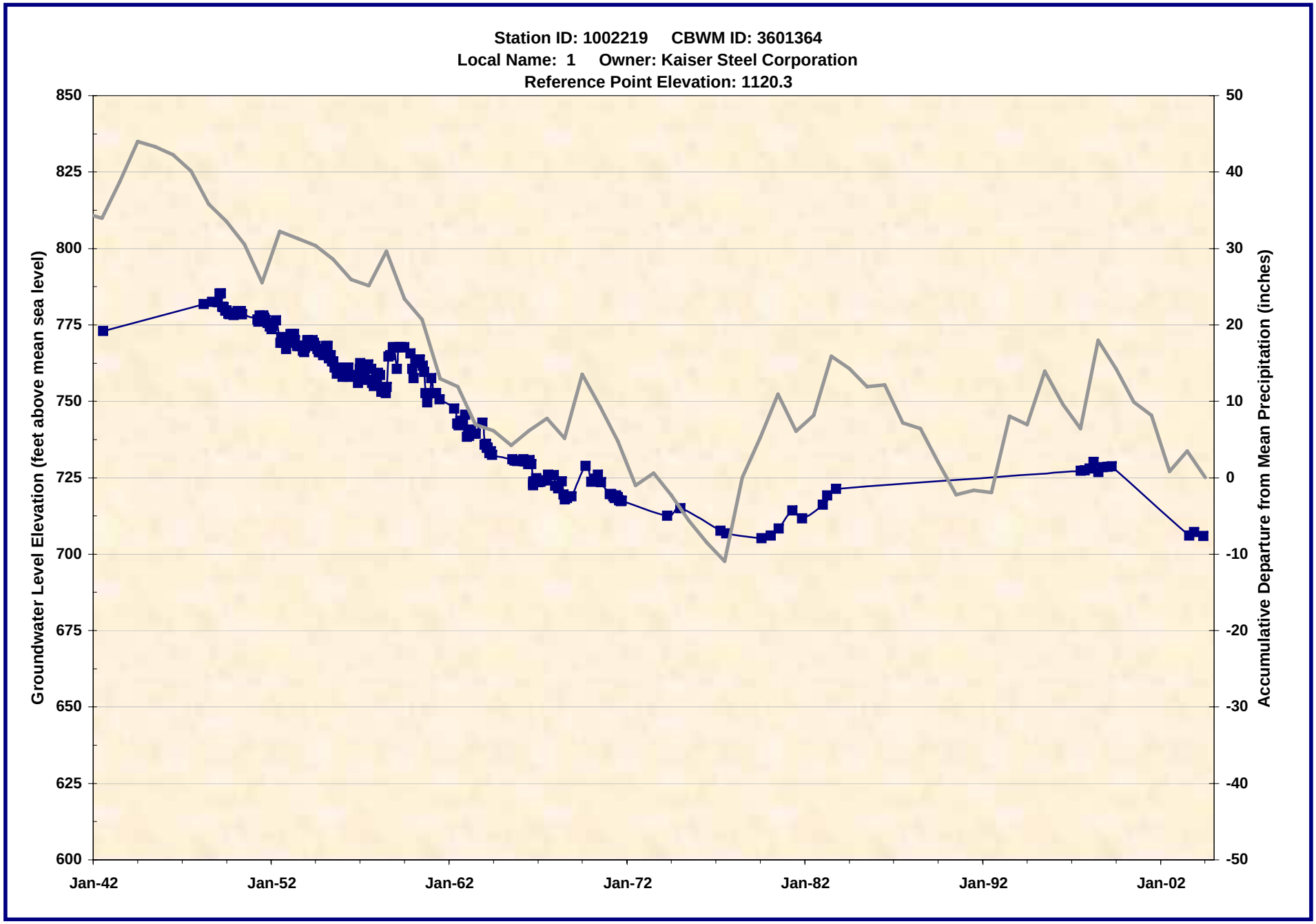

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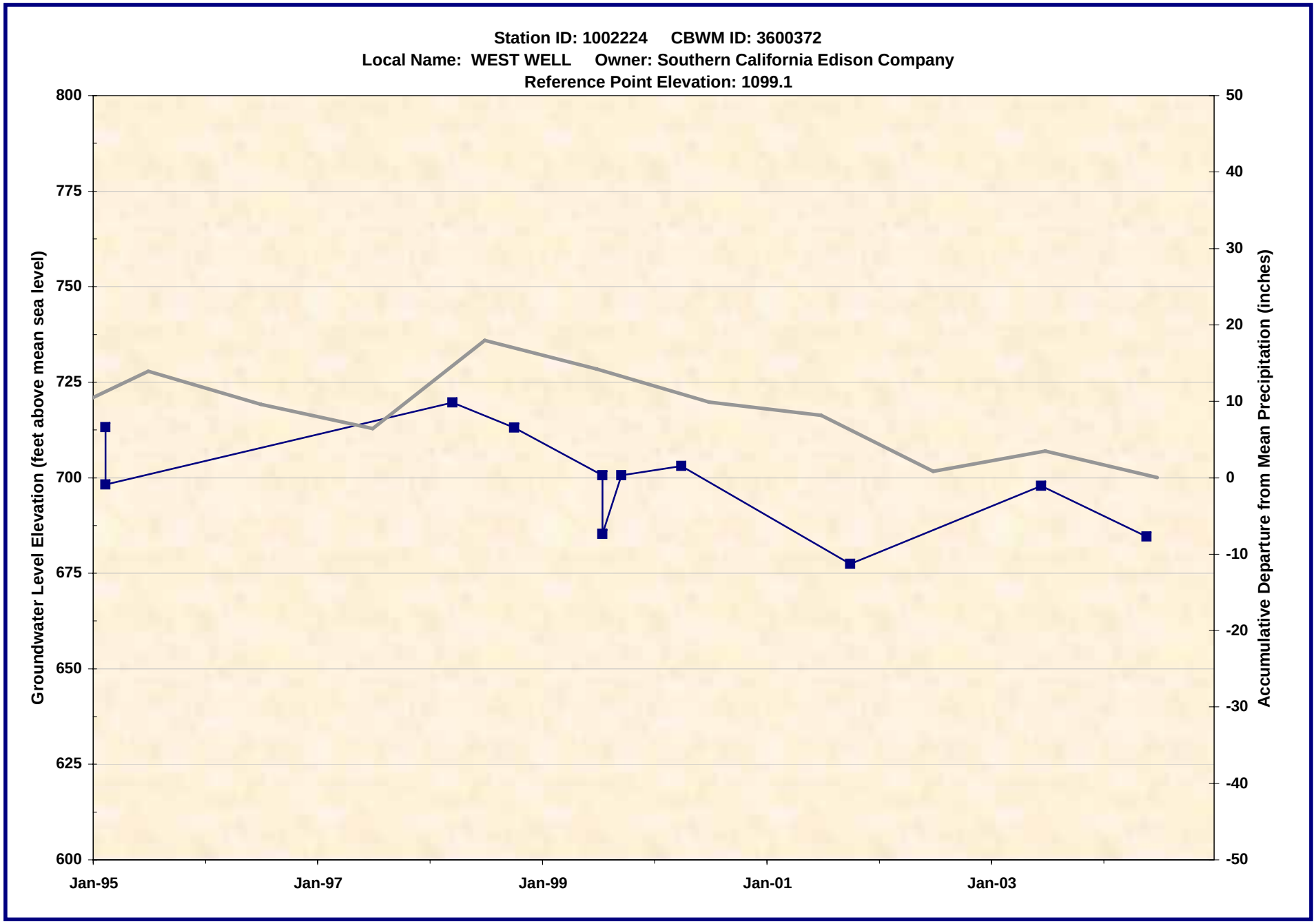

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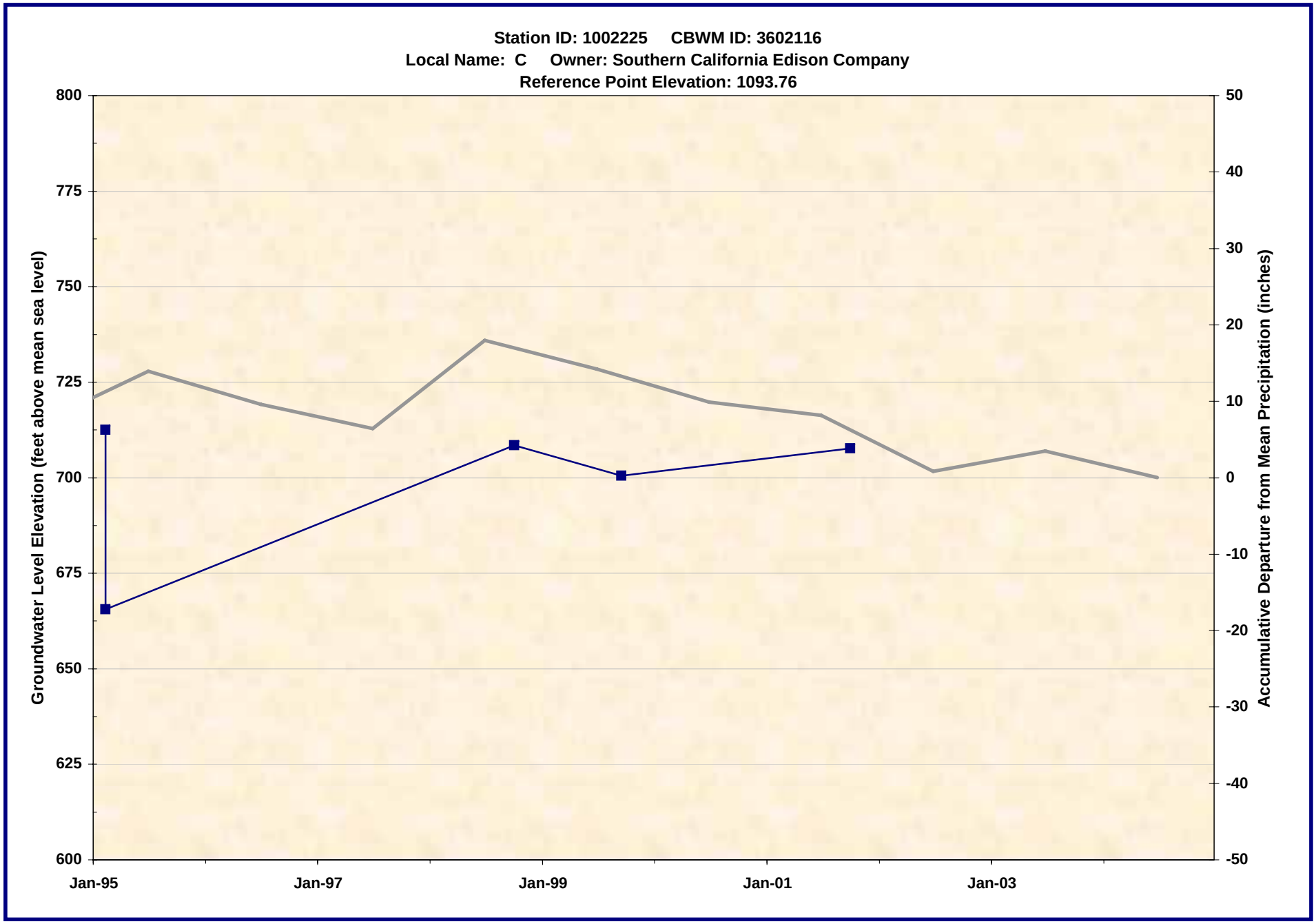

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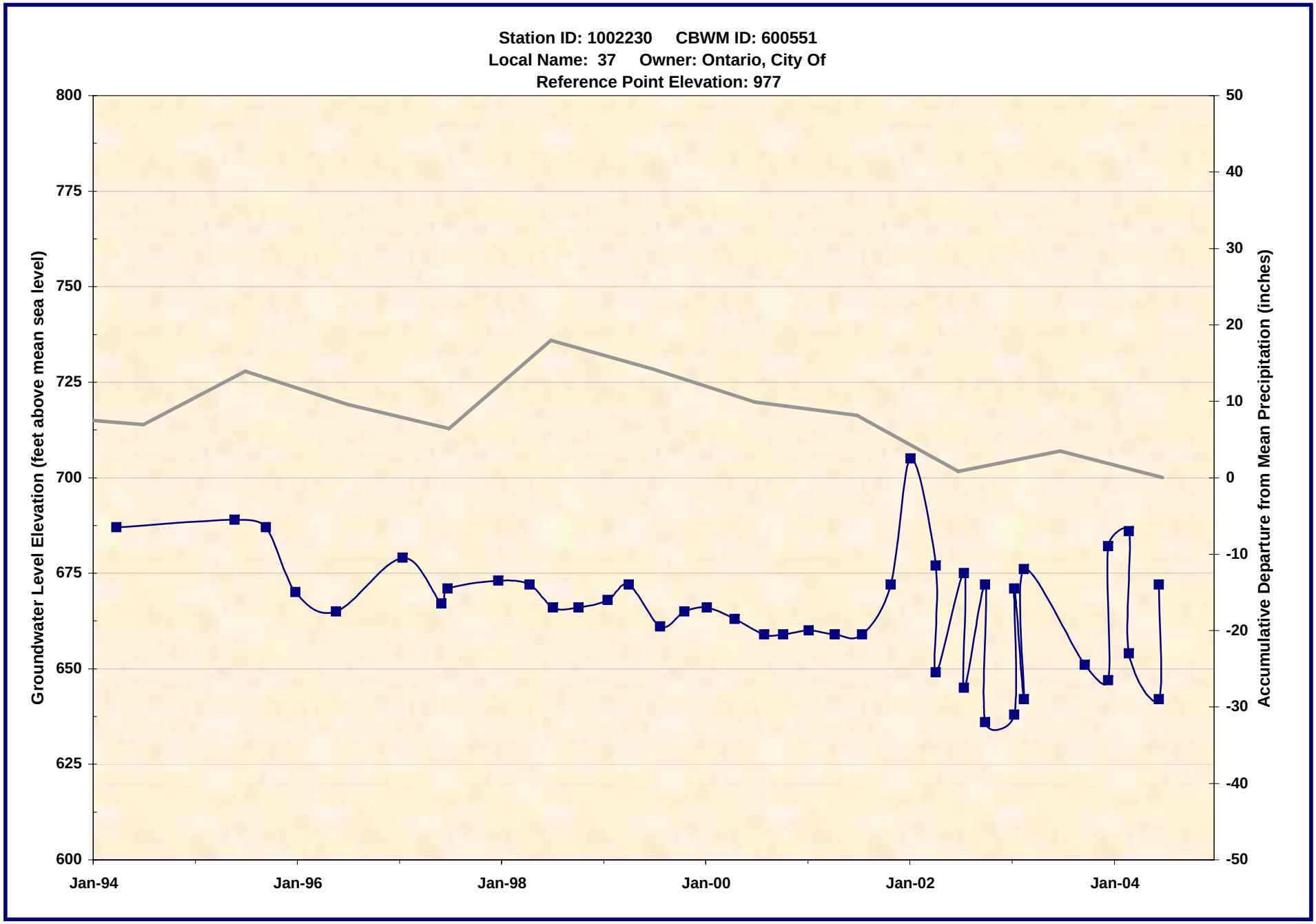

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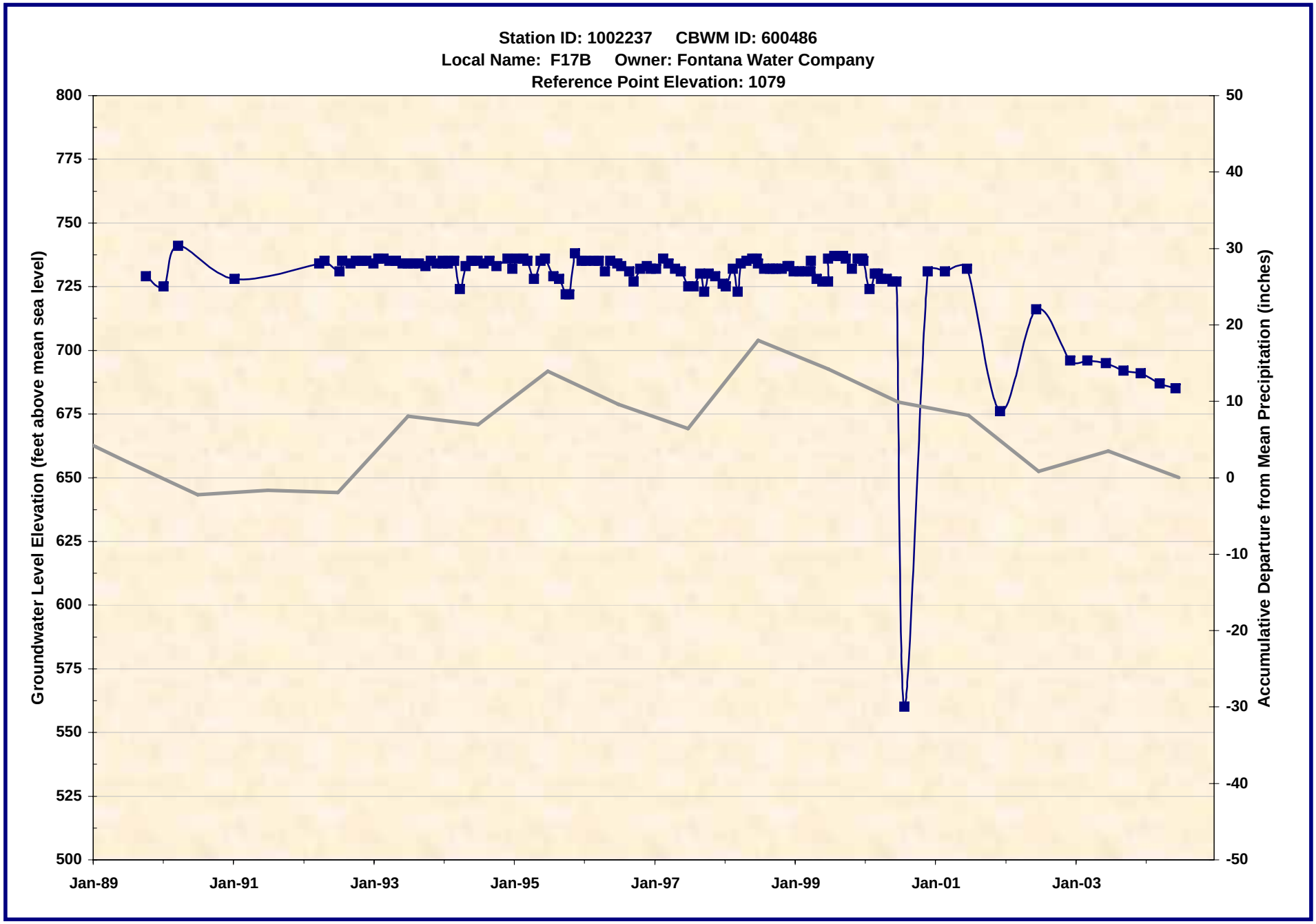

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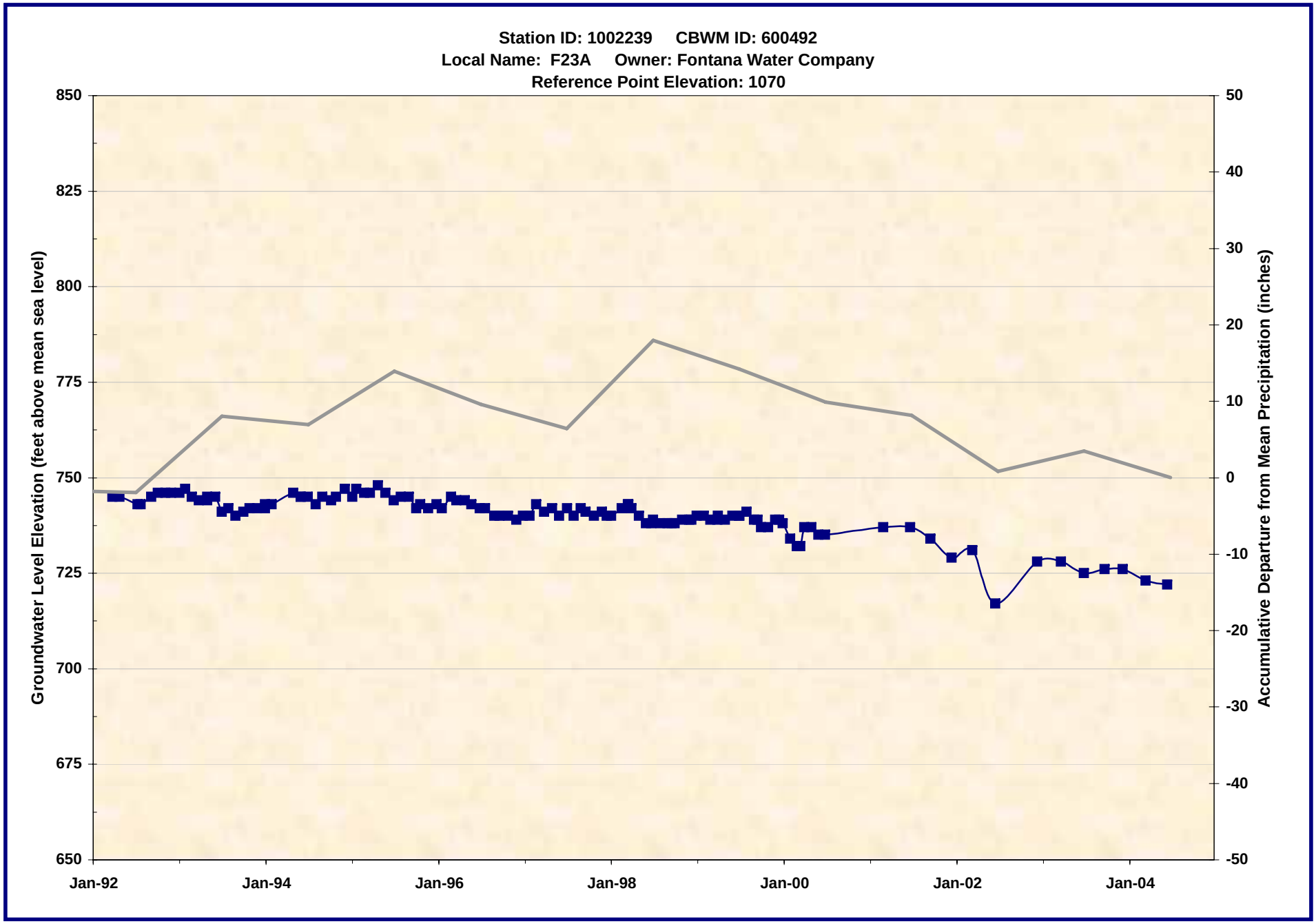

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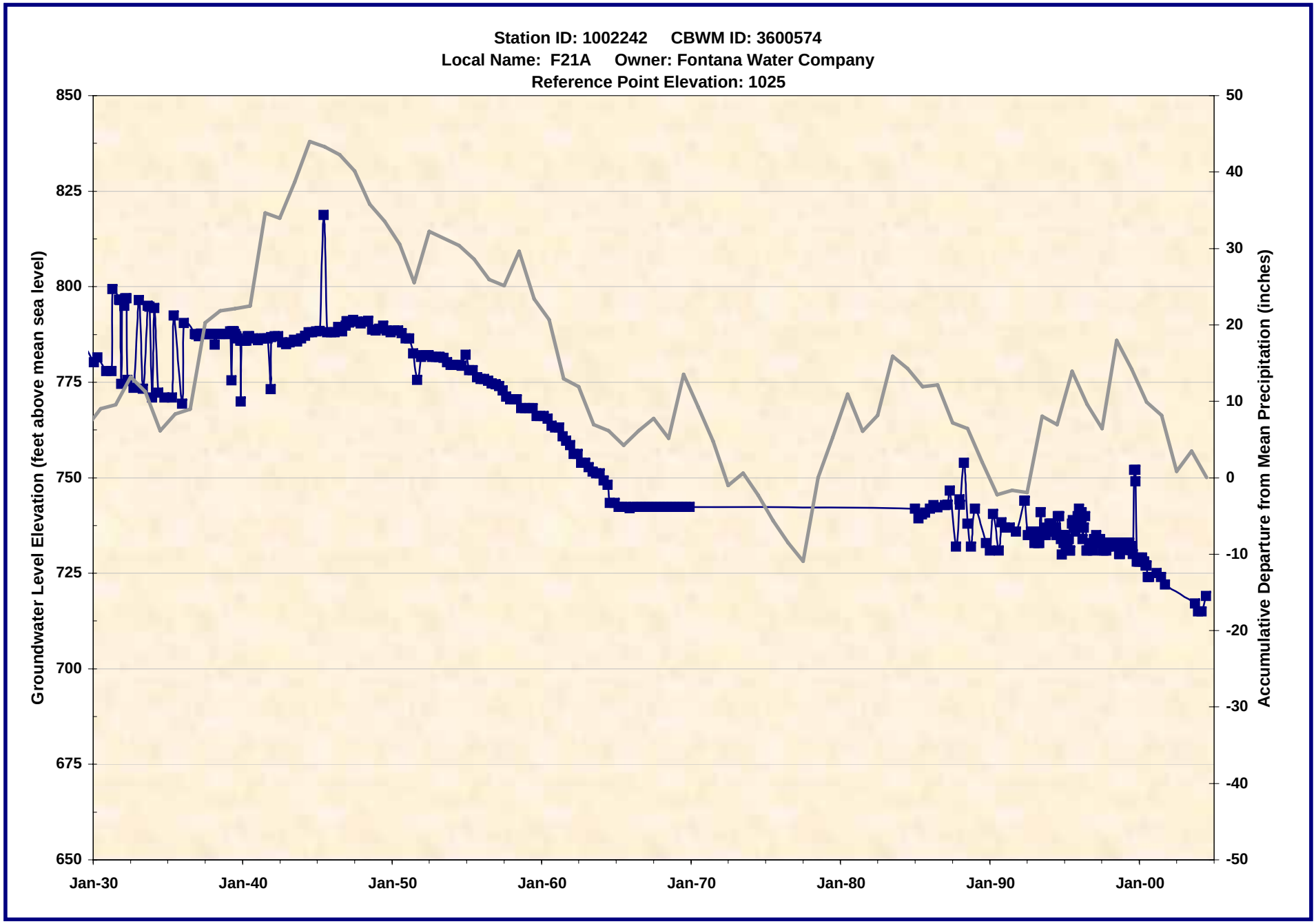

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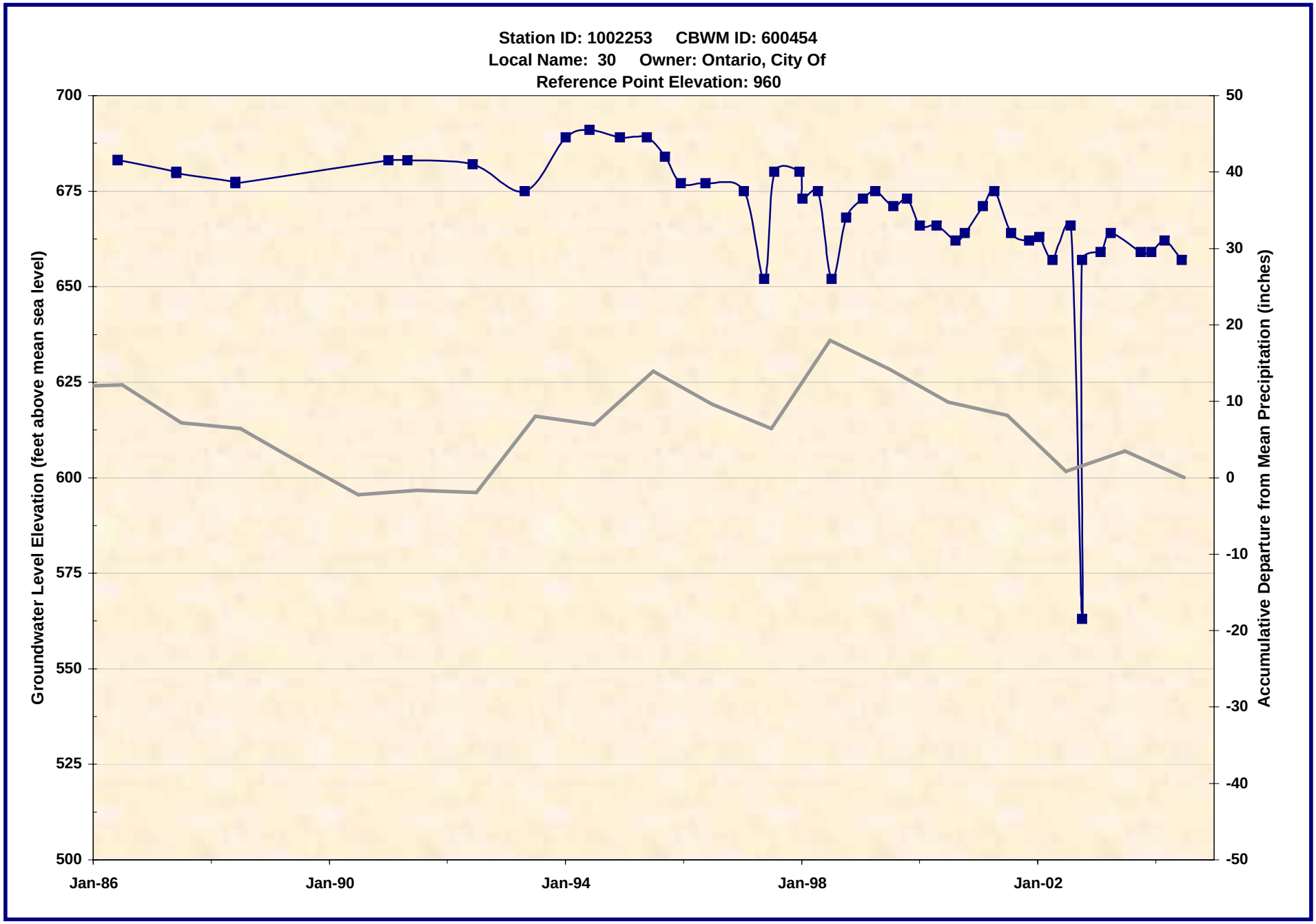

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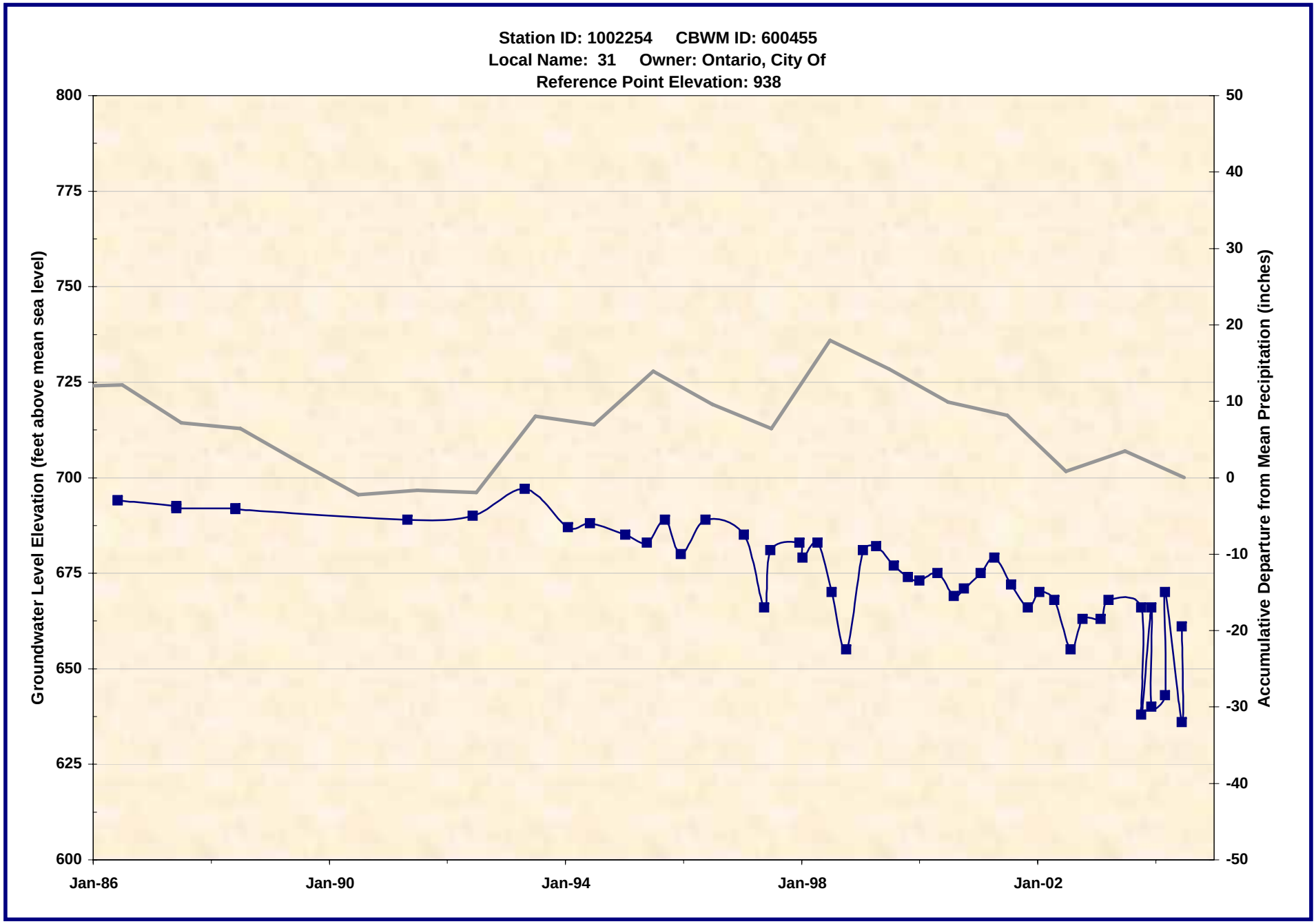

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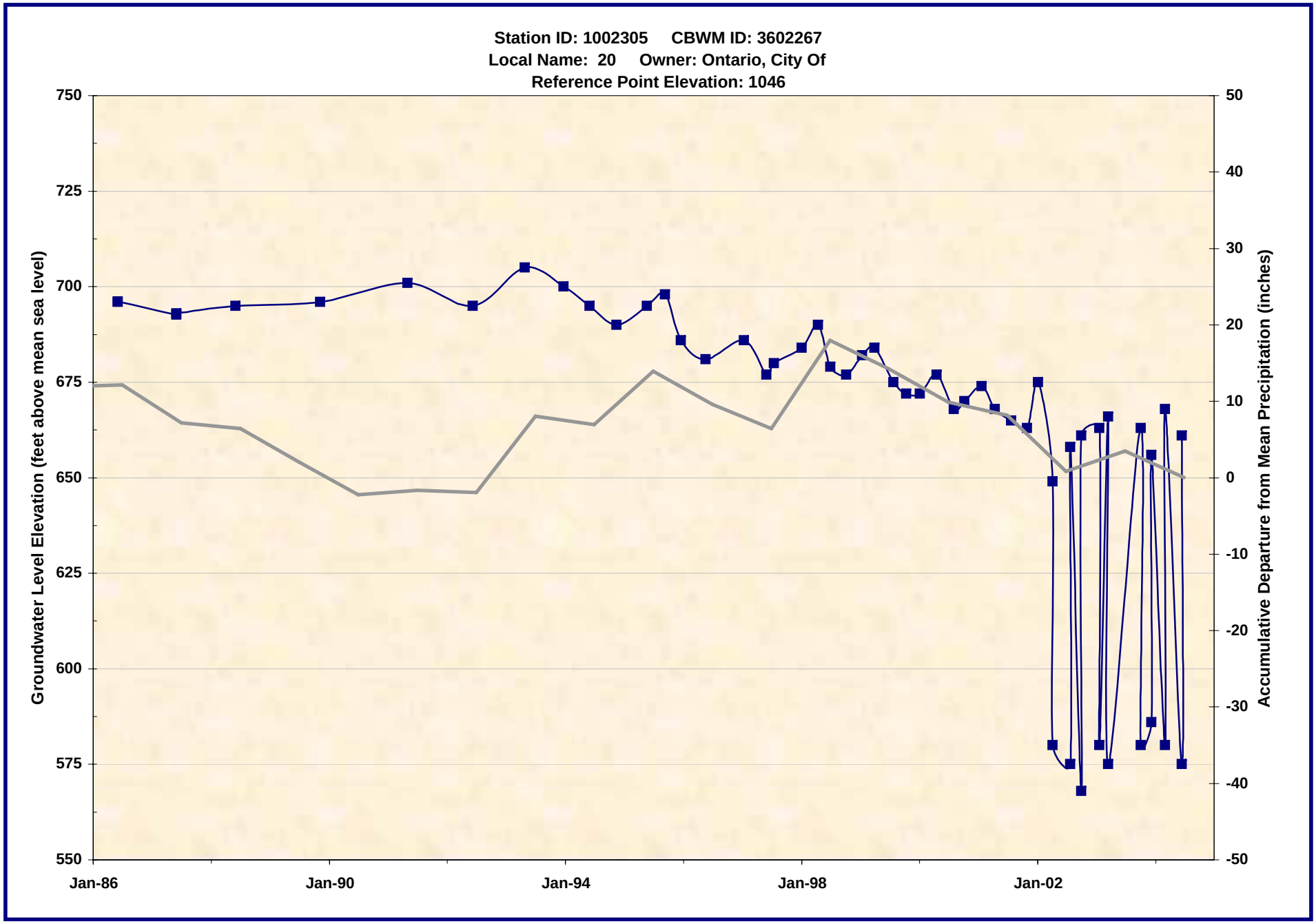

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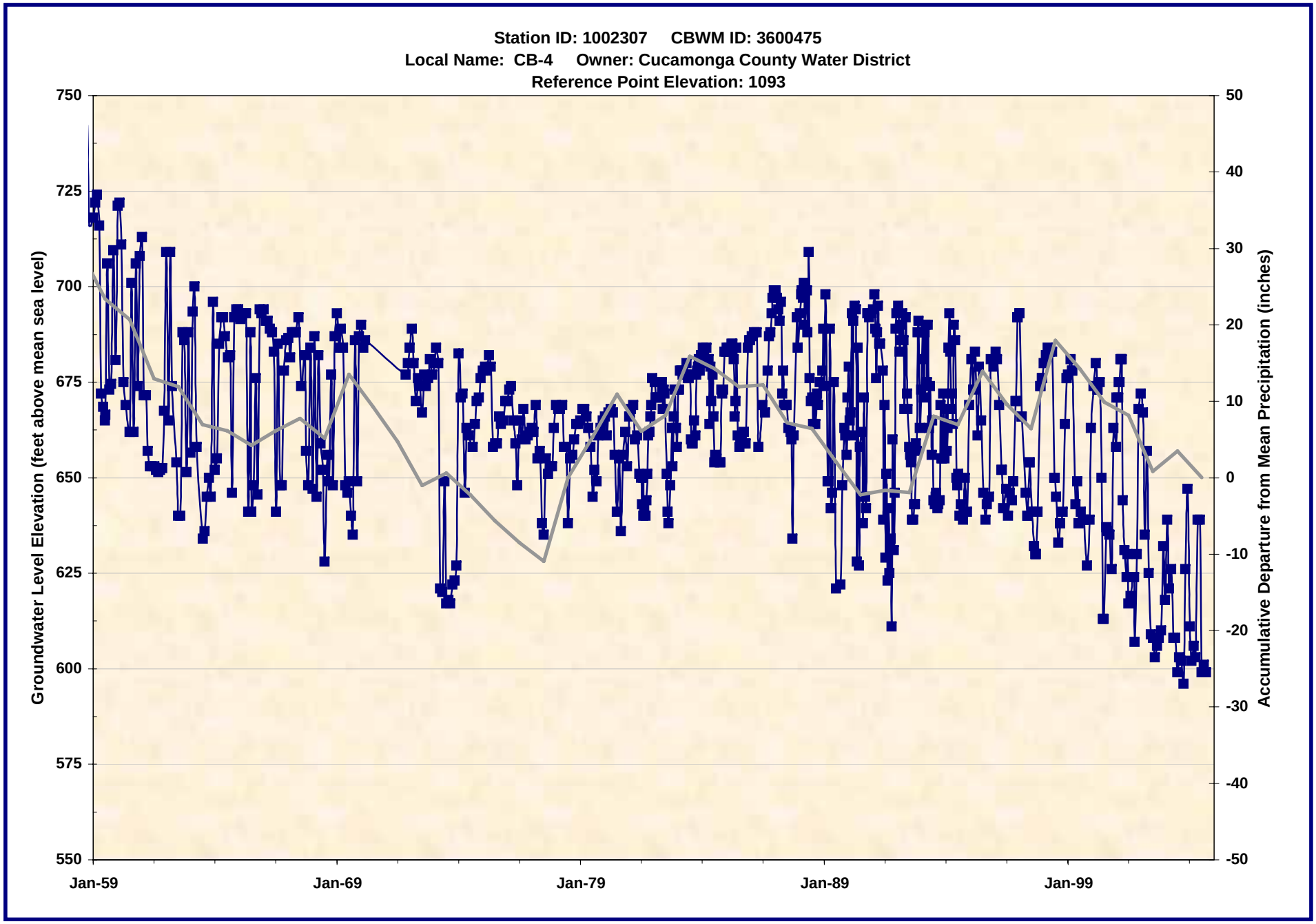

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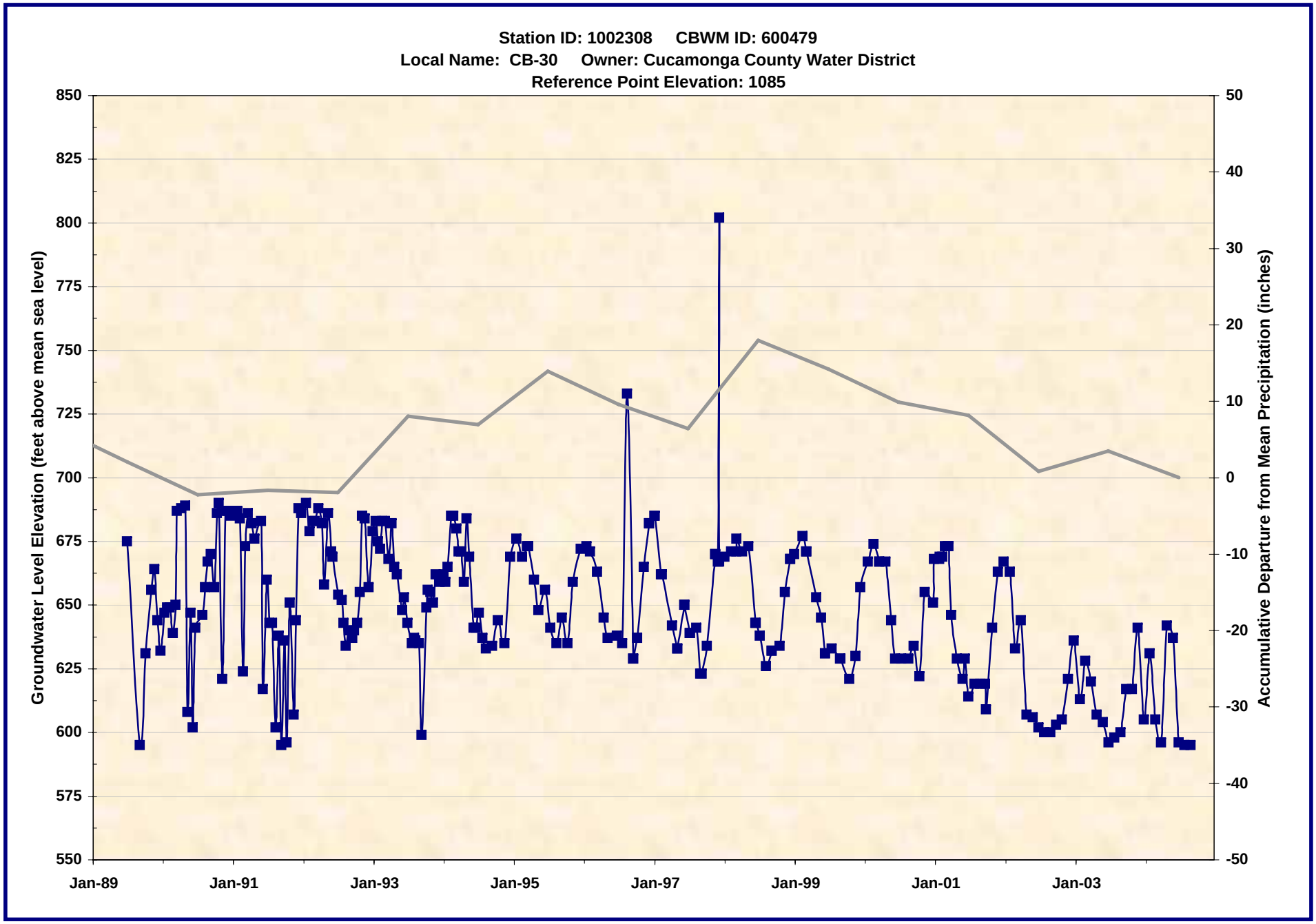

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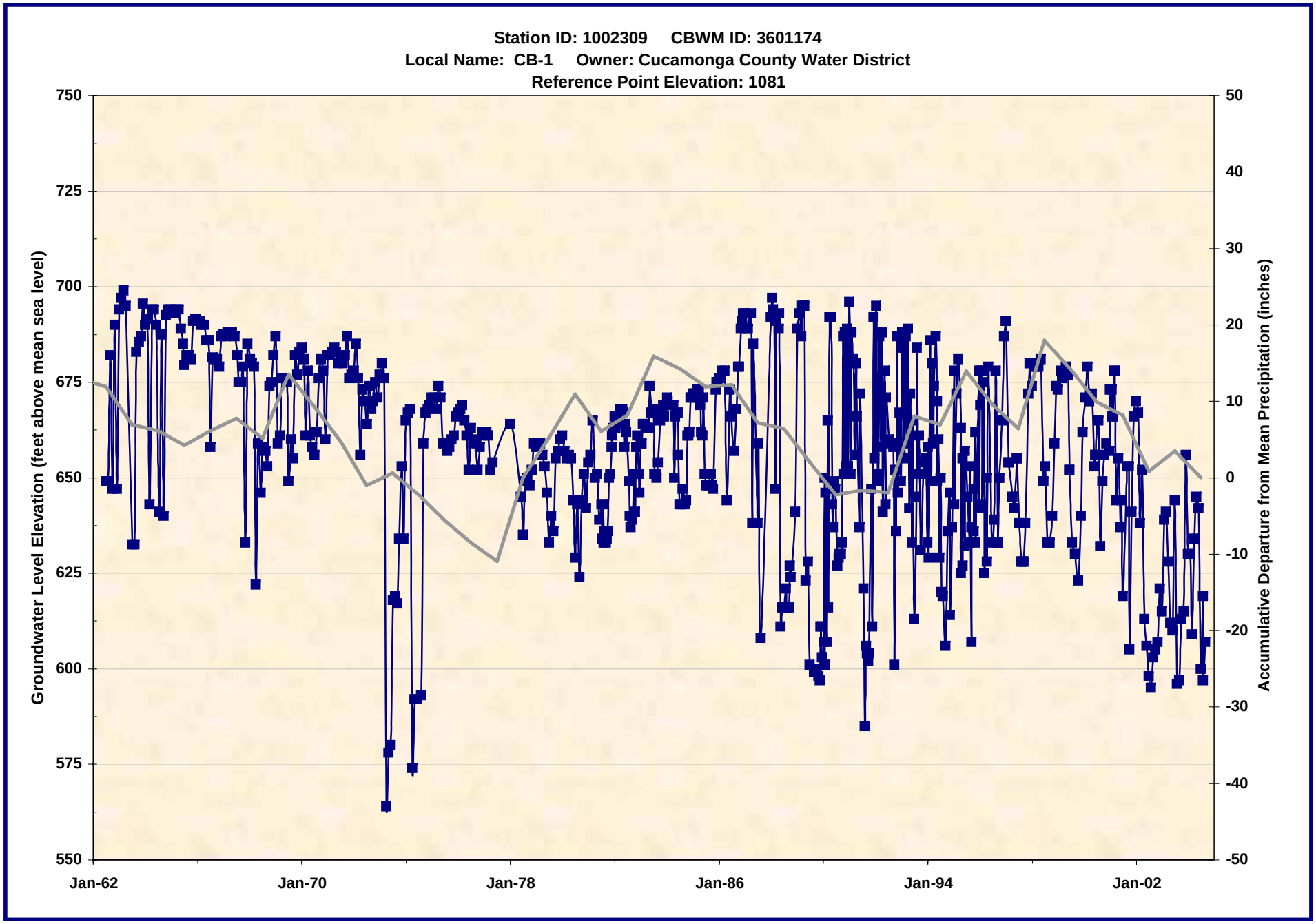

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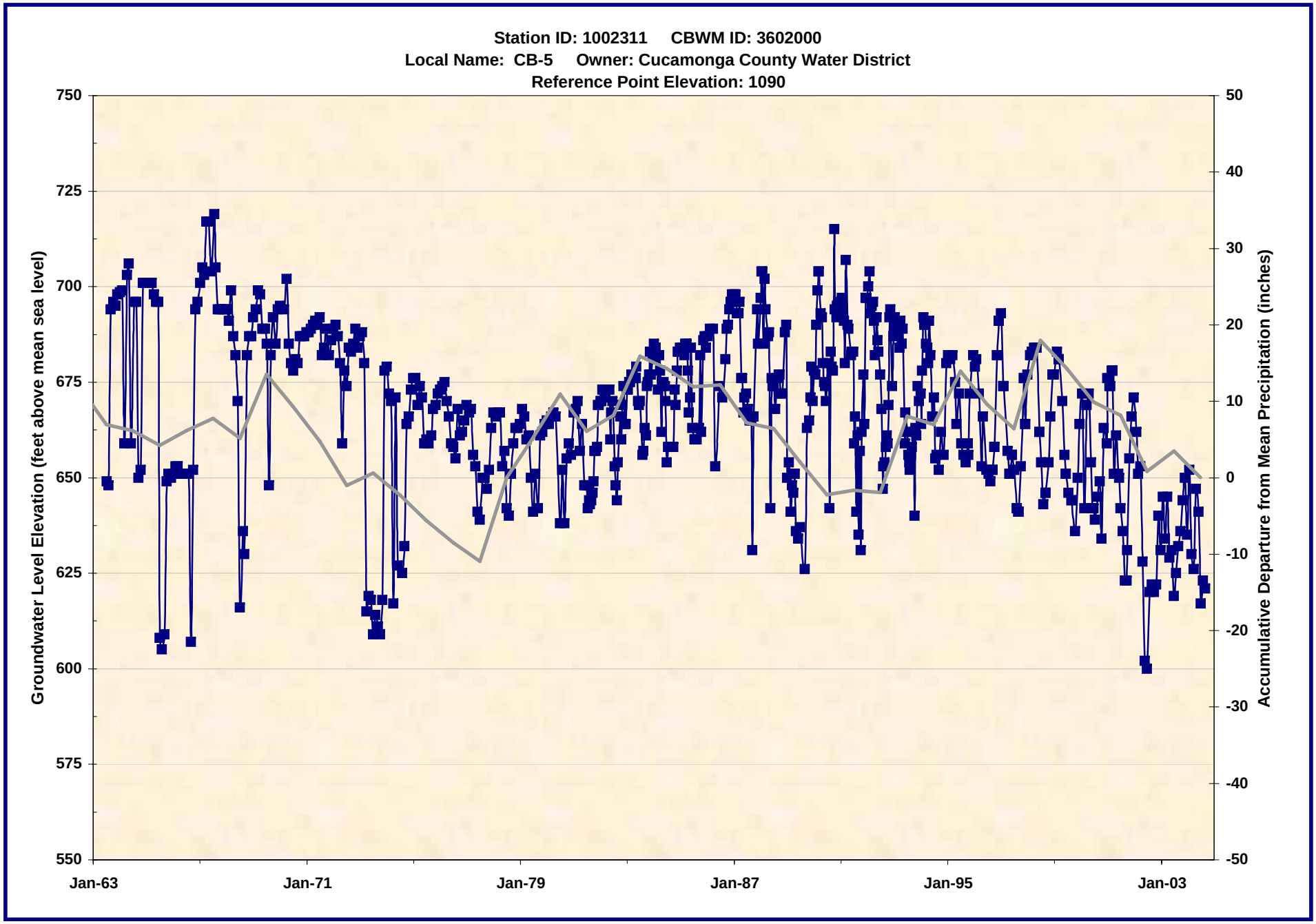

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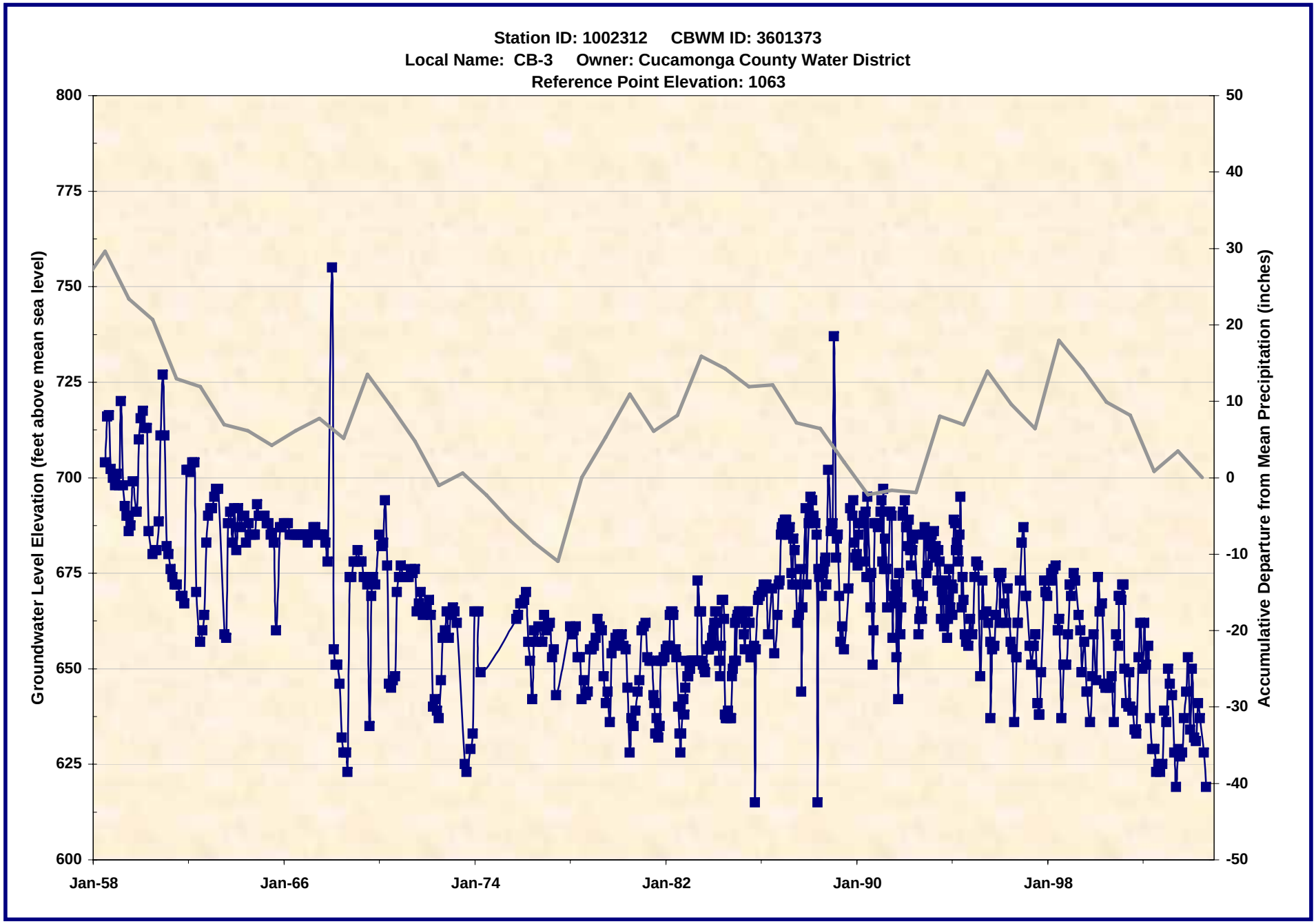

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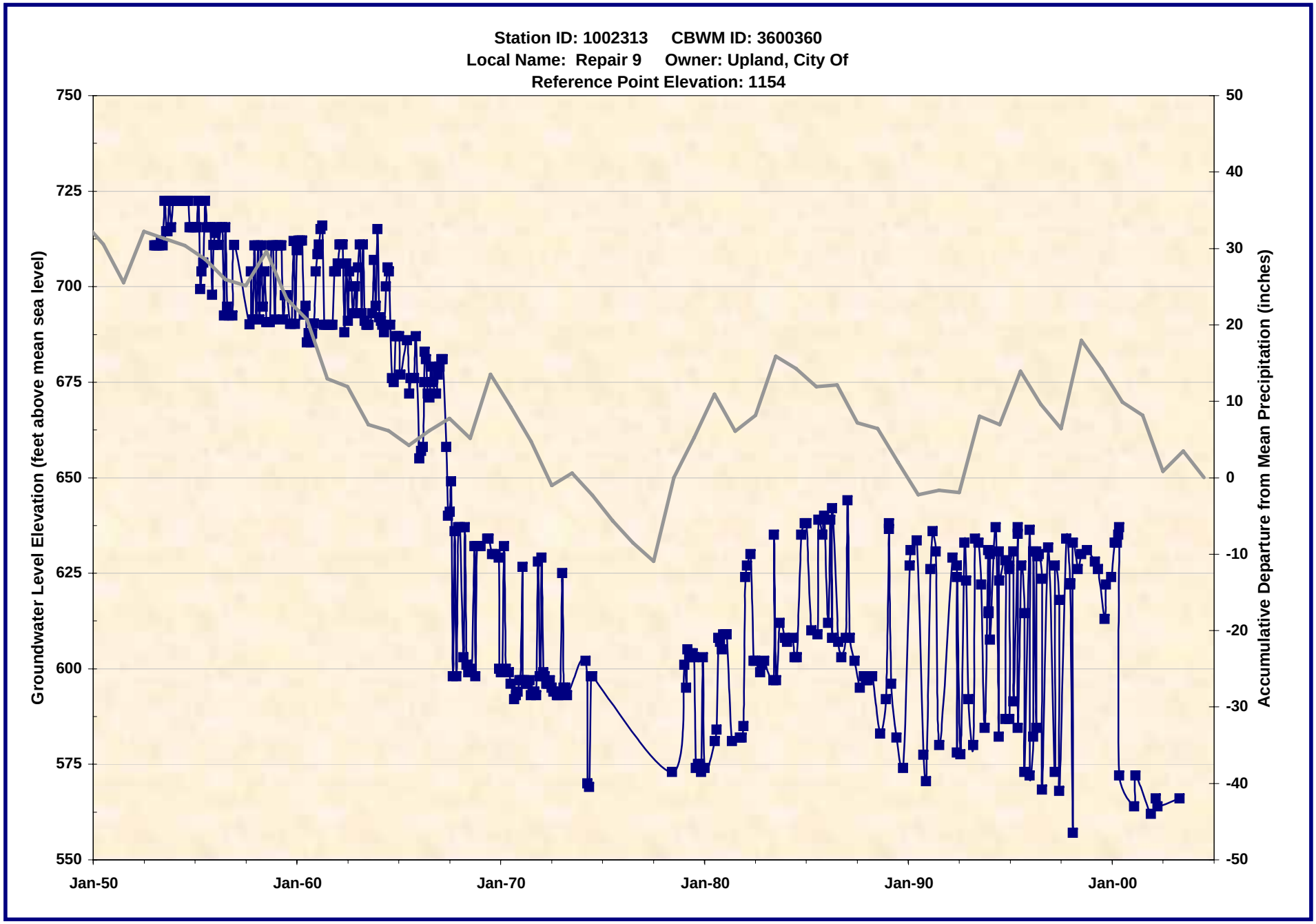

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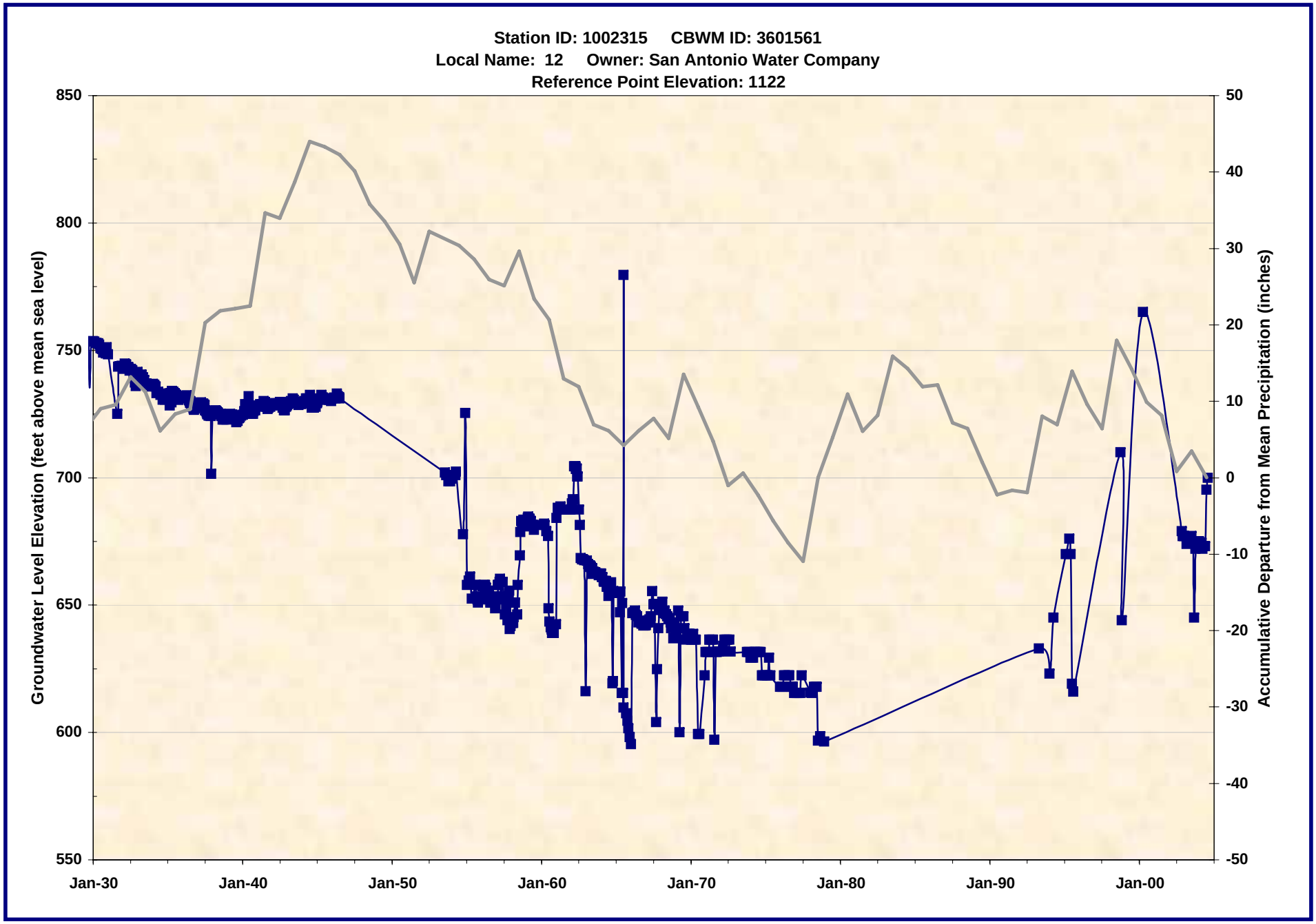

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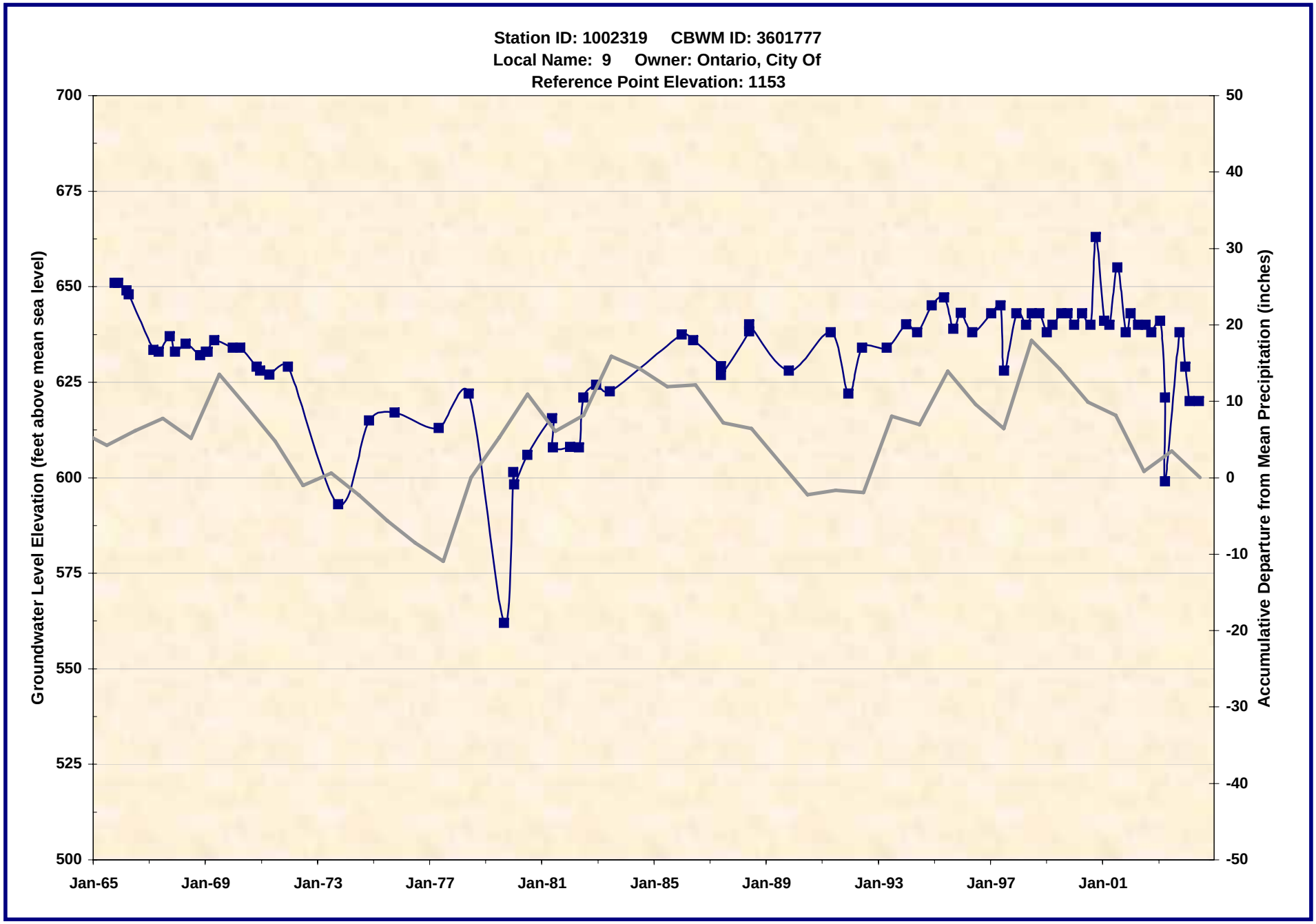

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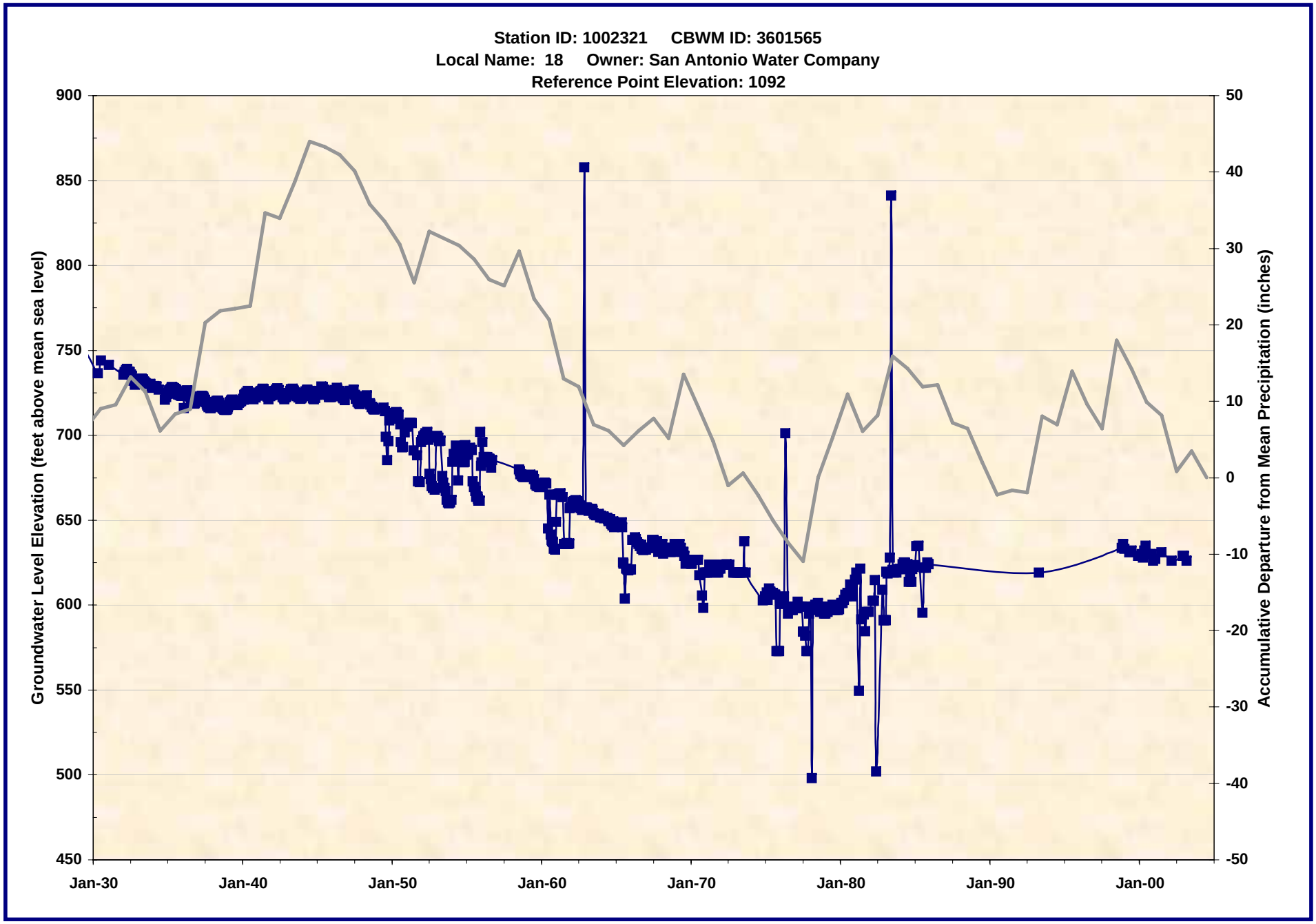

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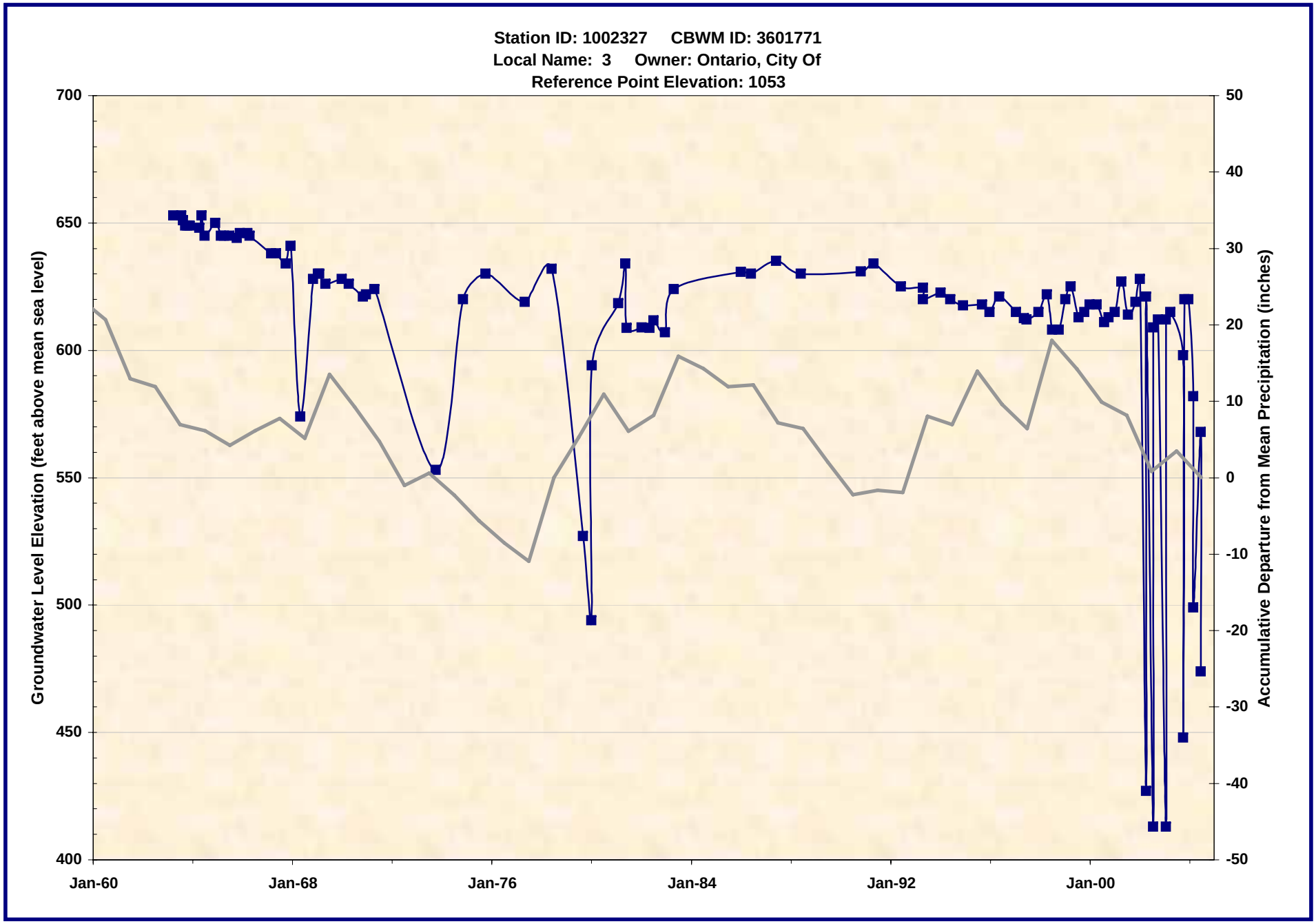

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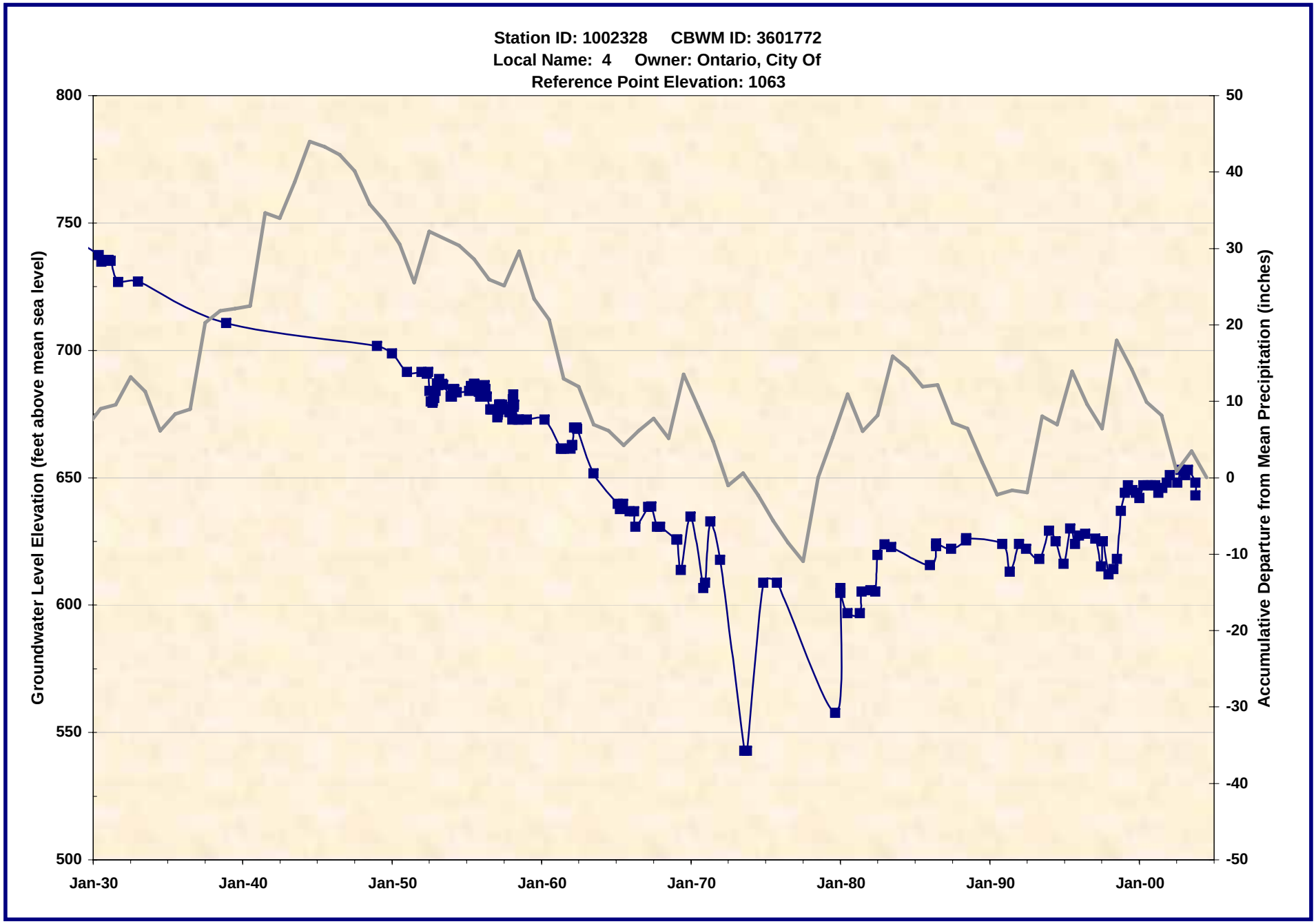

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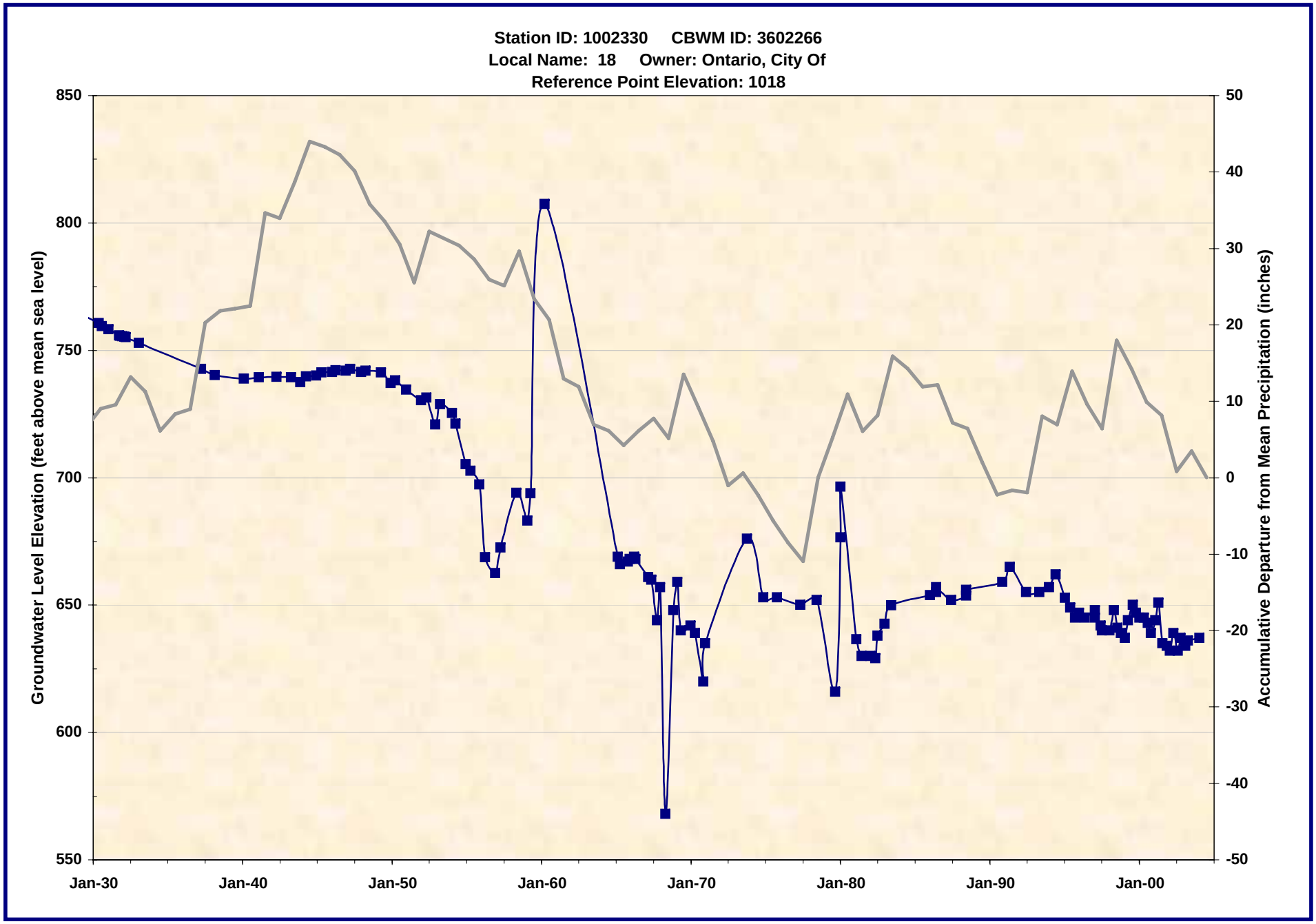

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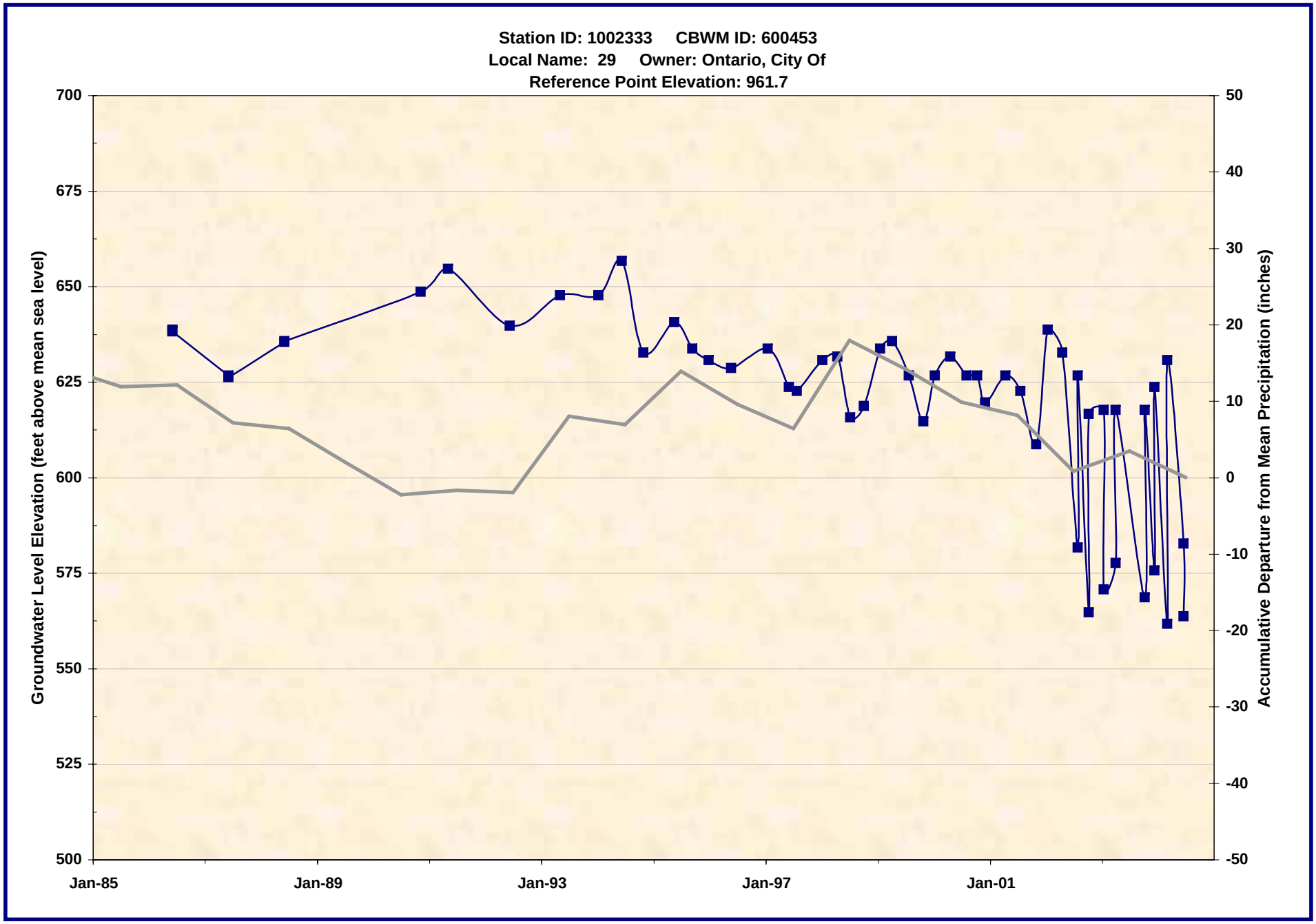

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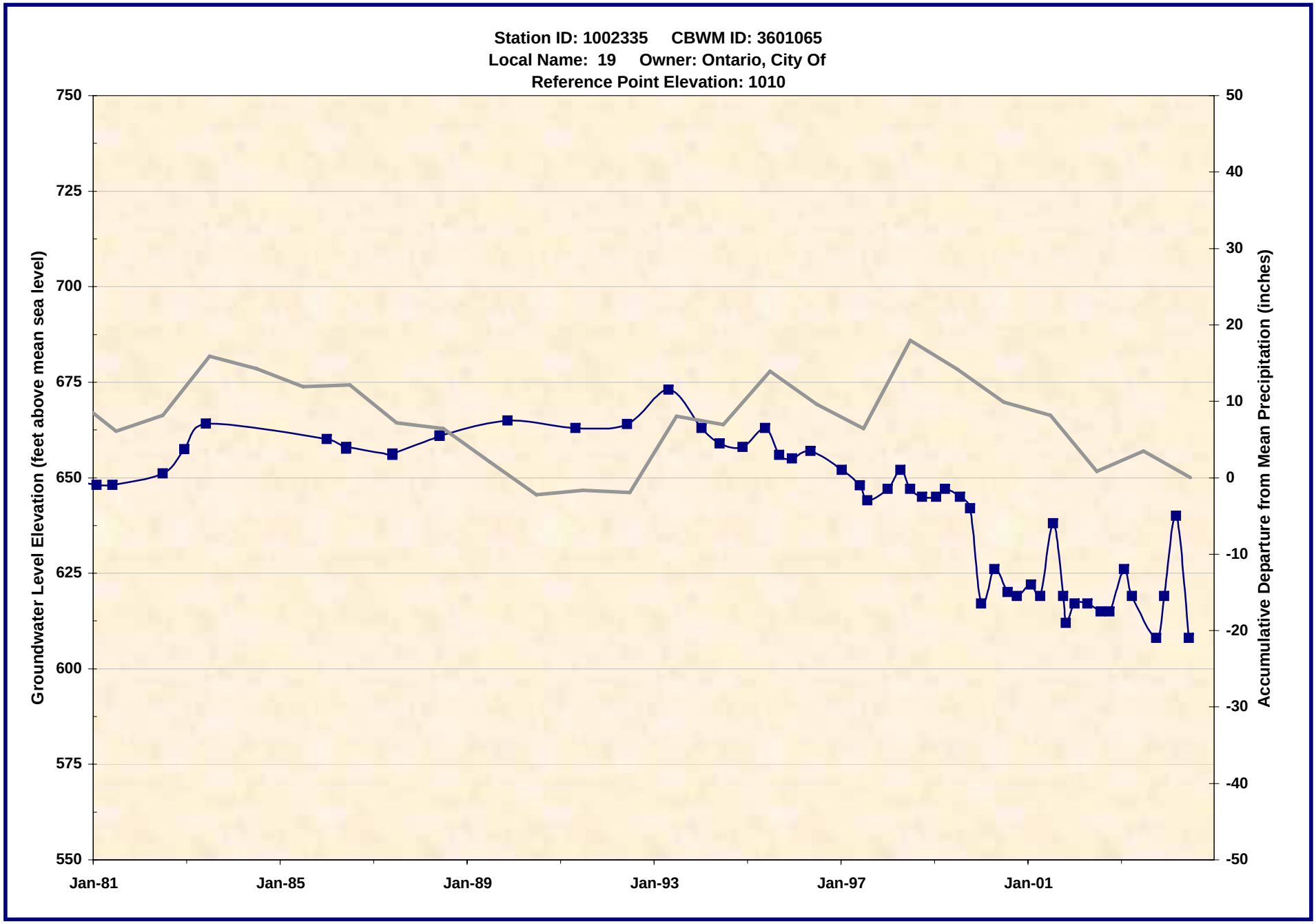

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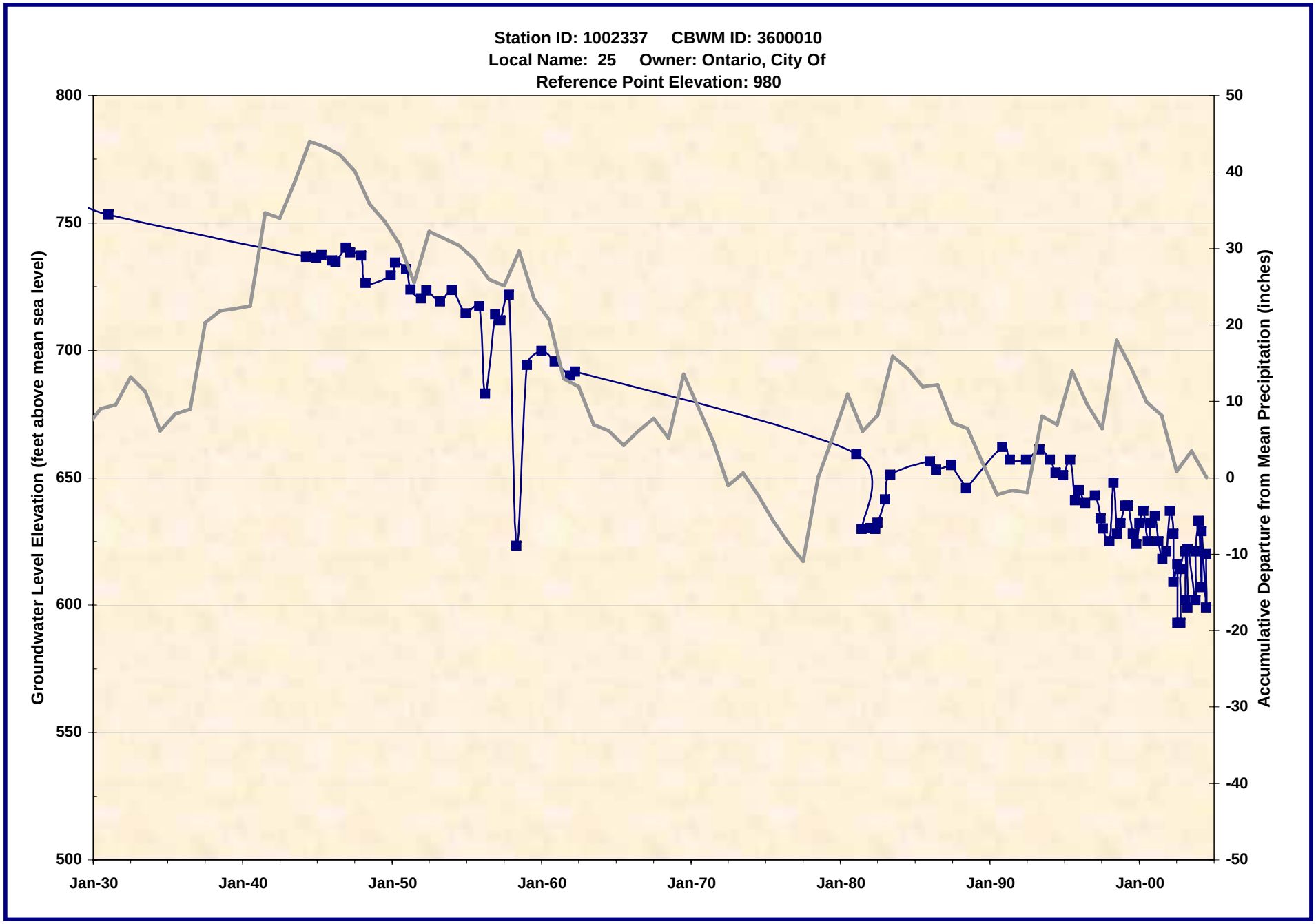

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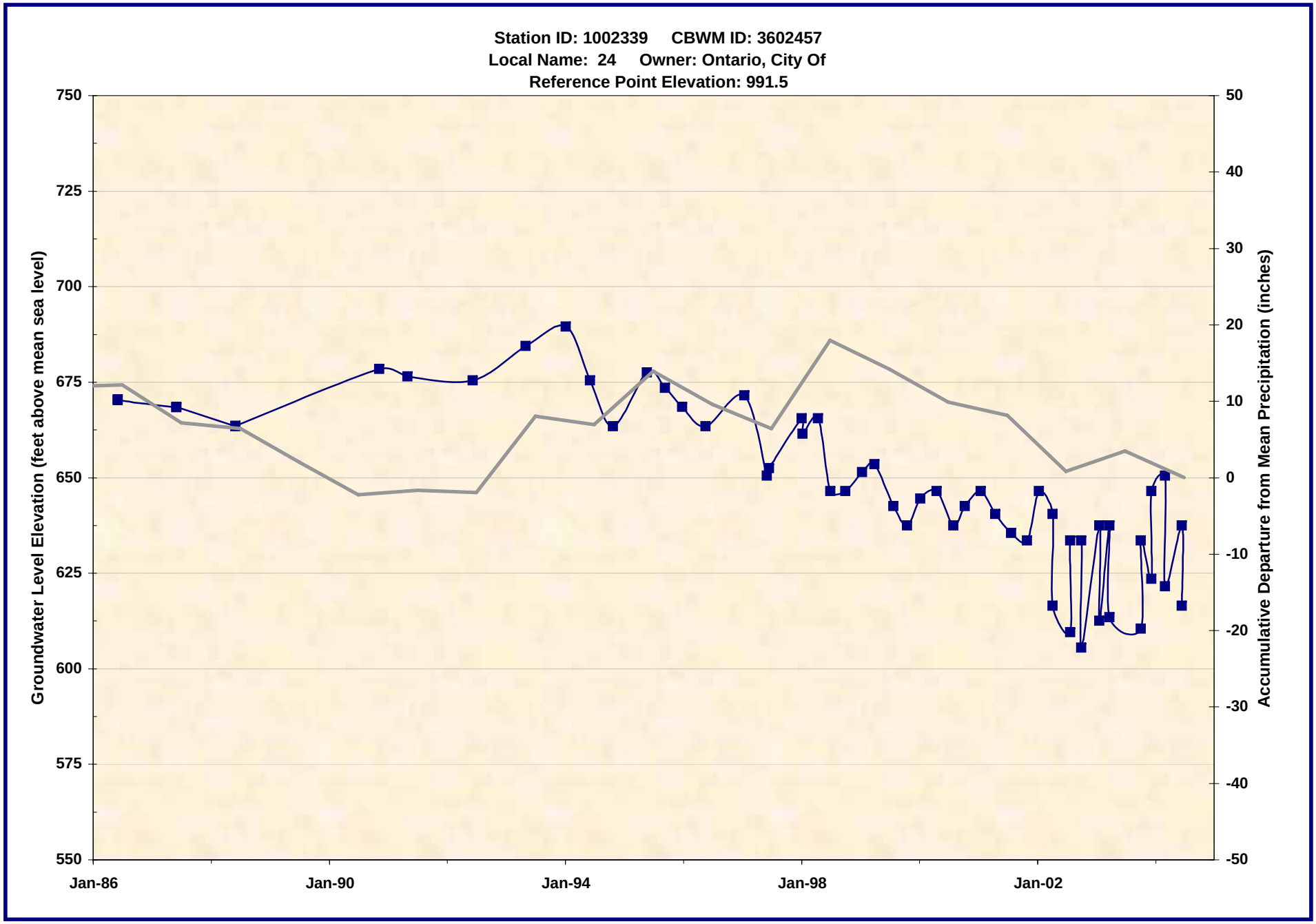

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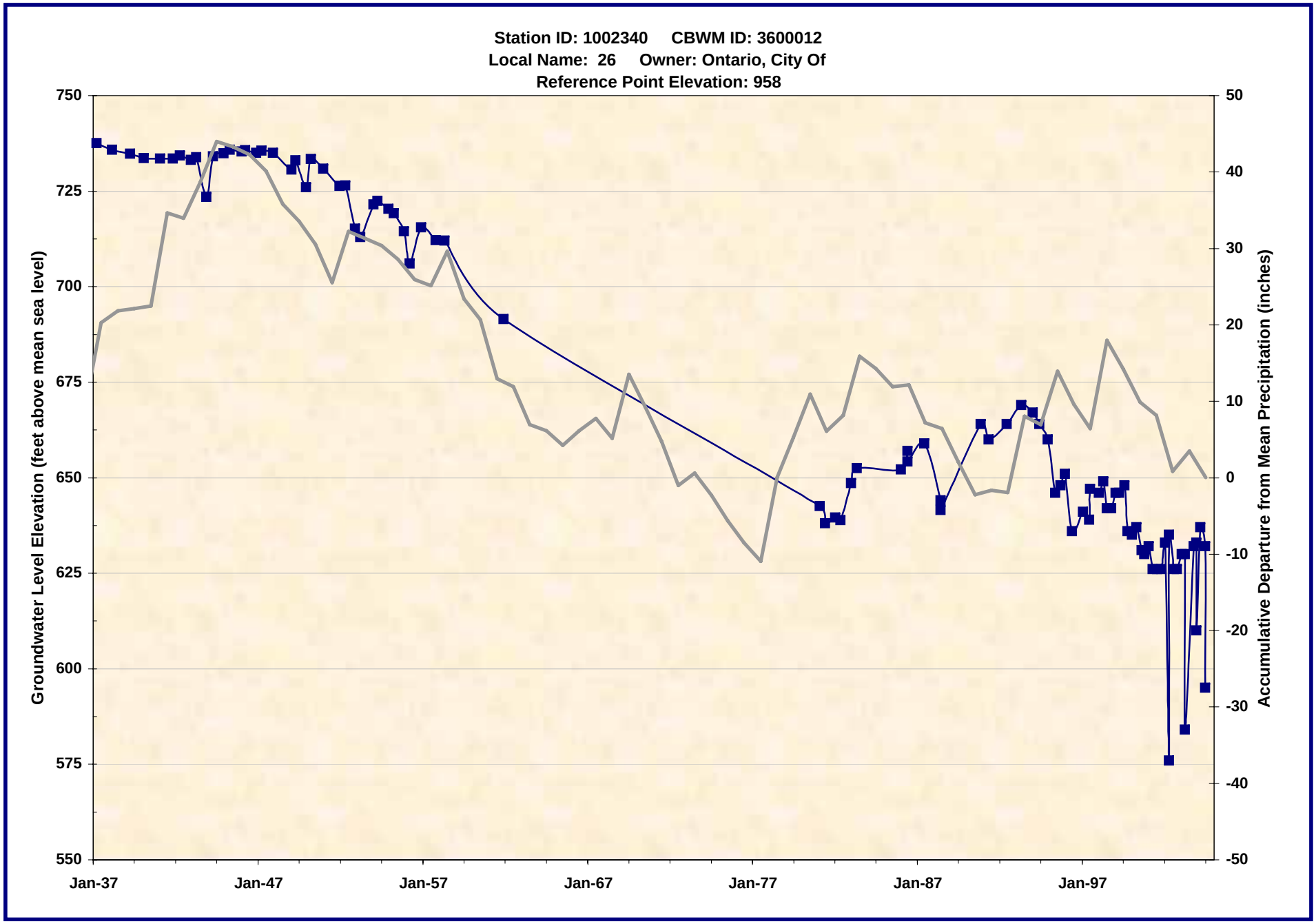

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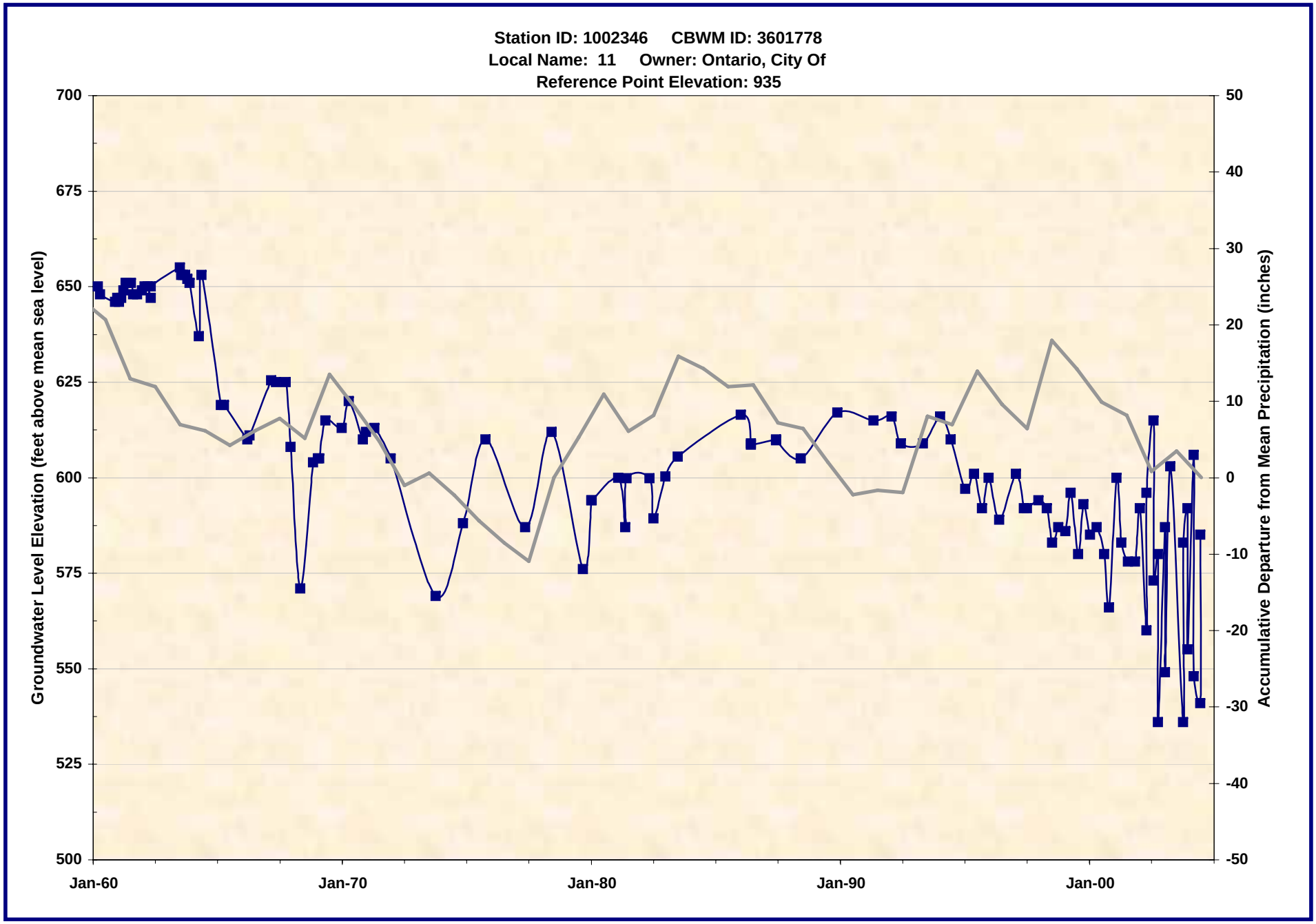

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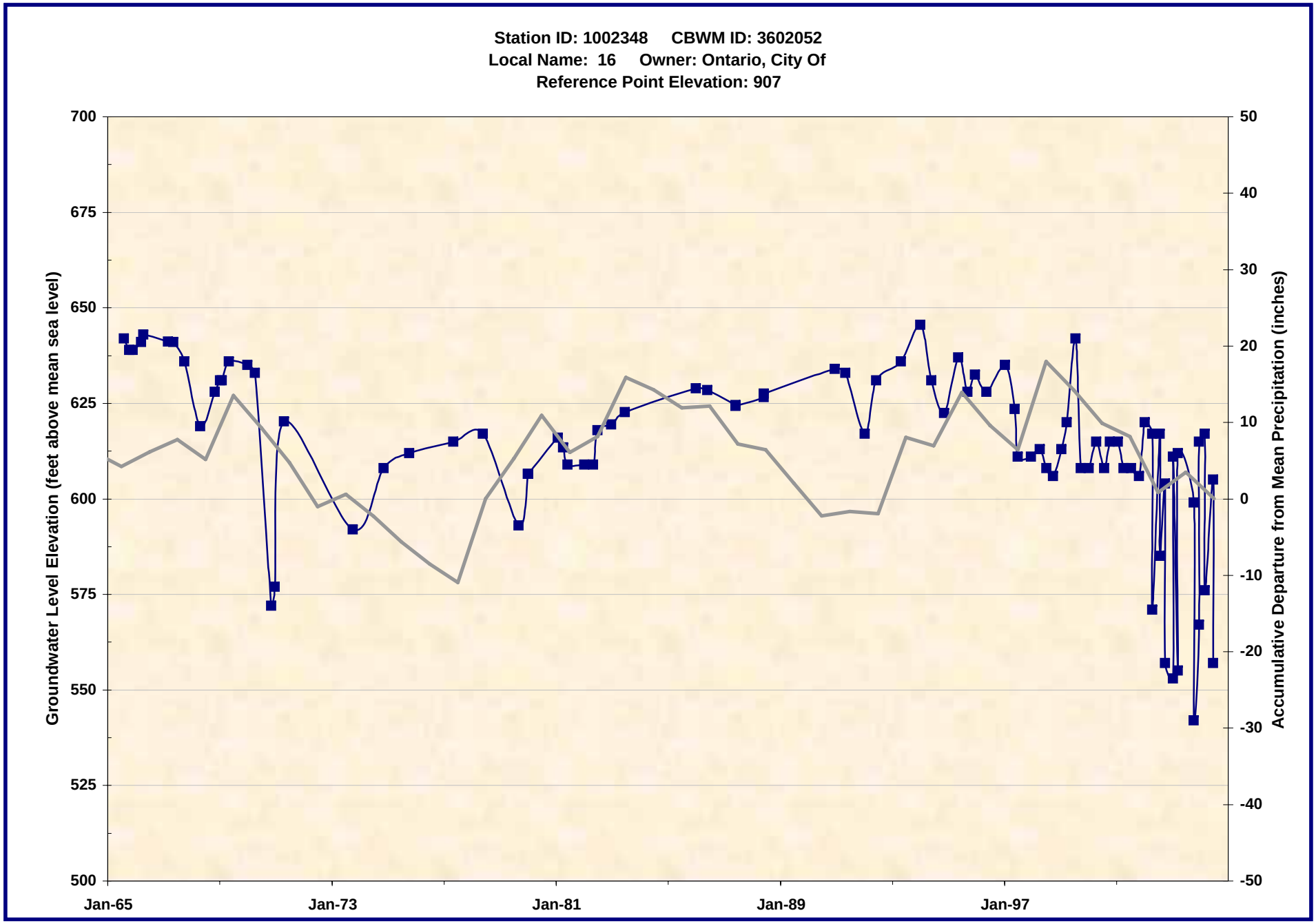

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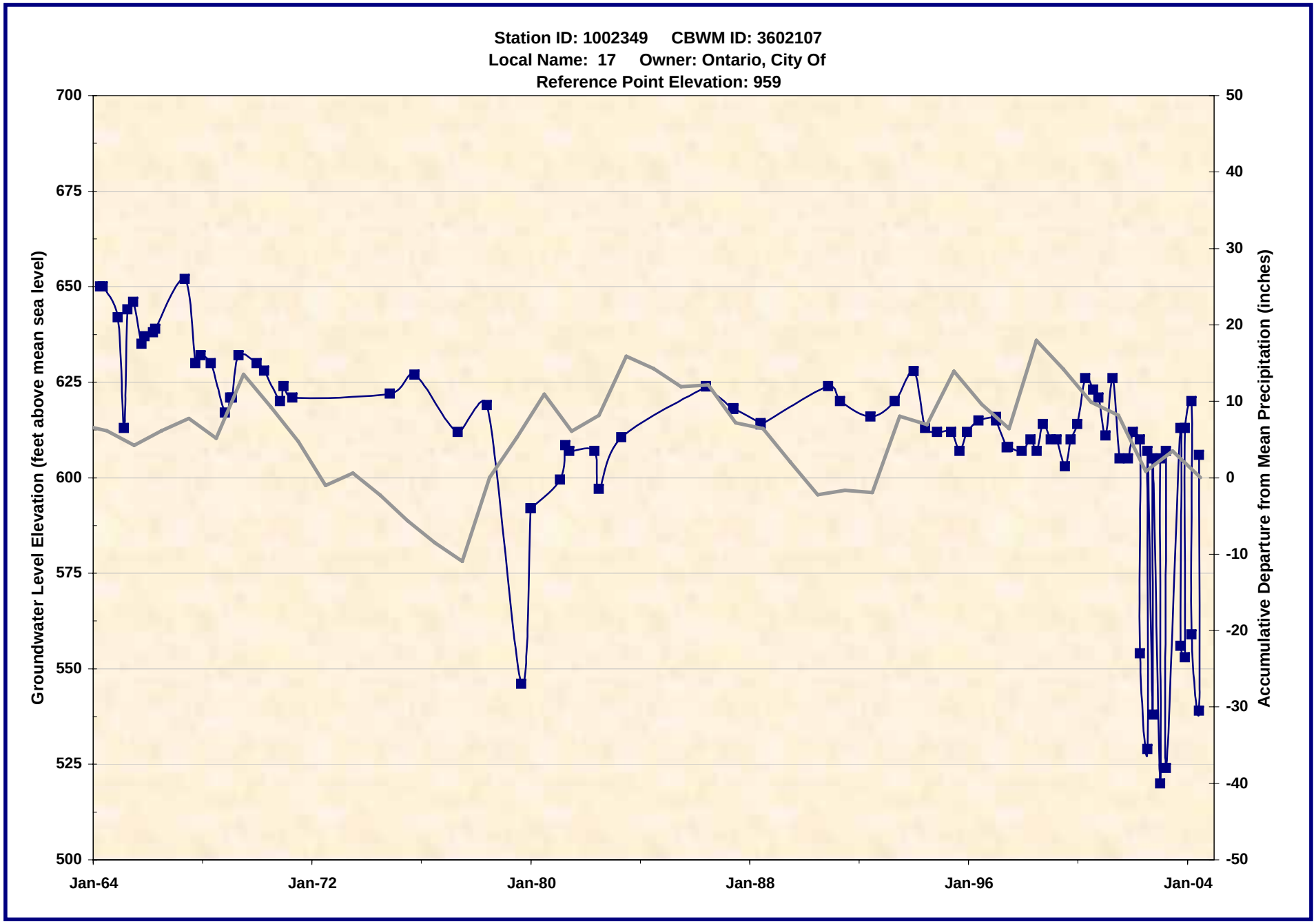

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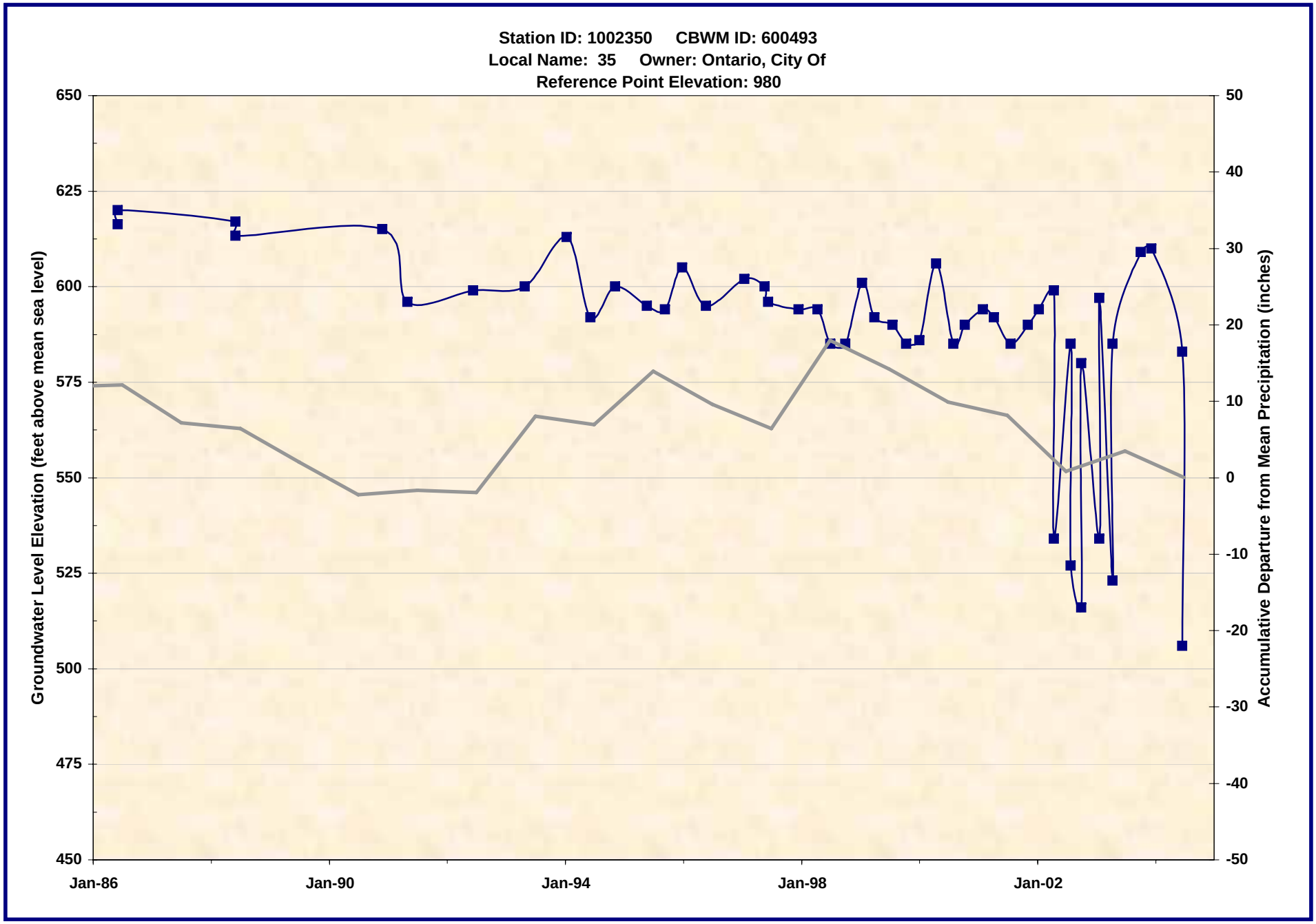

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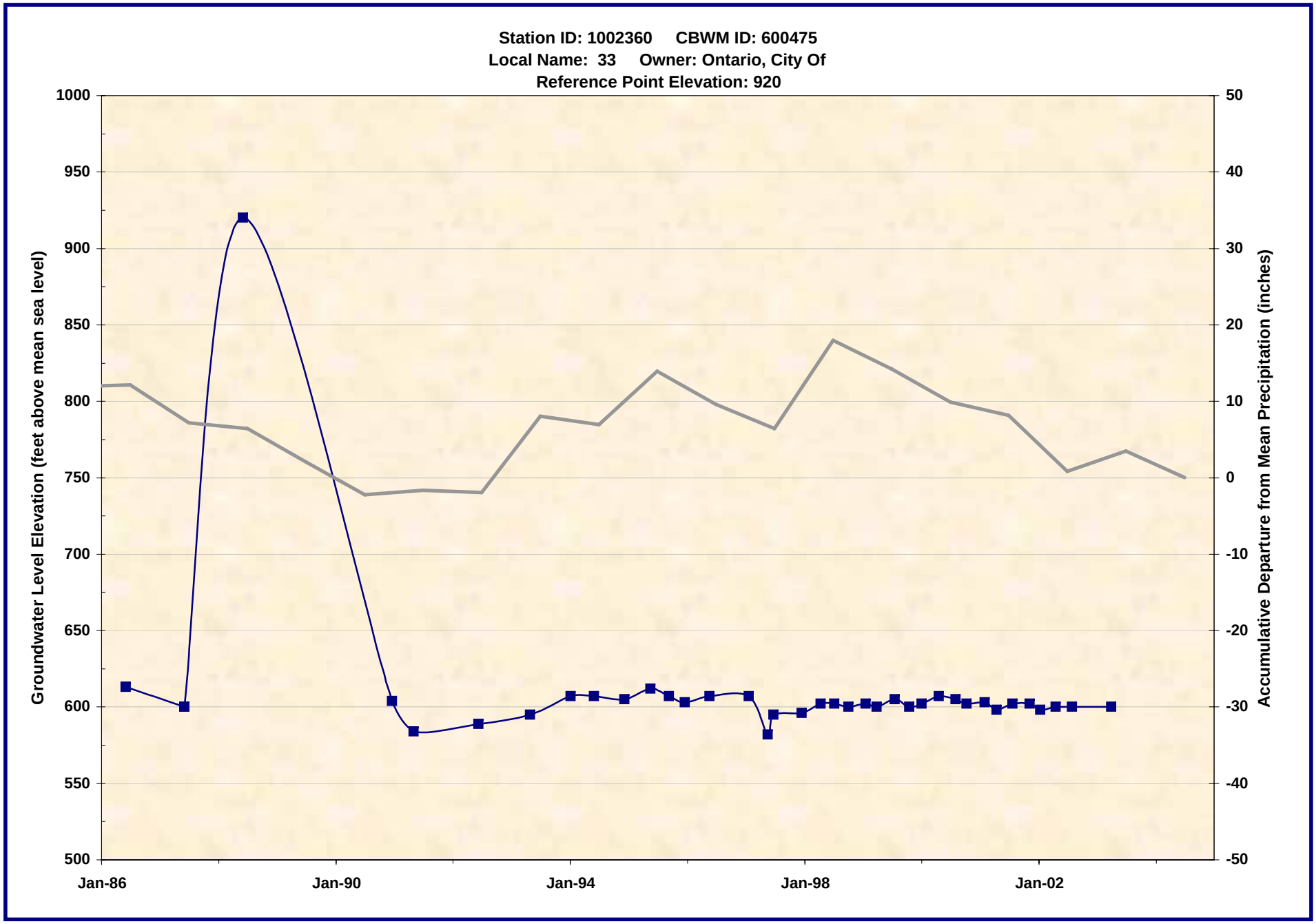

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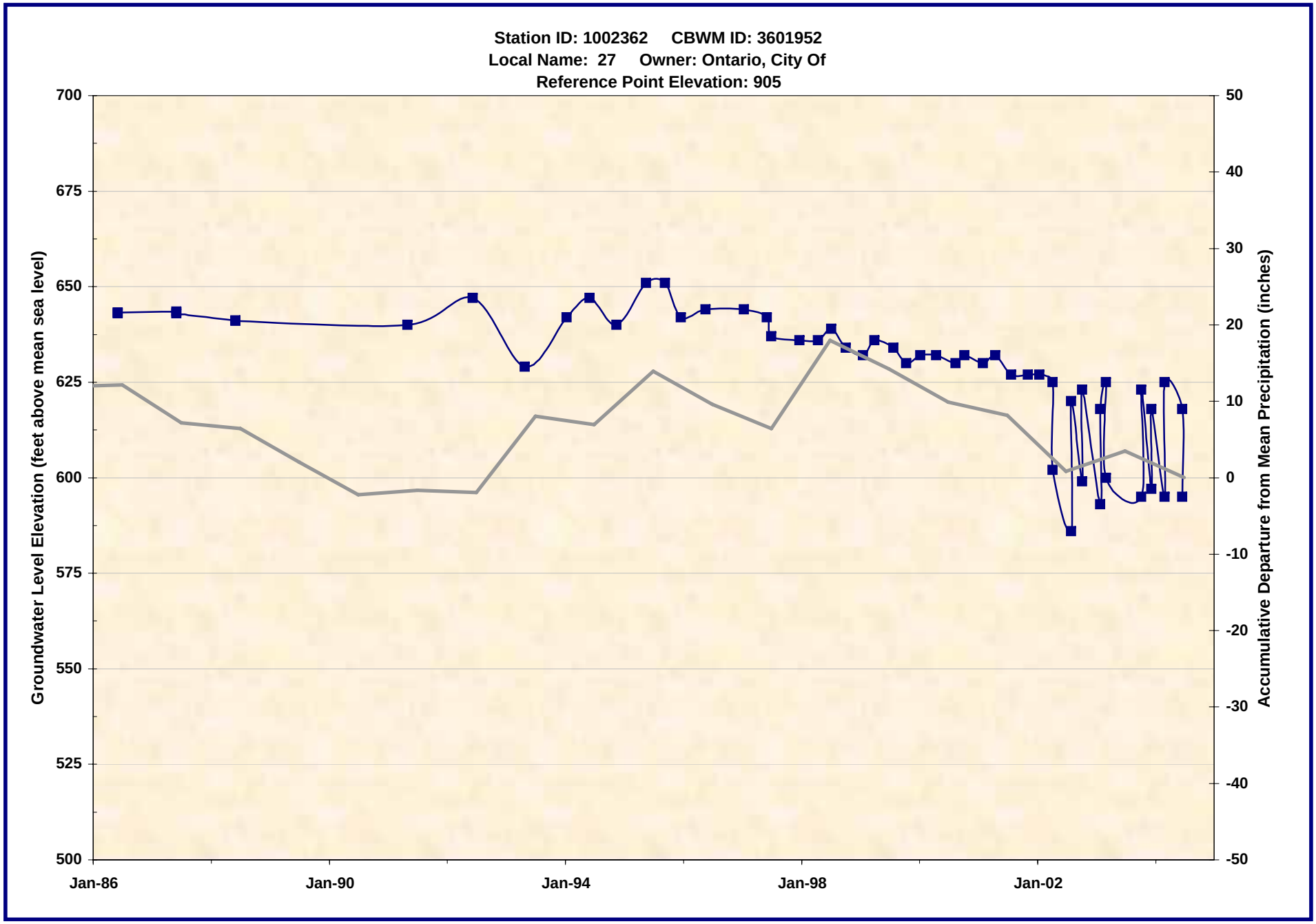

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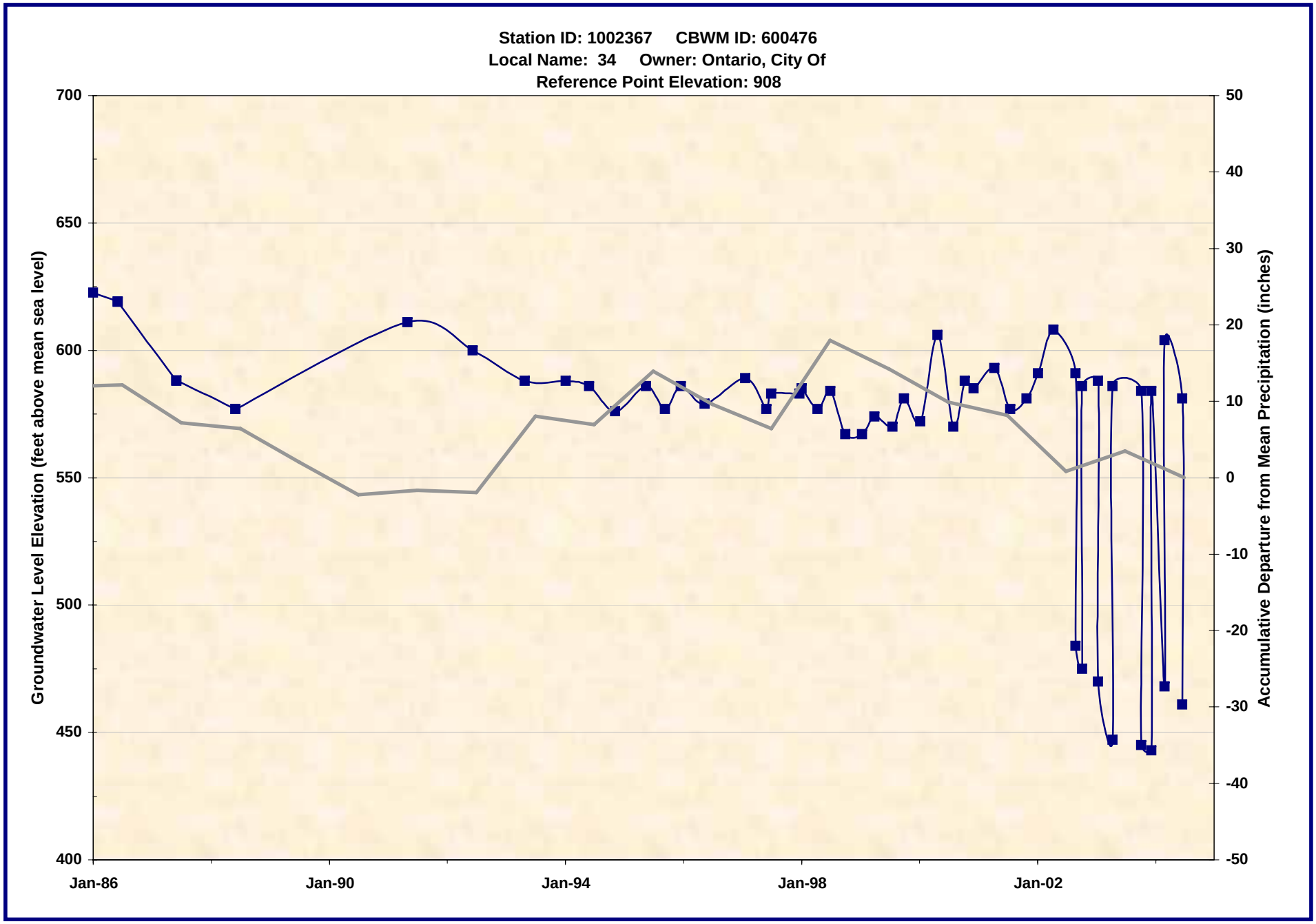

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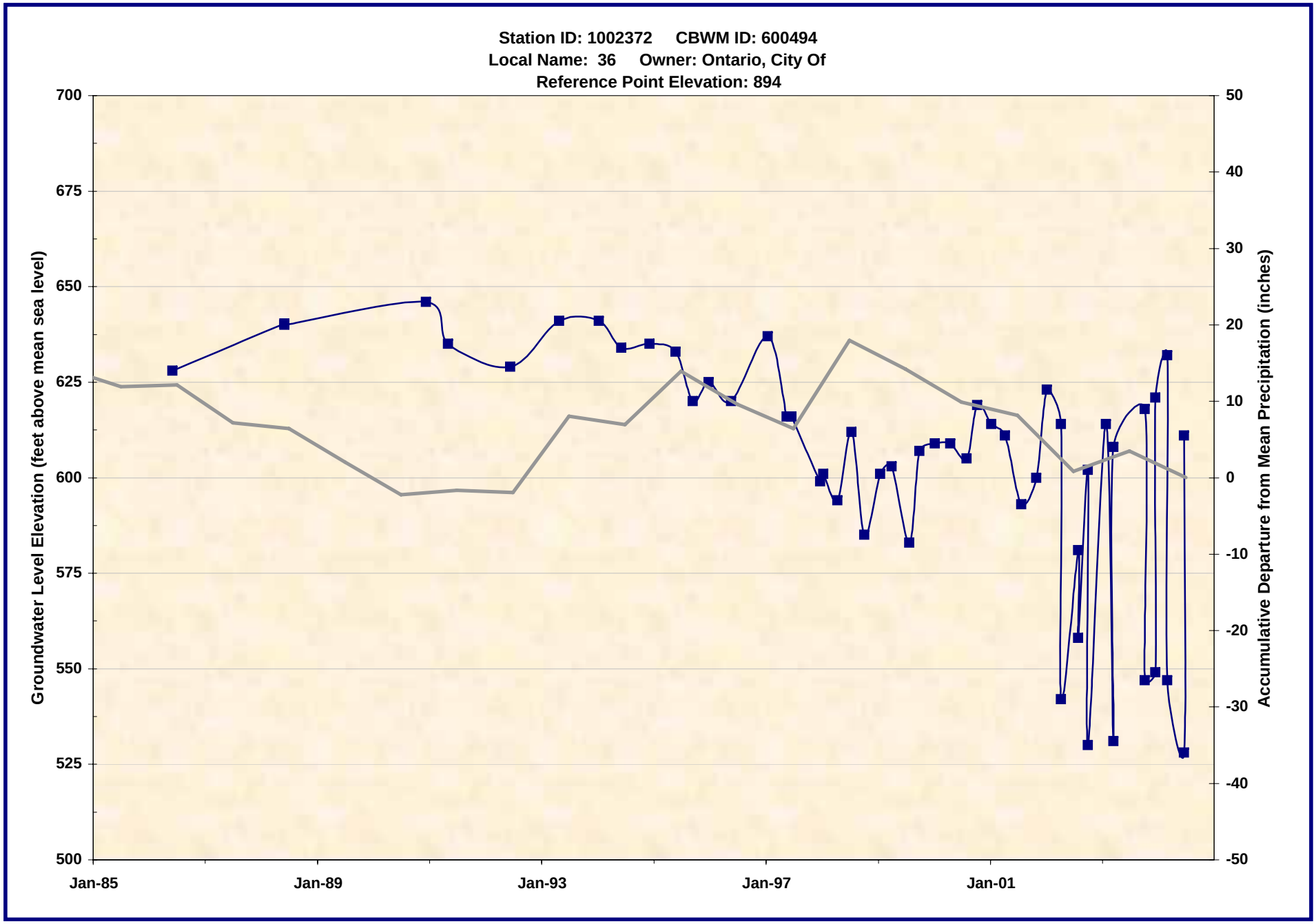

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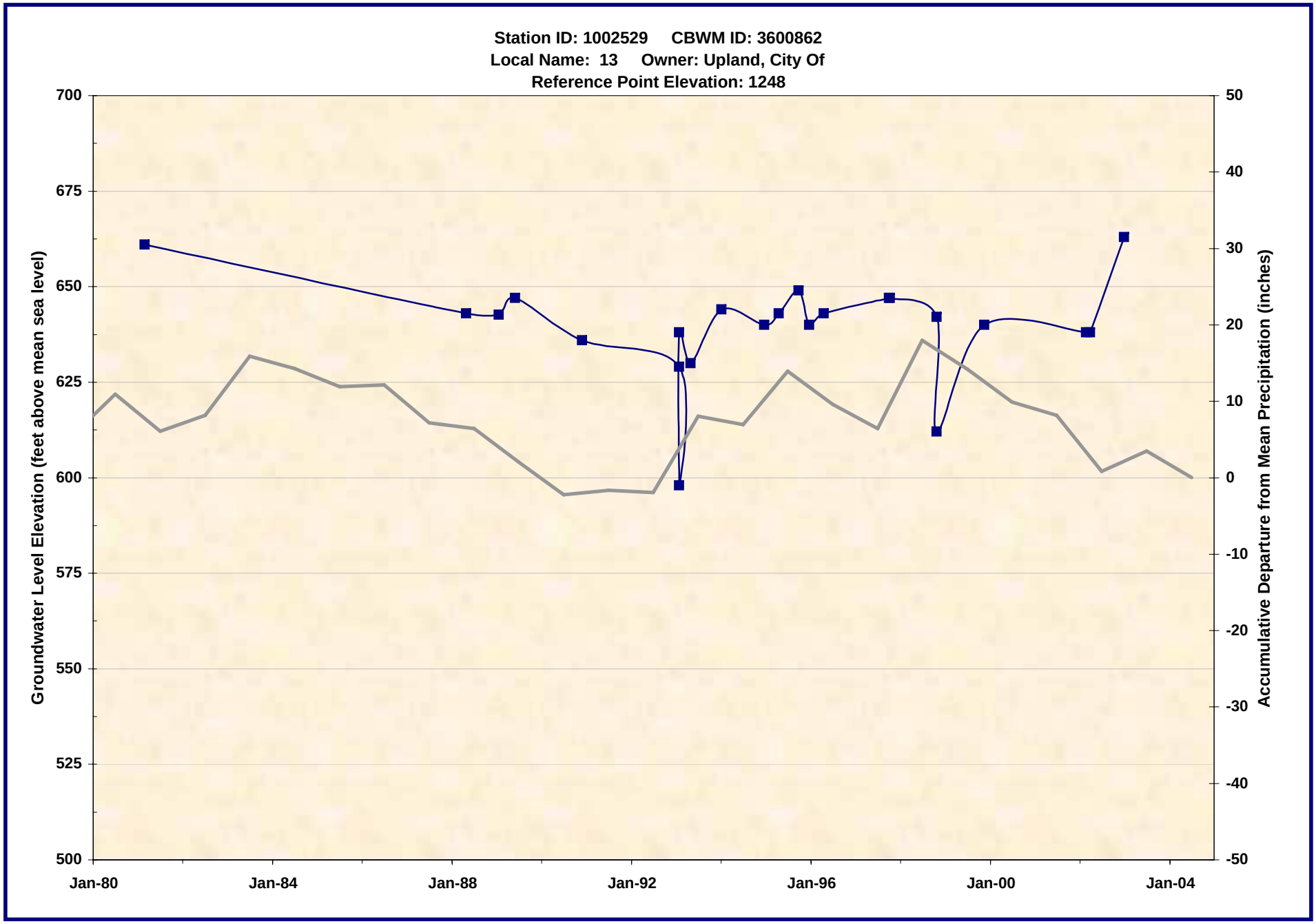

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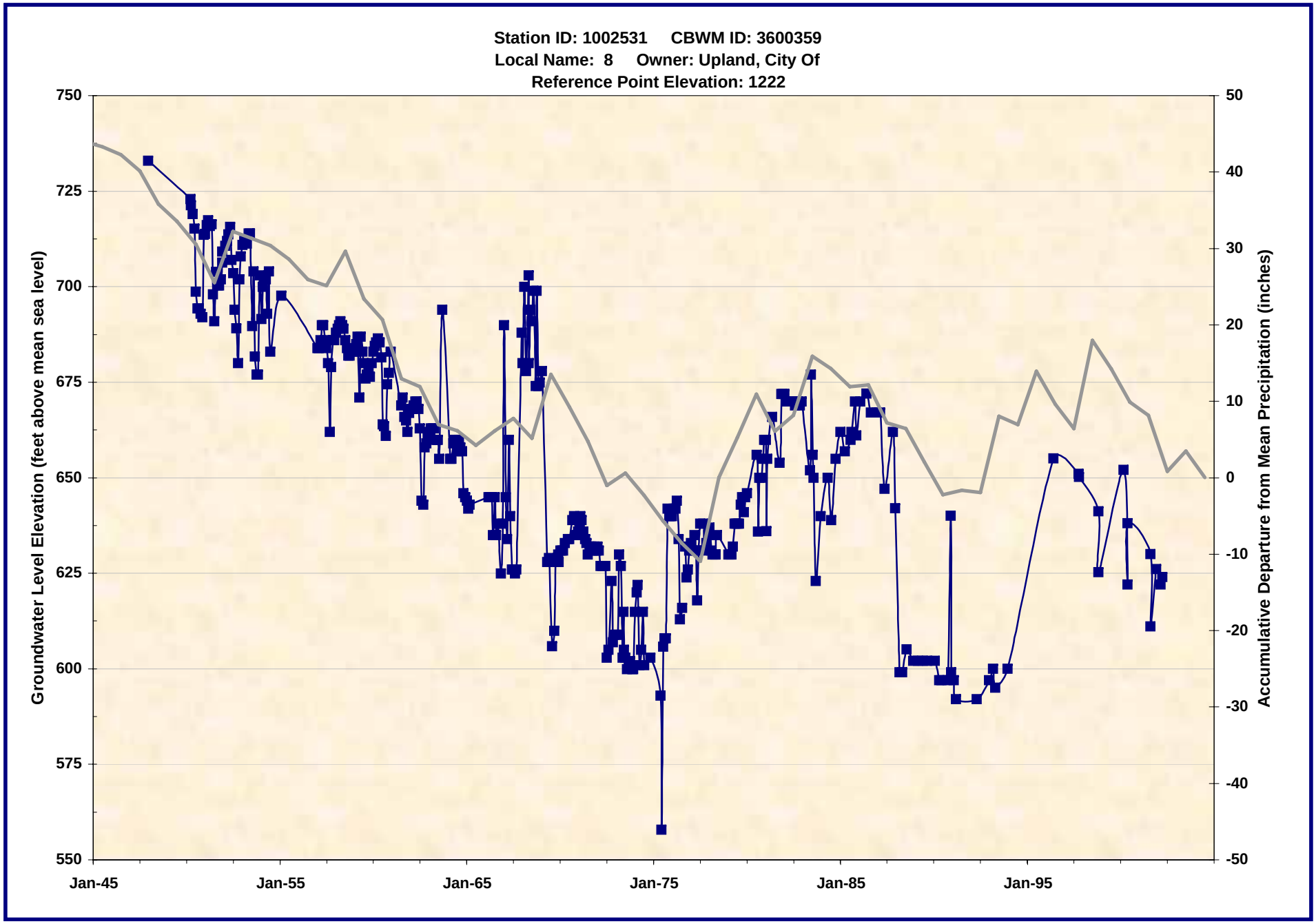

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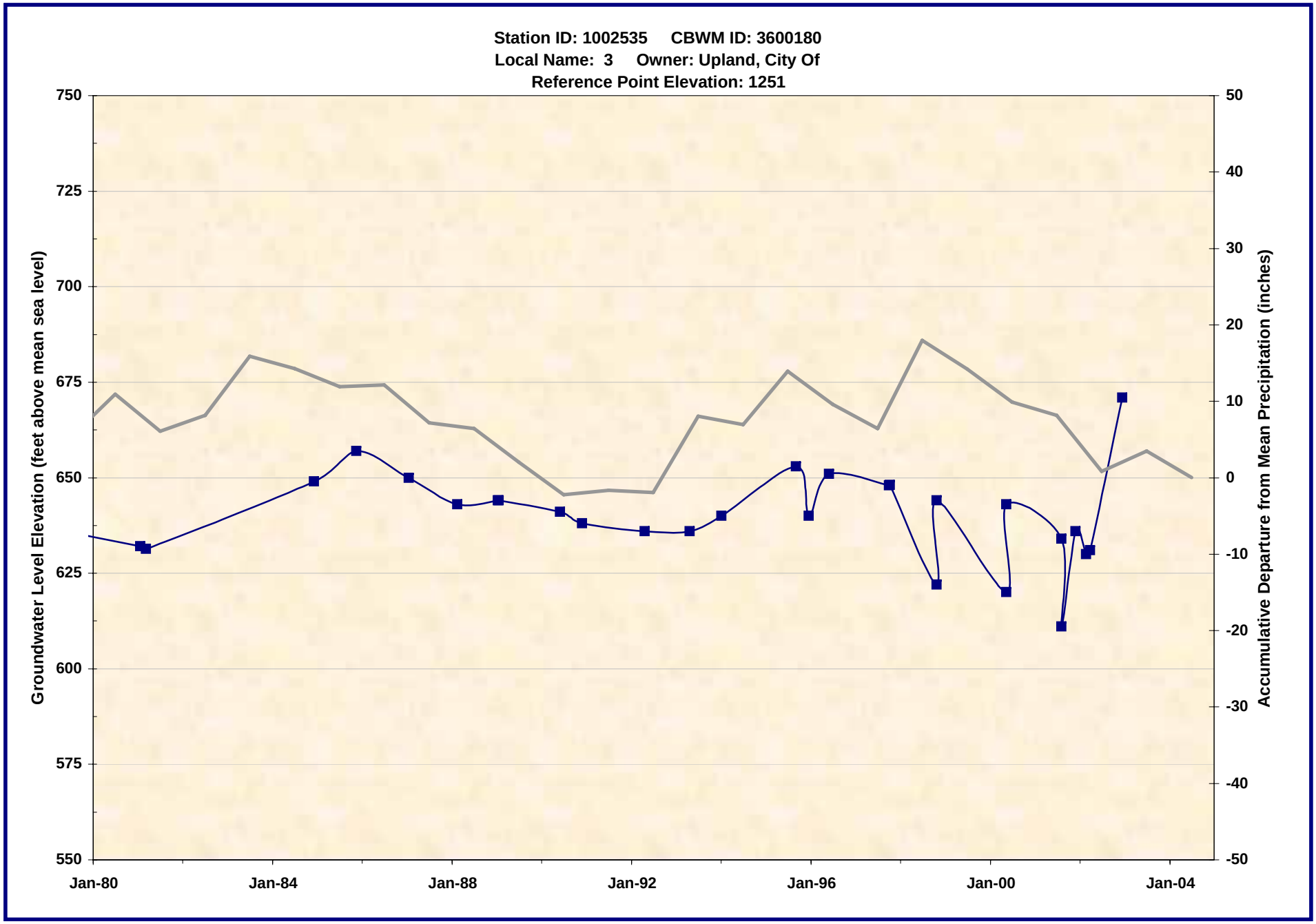

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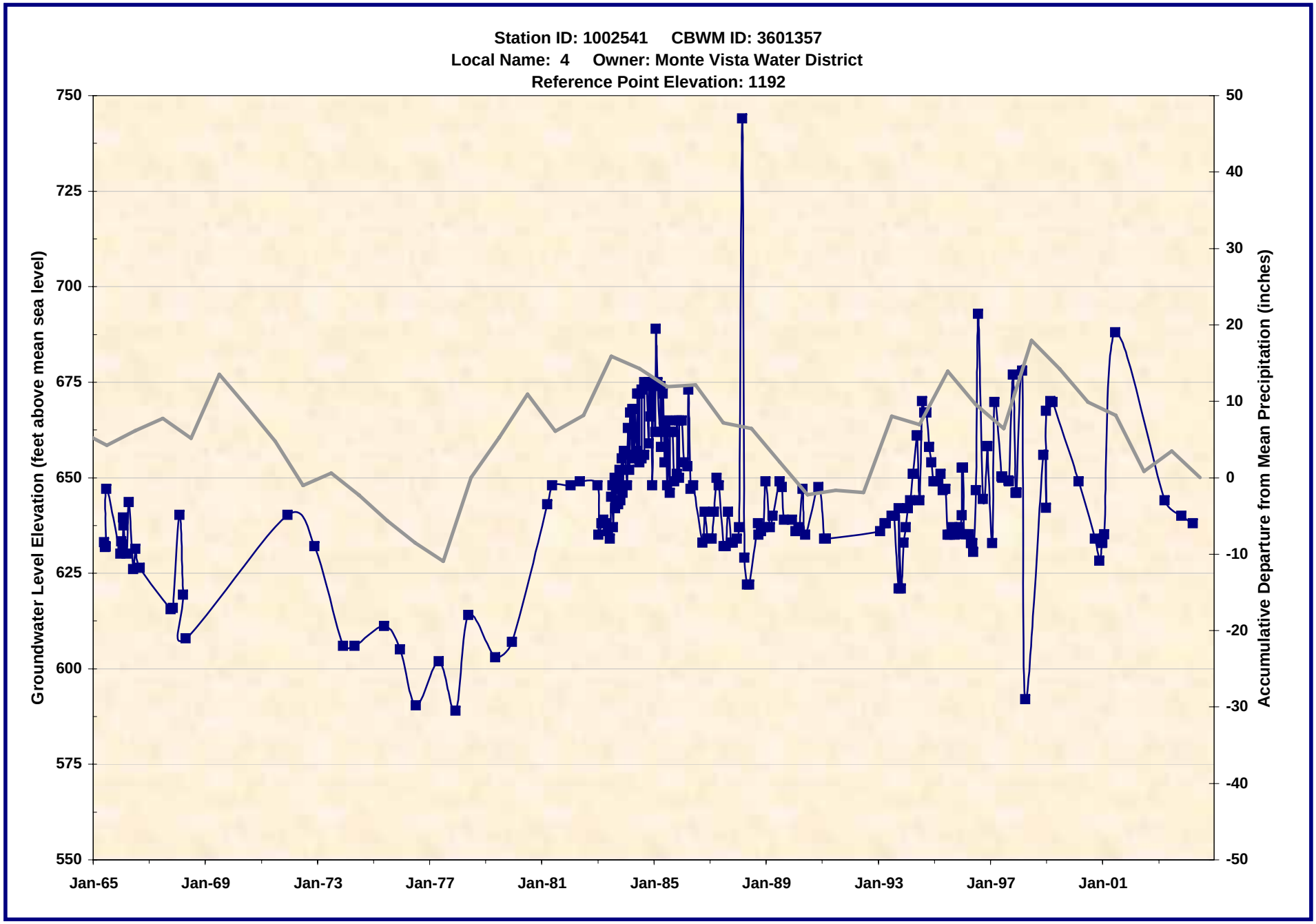

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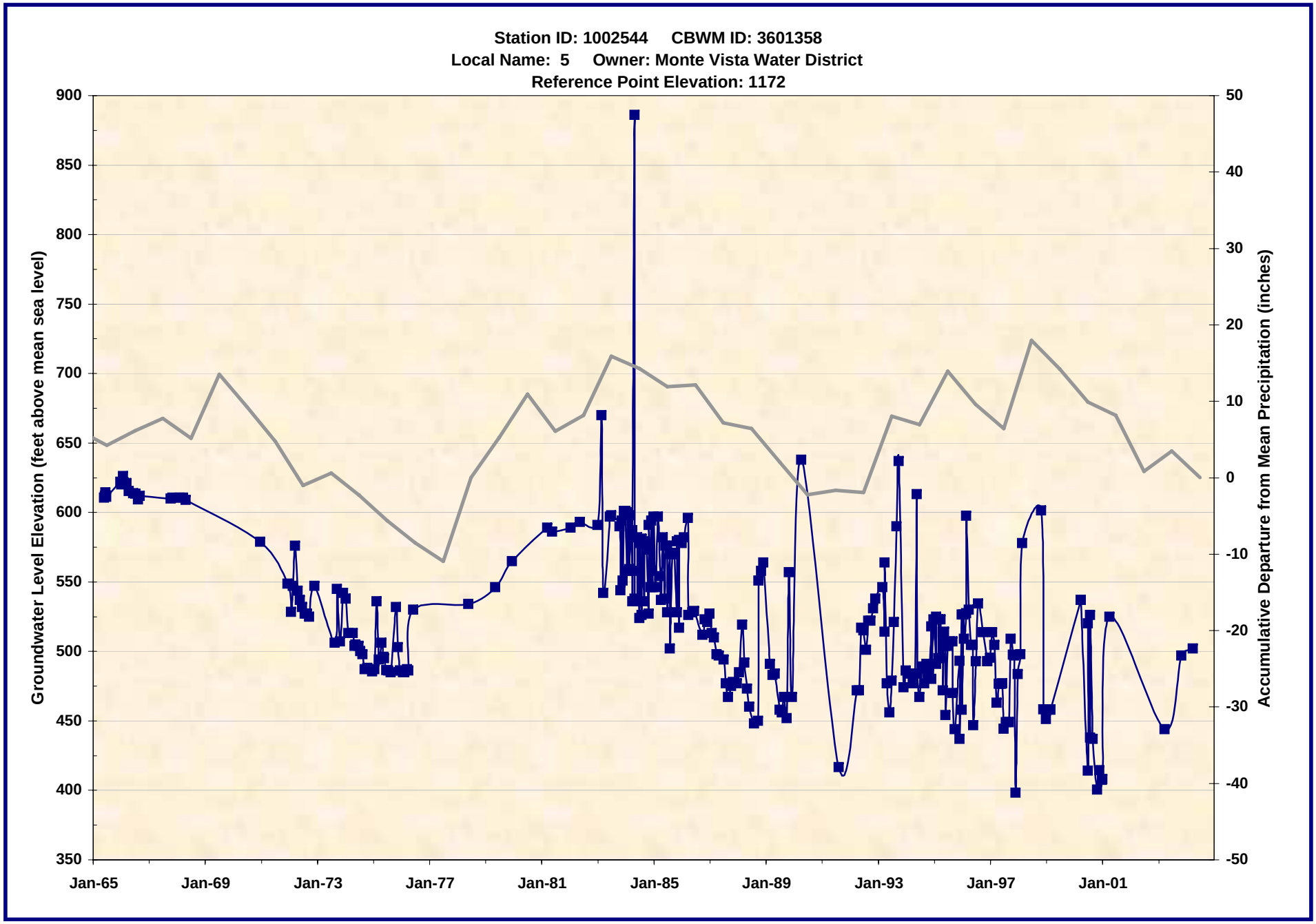

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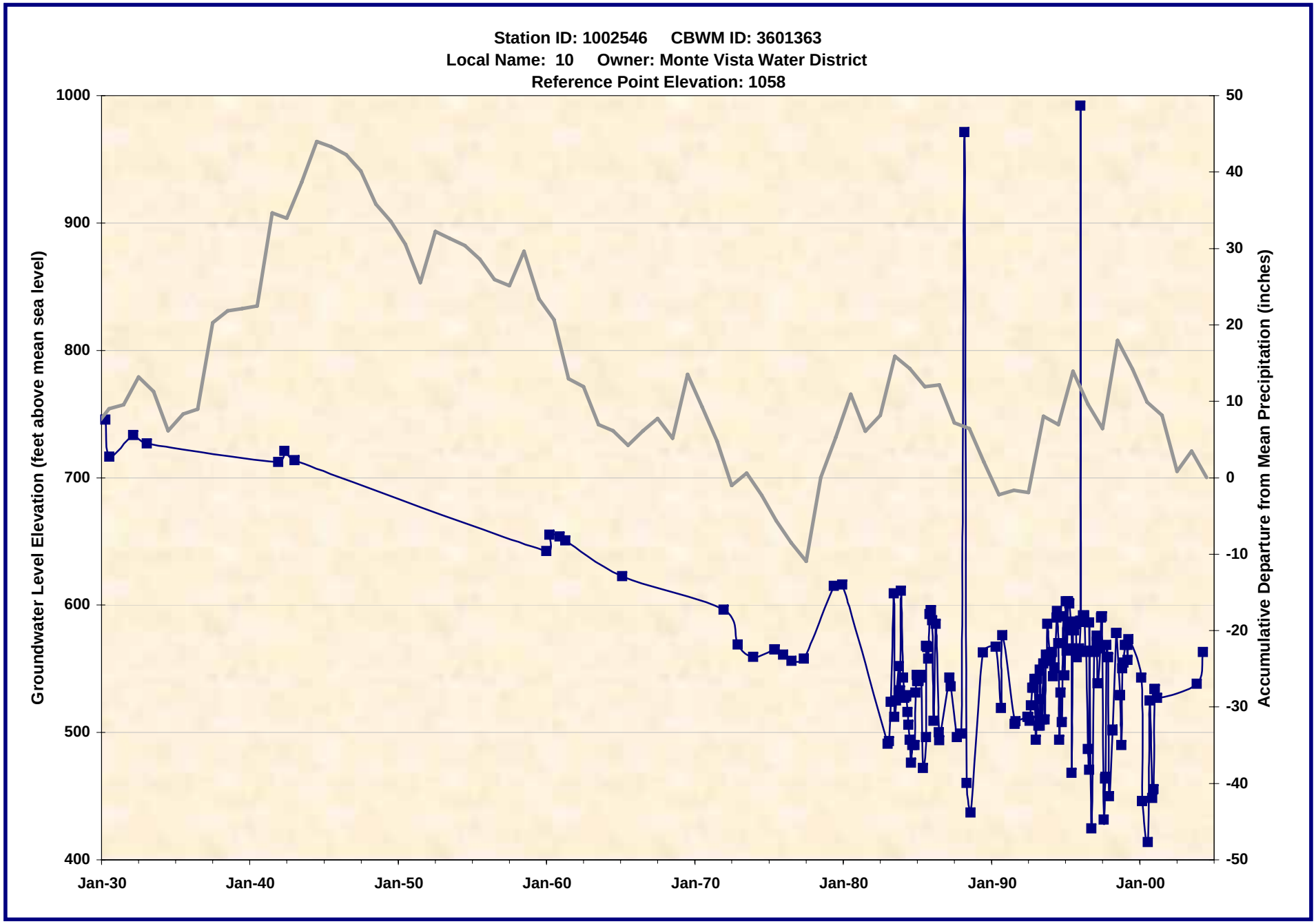

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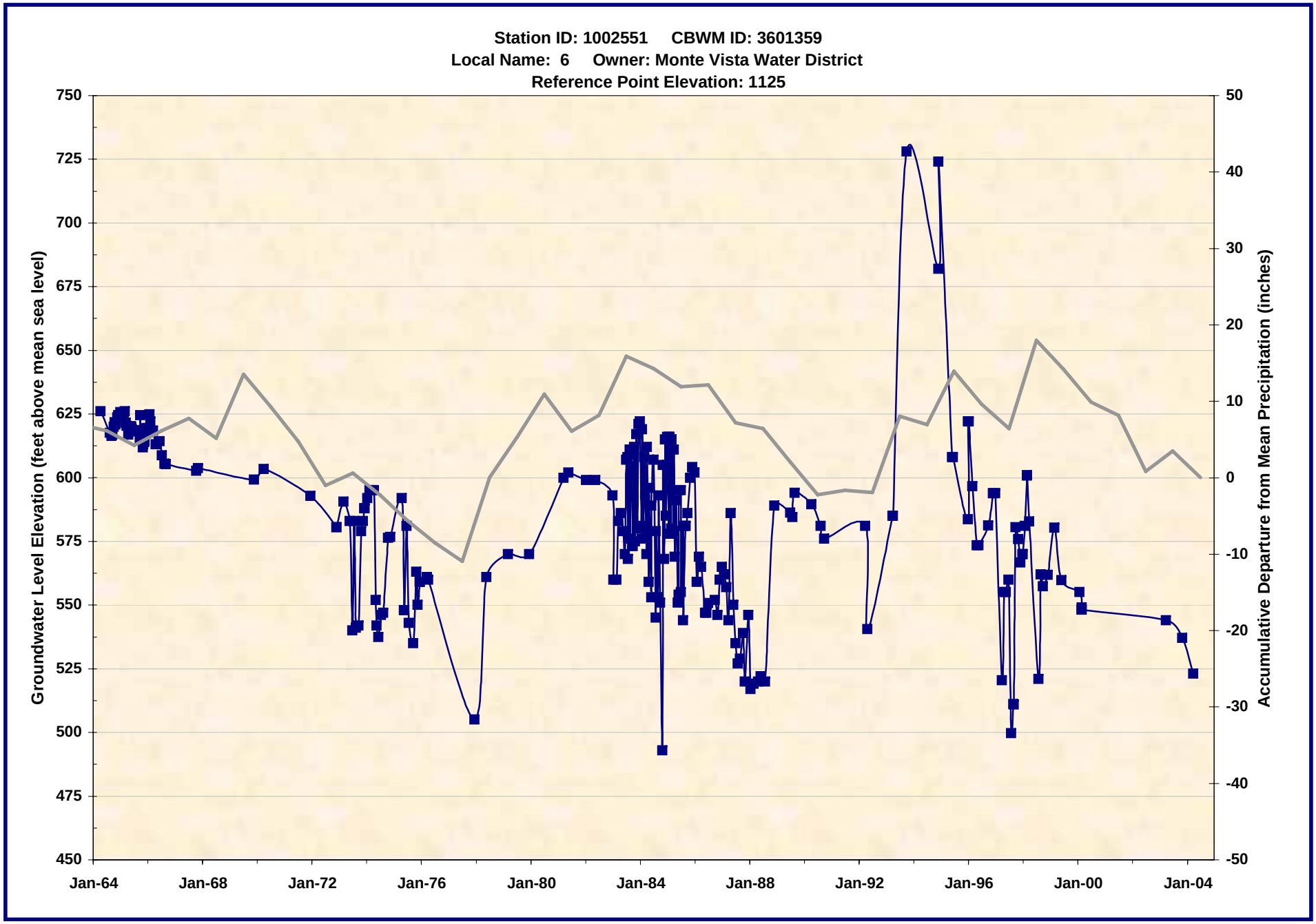

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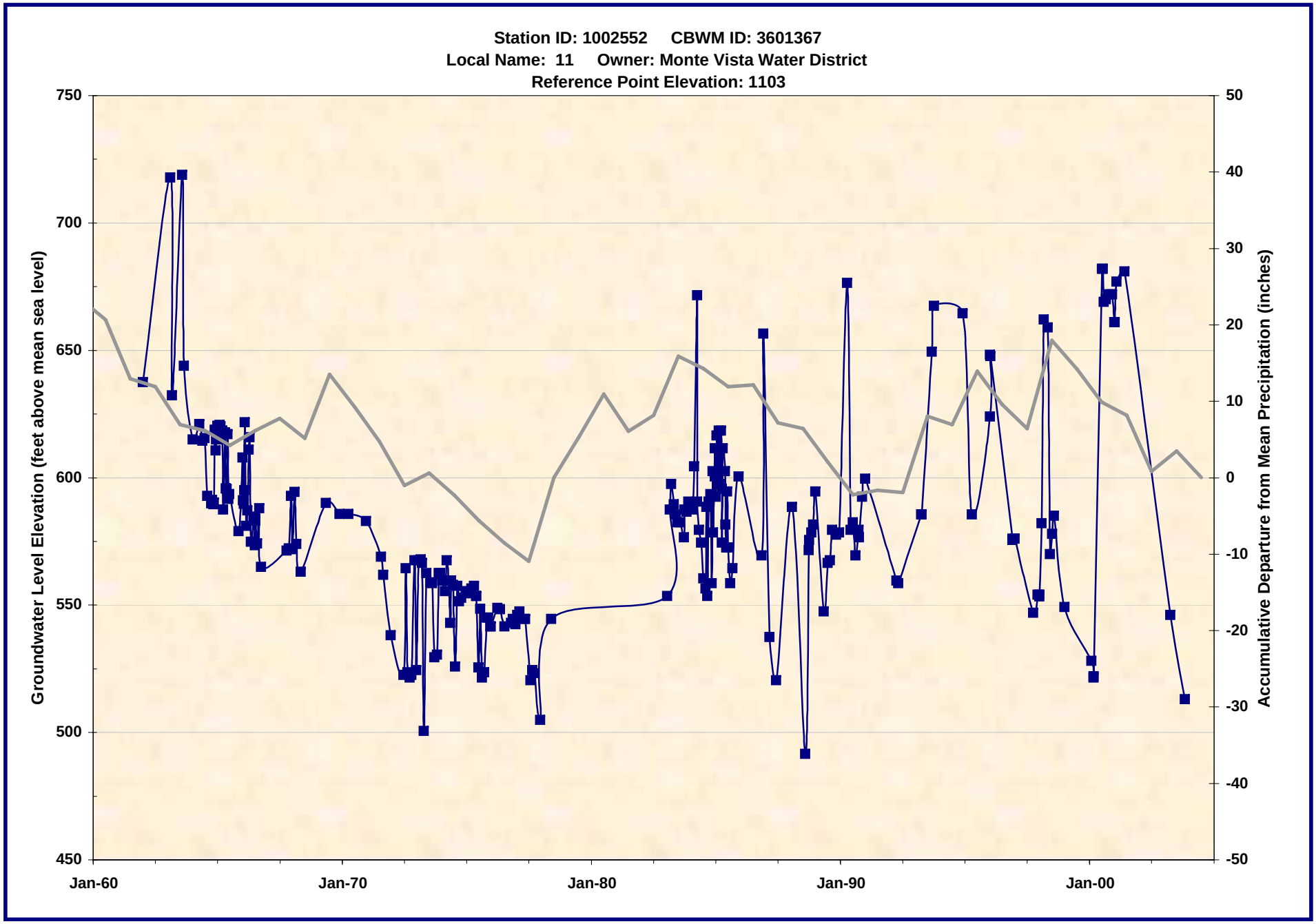

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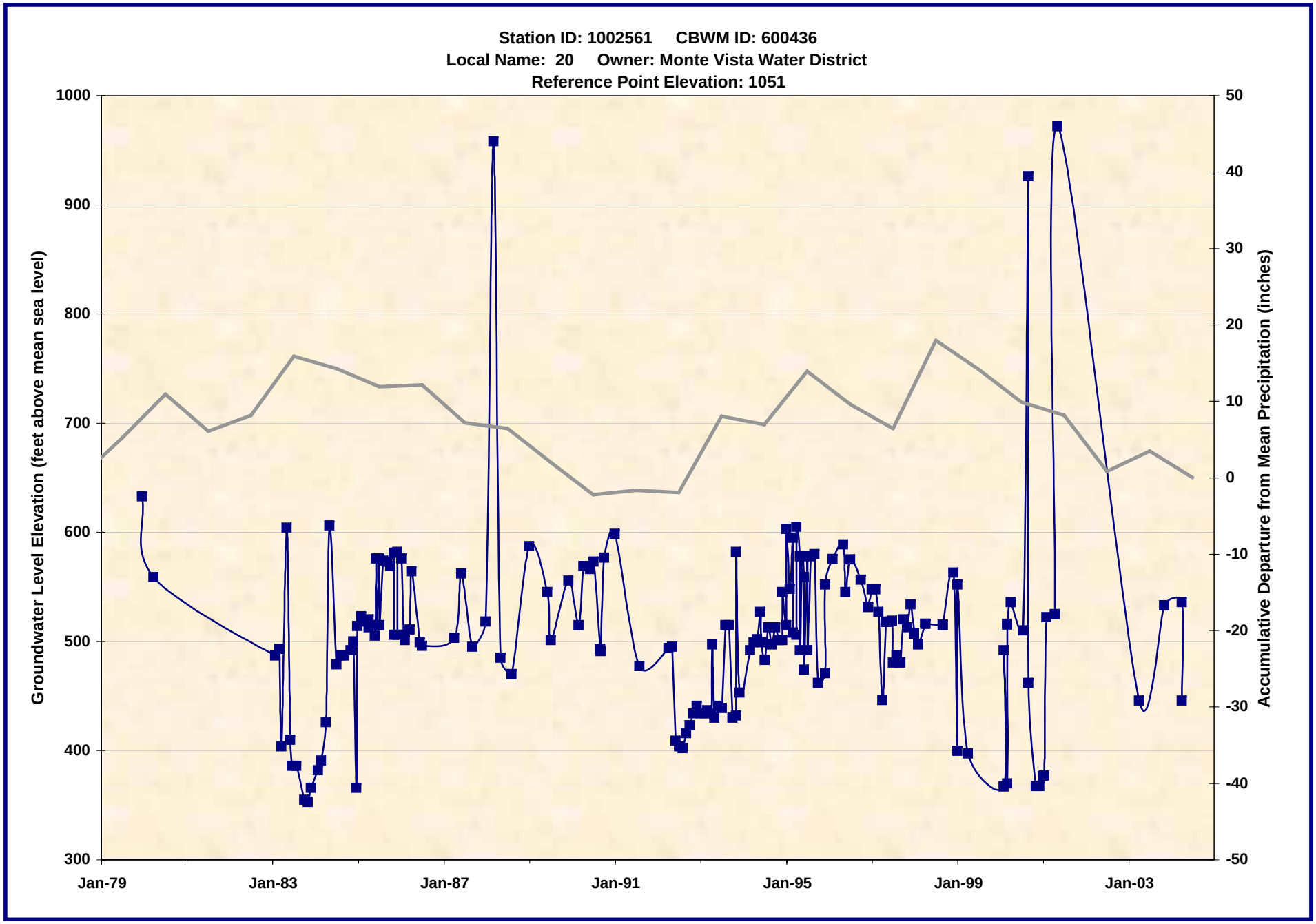

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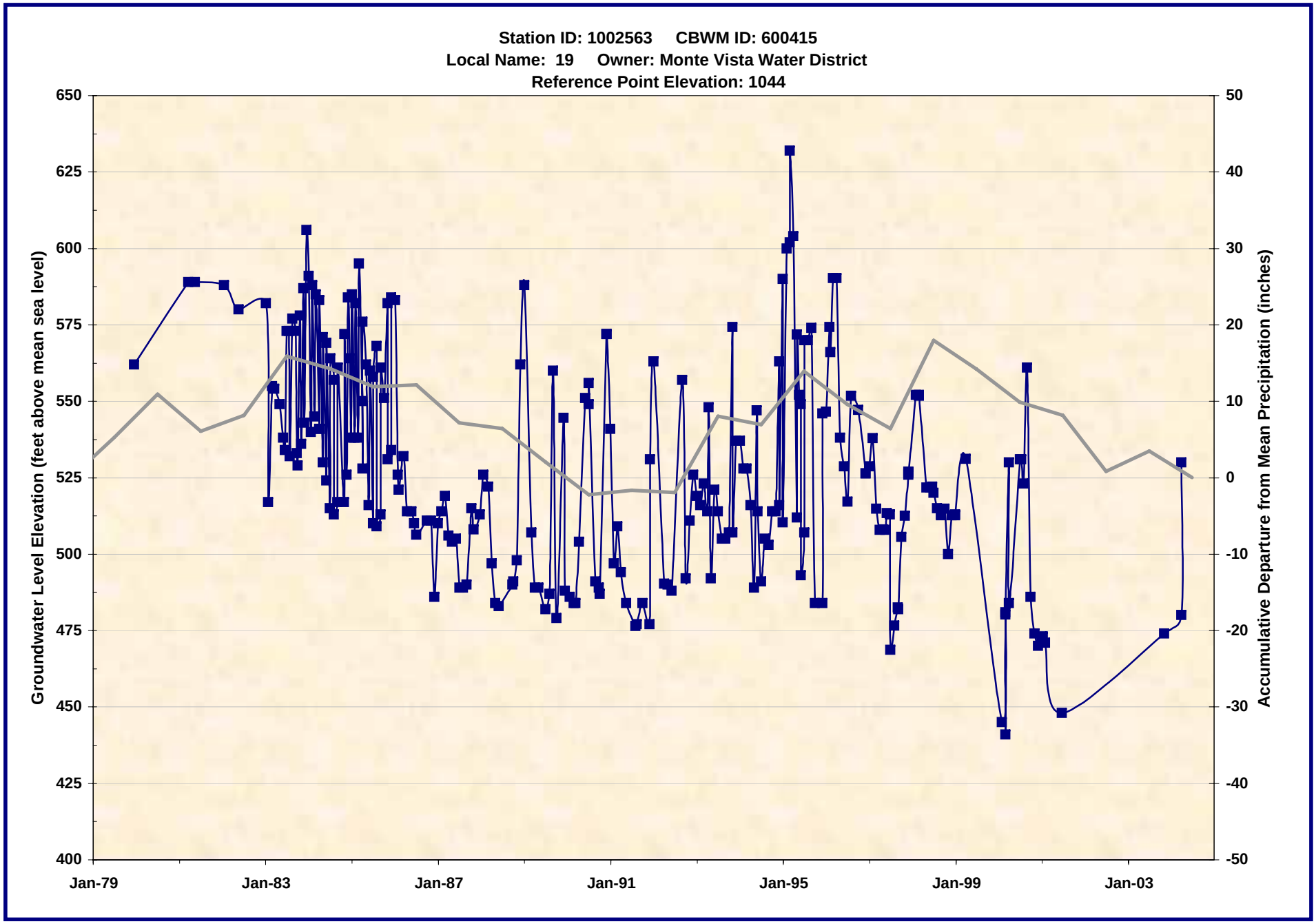

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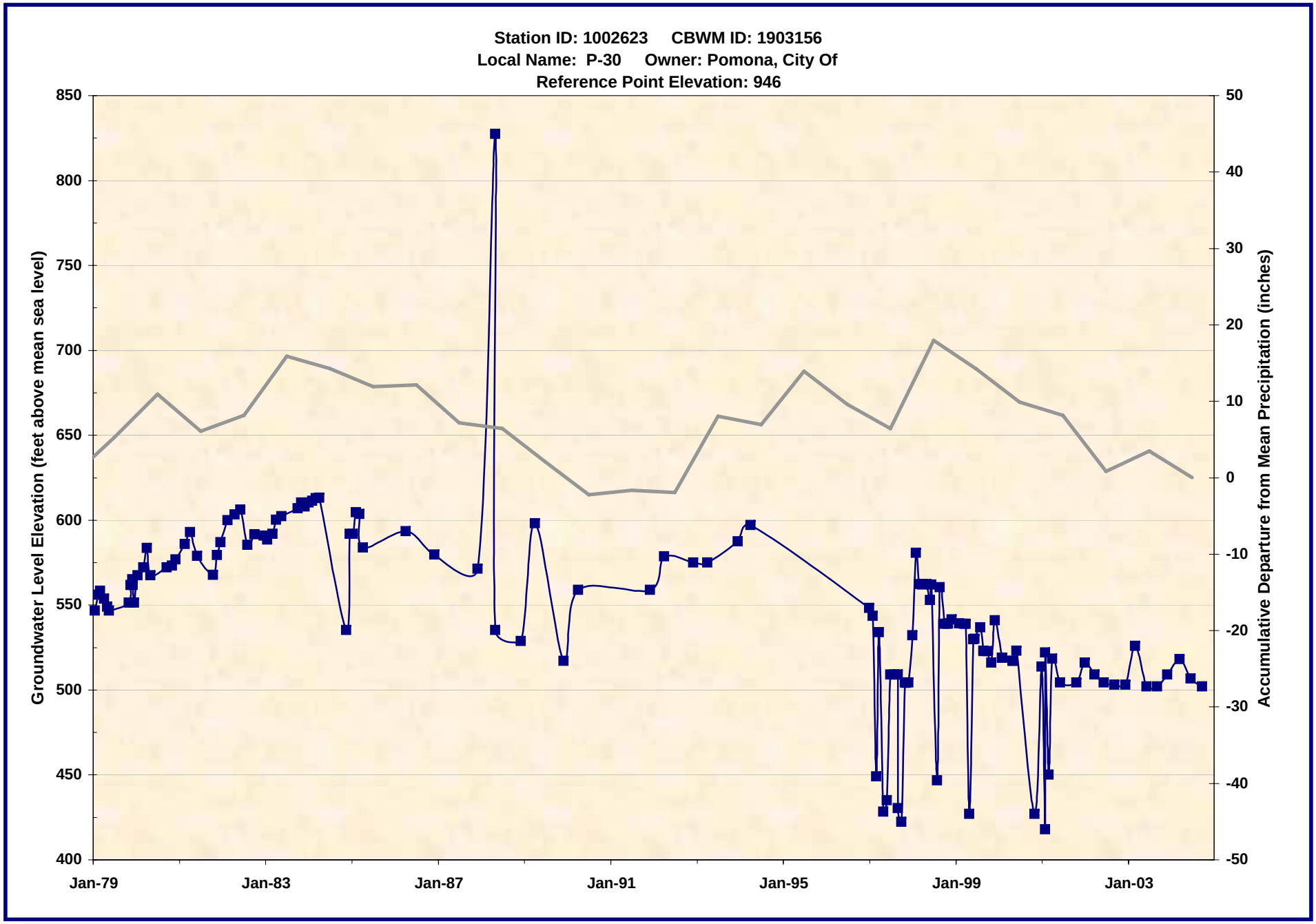

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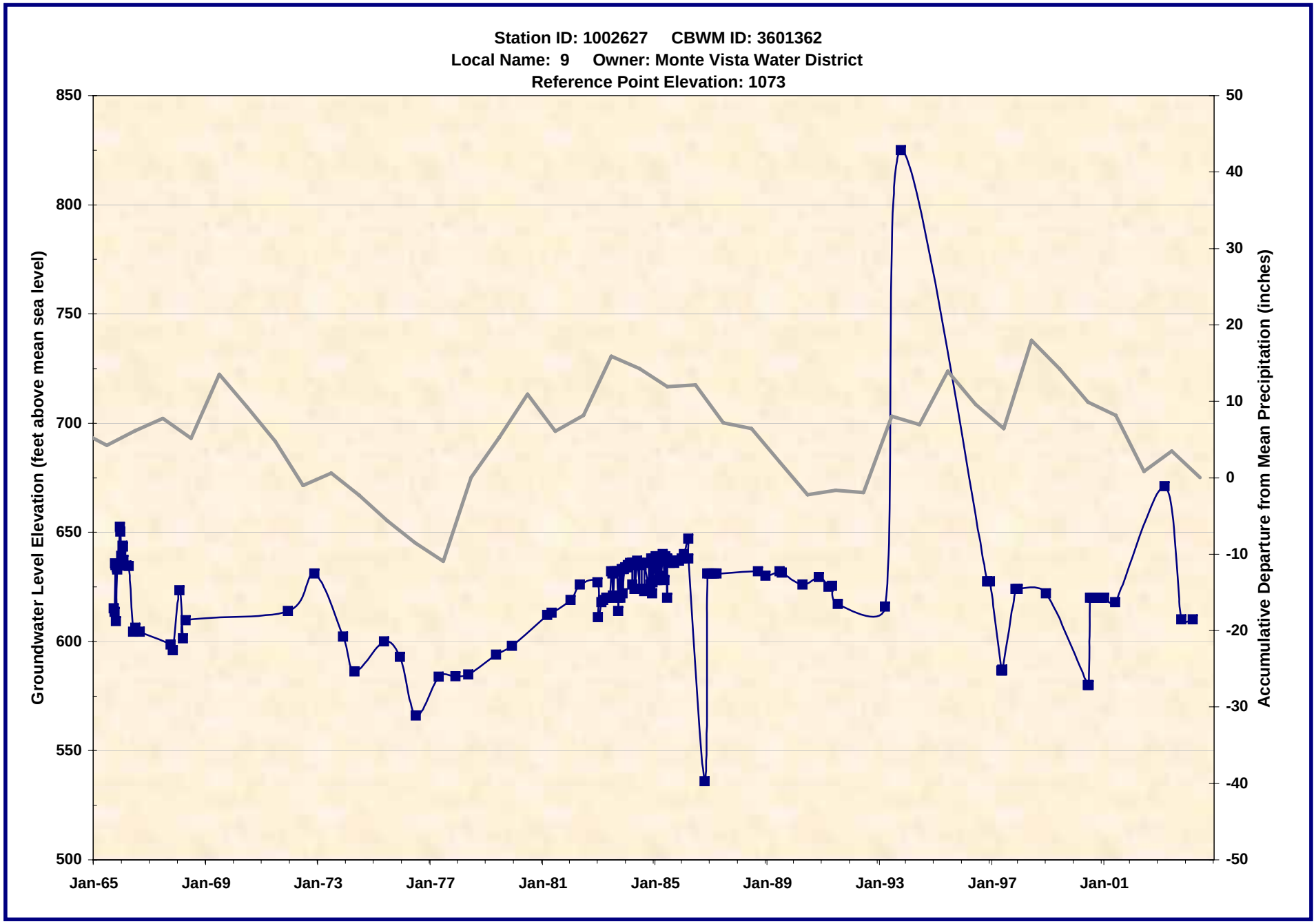

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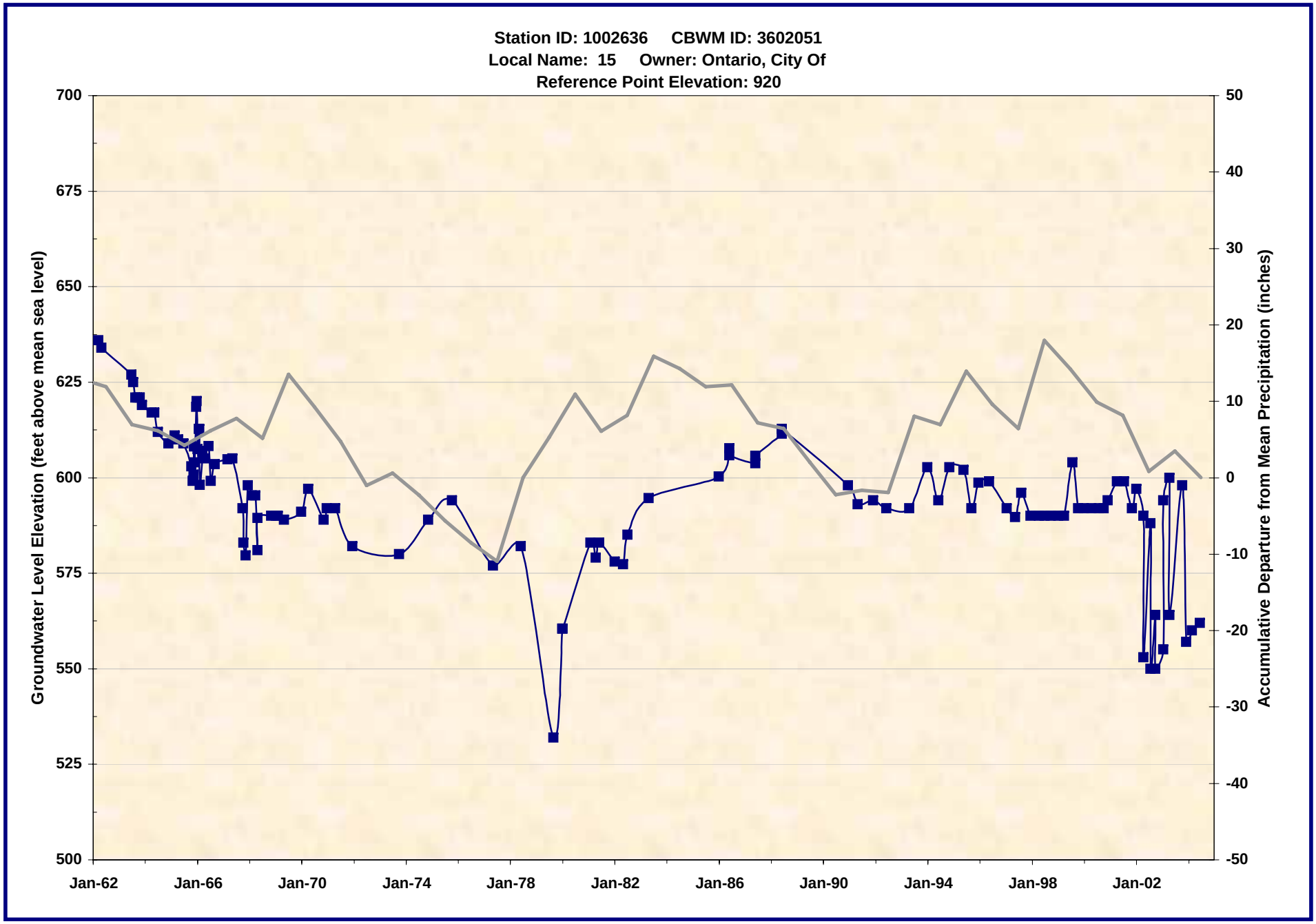

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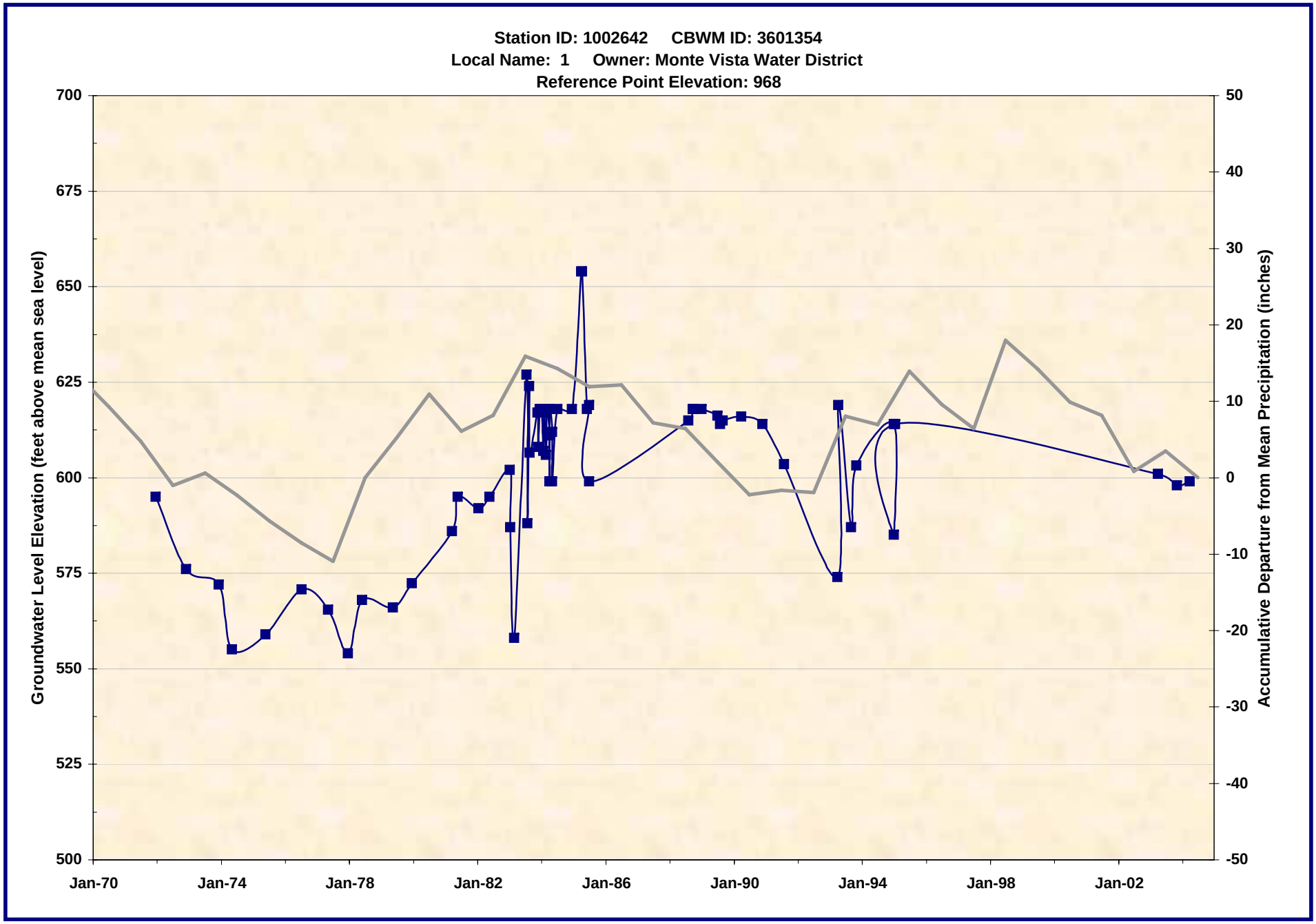

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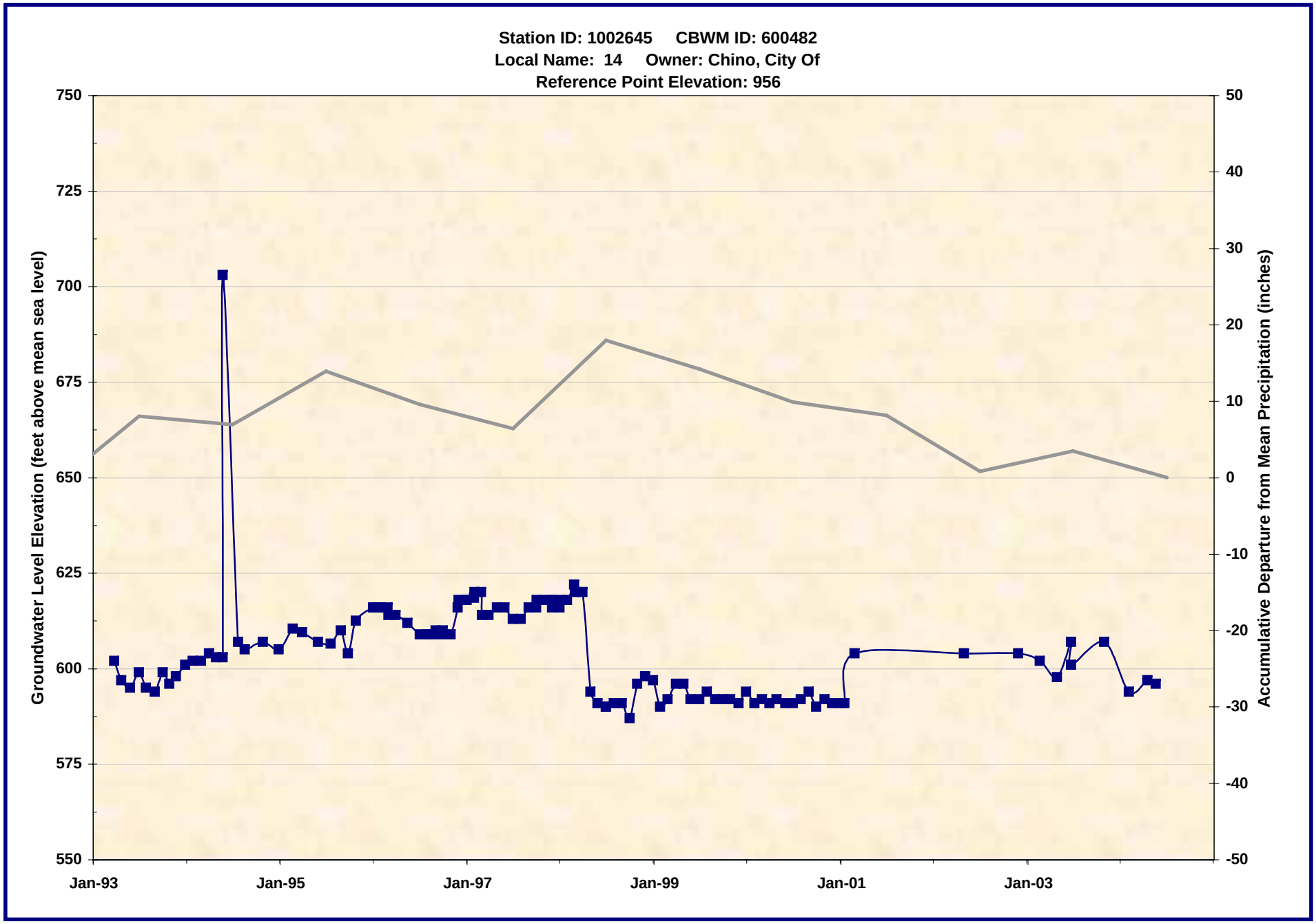

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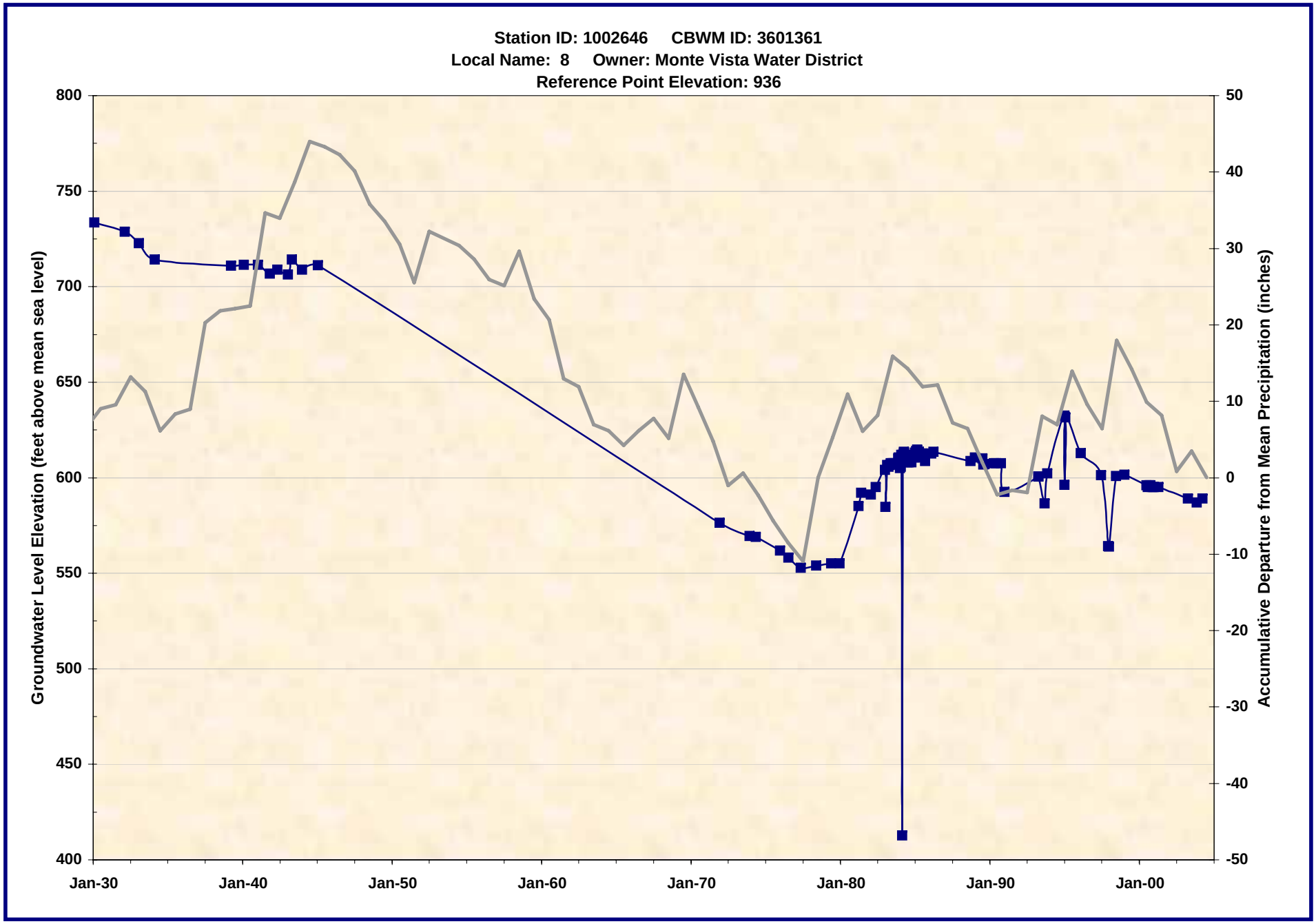

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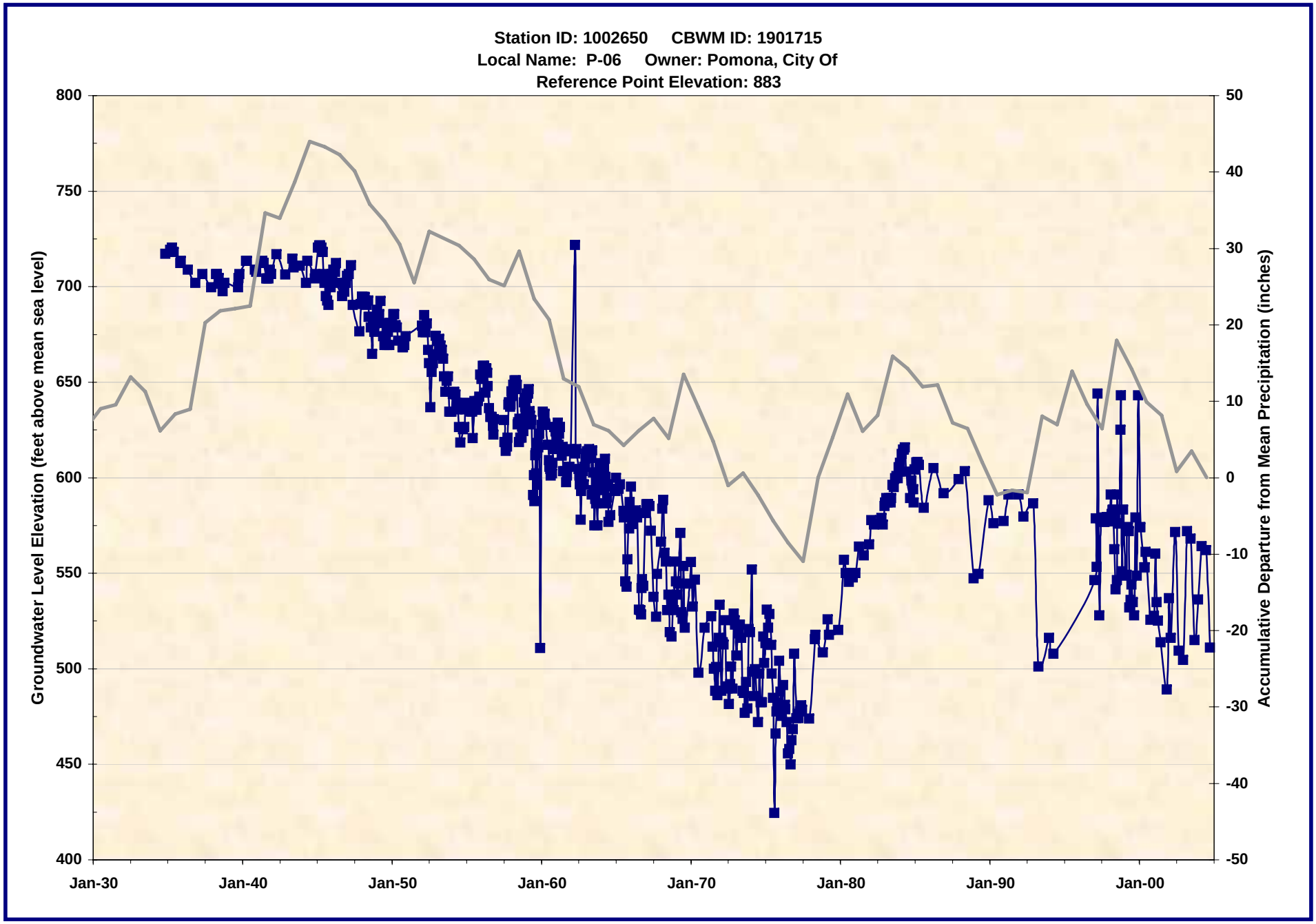

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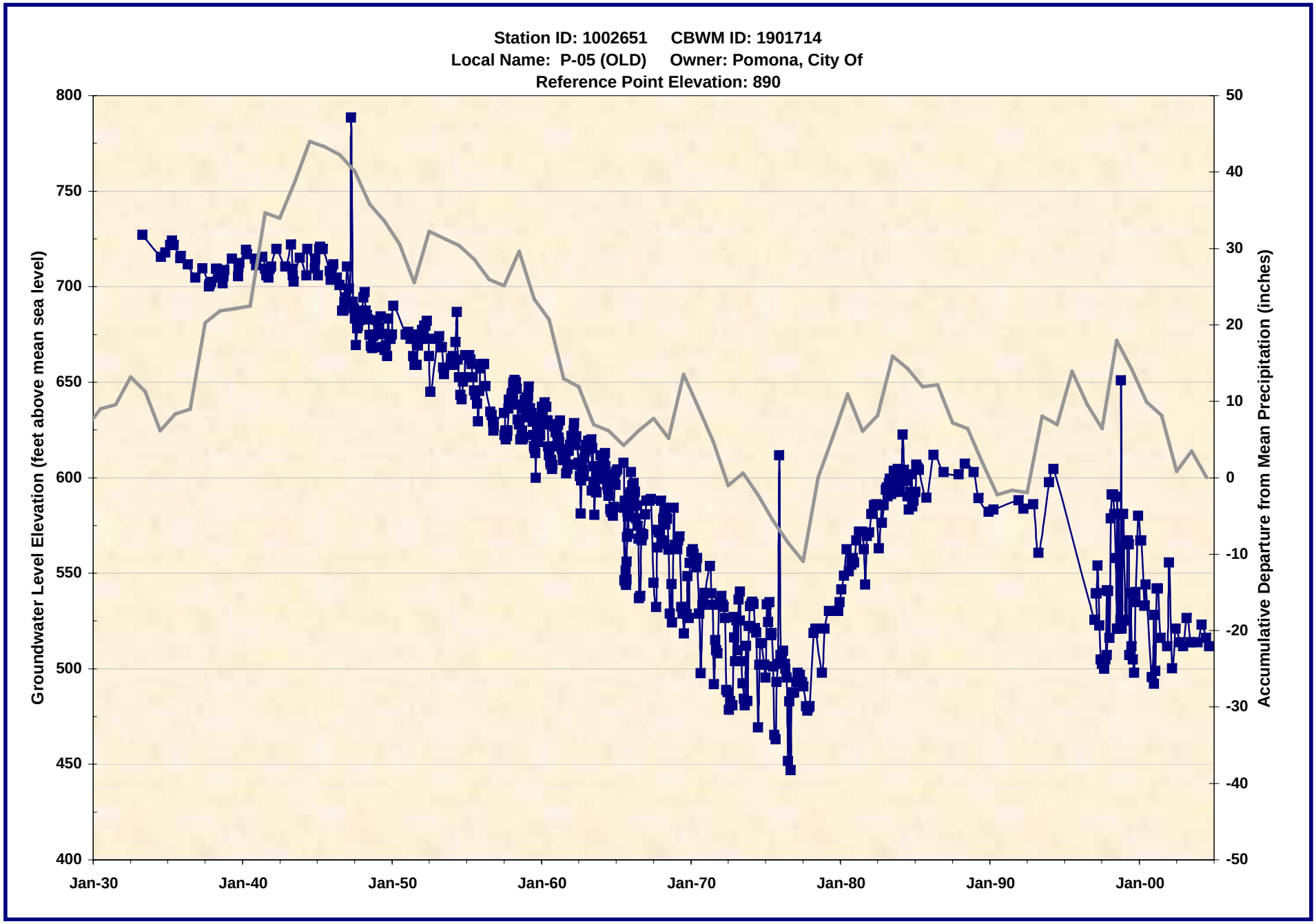

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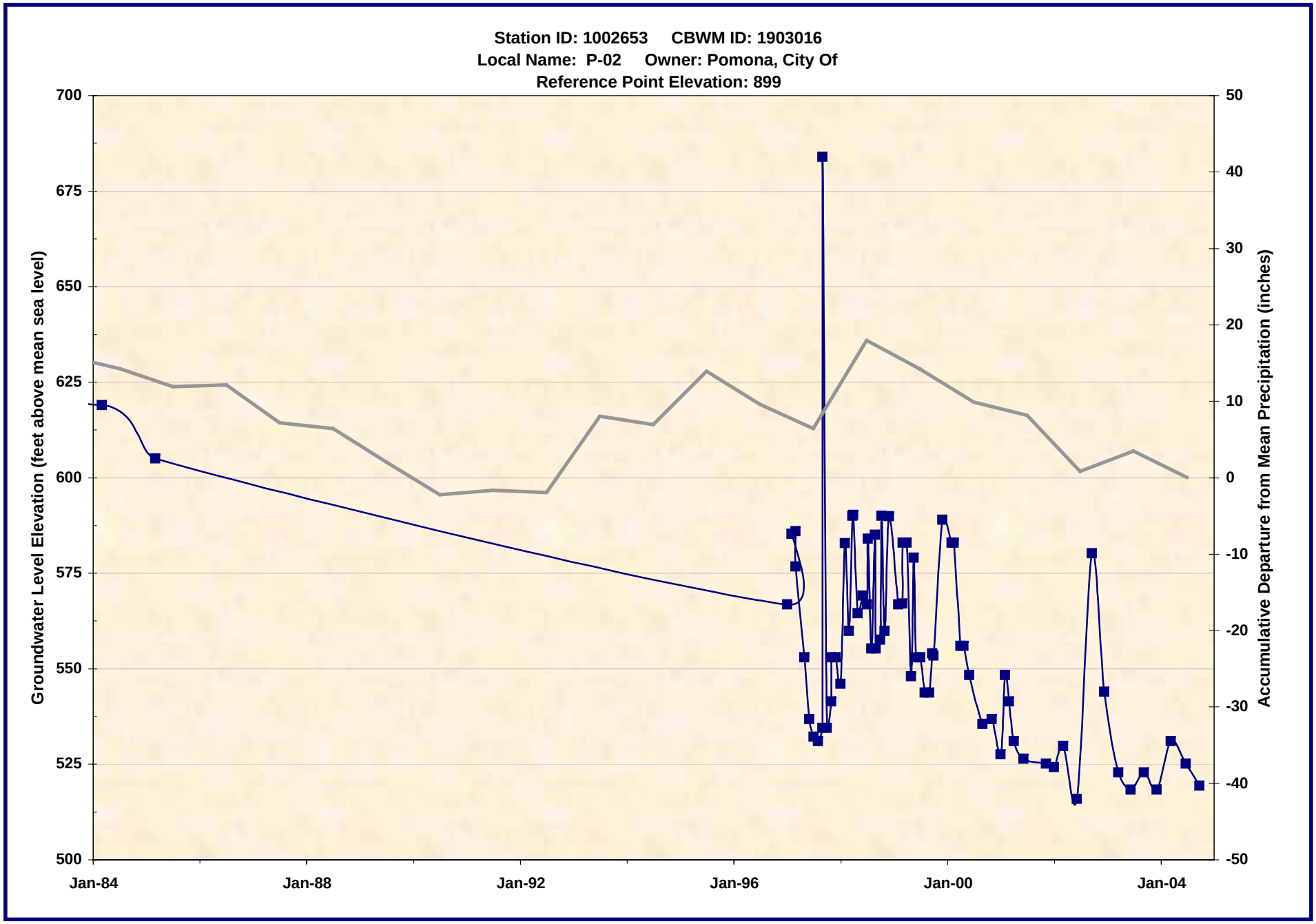

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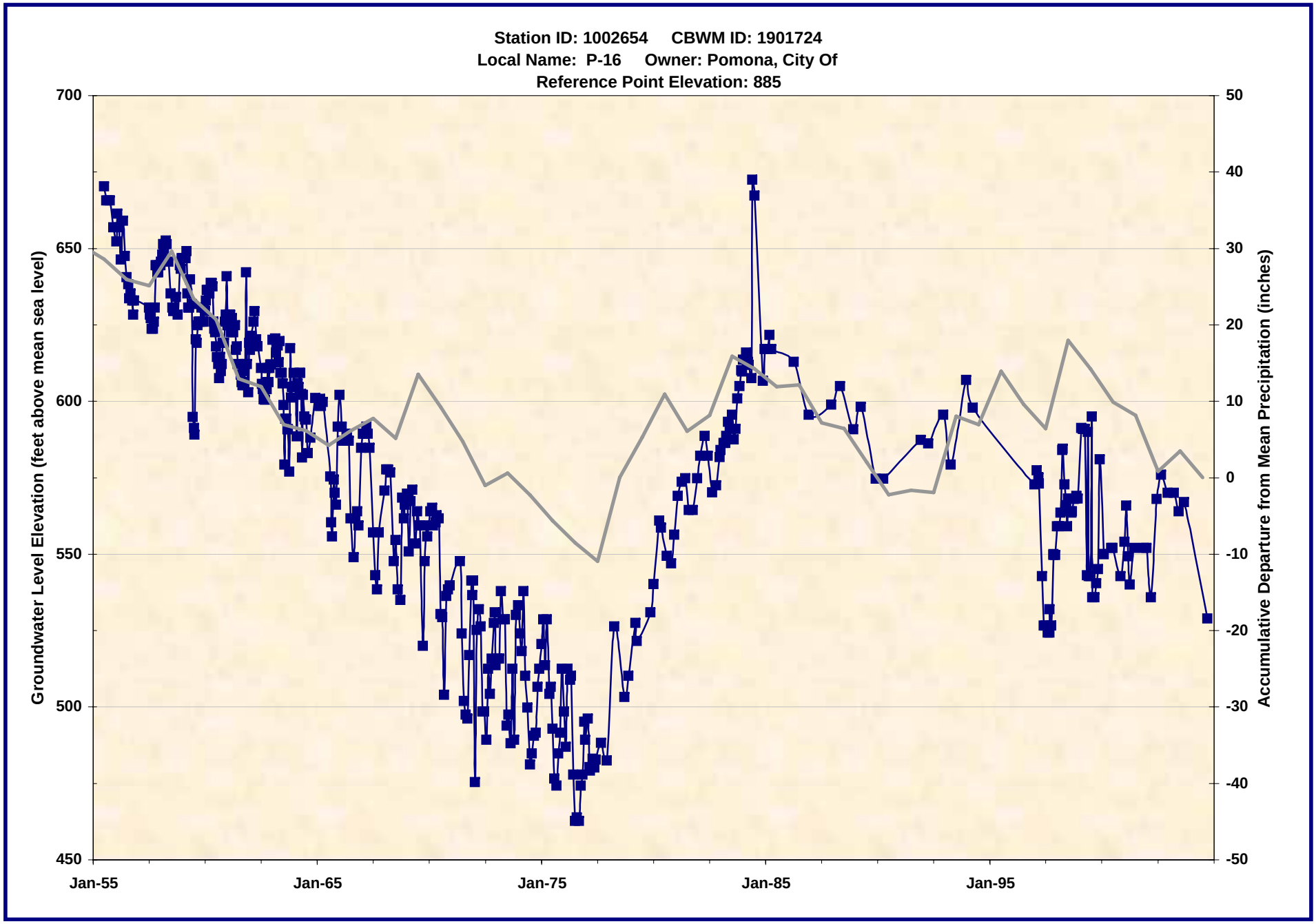

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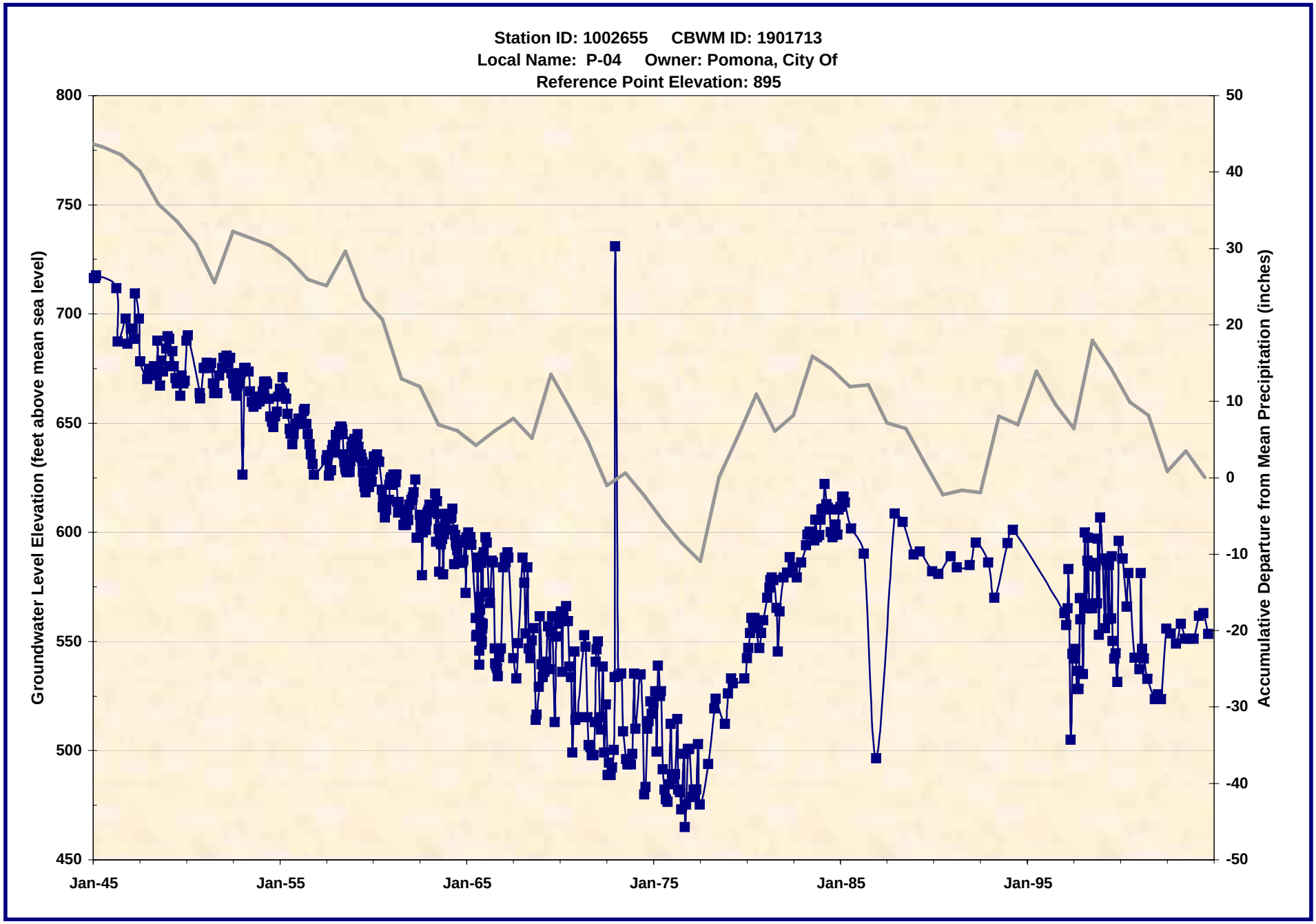

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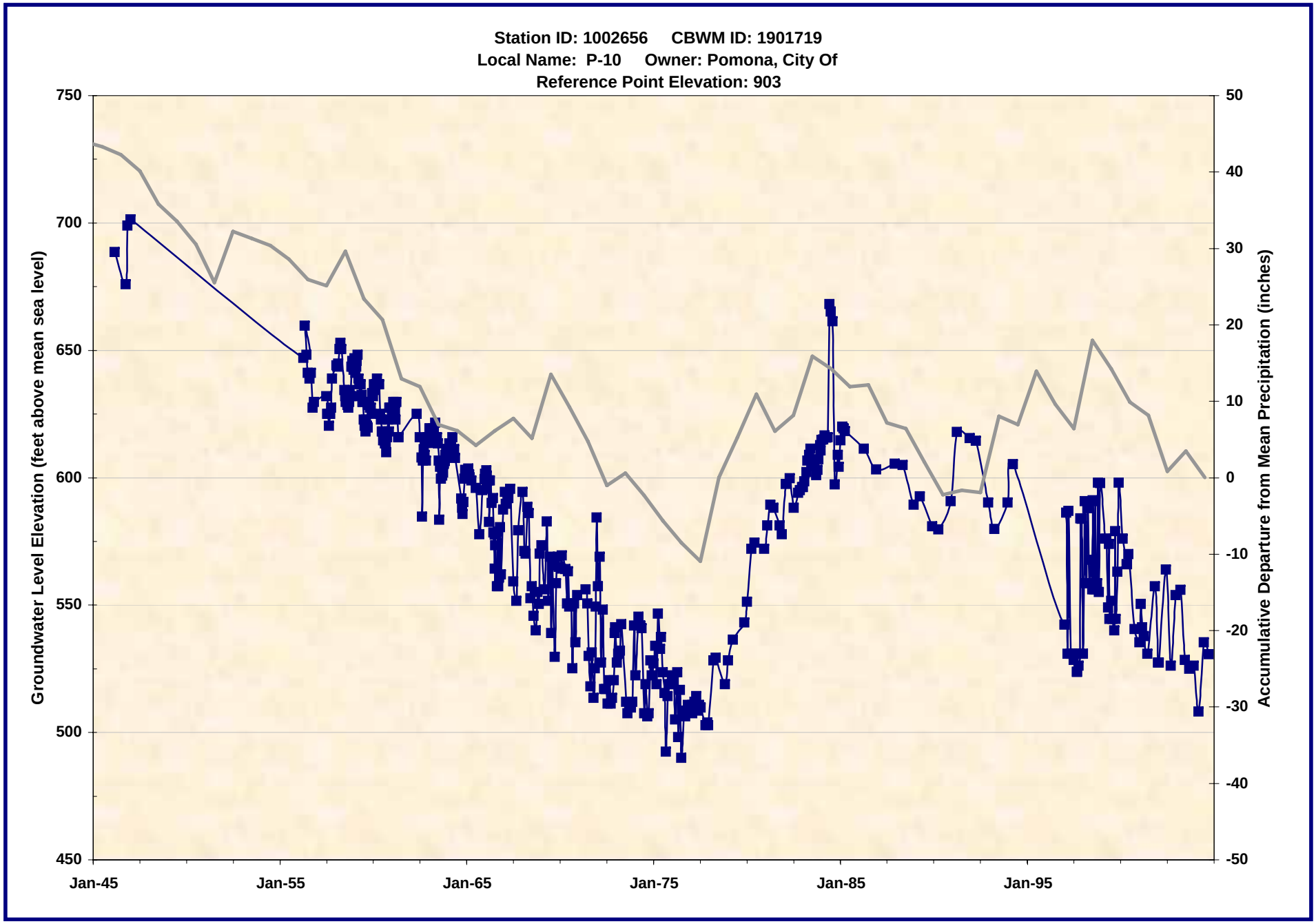

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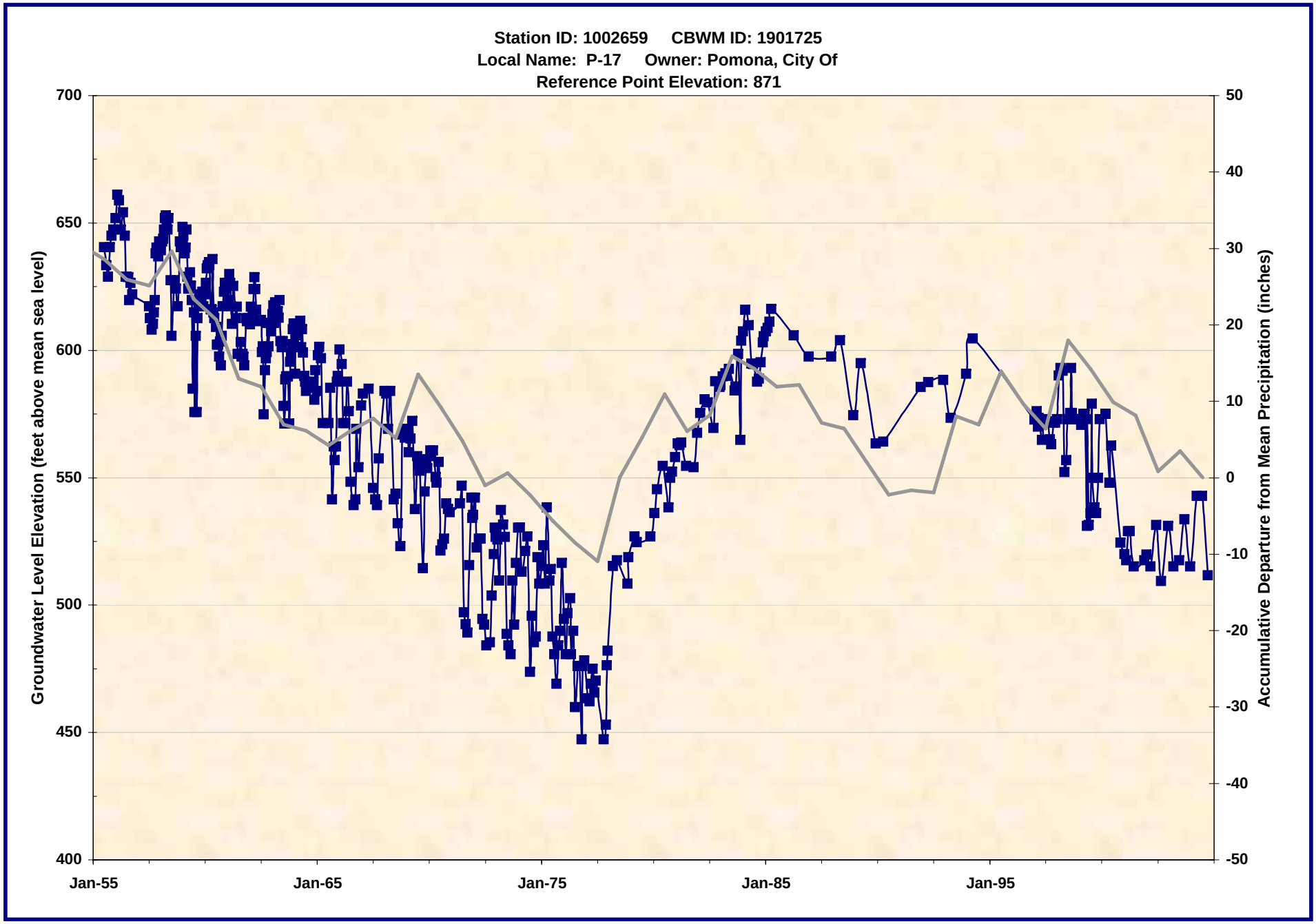

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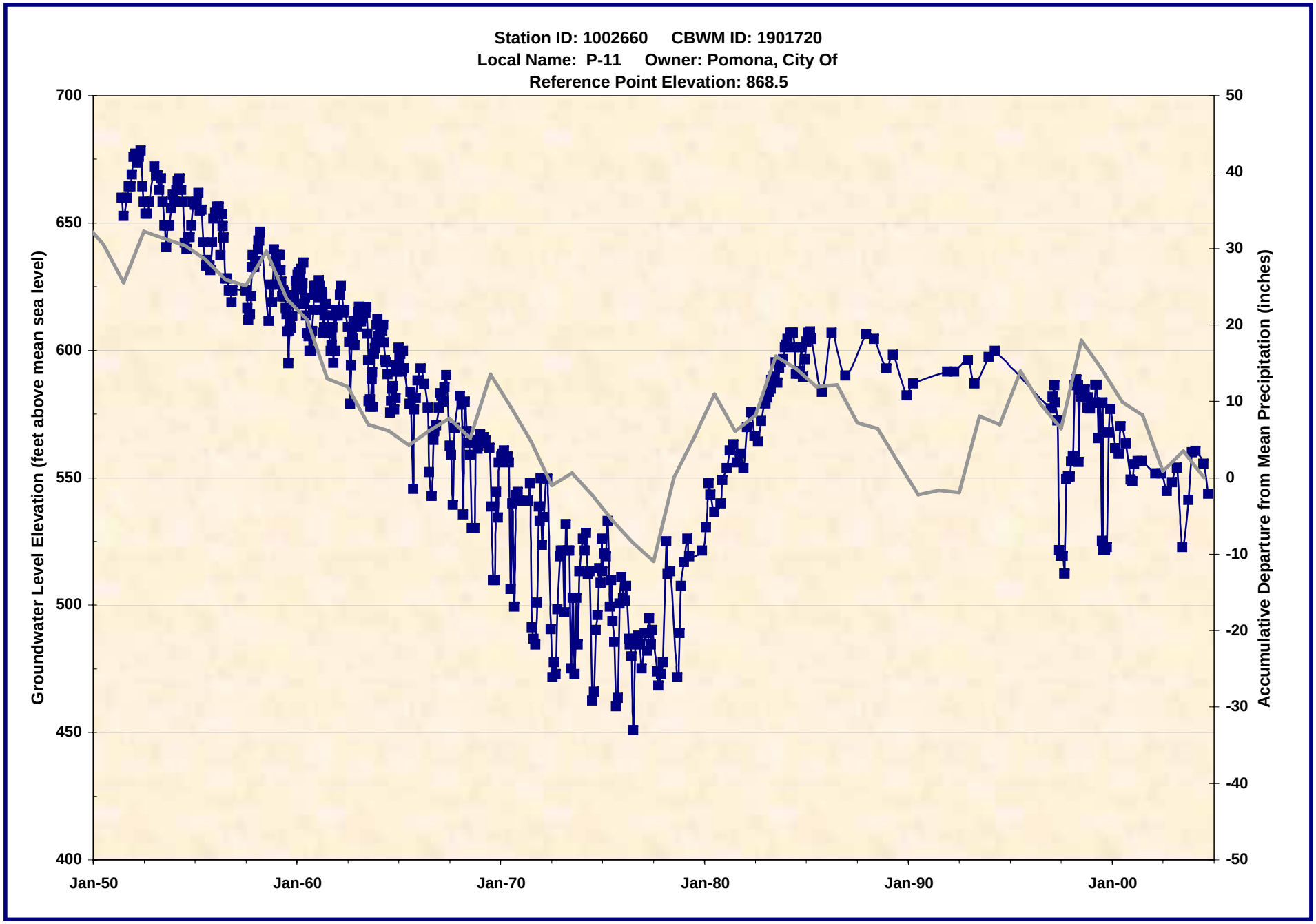

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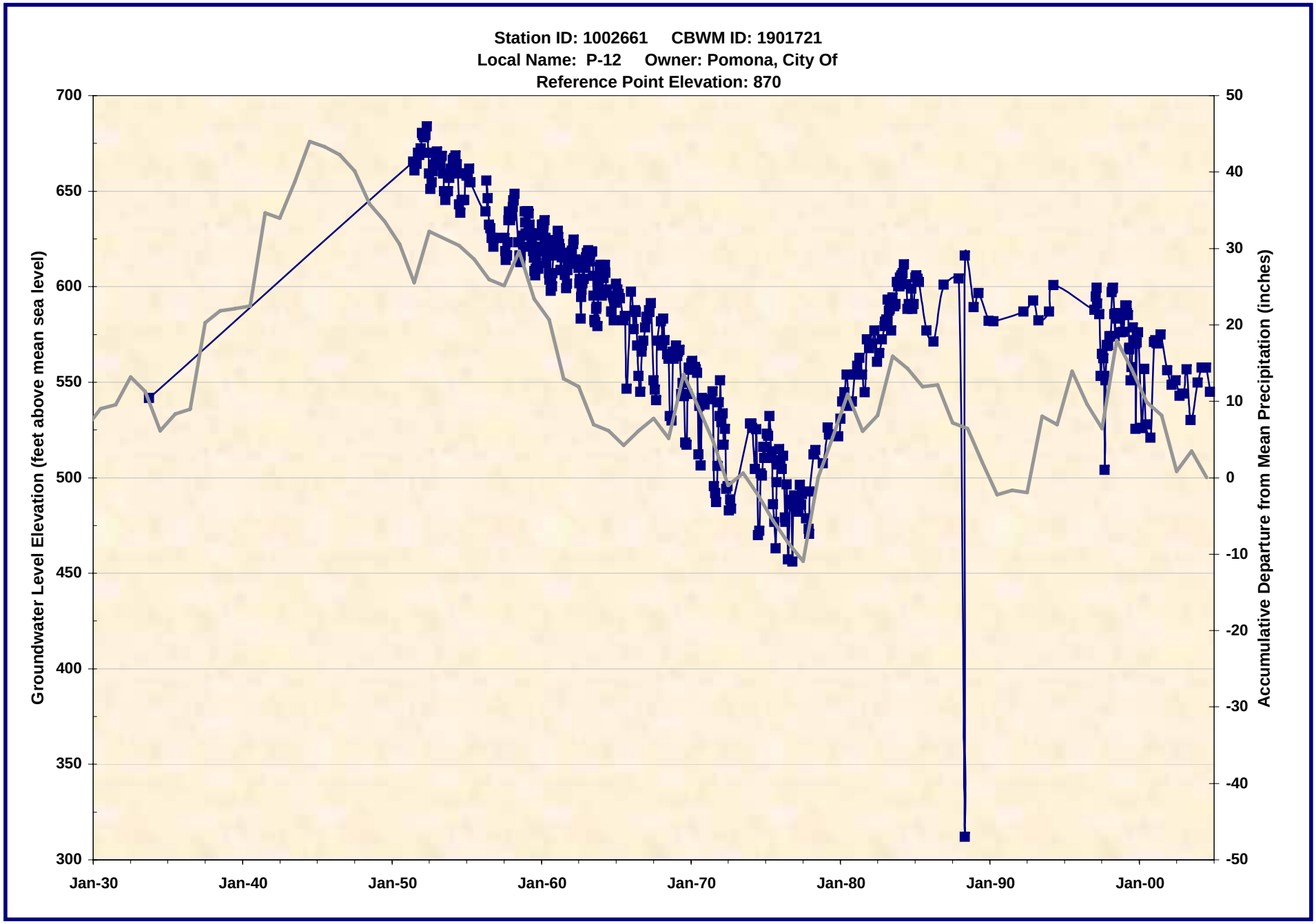

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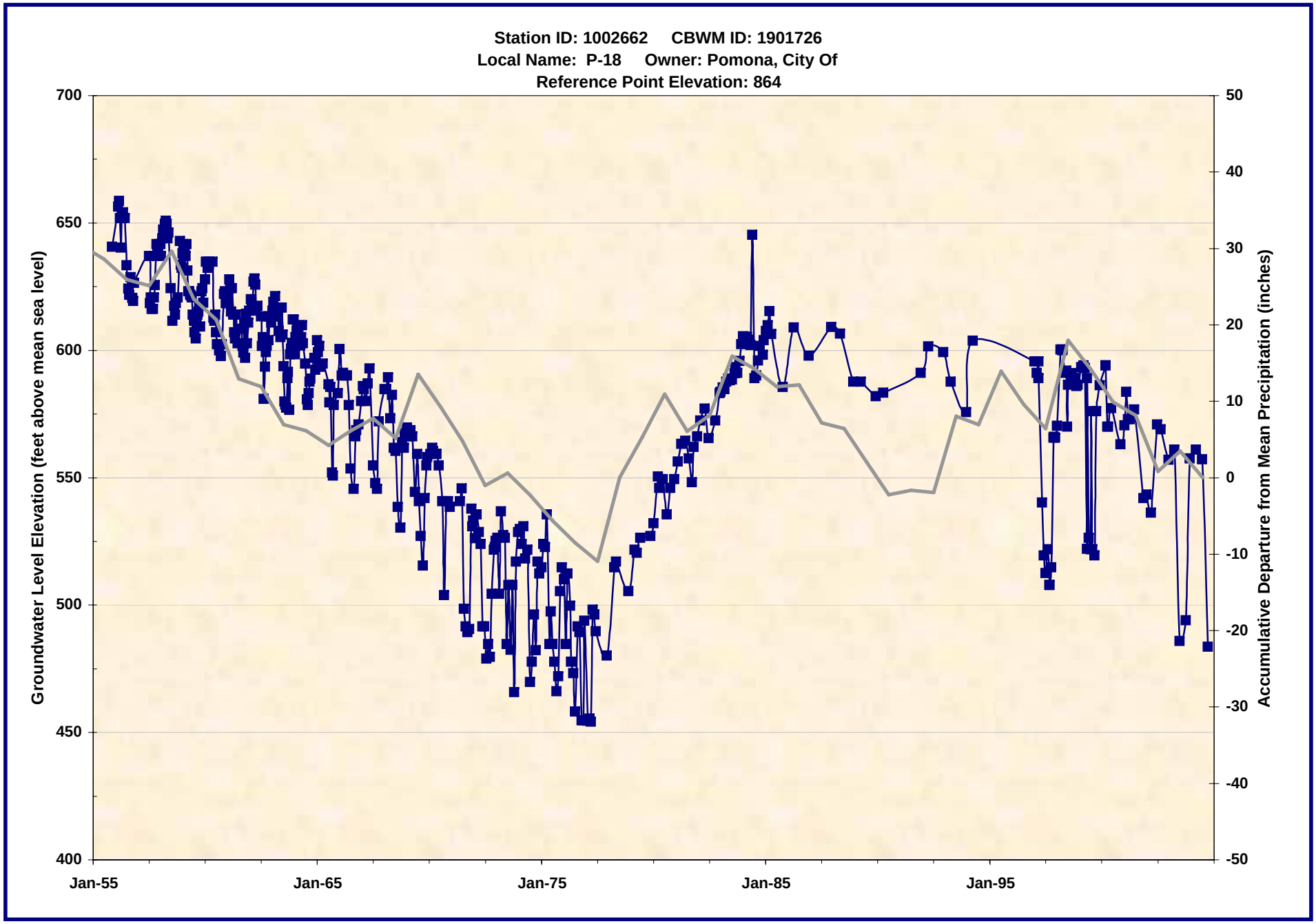

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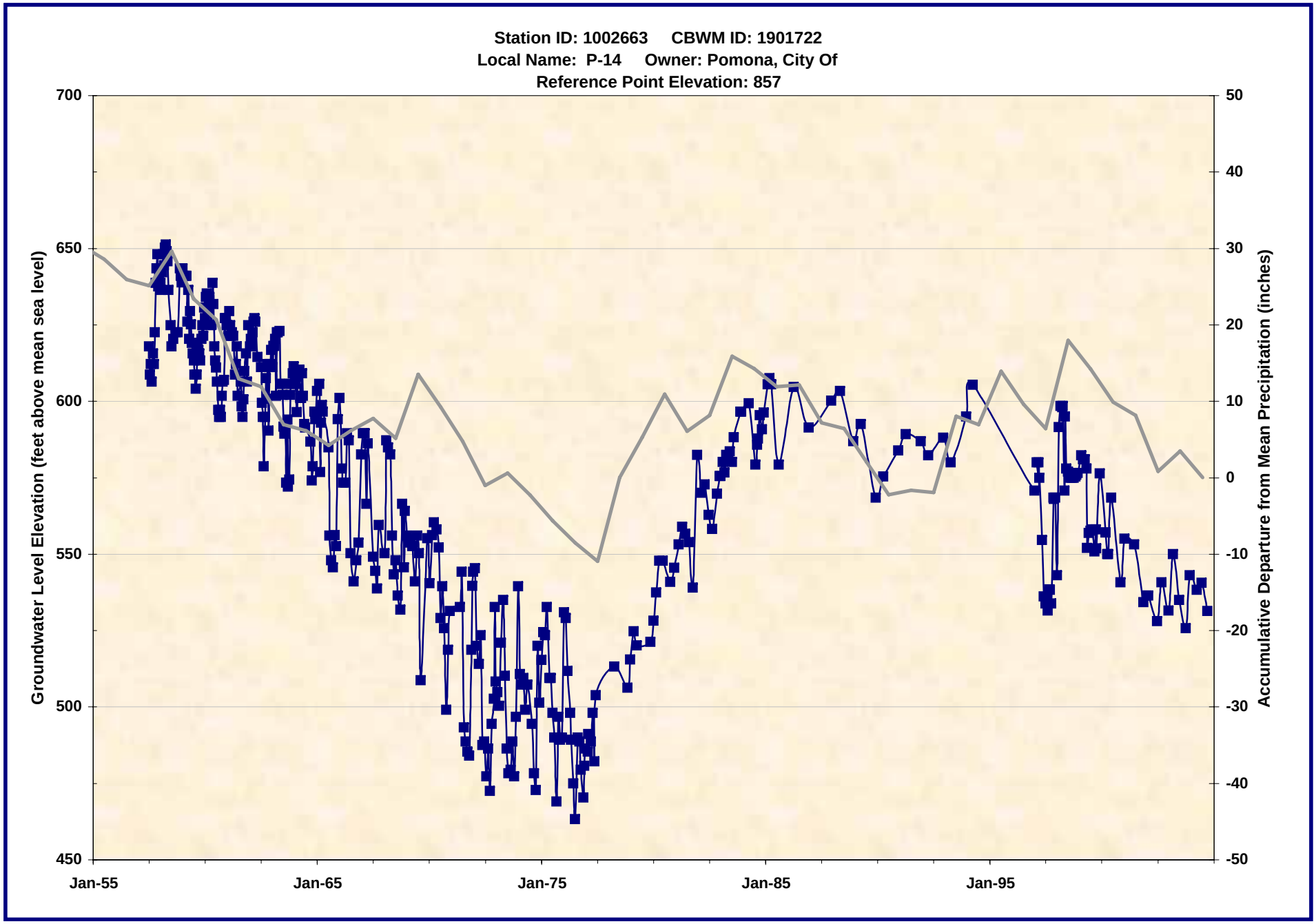

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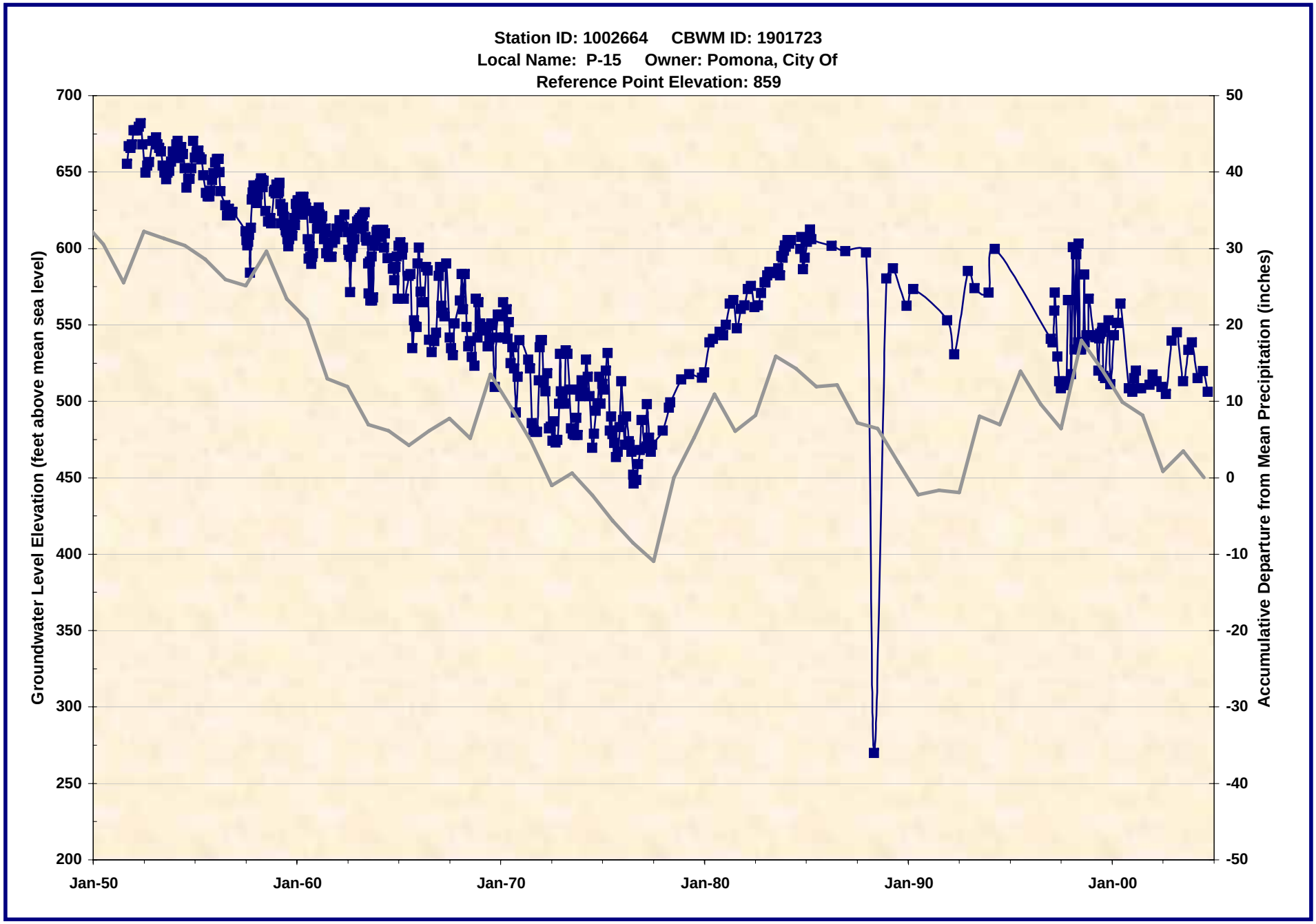

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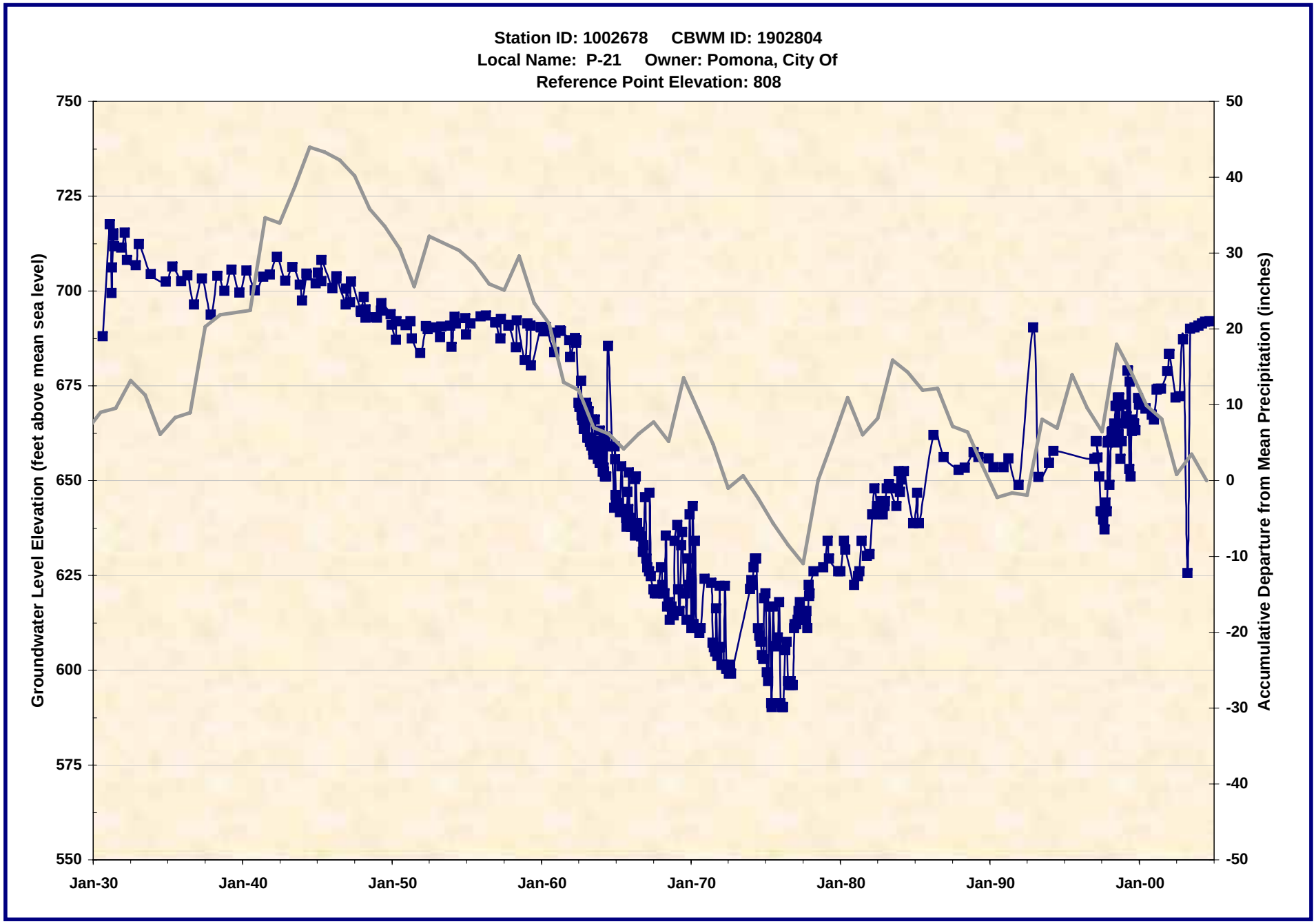

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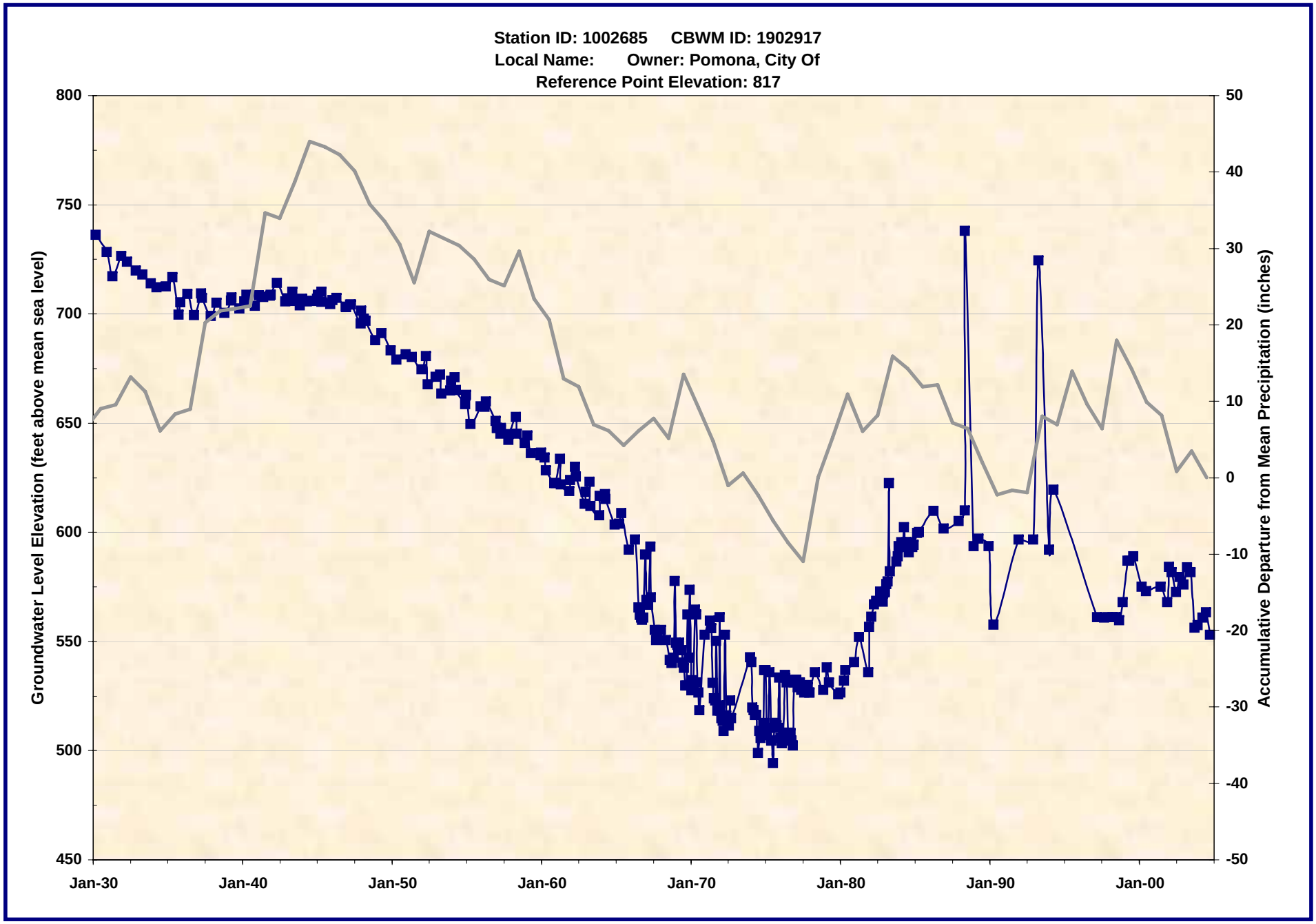

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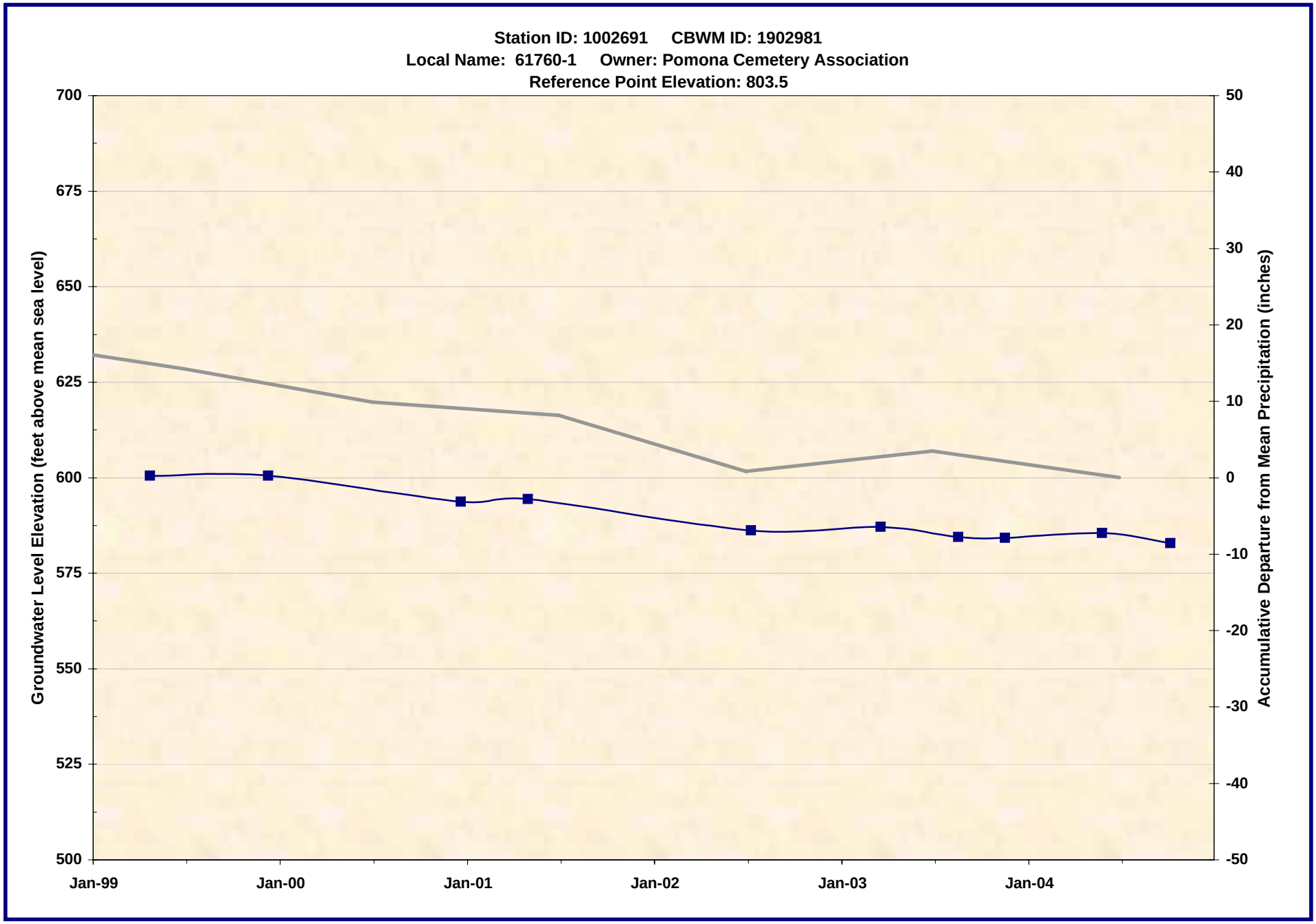

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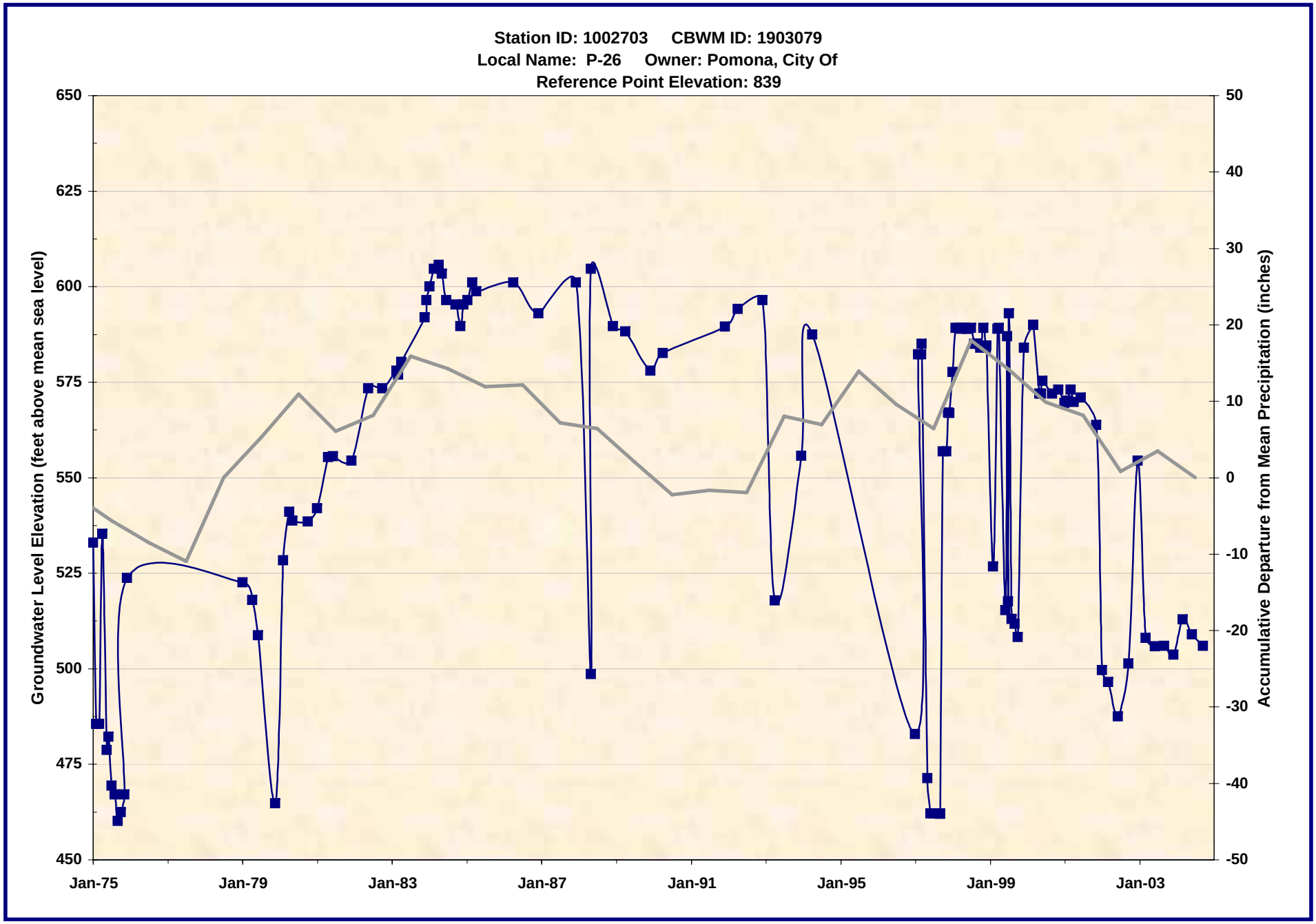

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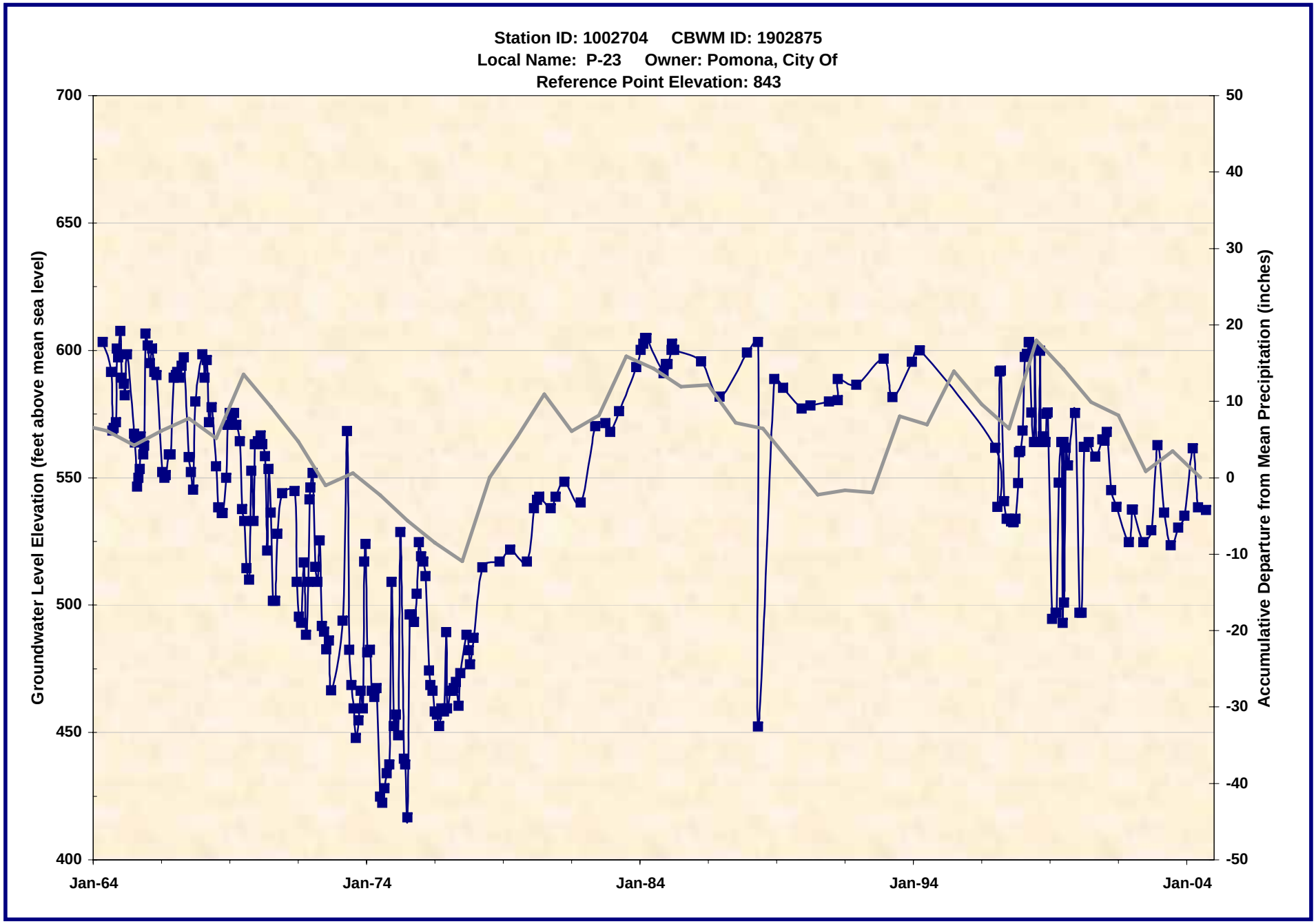

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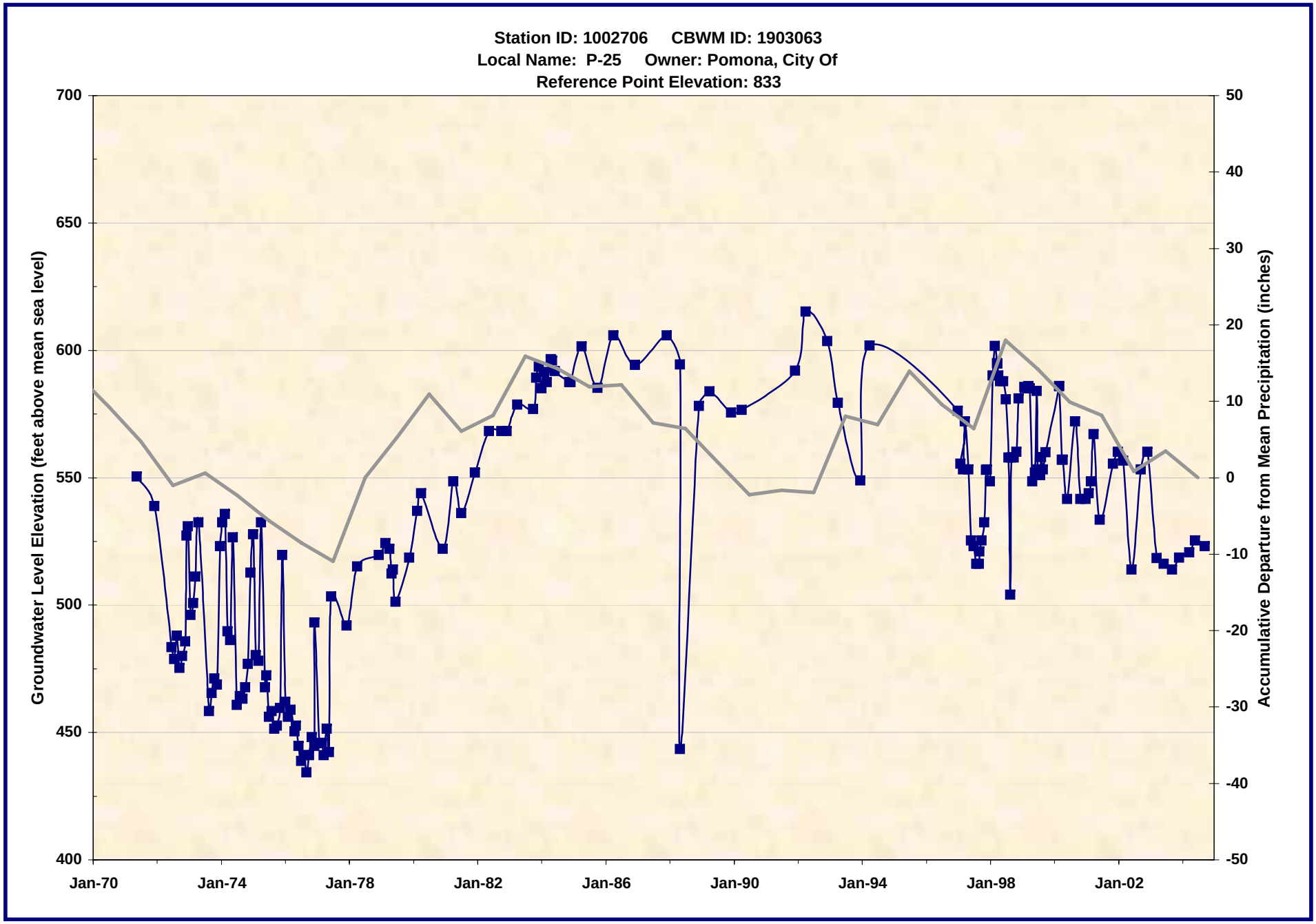

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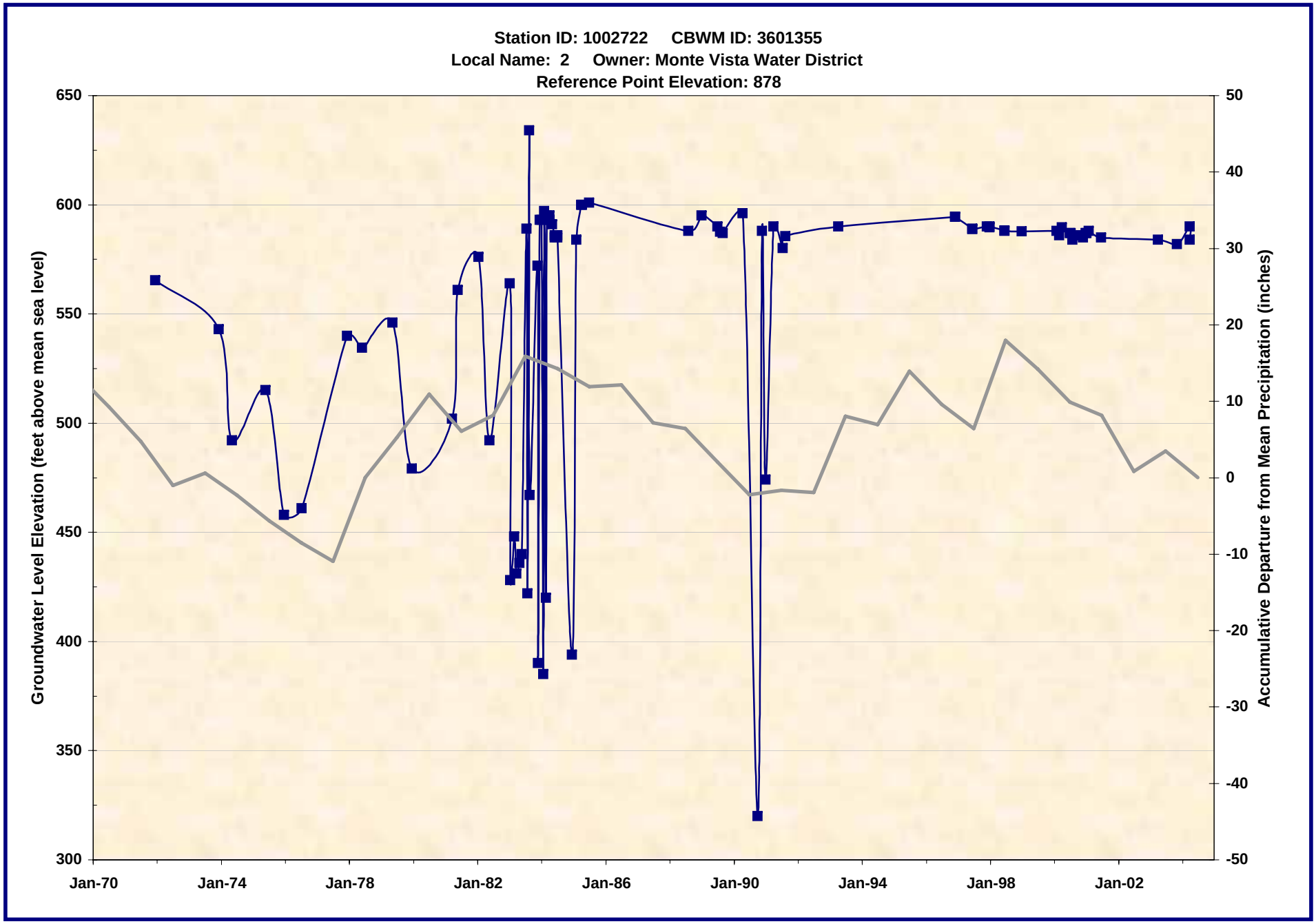

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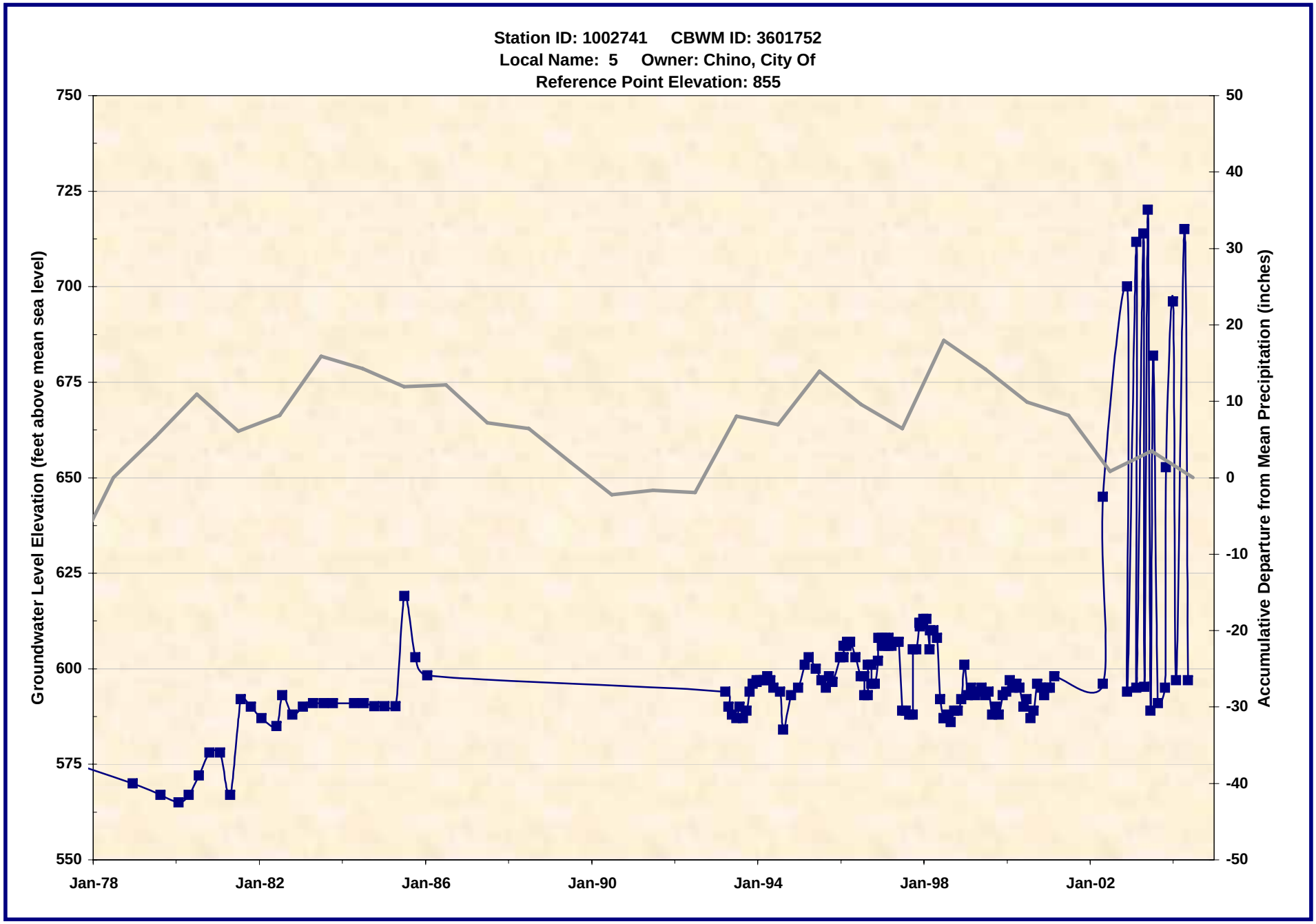

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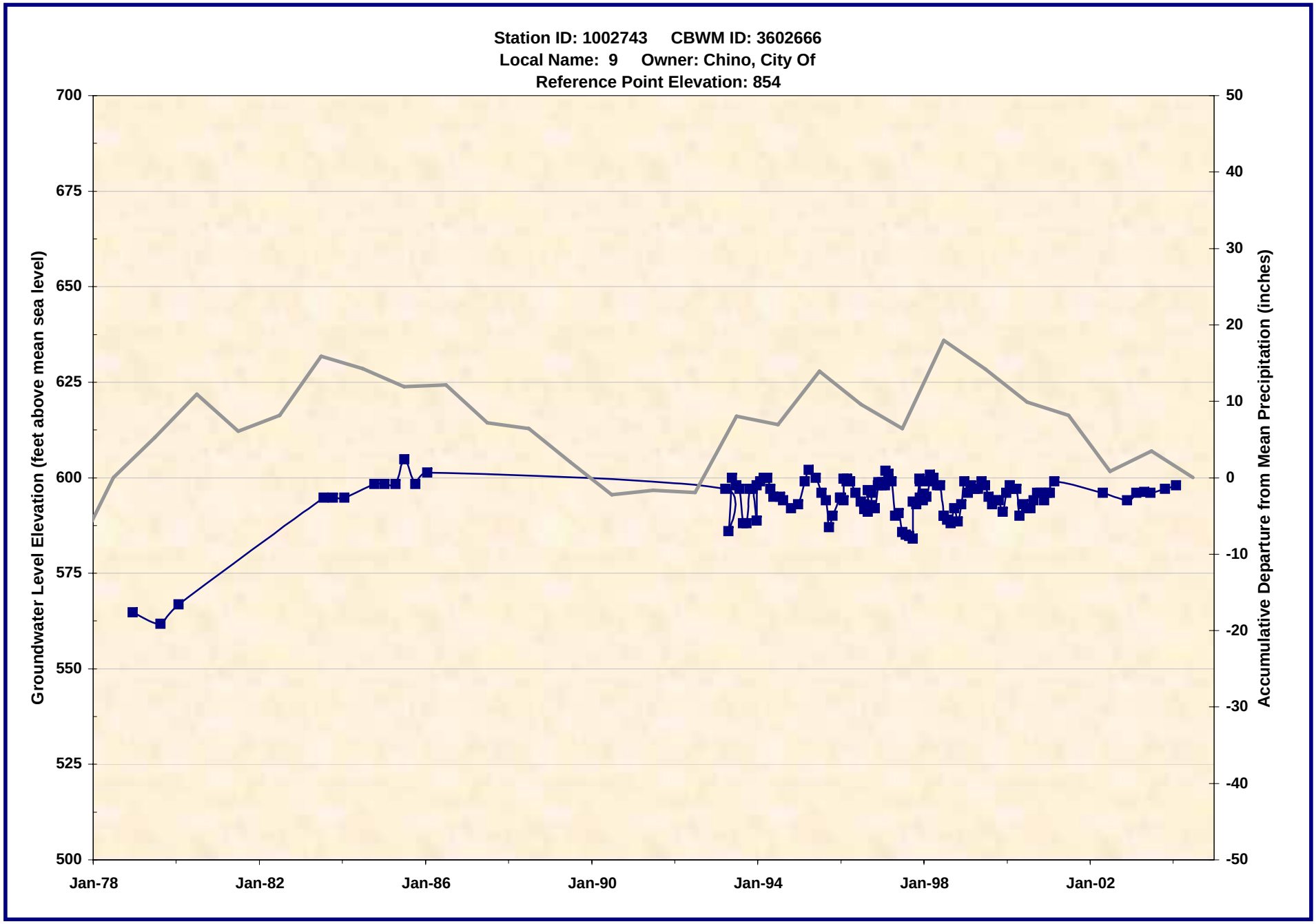

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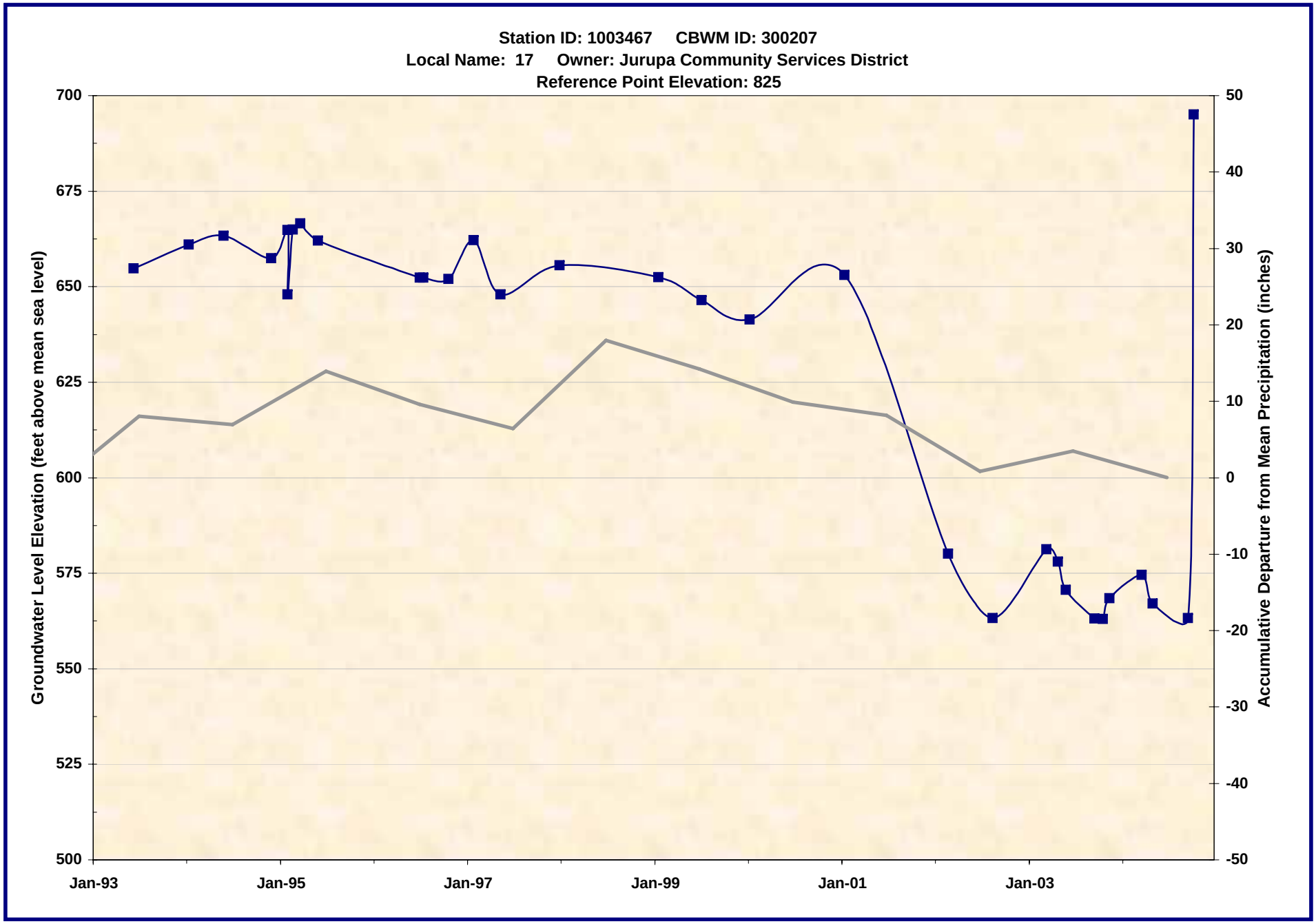

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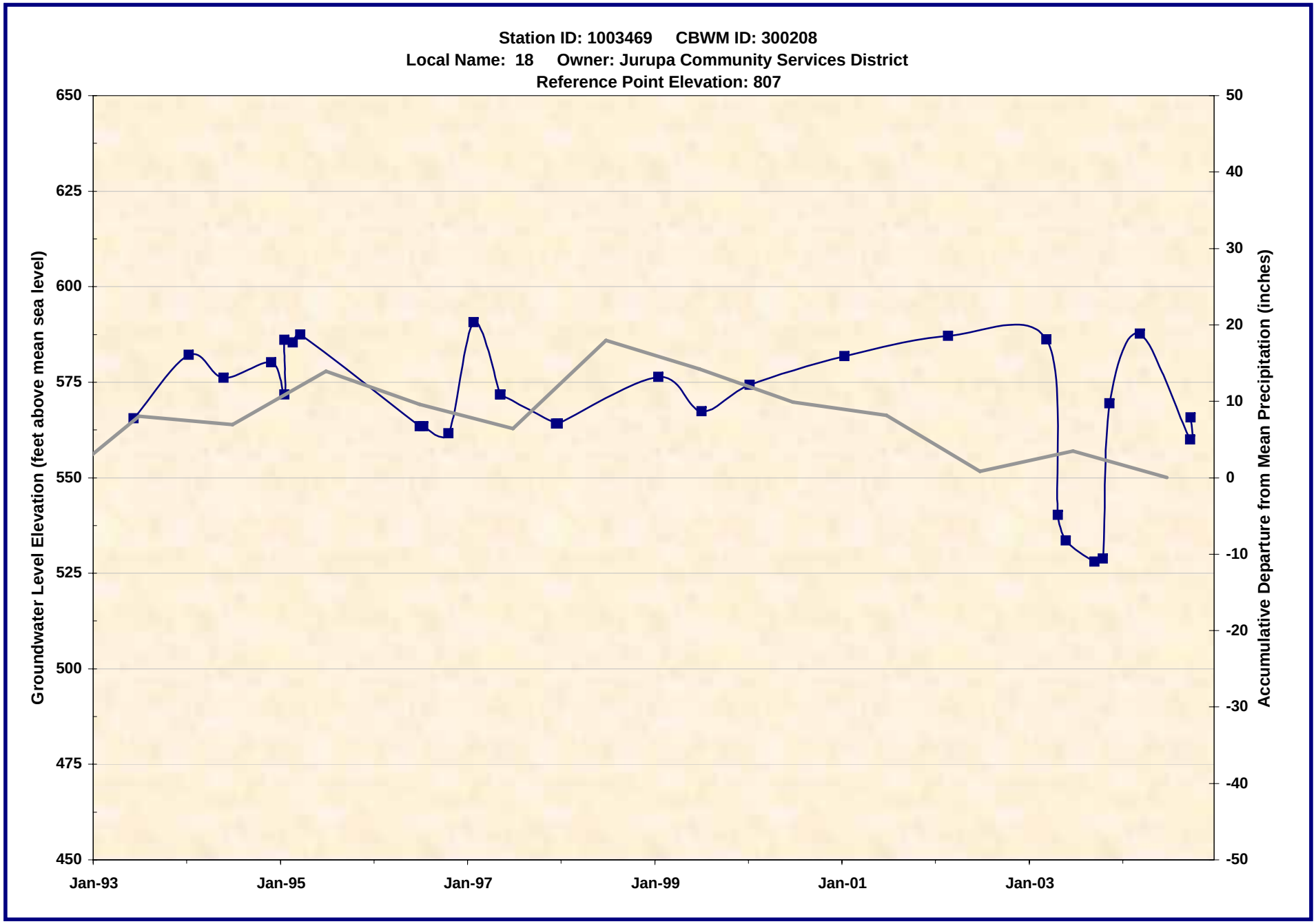

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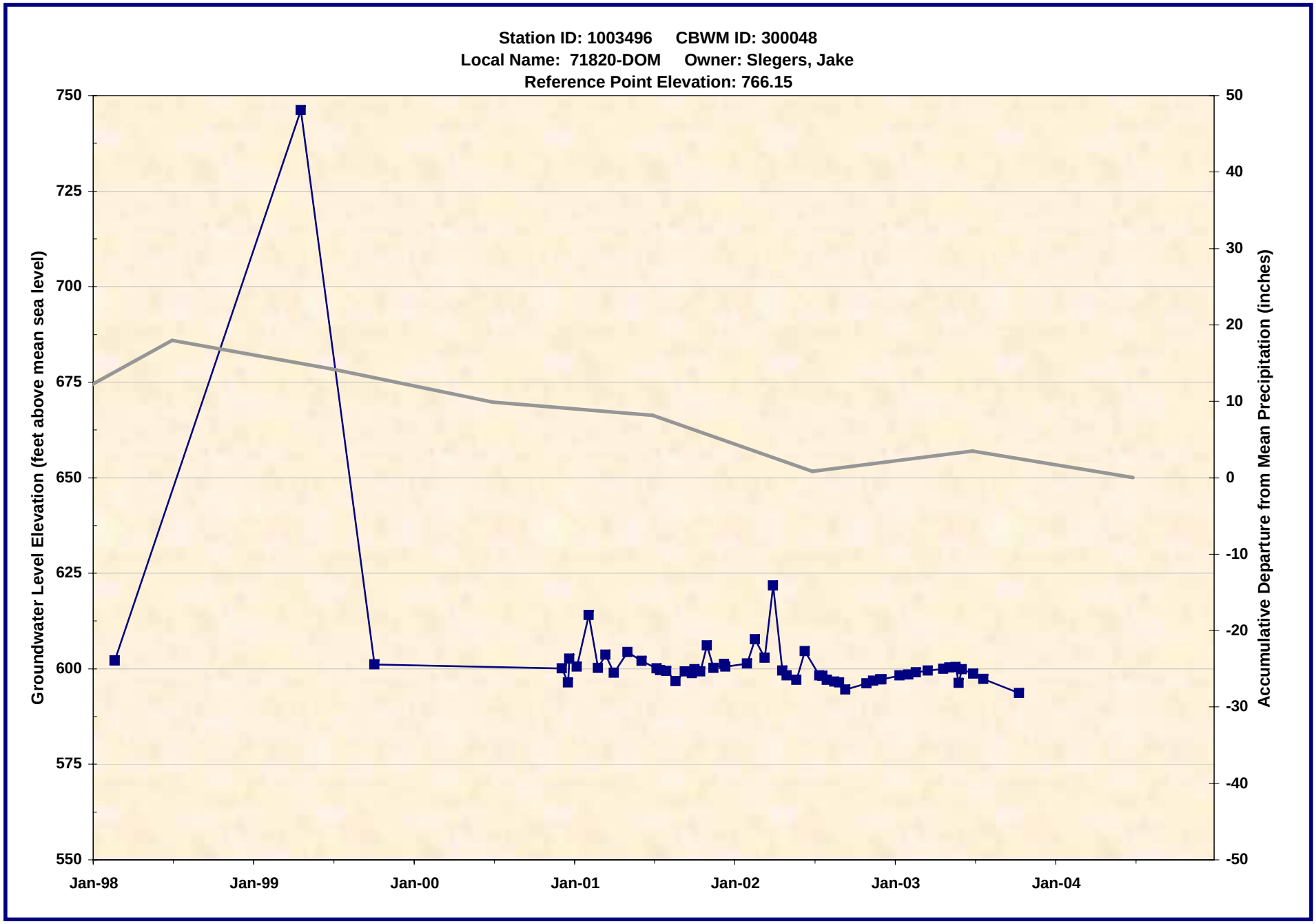

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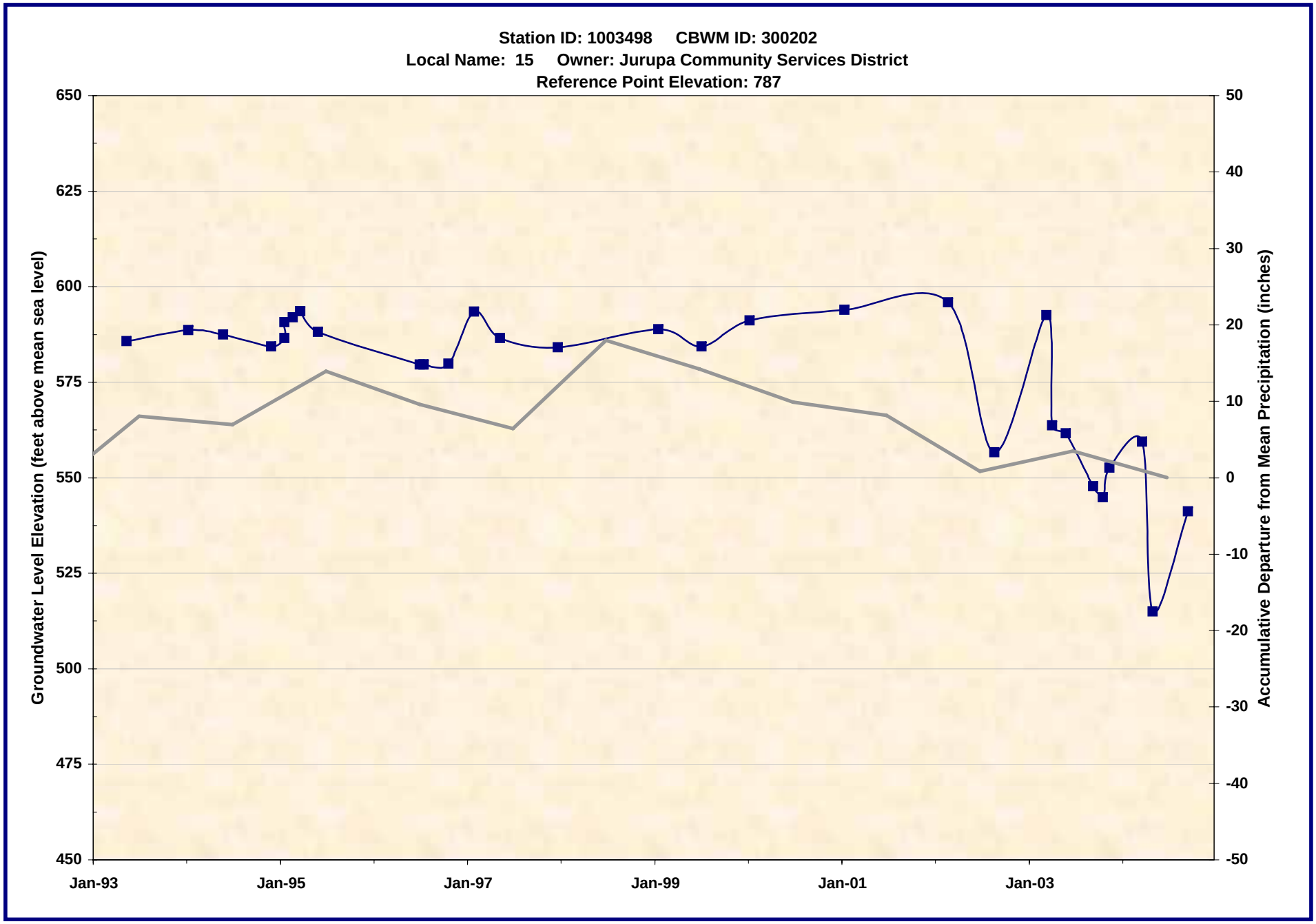

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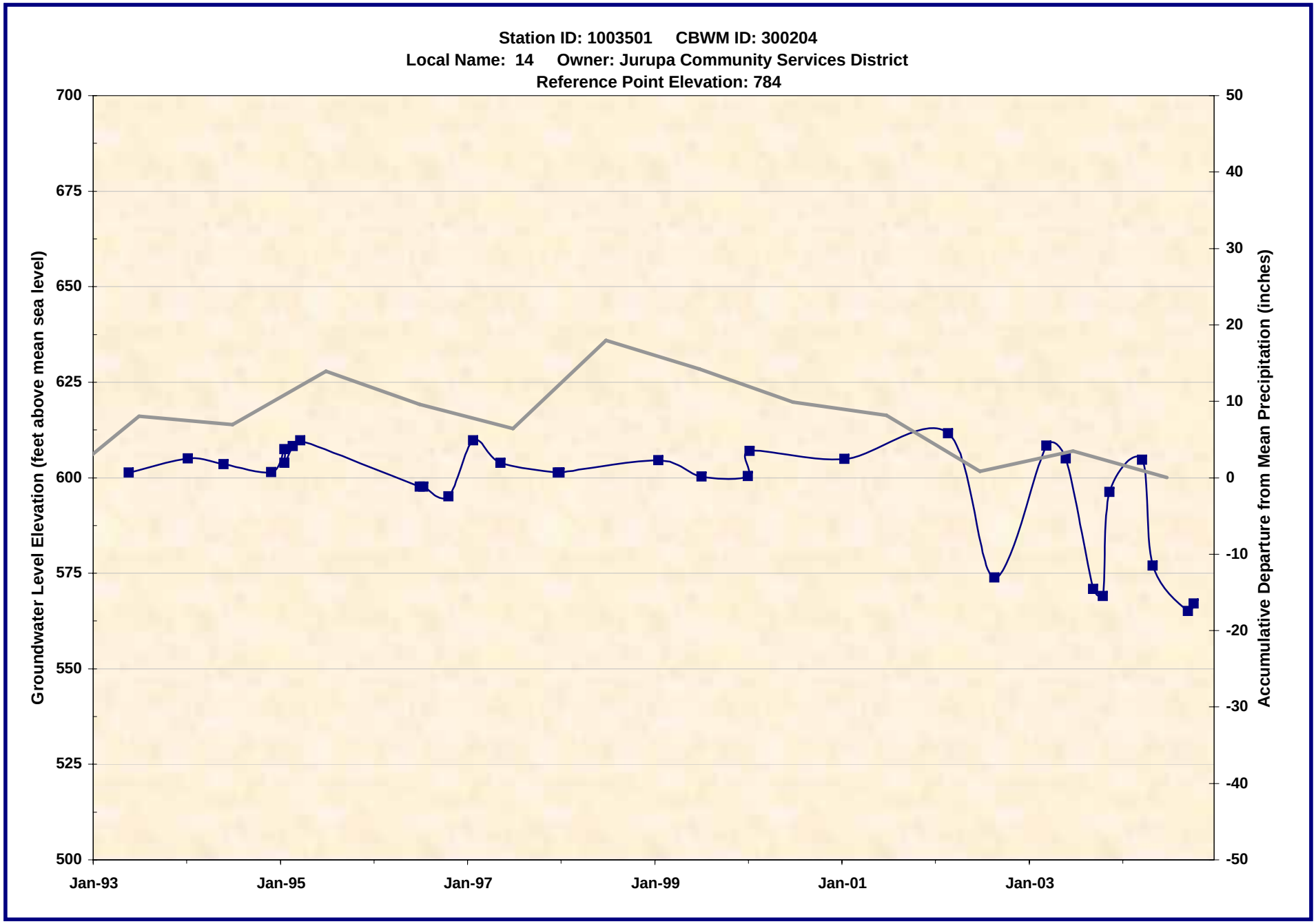

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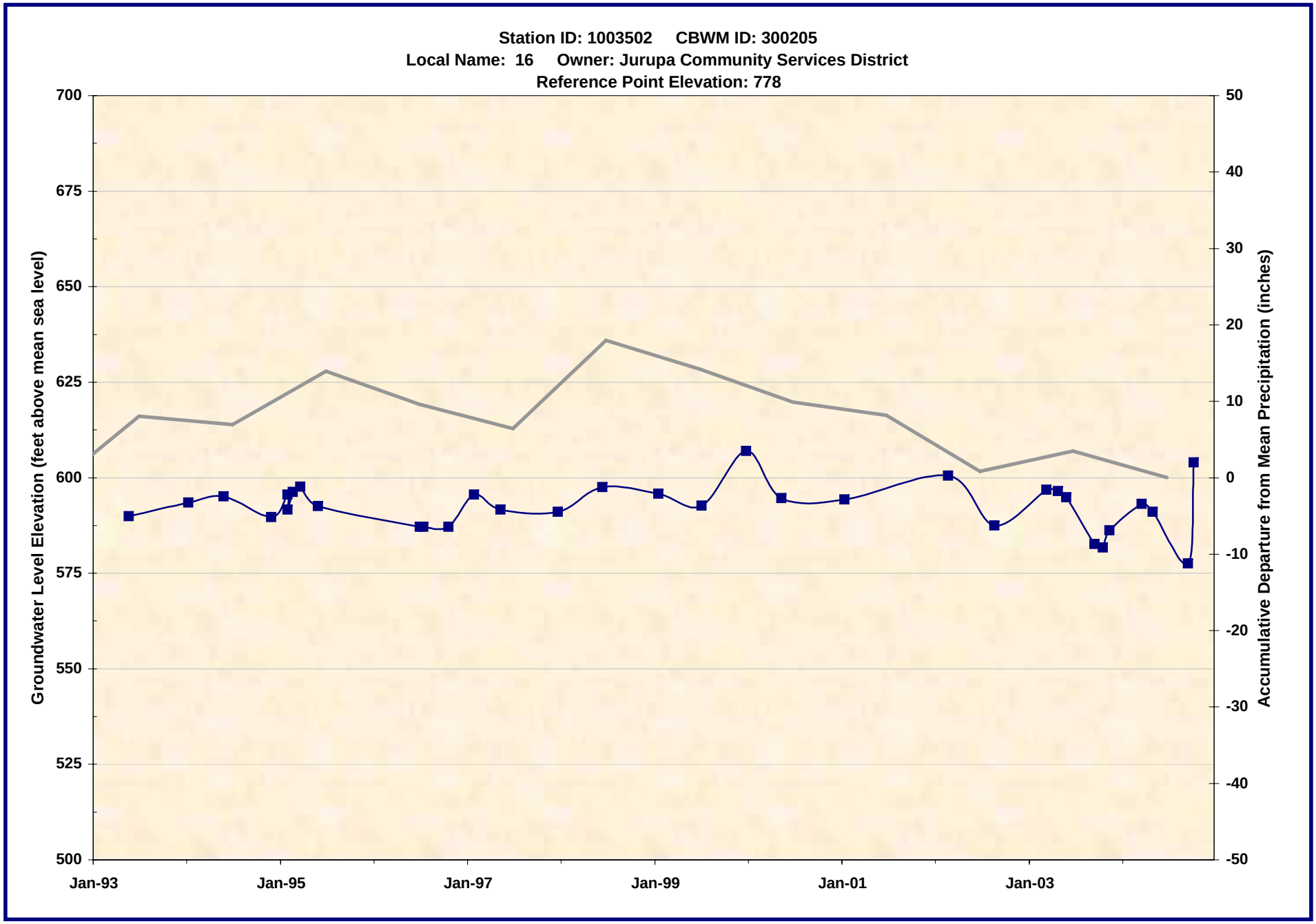

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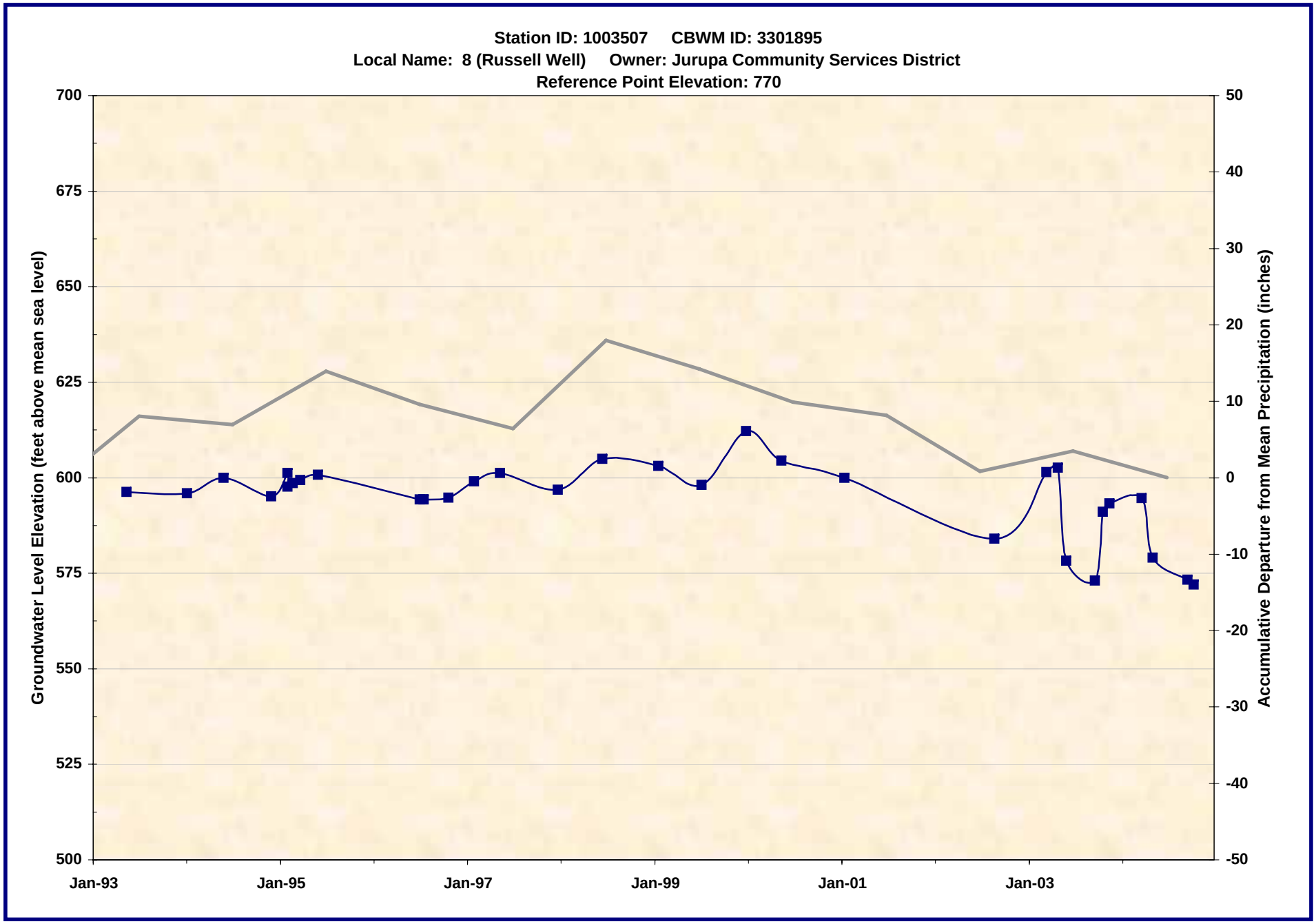

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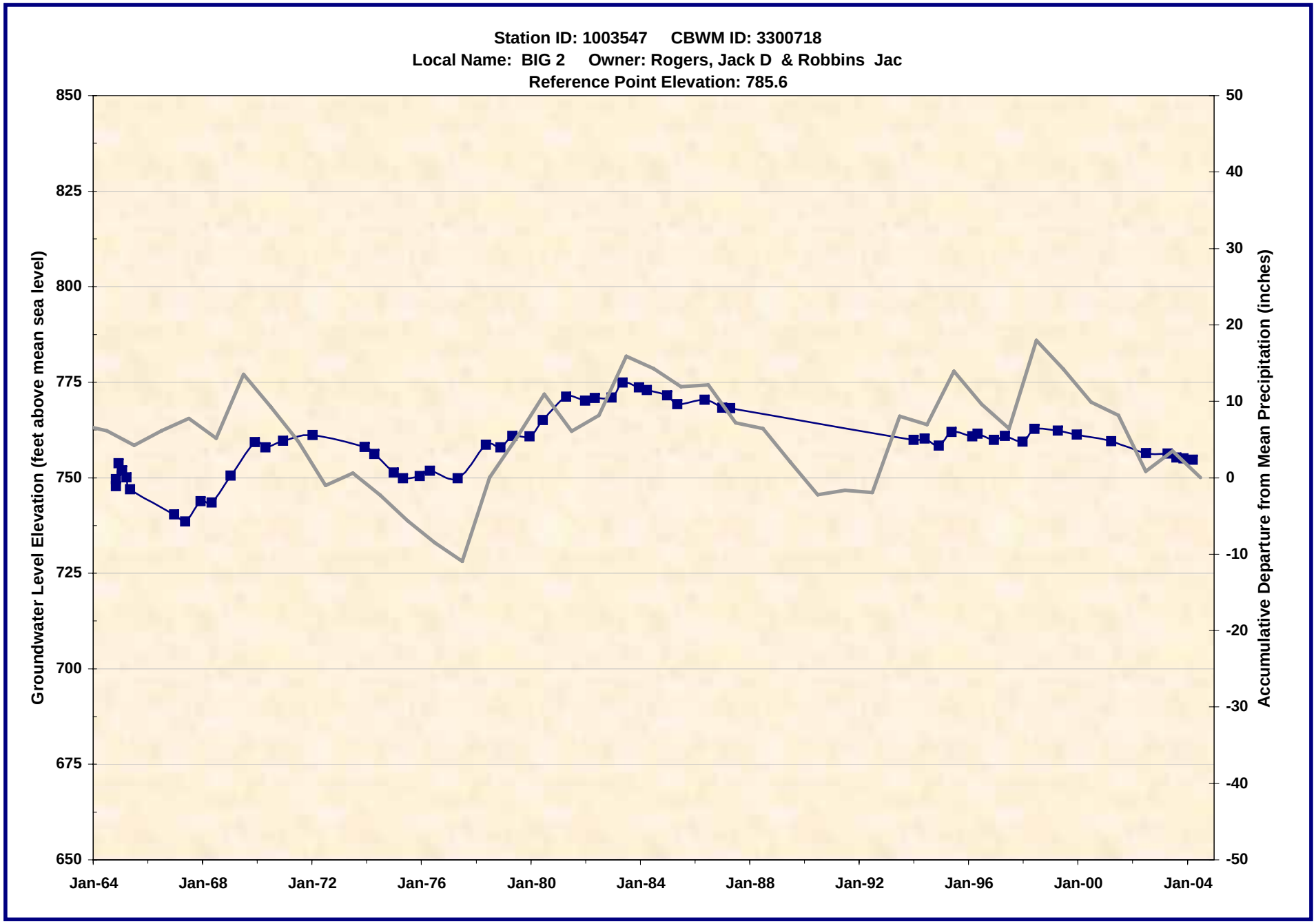

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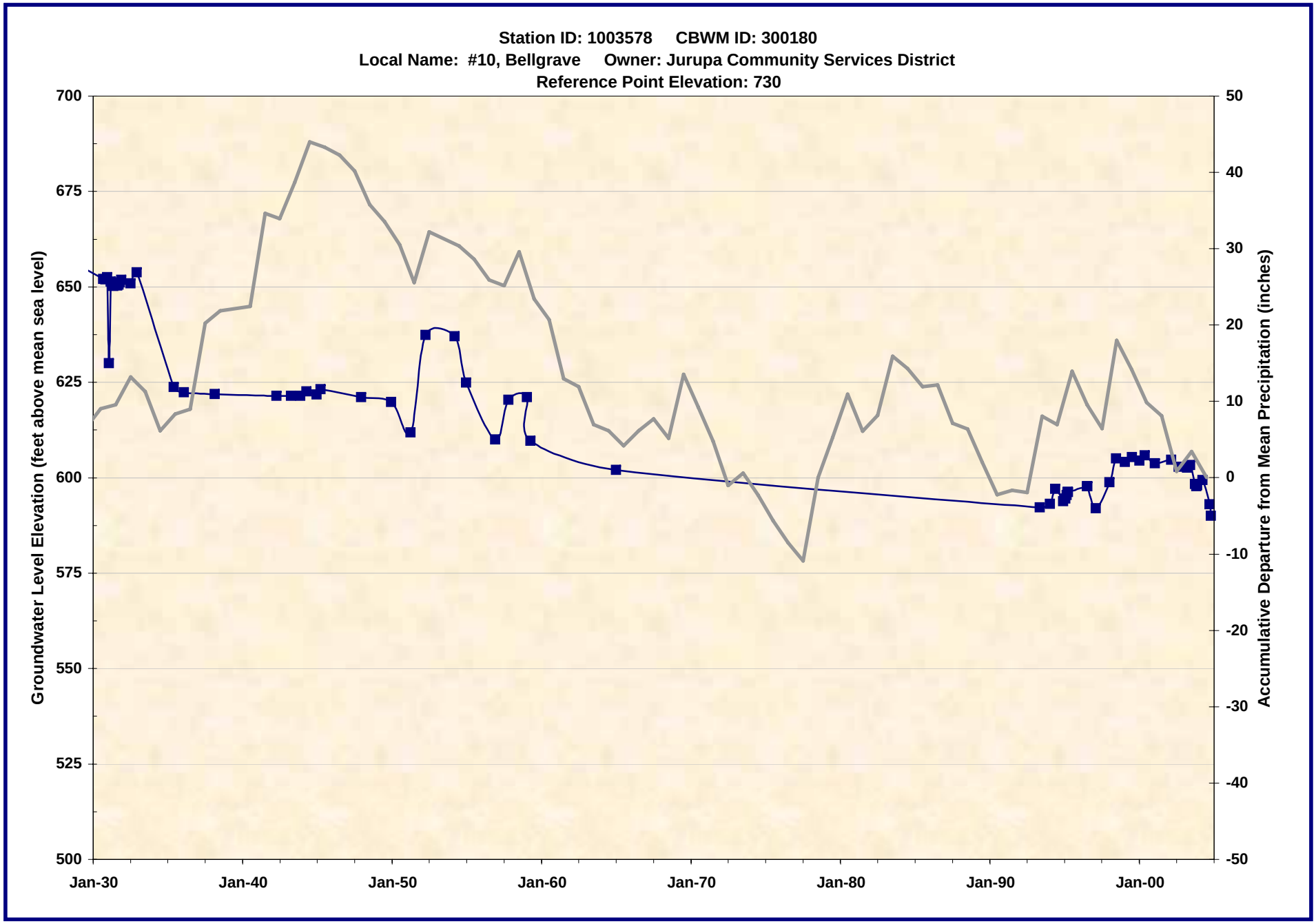

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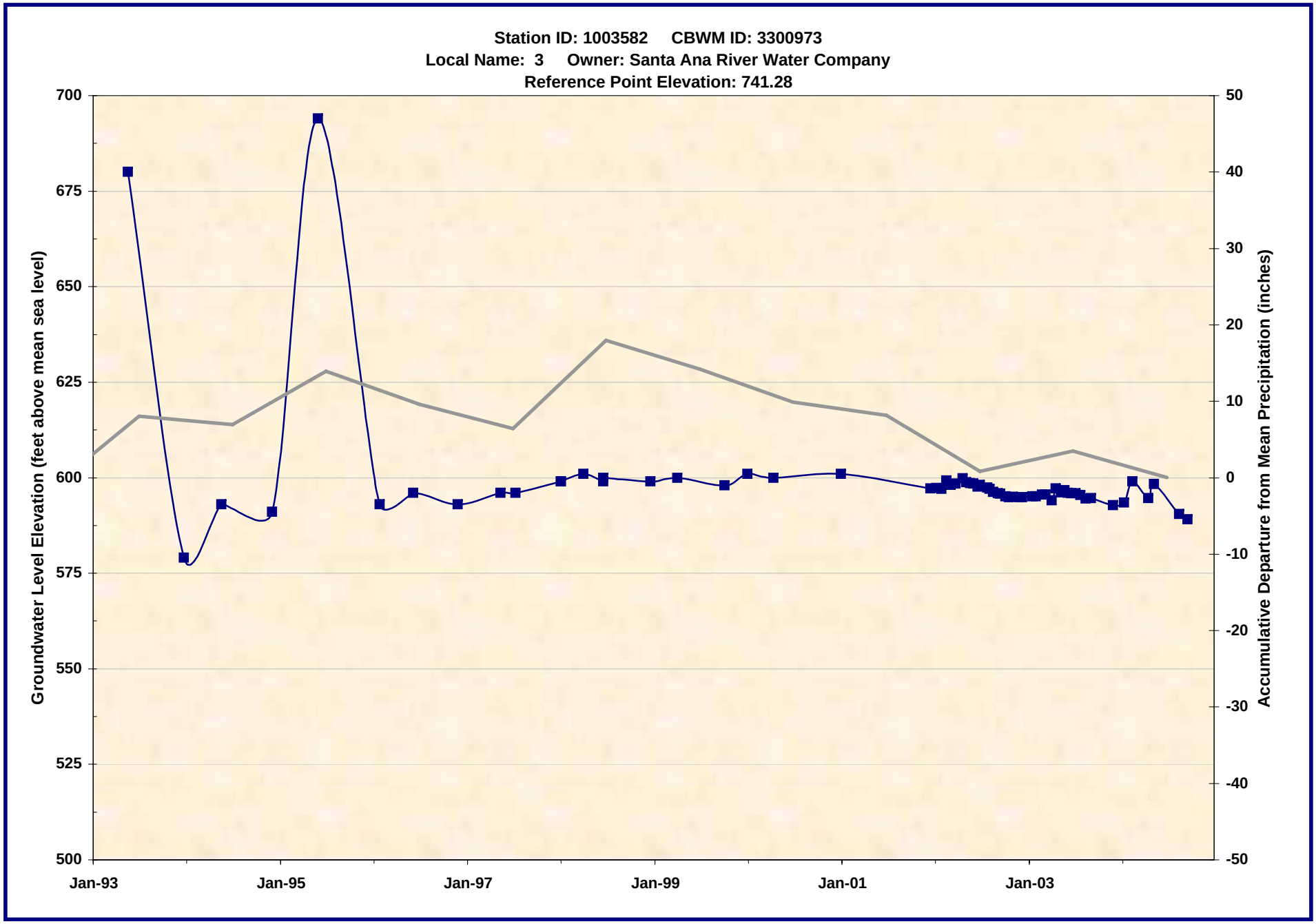

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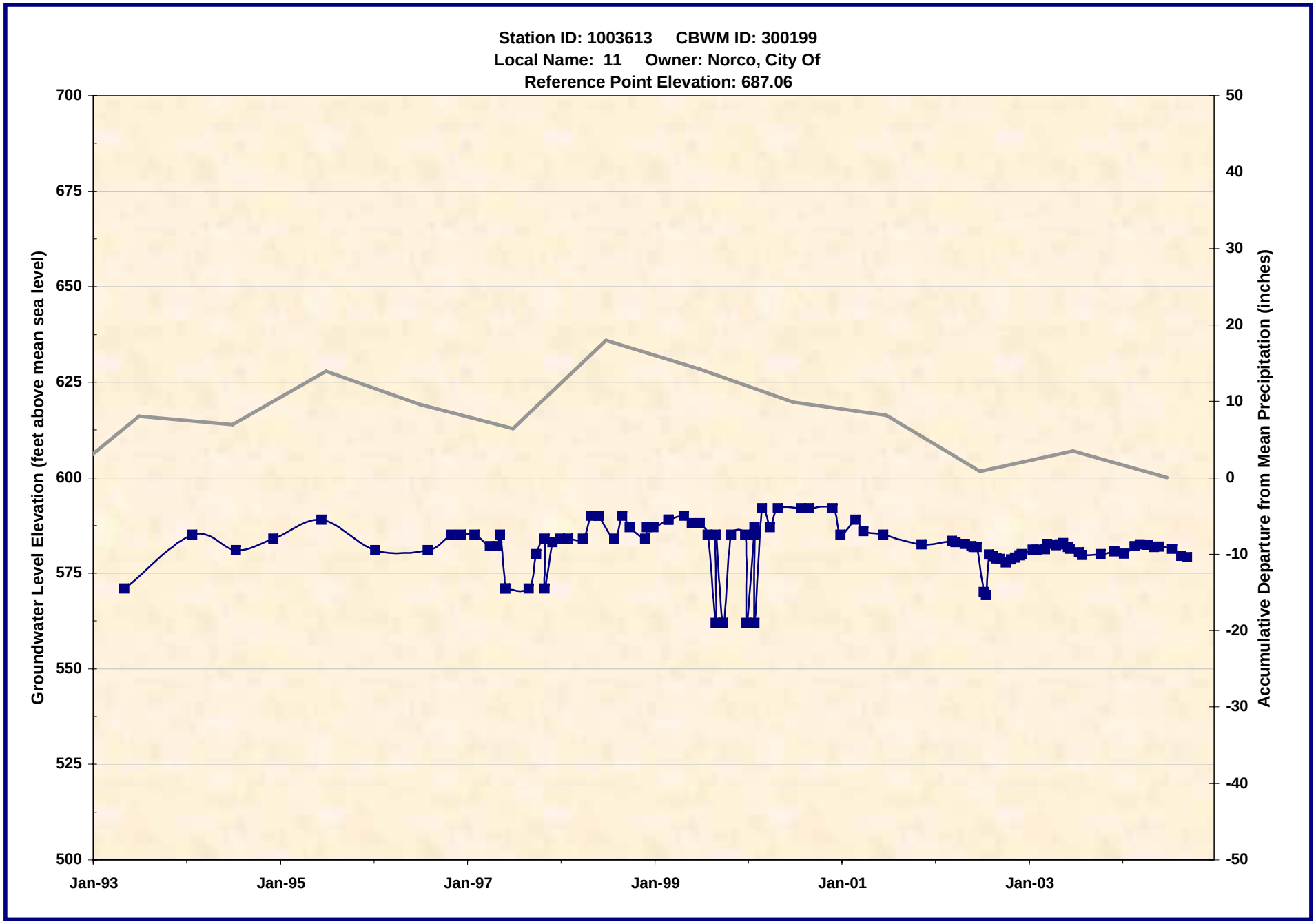

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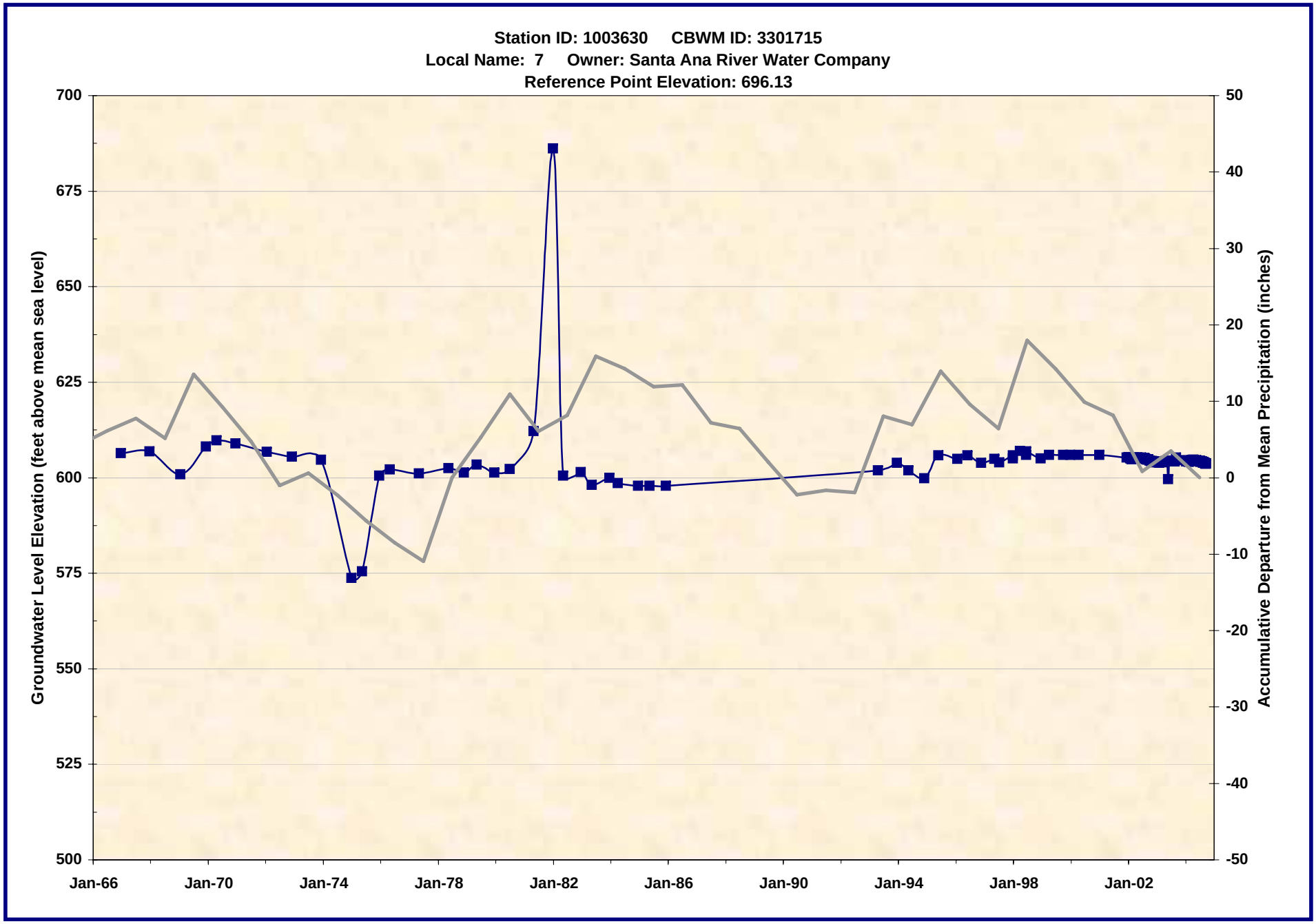

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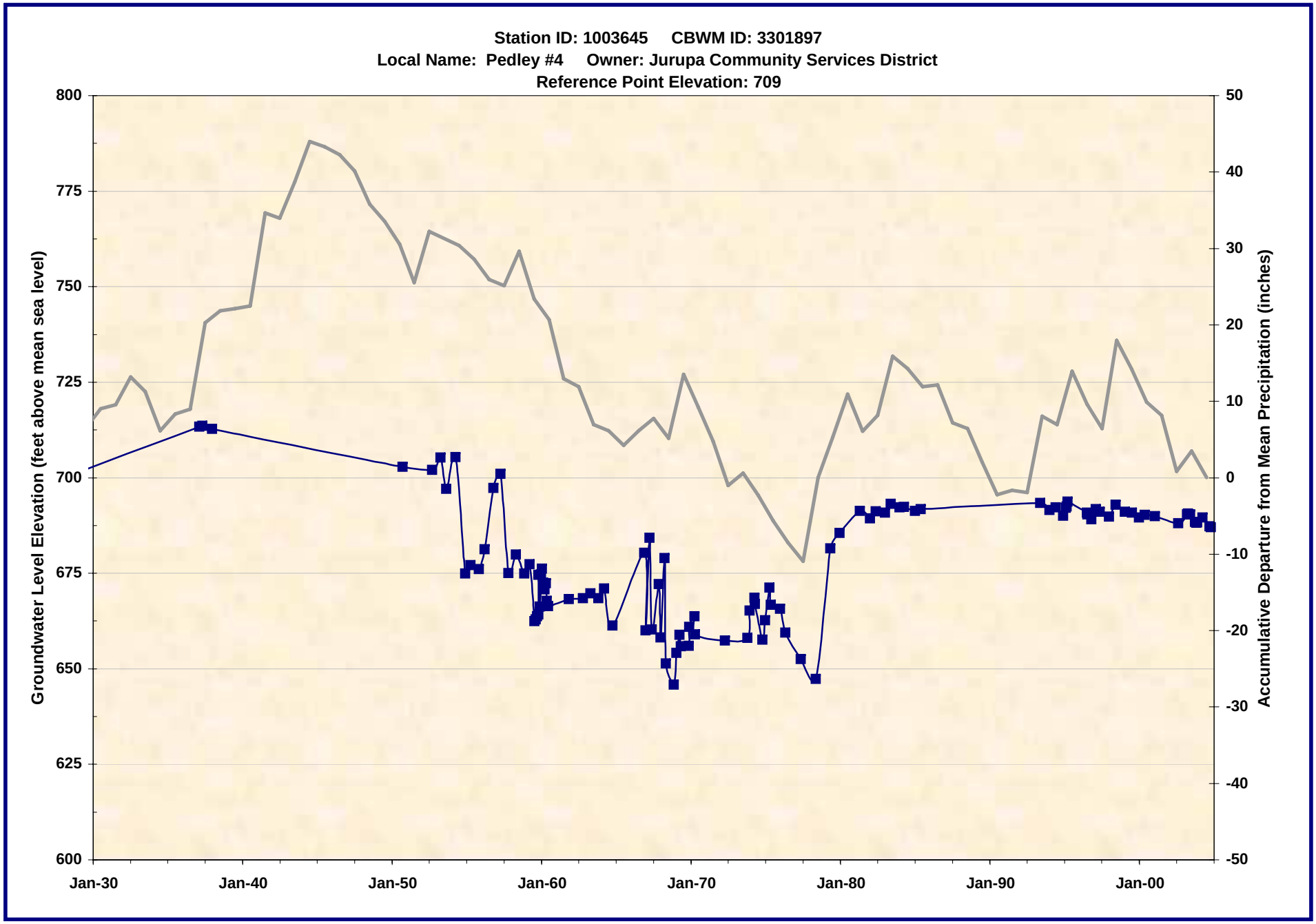

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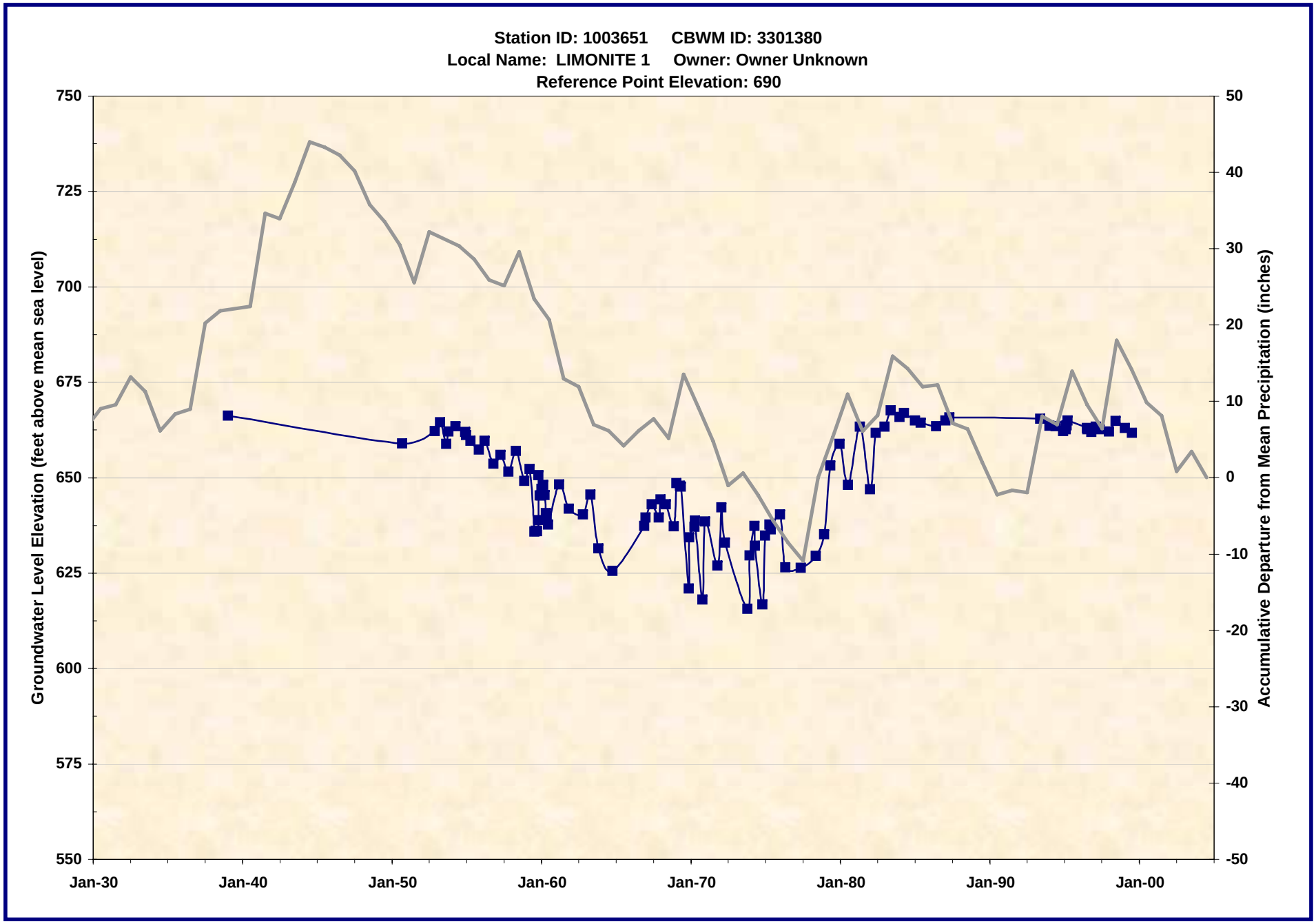

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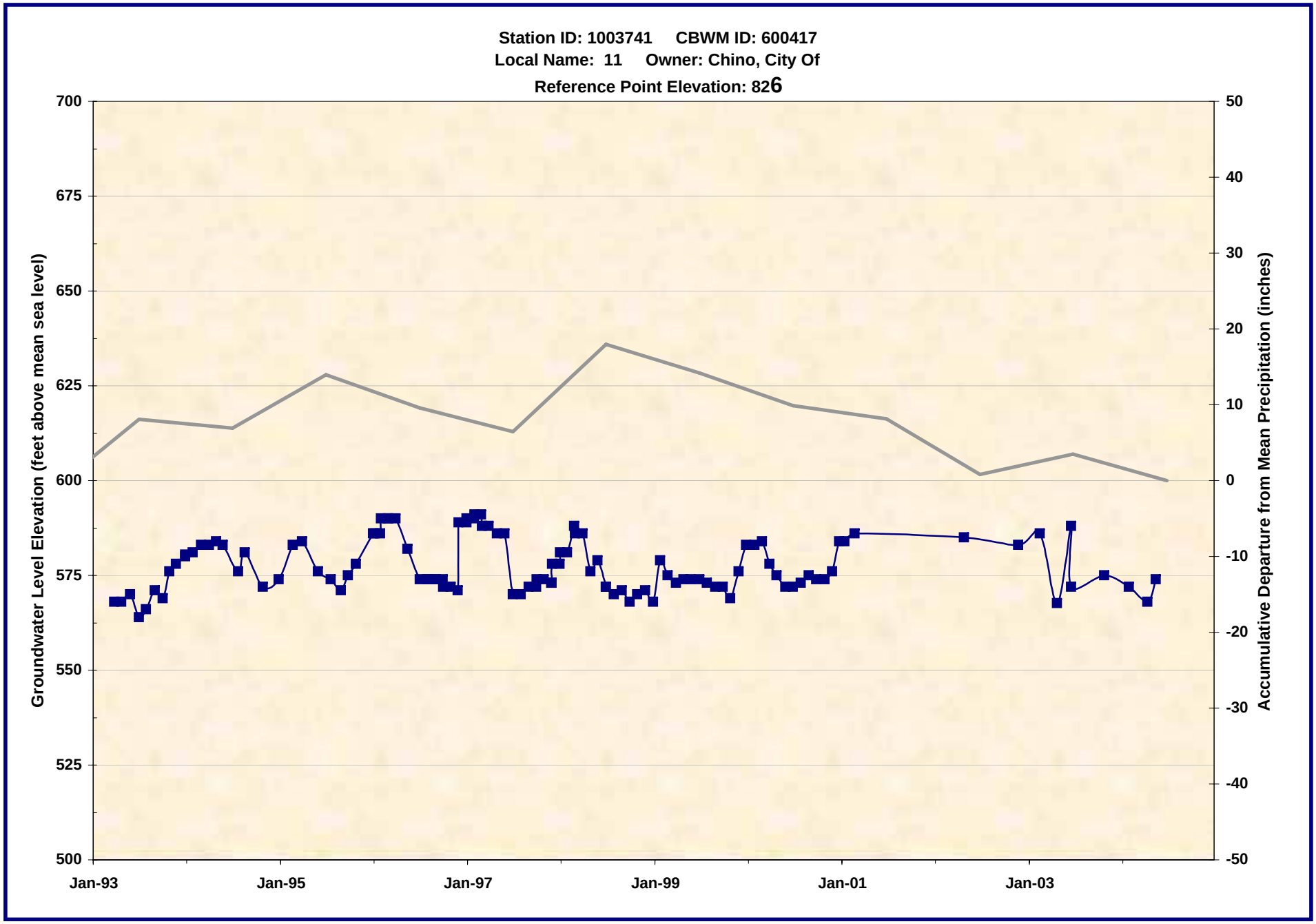

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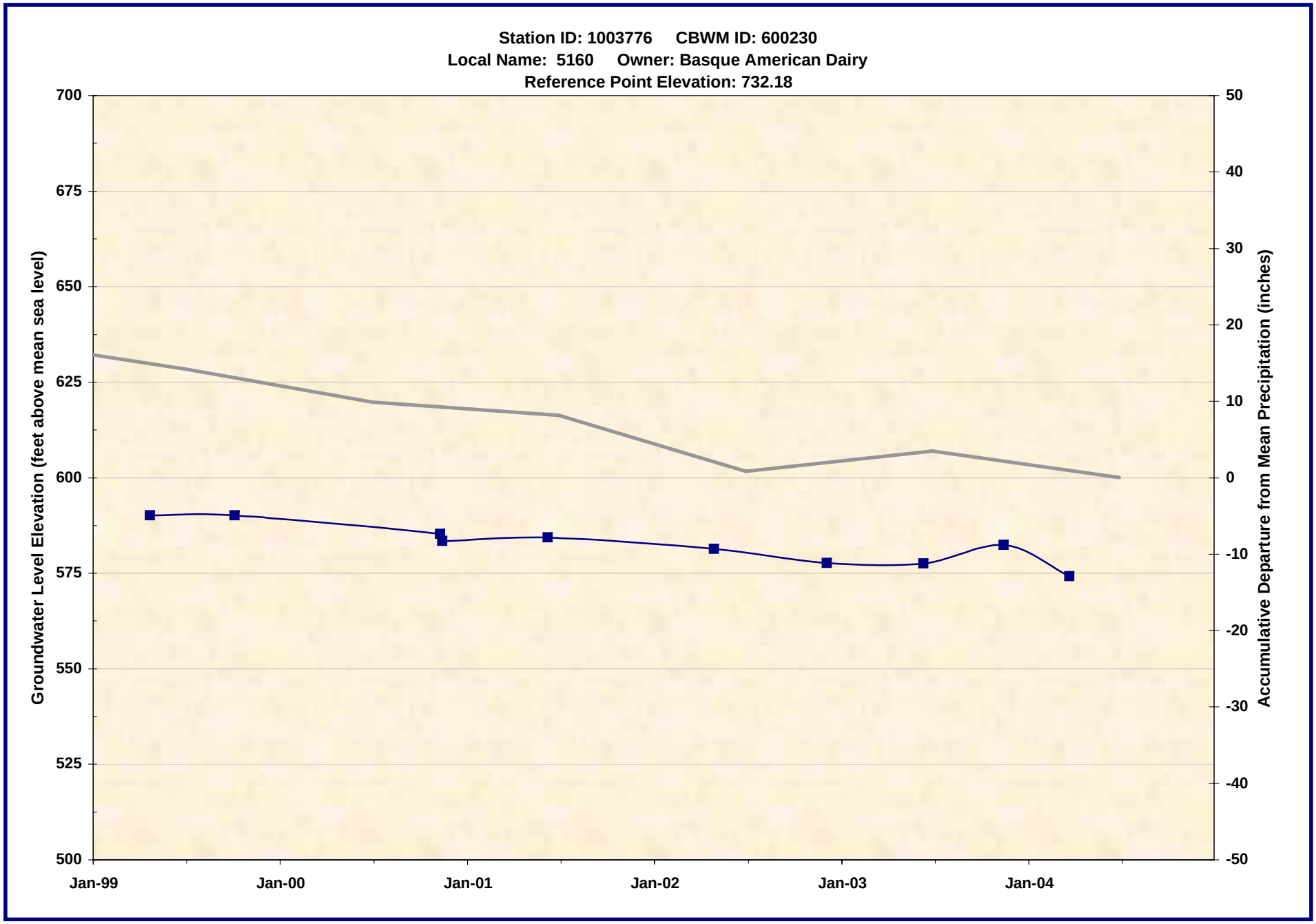

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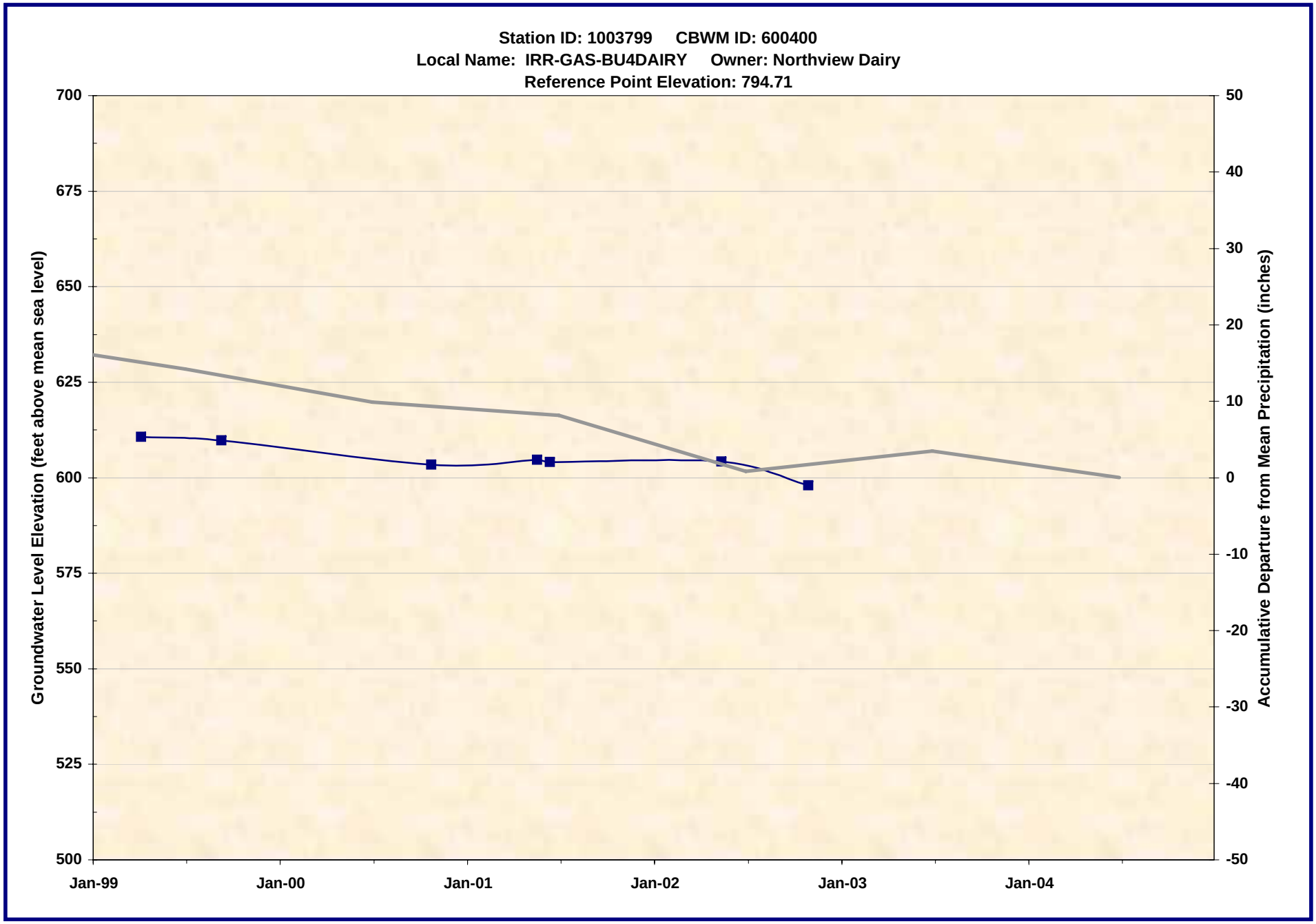

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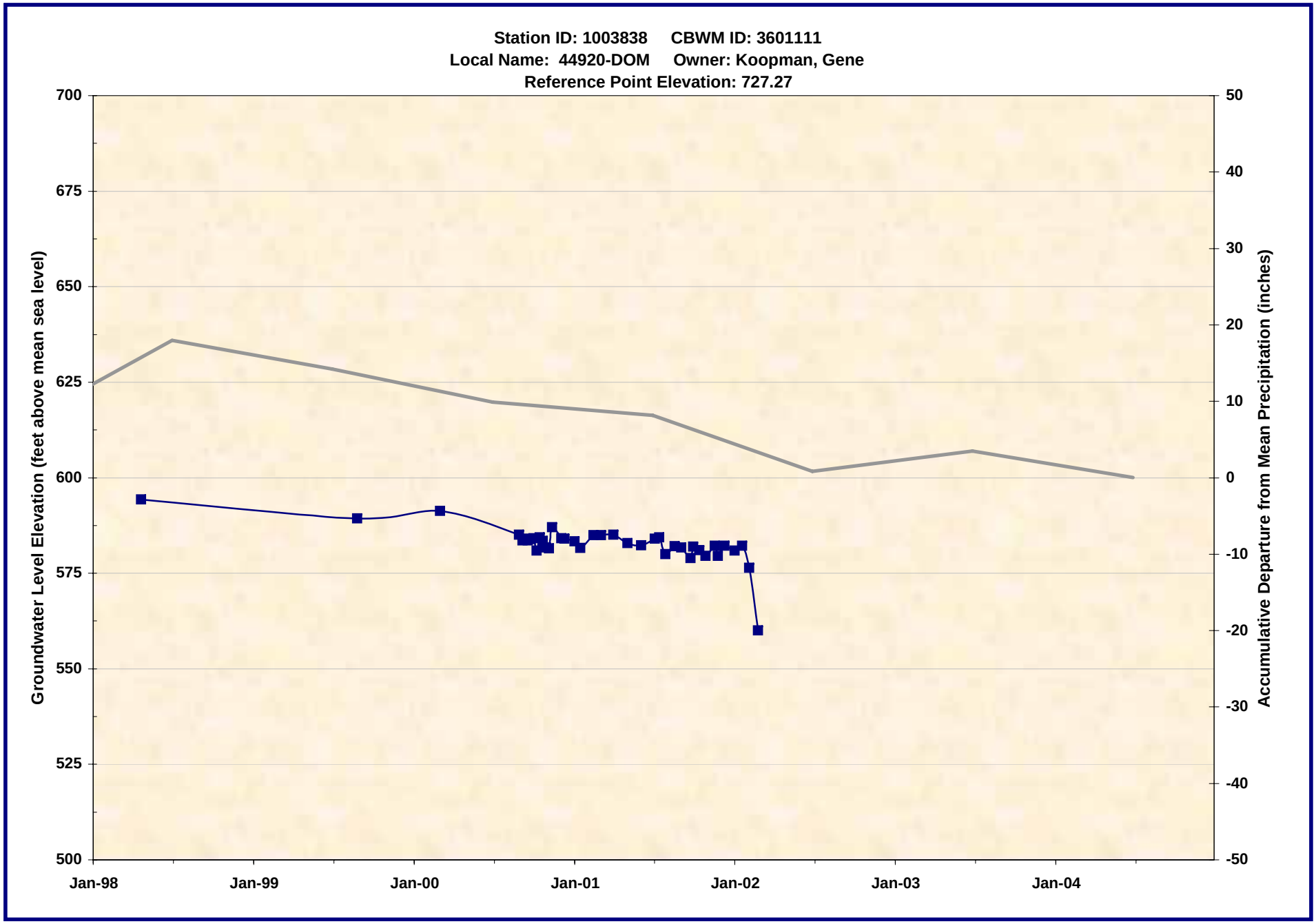

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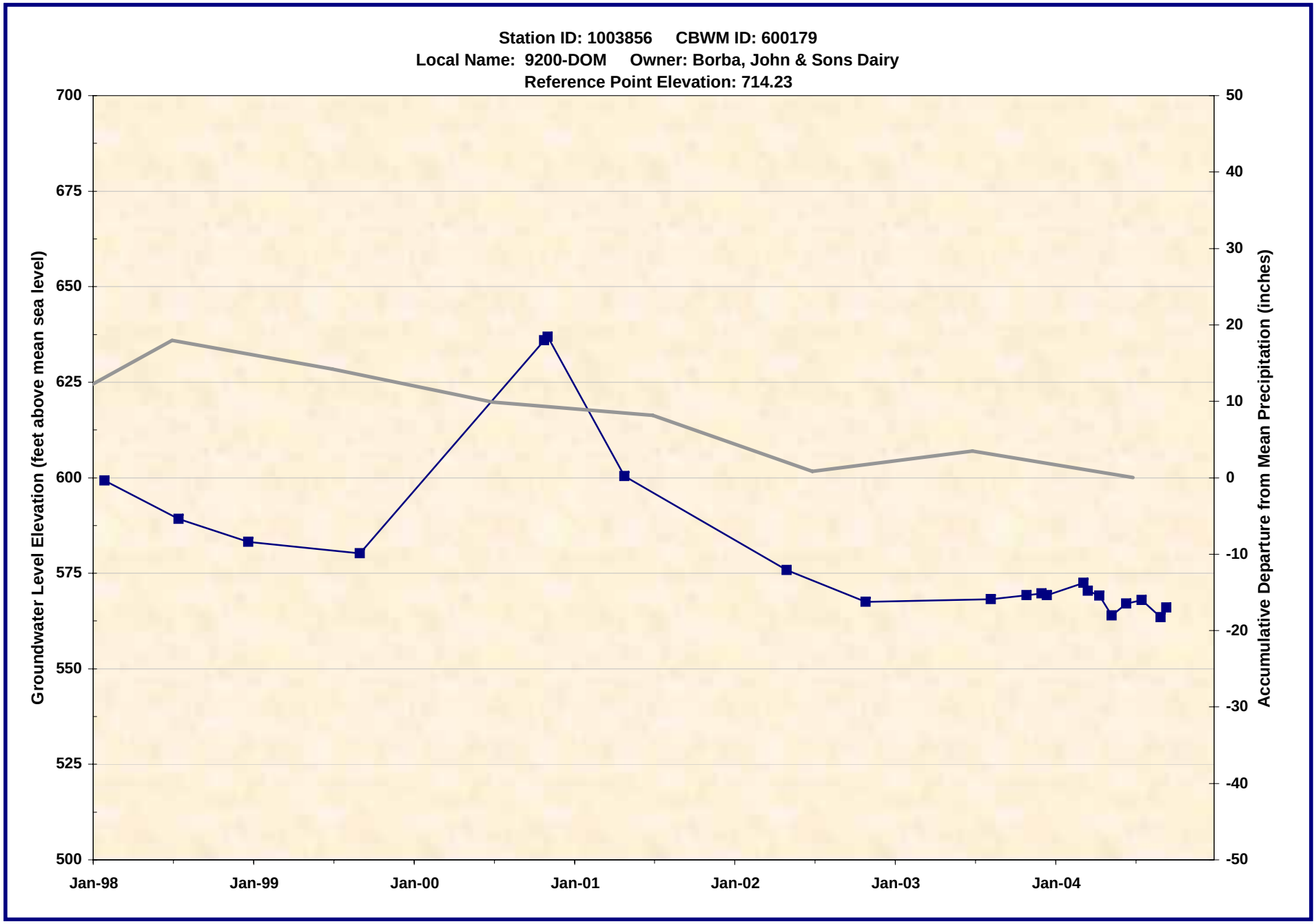

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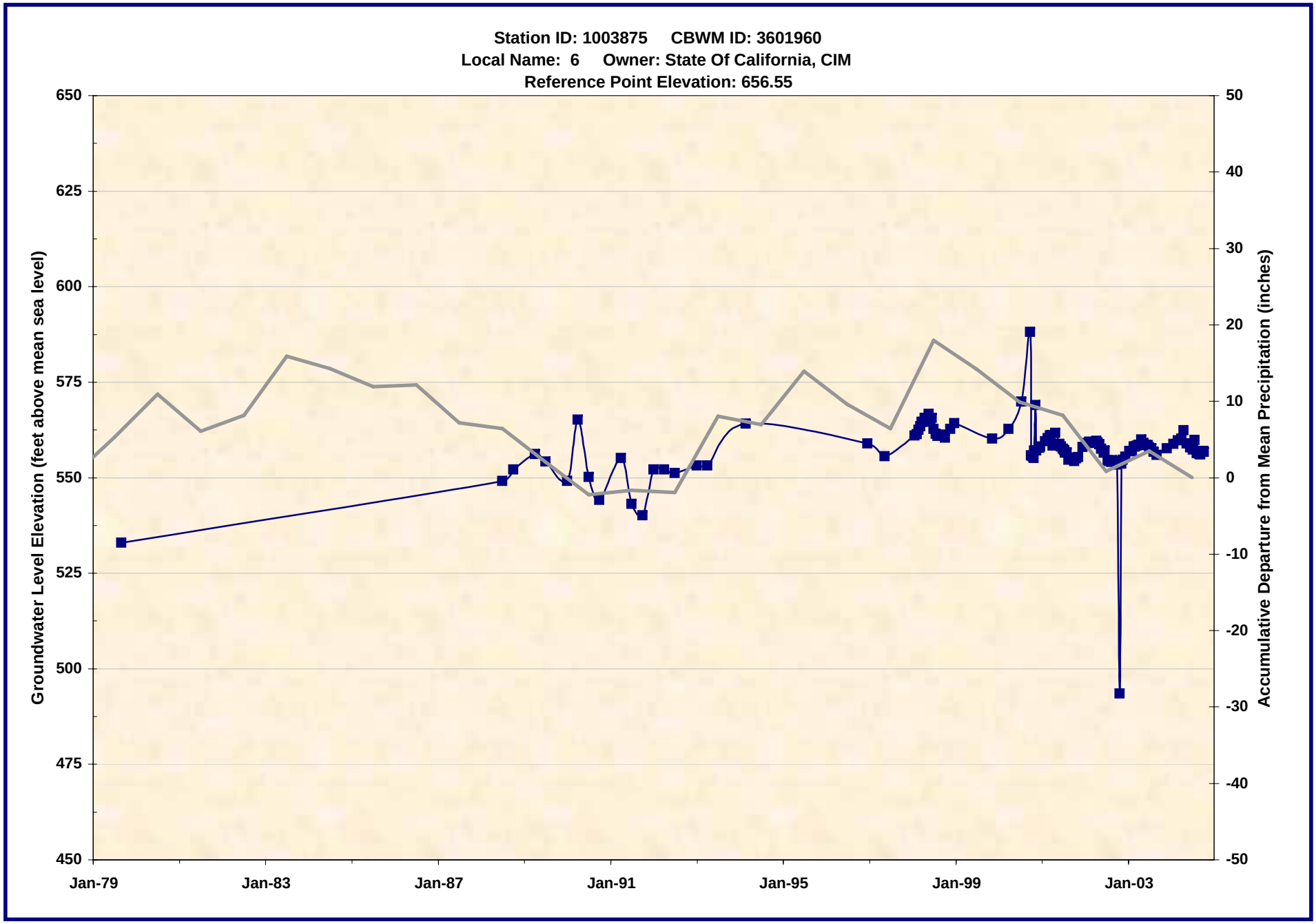

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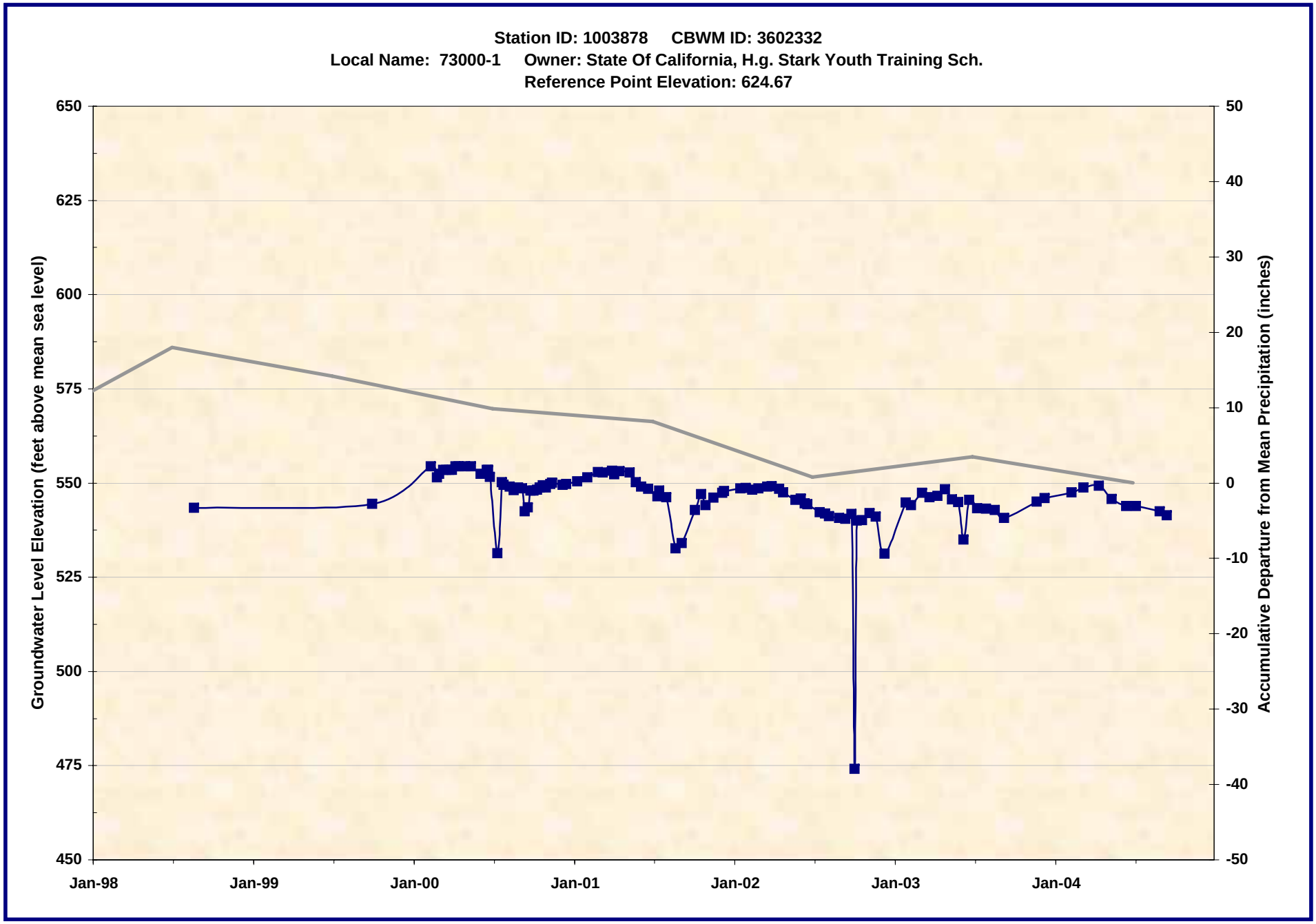

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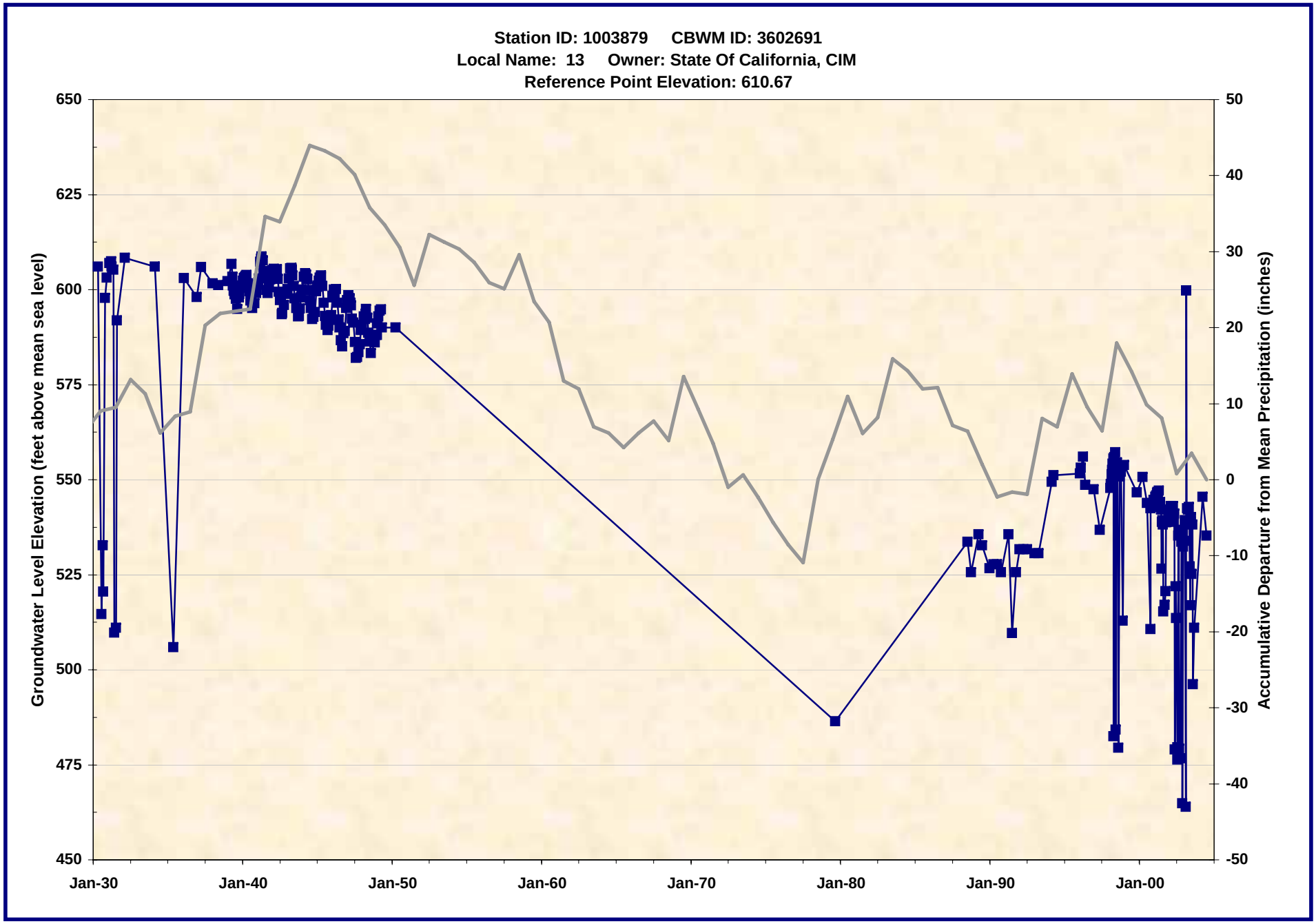

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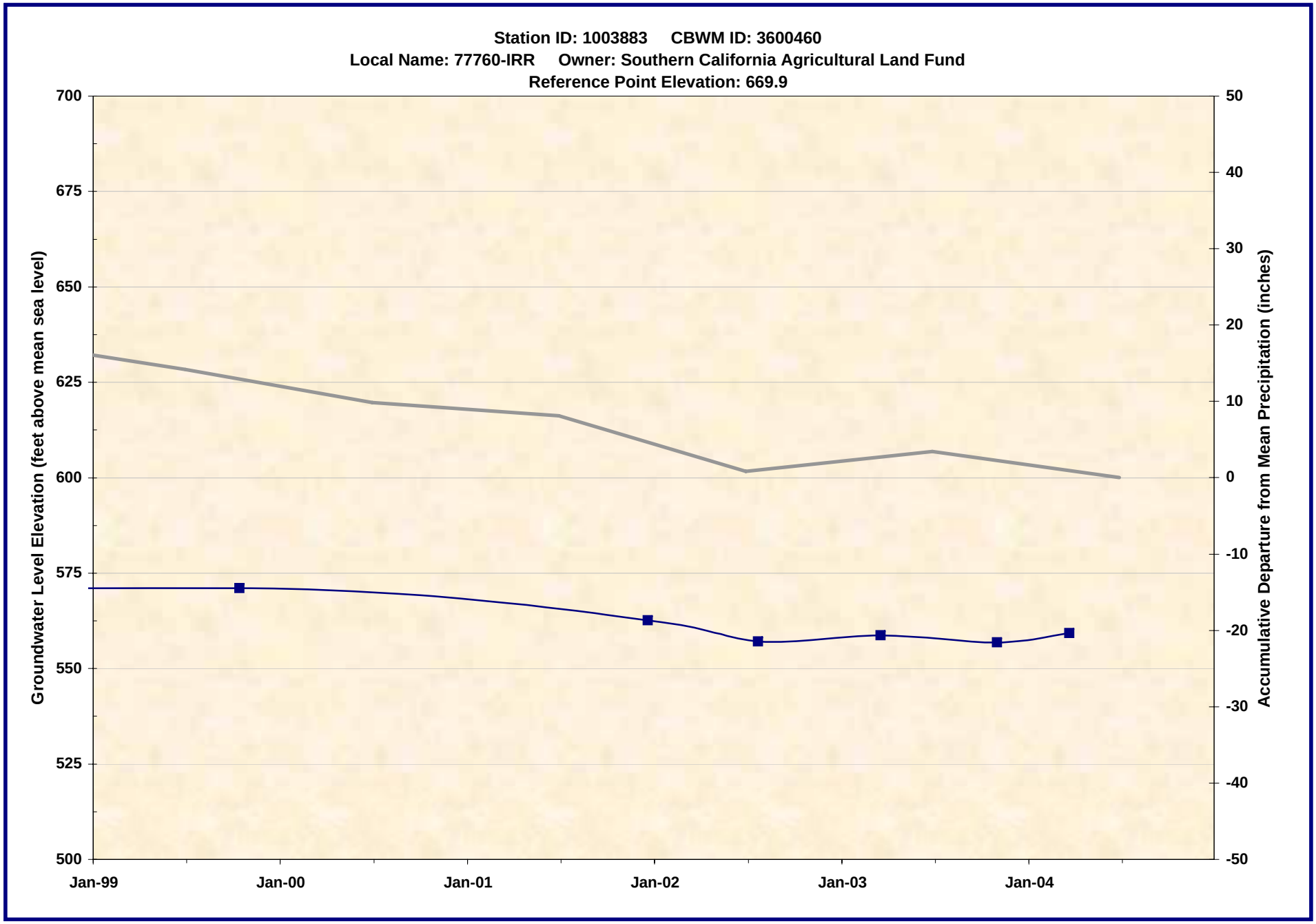
Wildermuth Environmental, Inc.



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Wildermuth Environmental, Inc.

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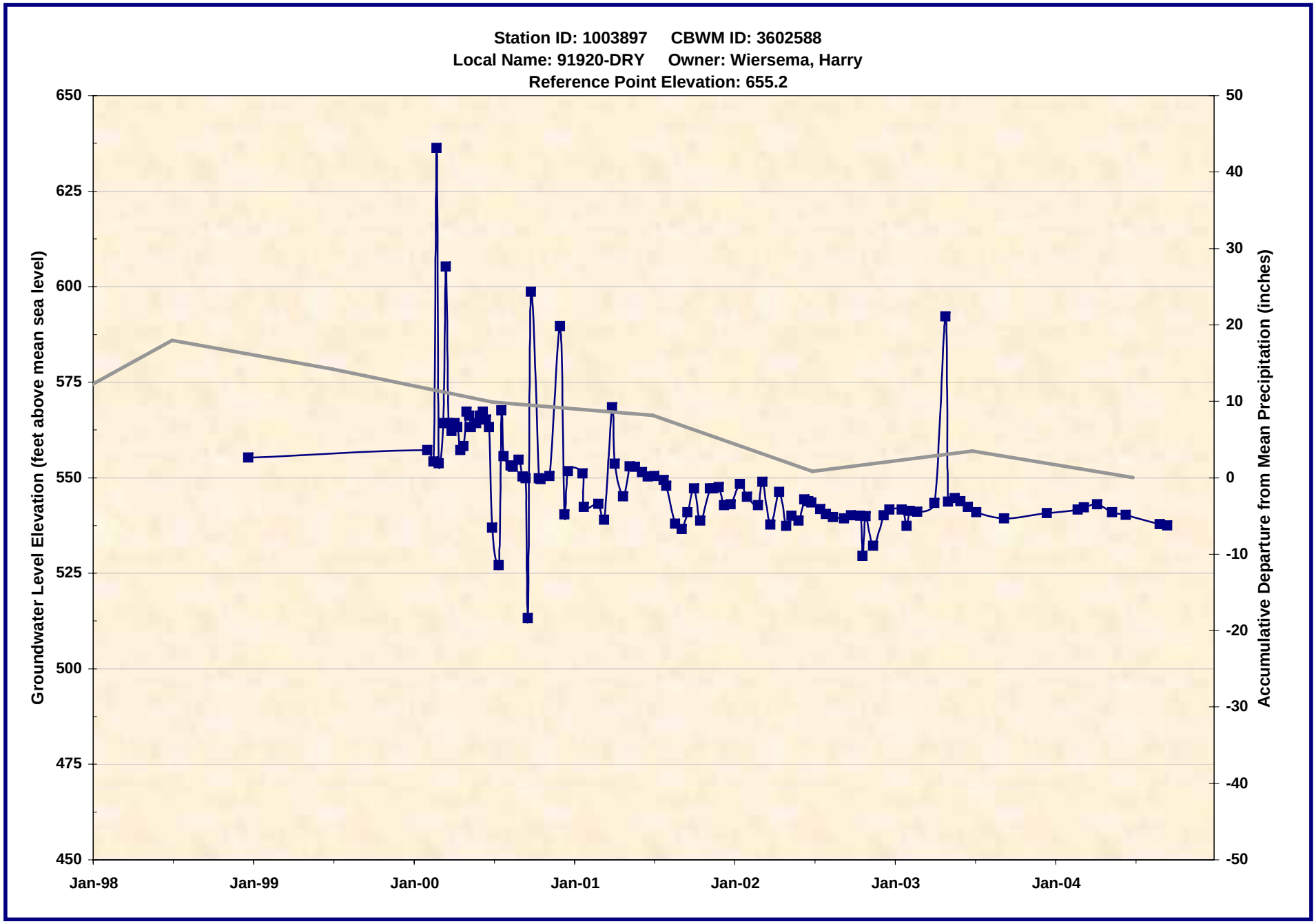

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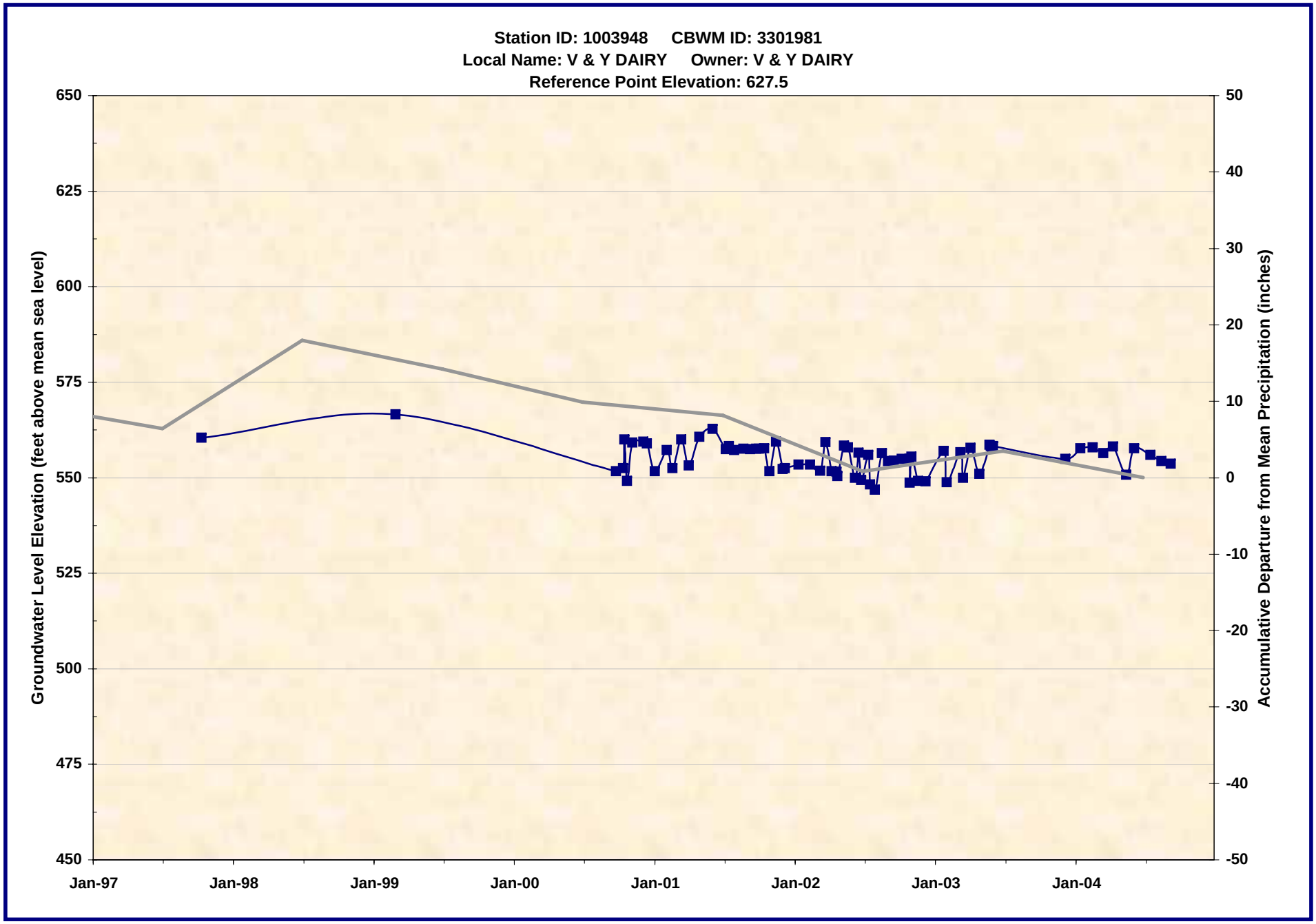

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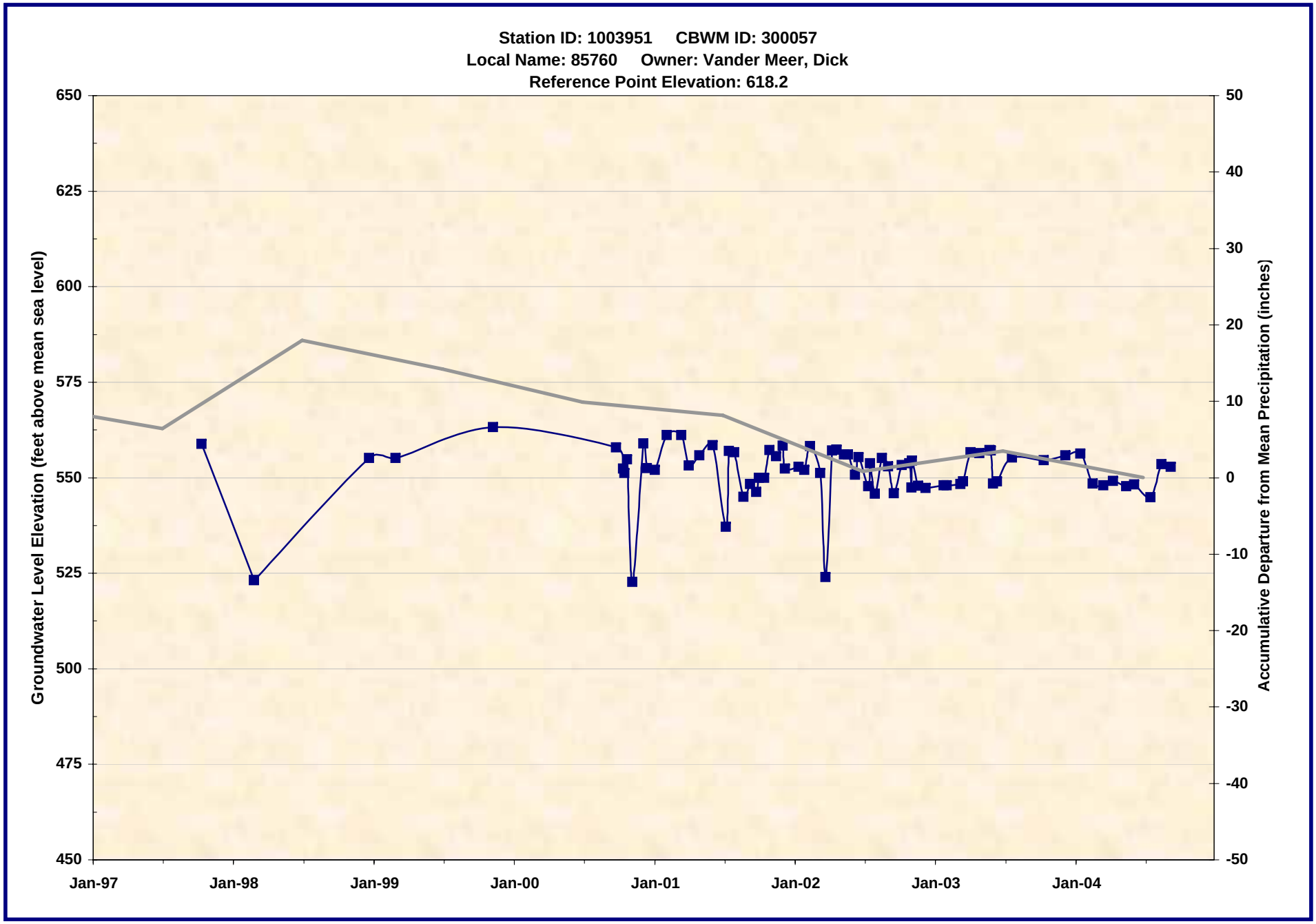

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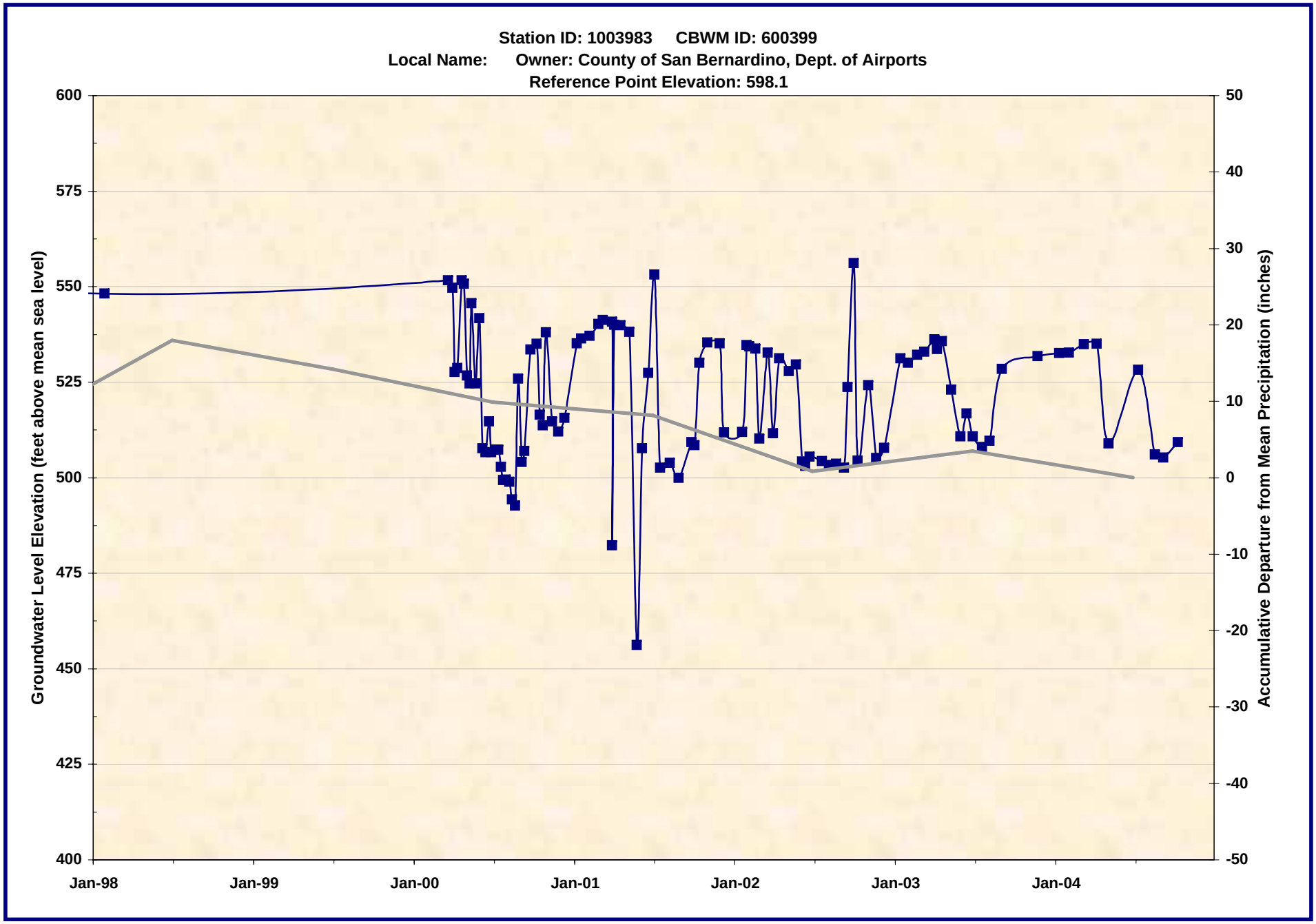

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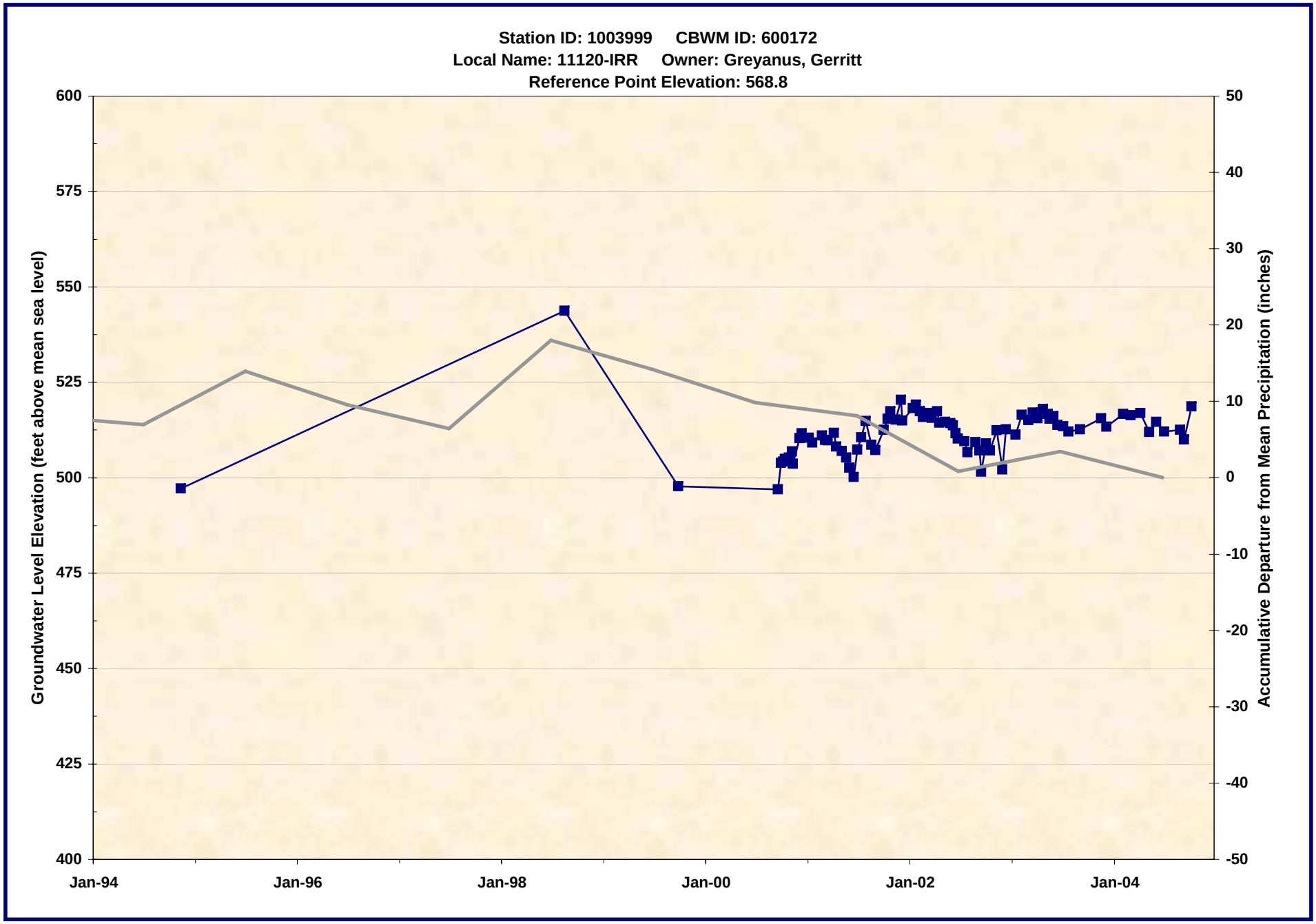

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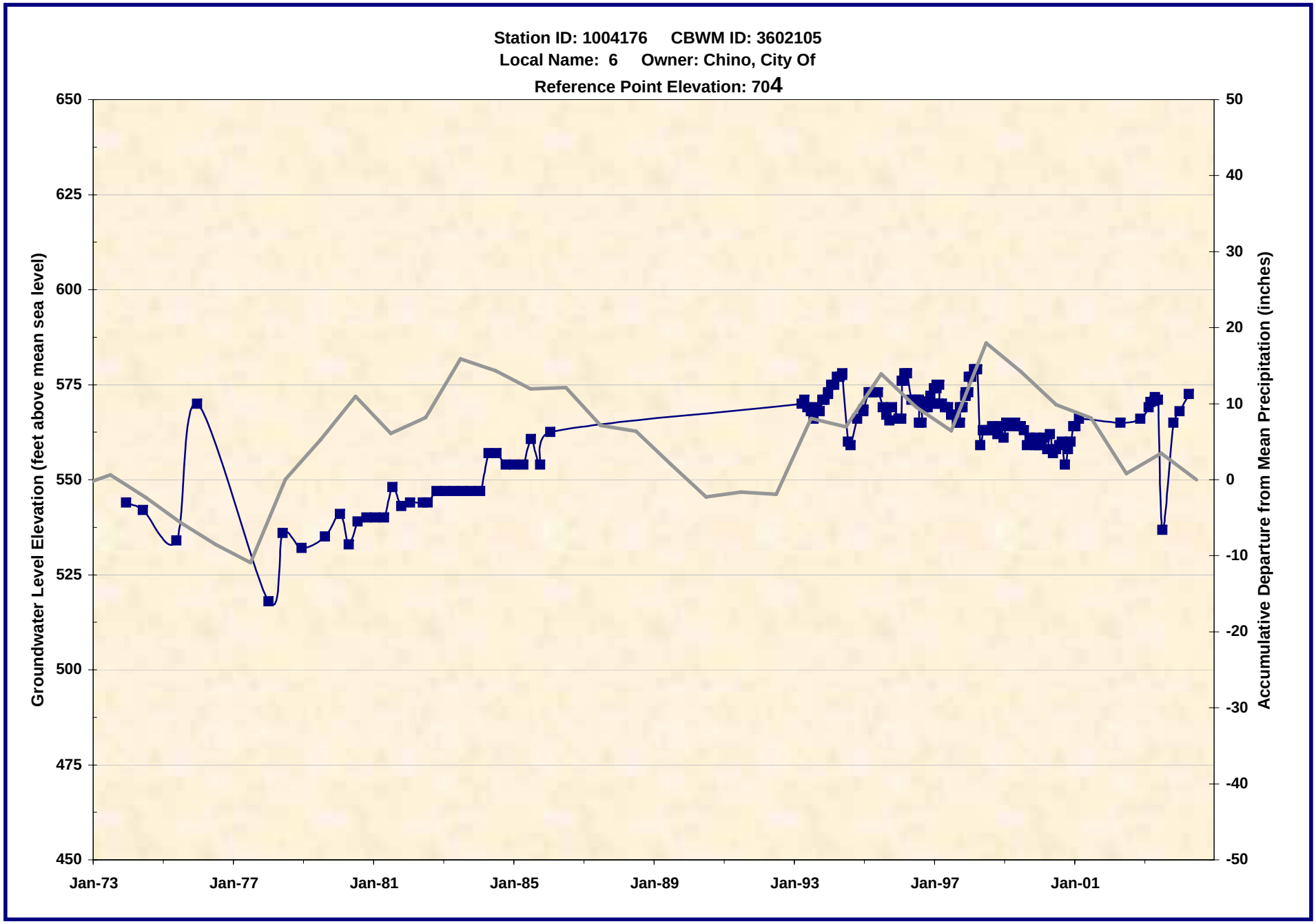

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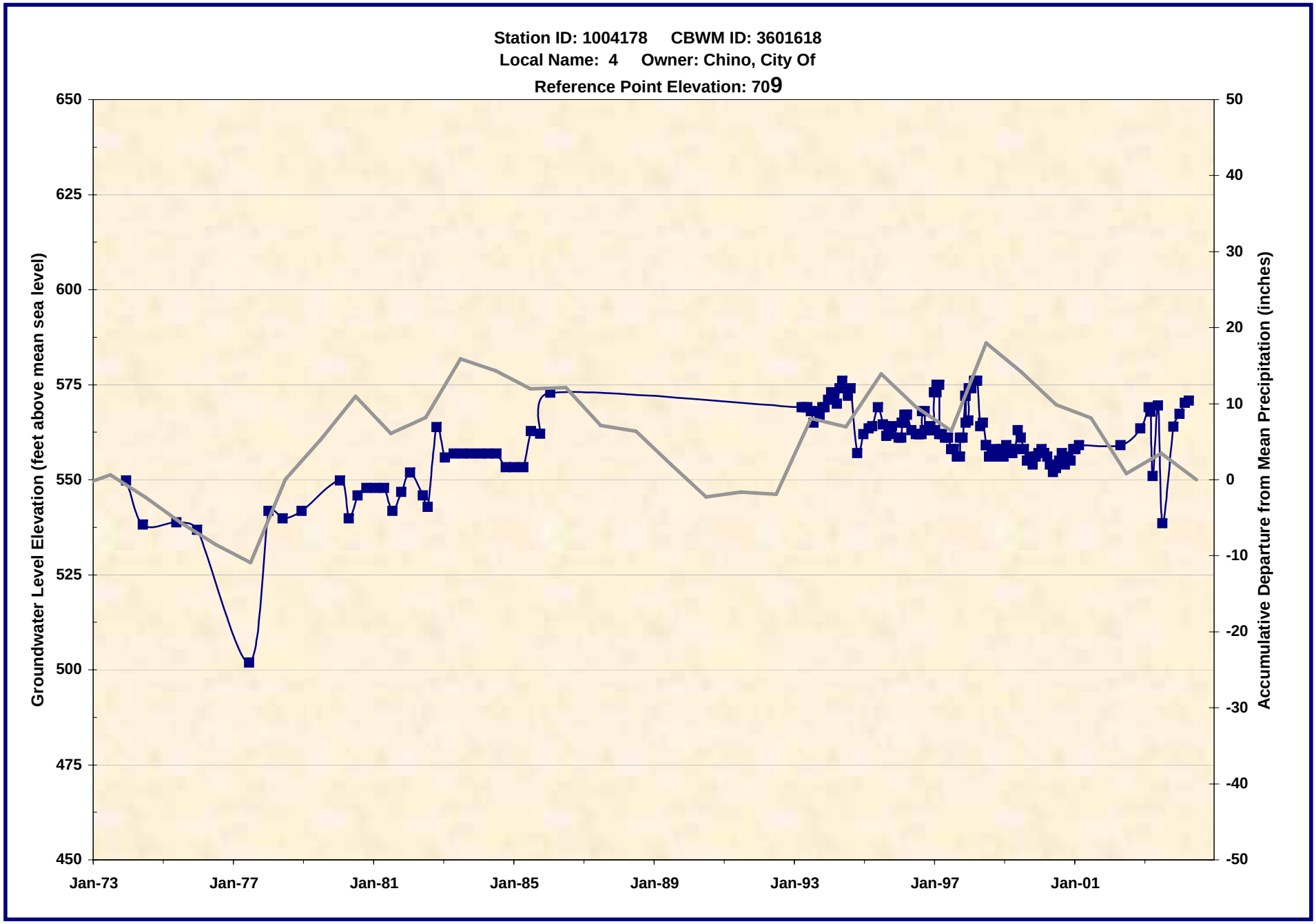

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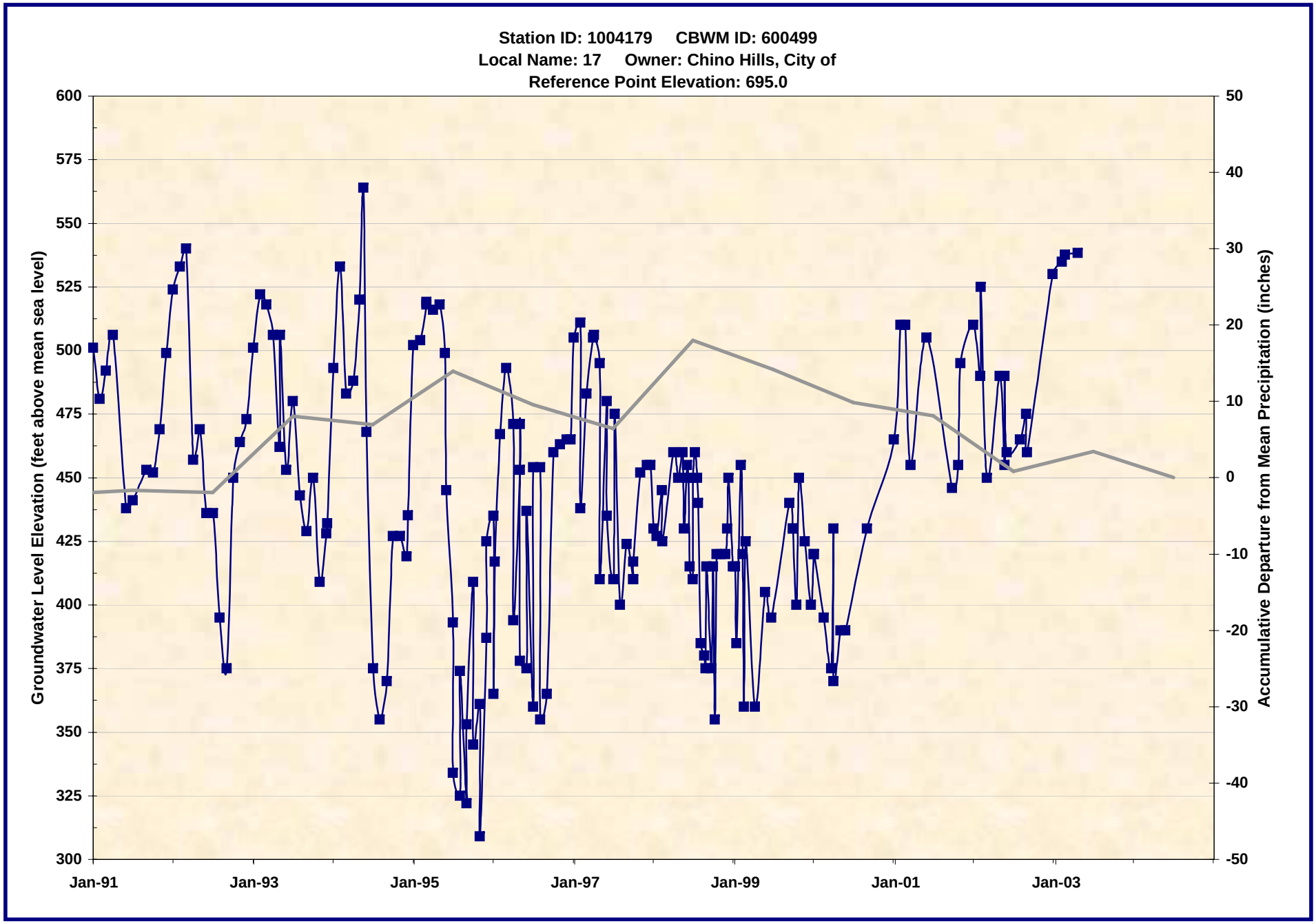

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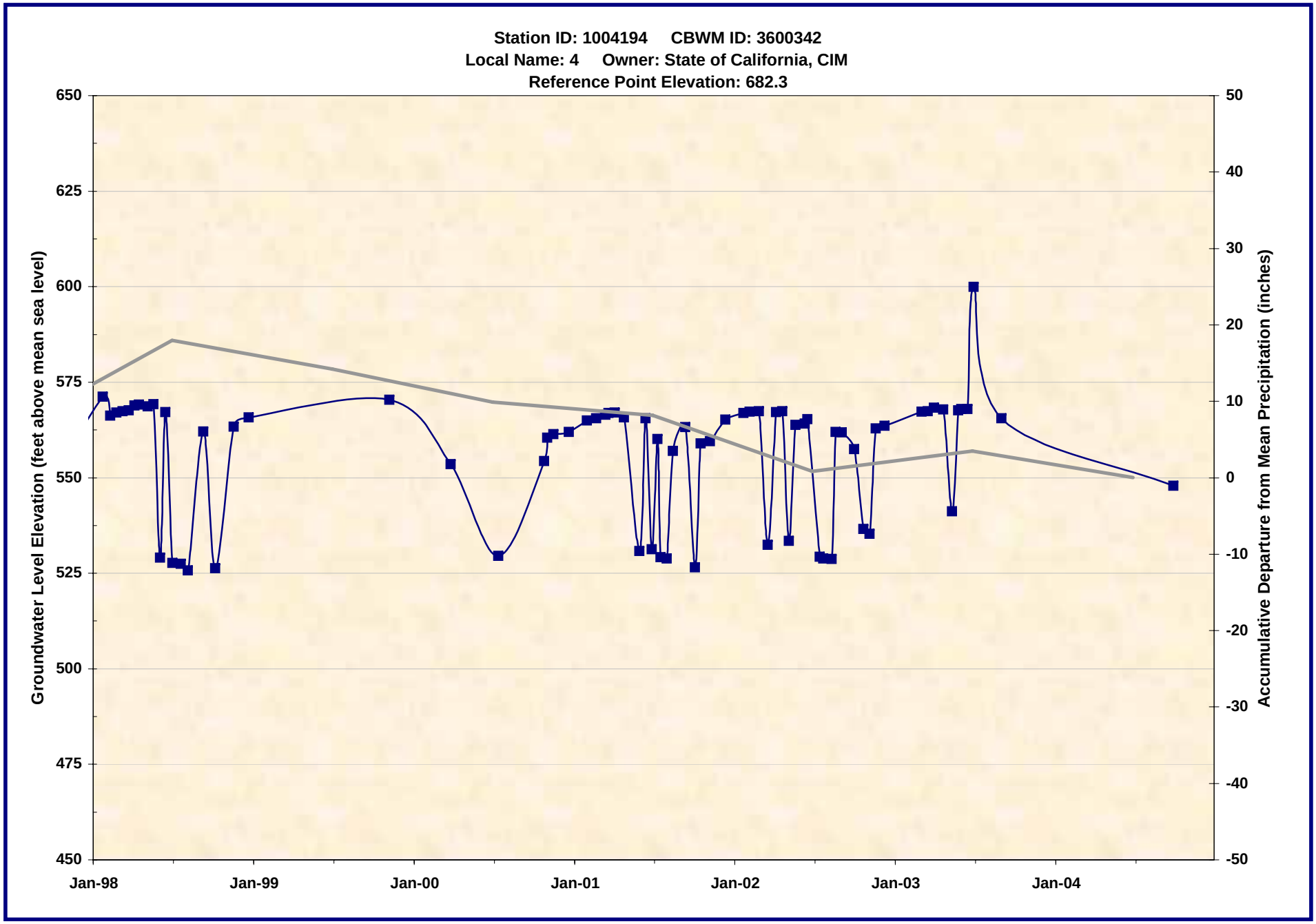

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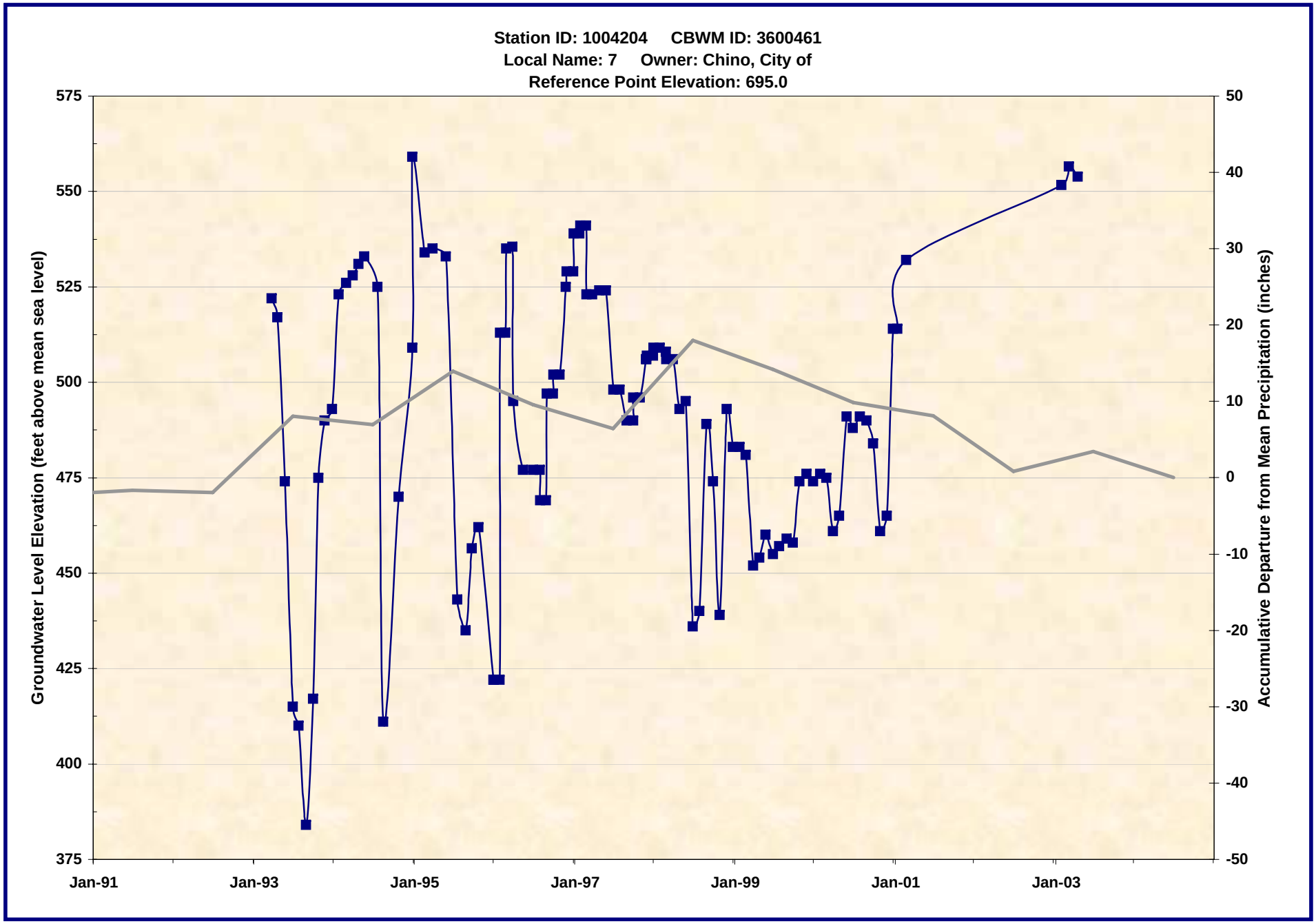

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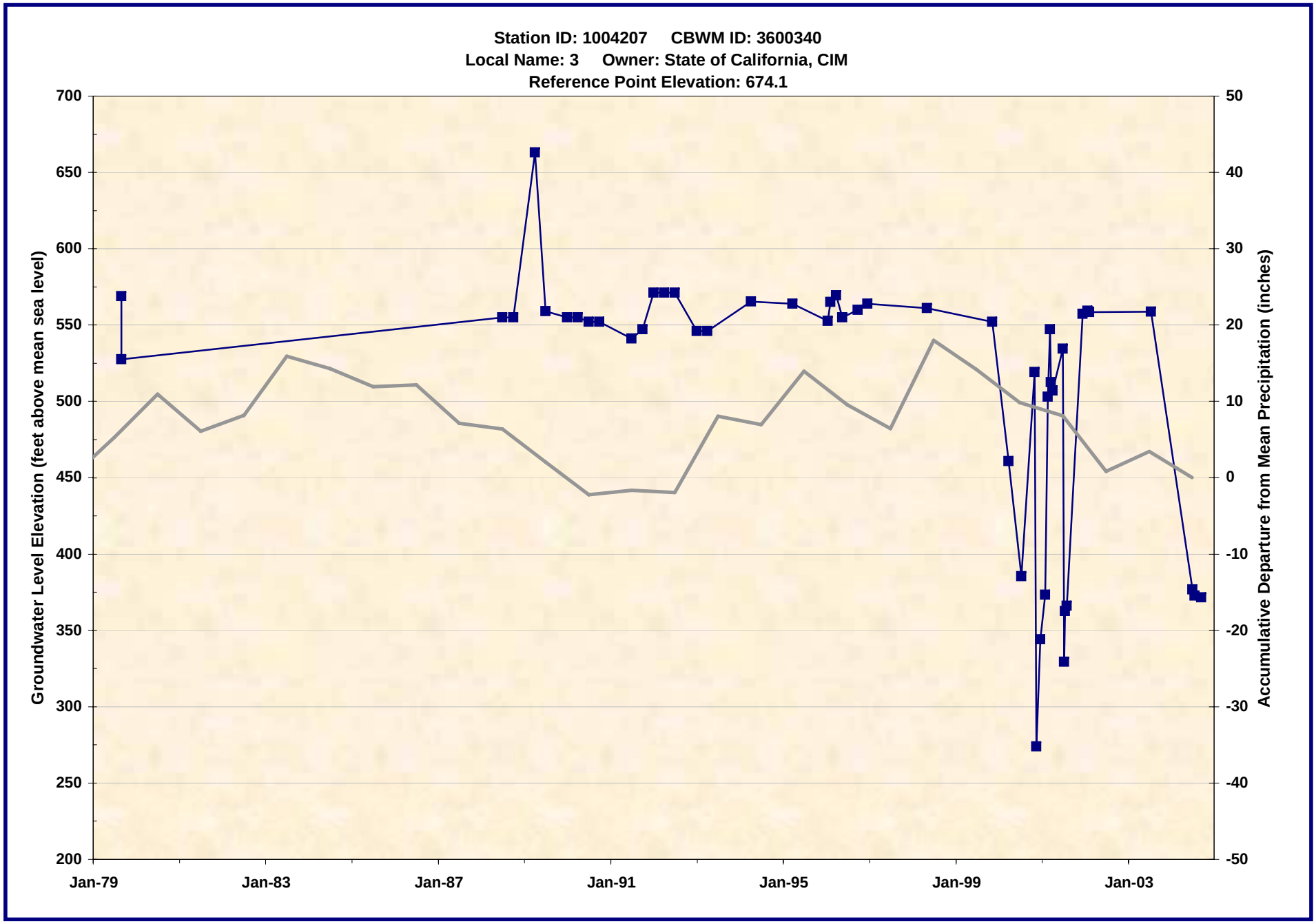

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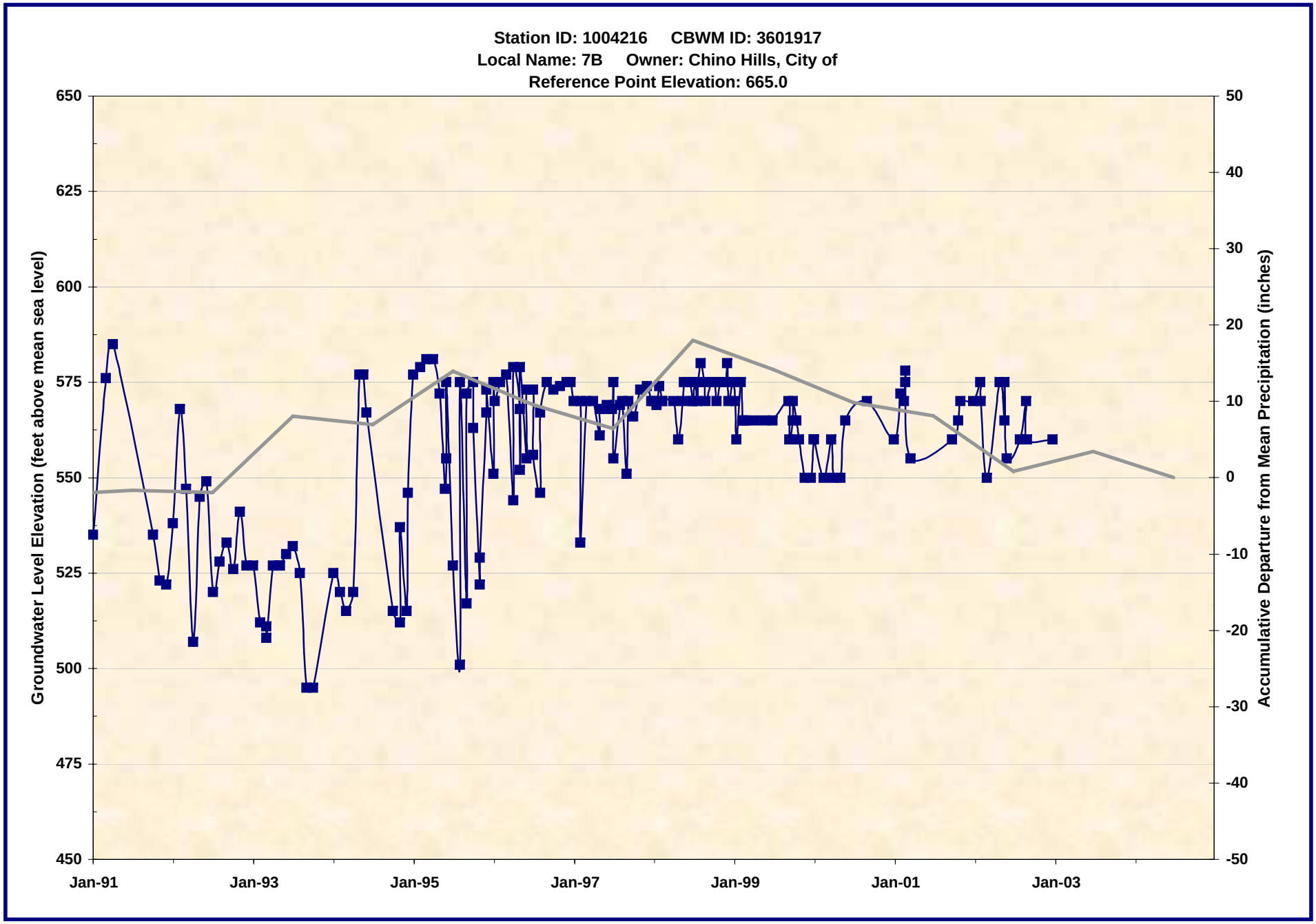

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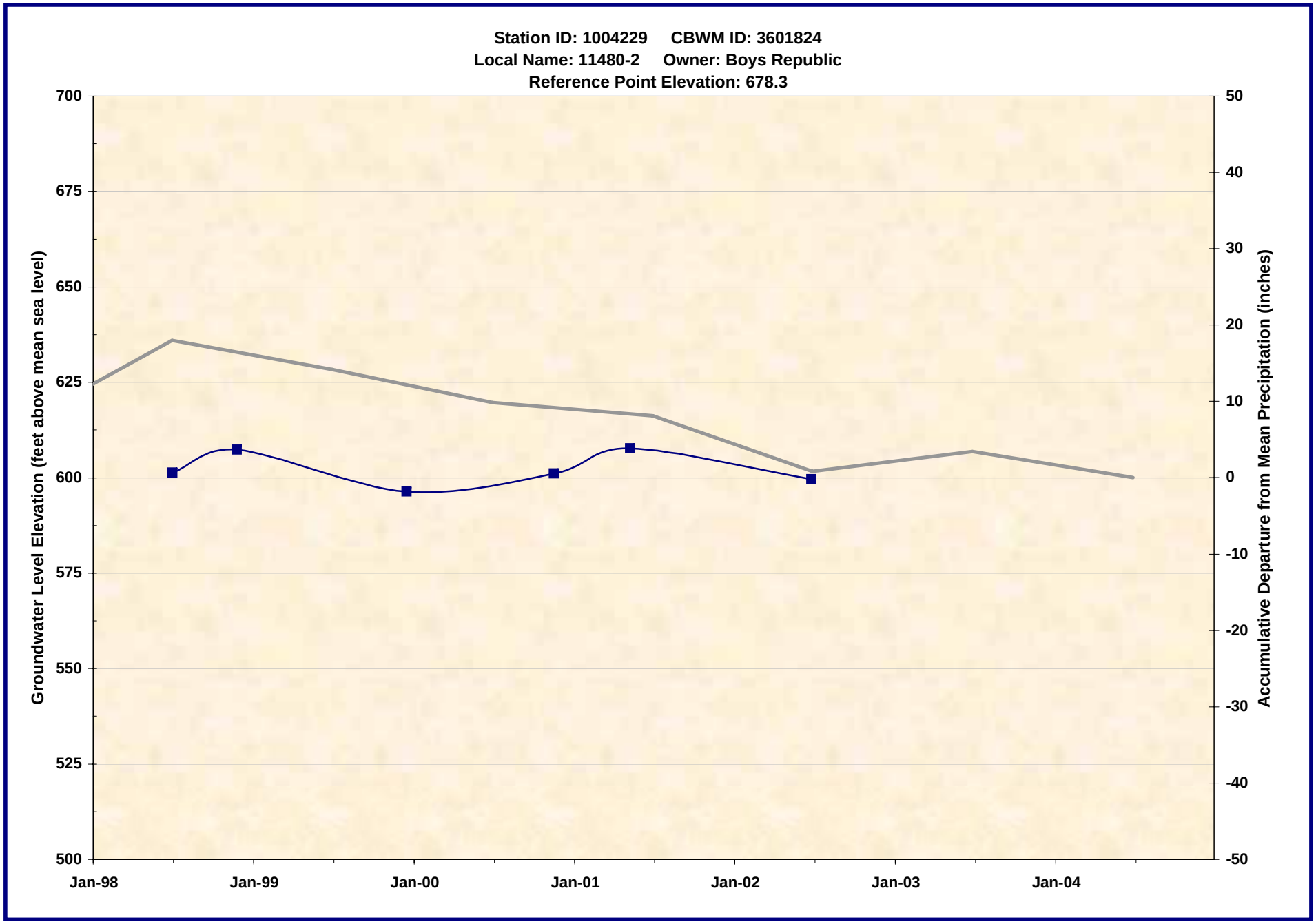

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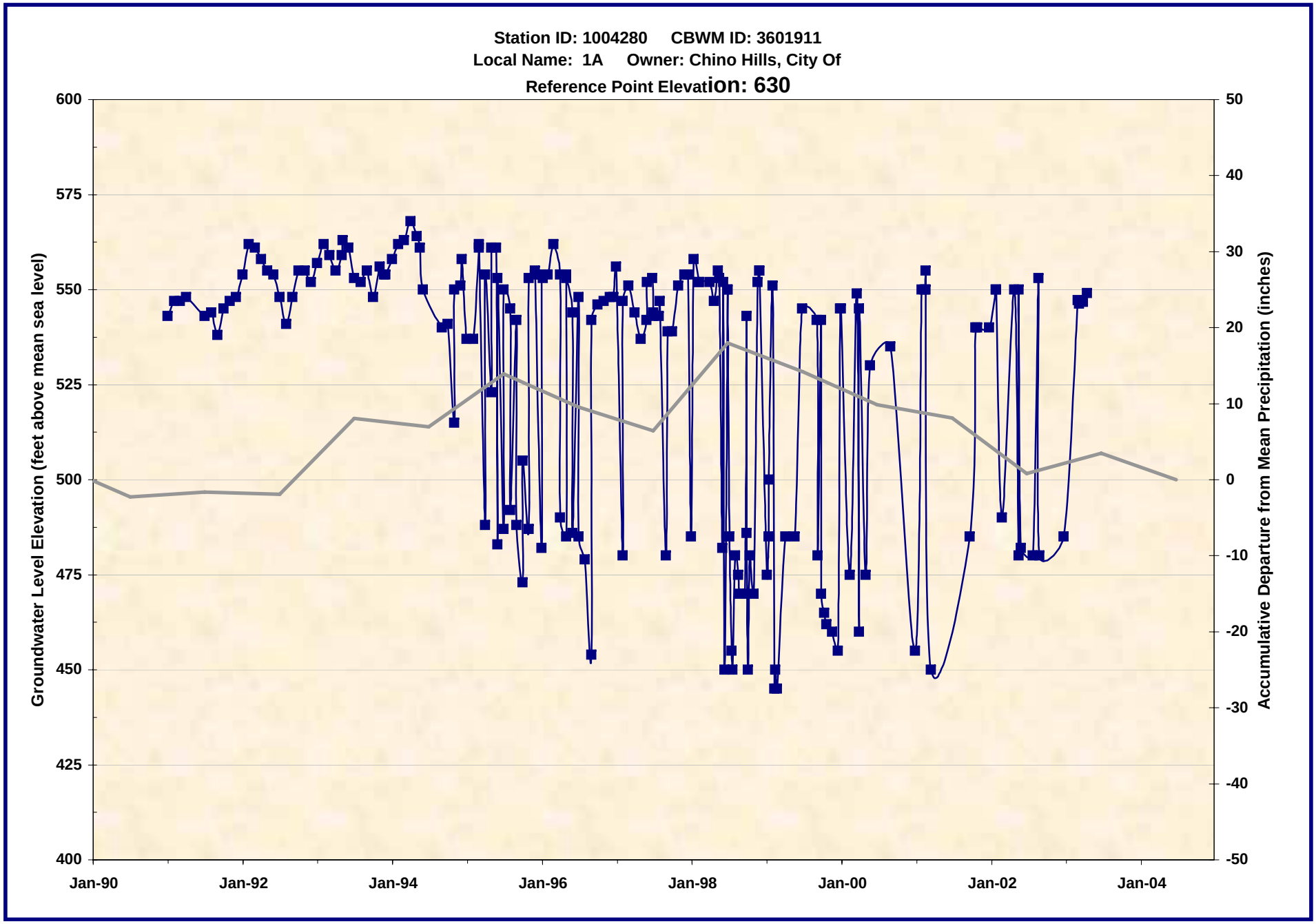

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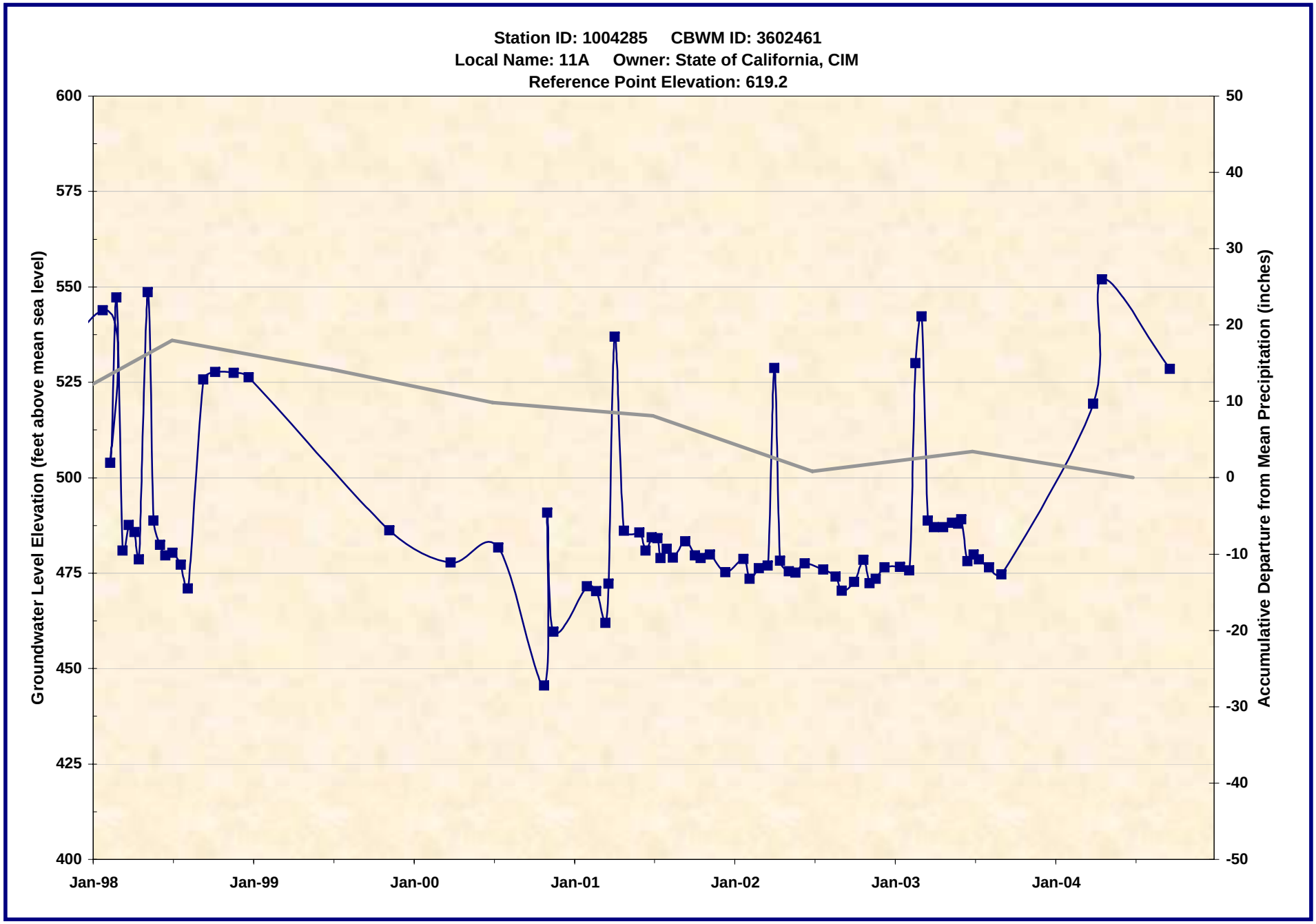

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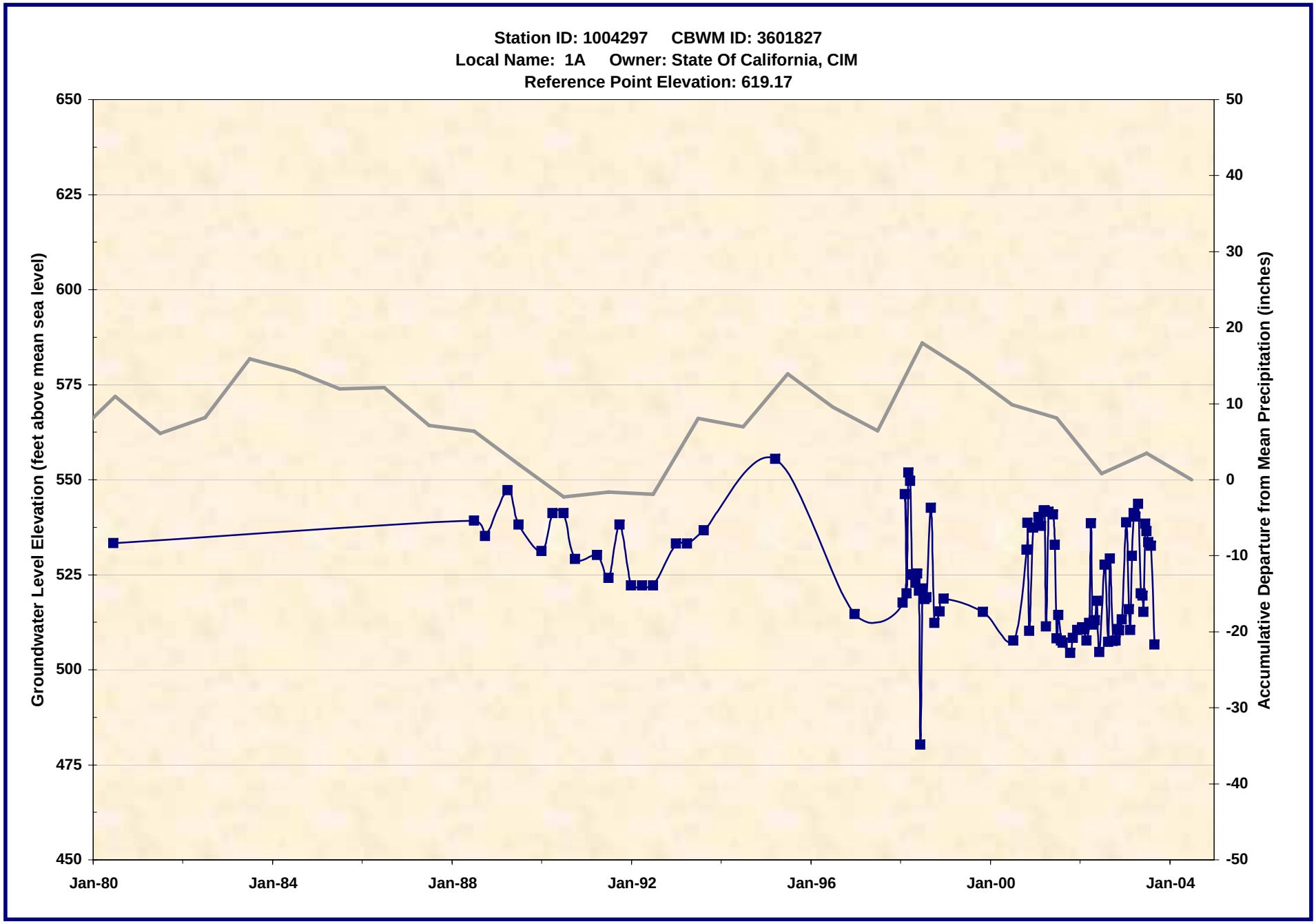

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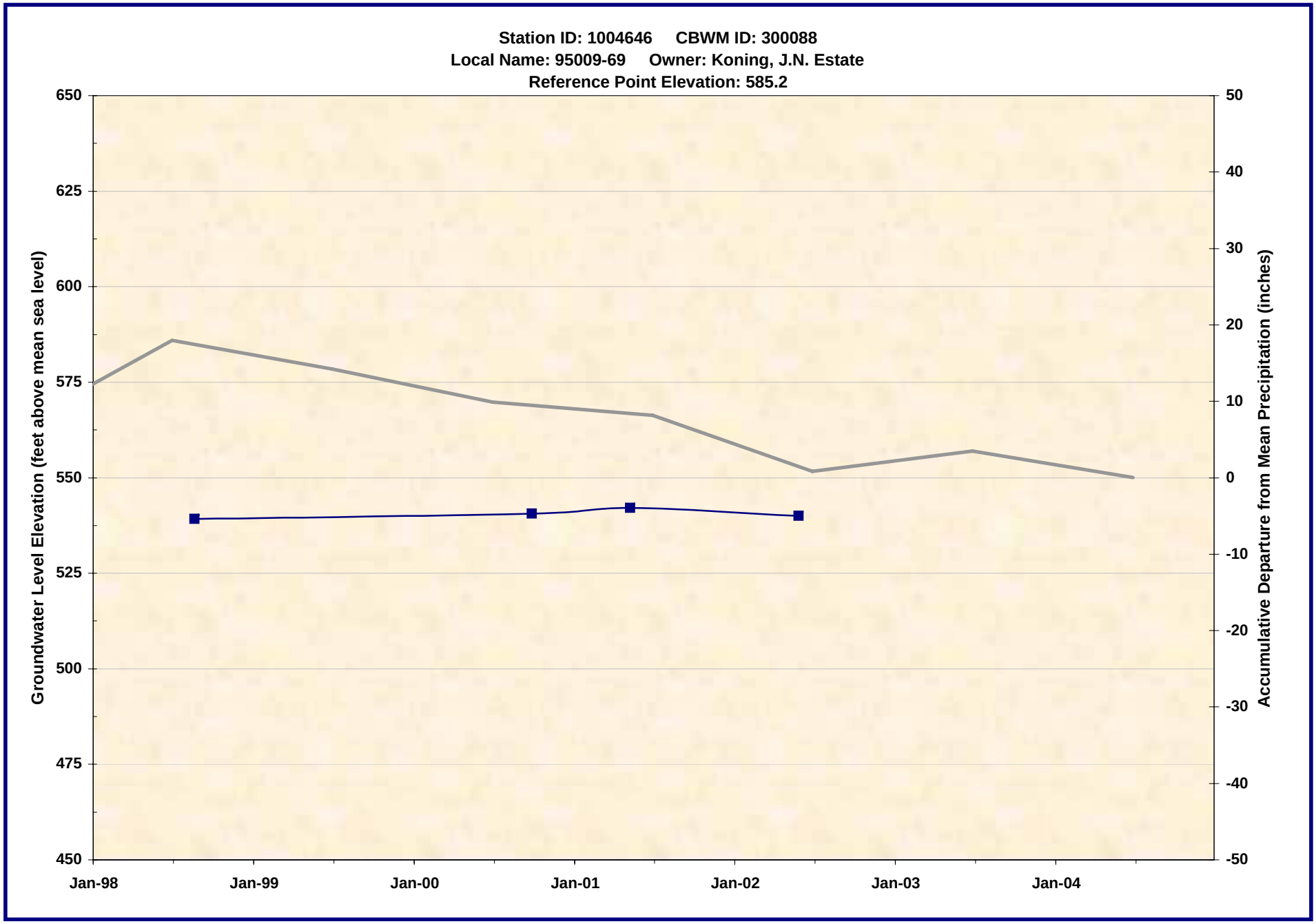

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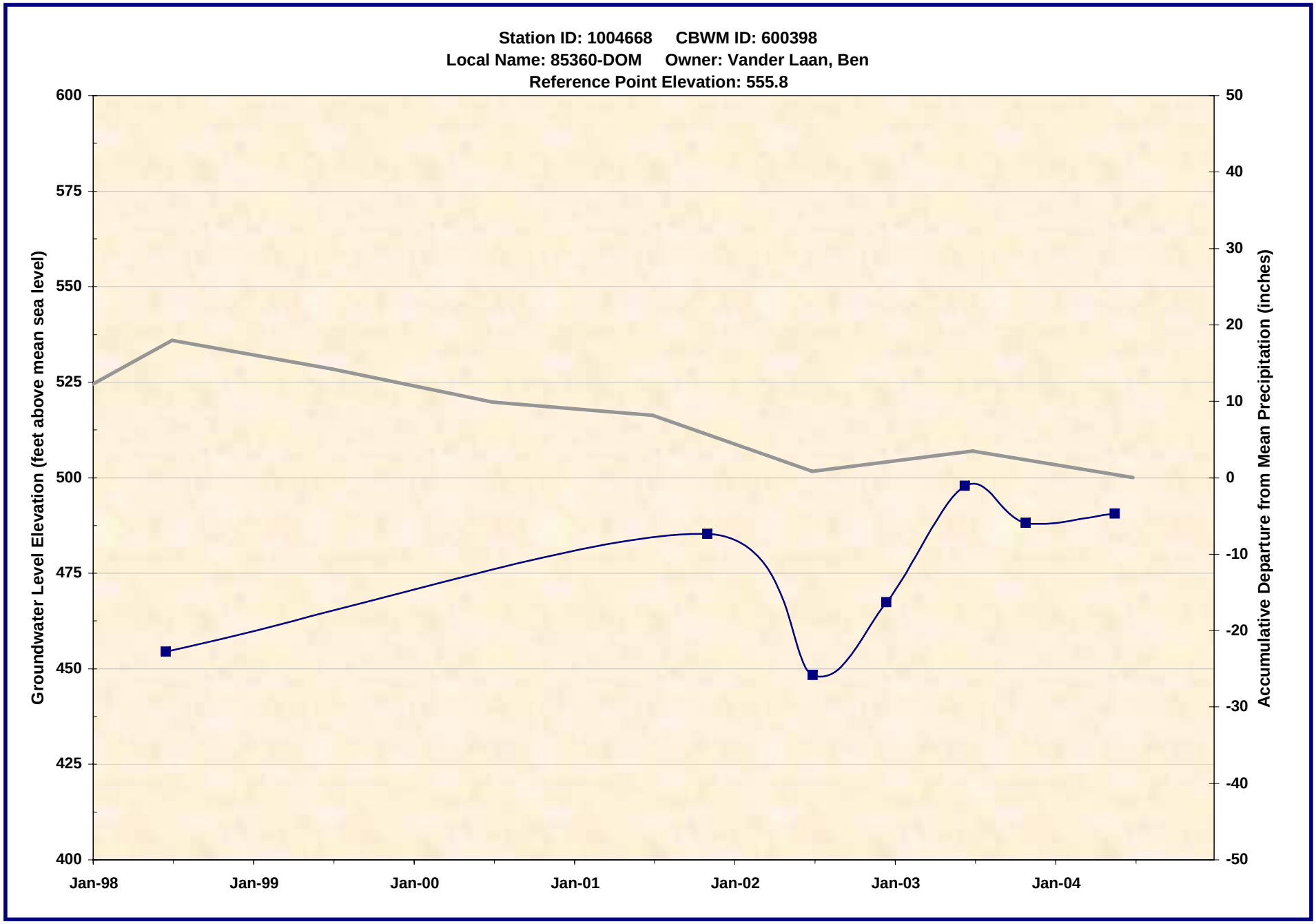

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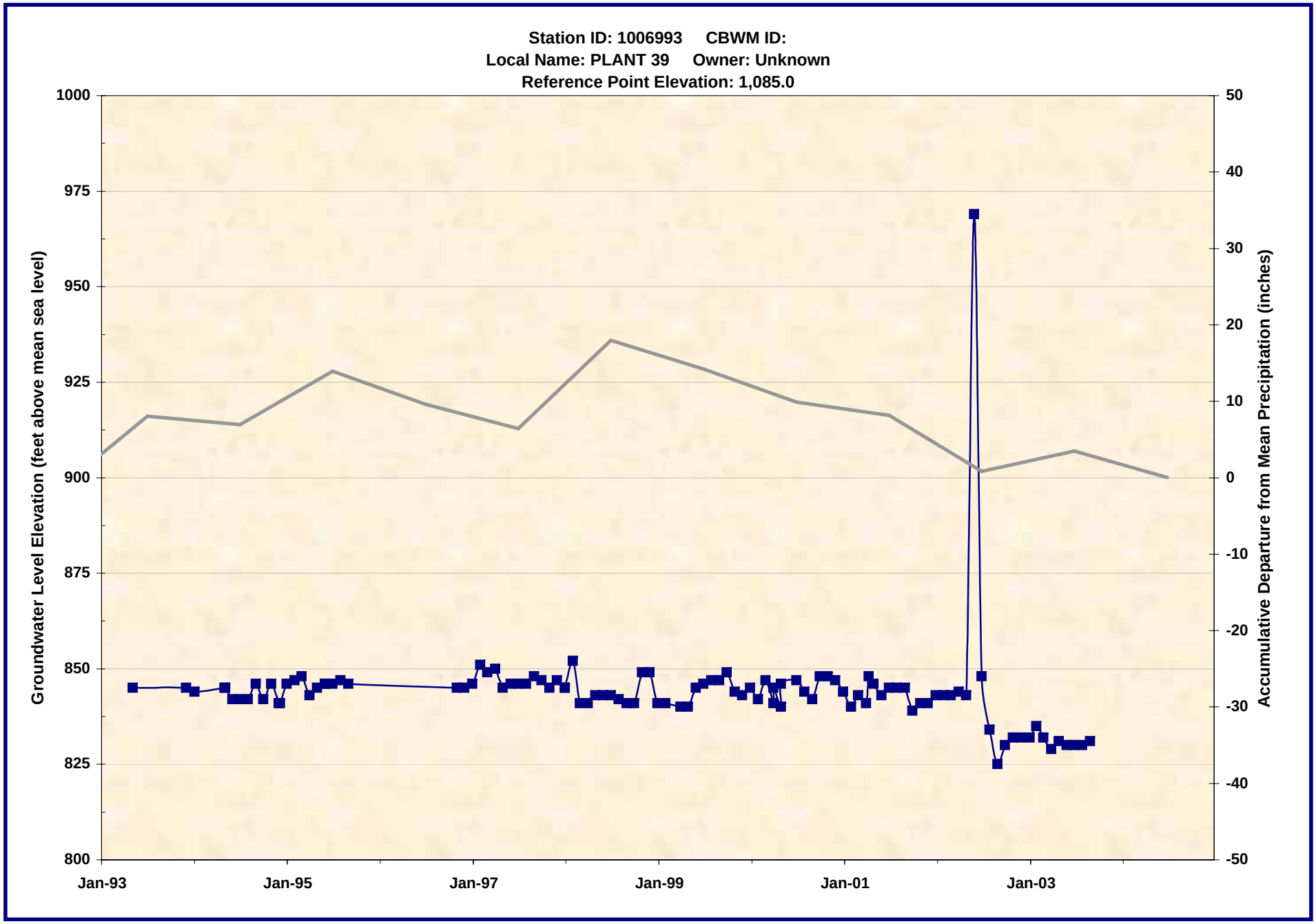

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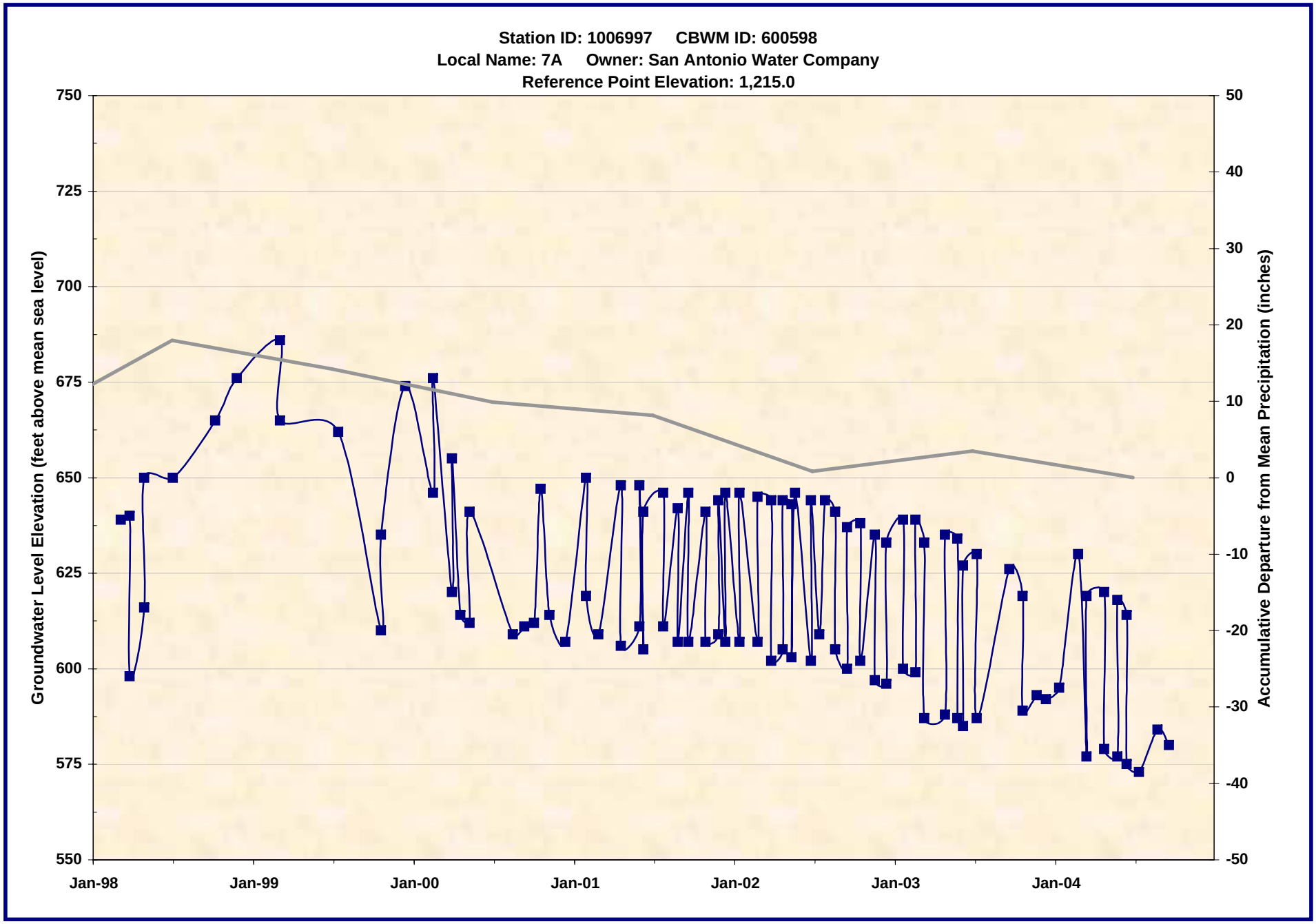

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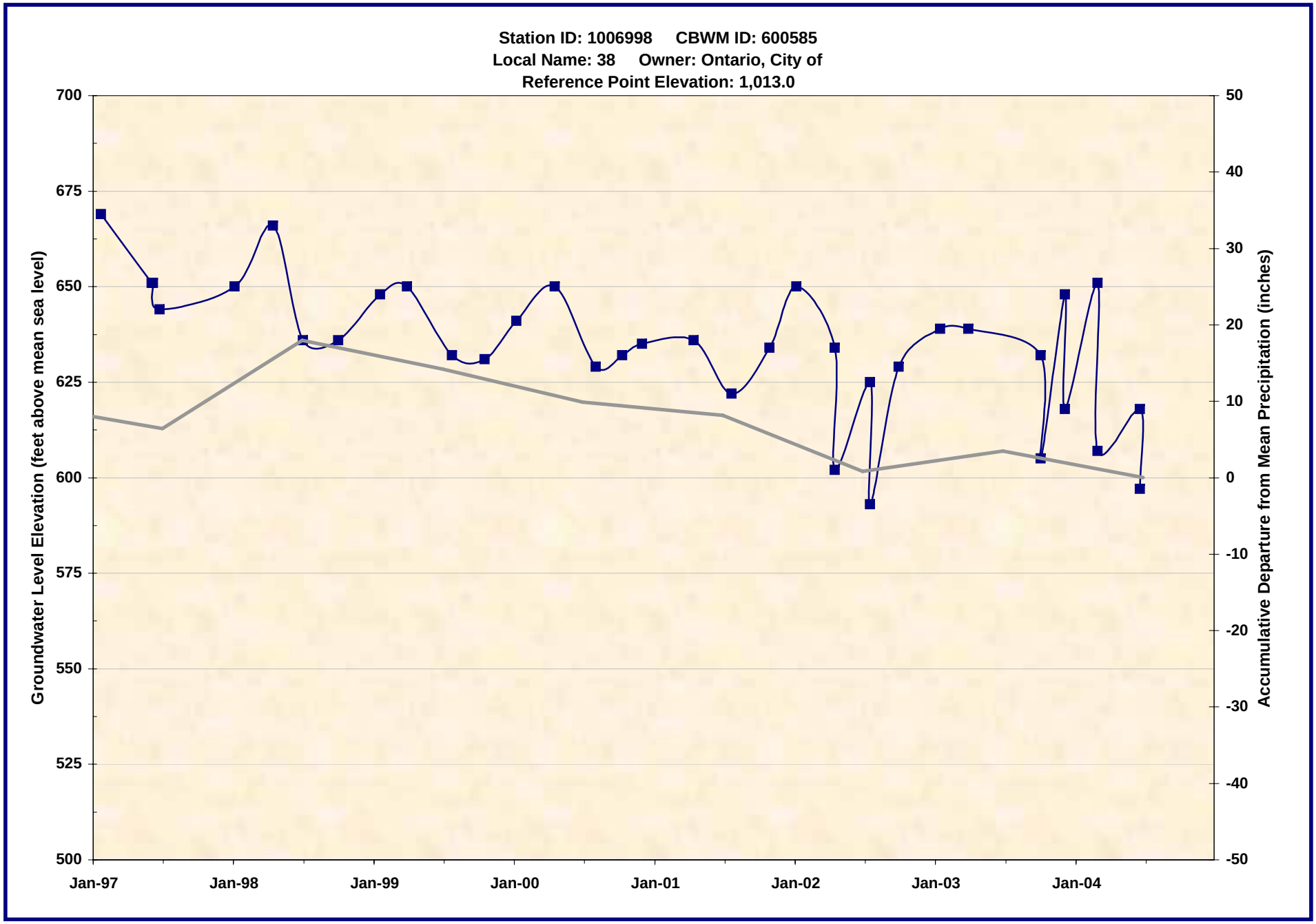

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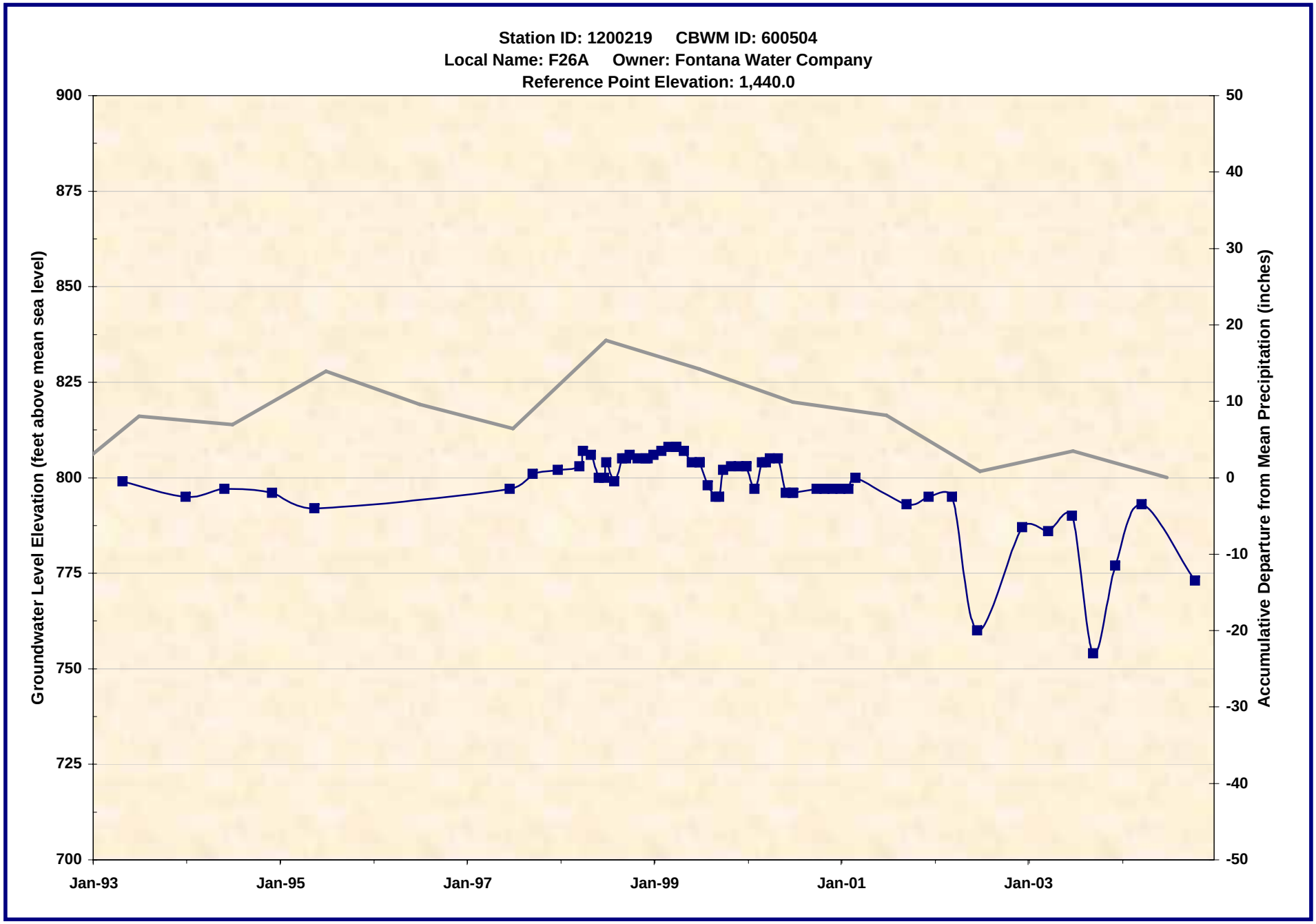

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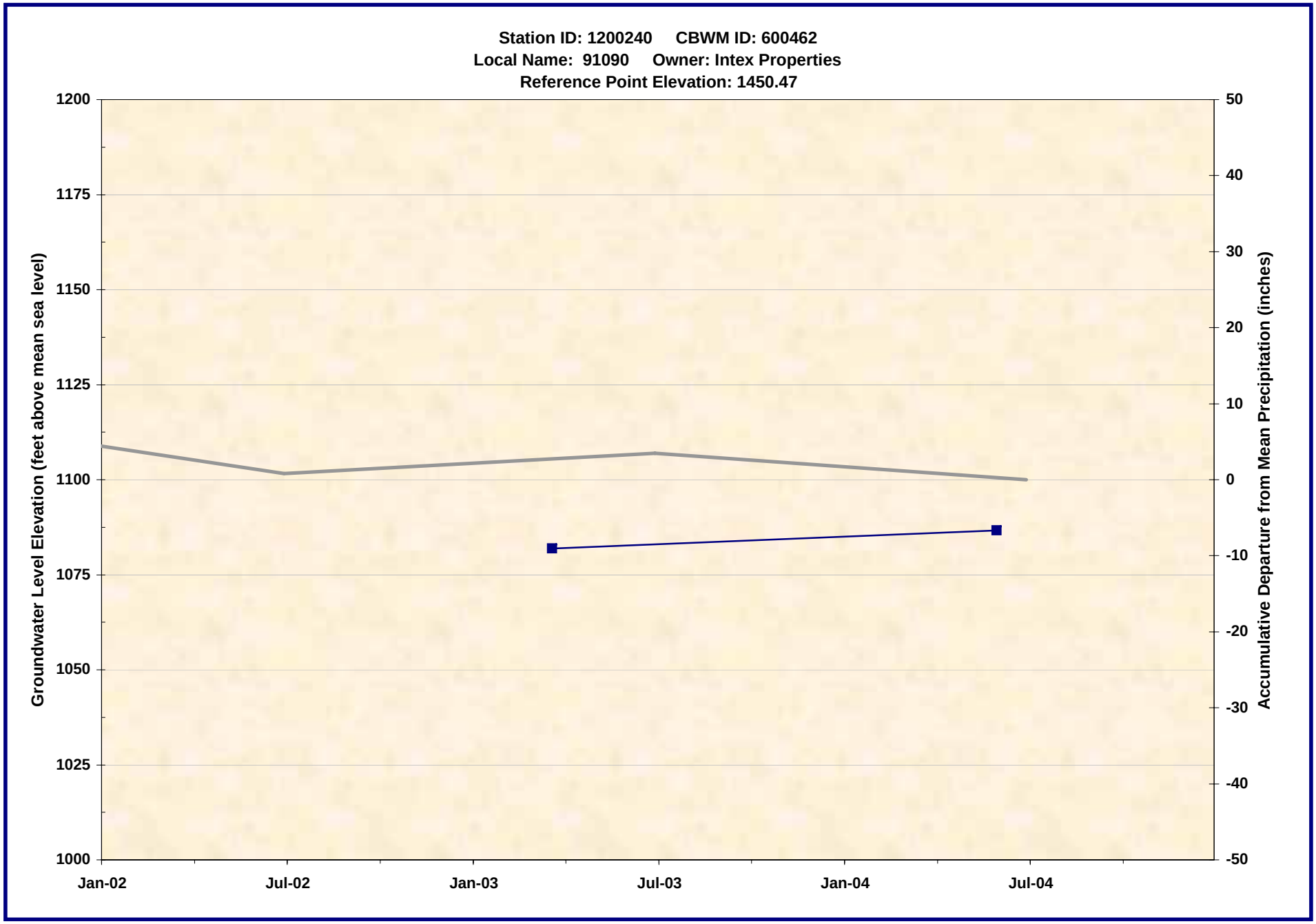

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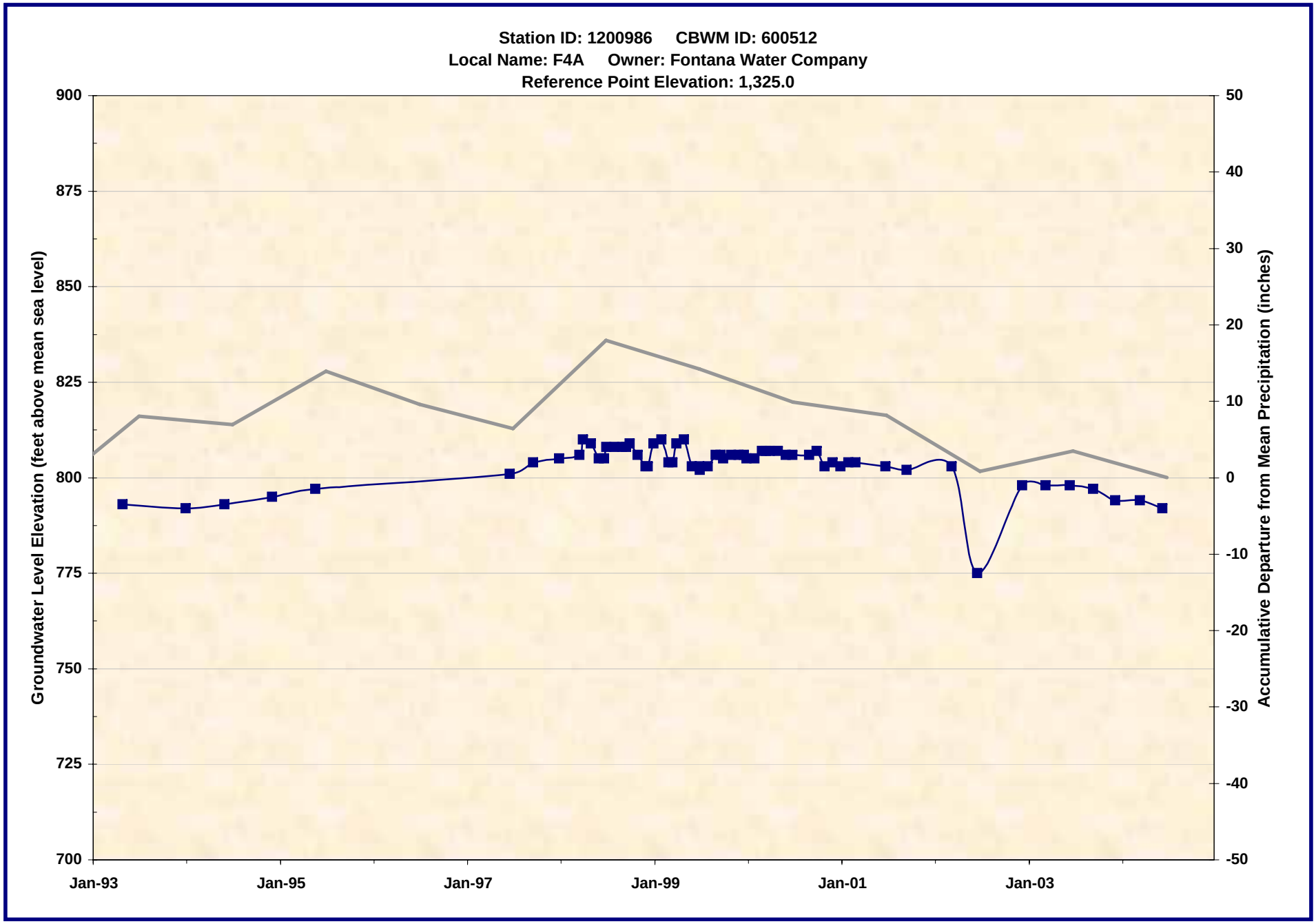

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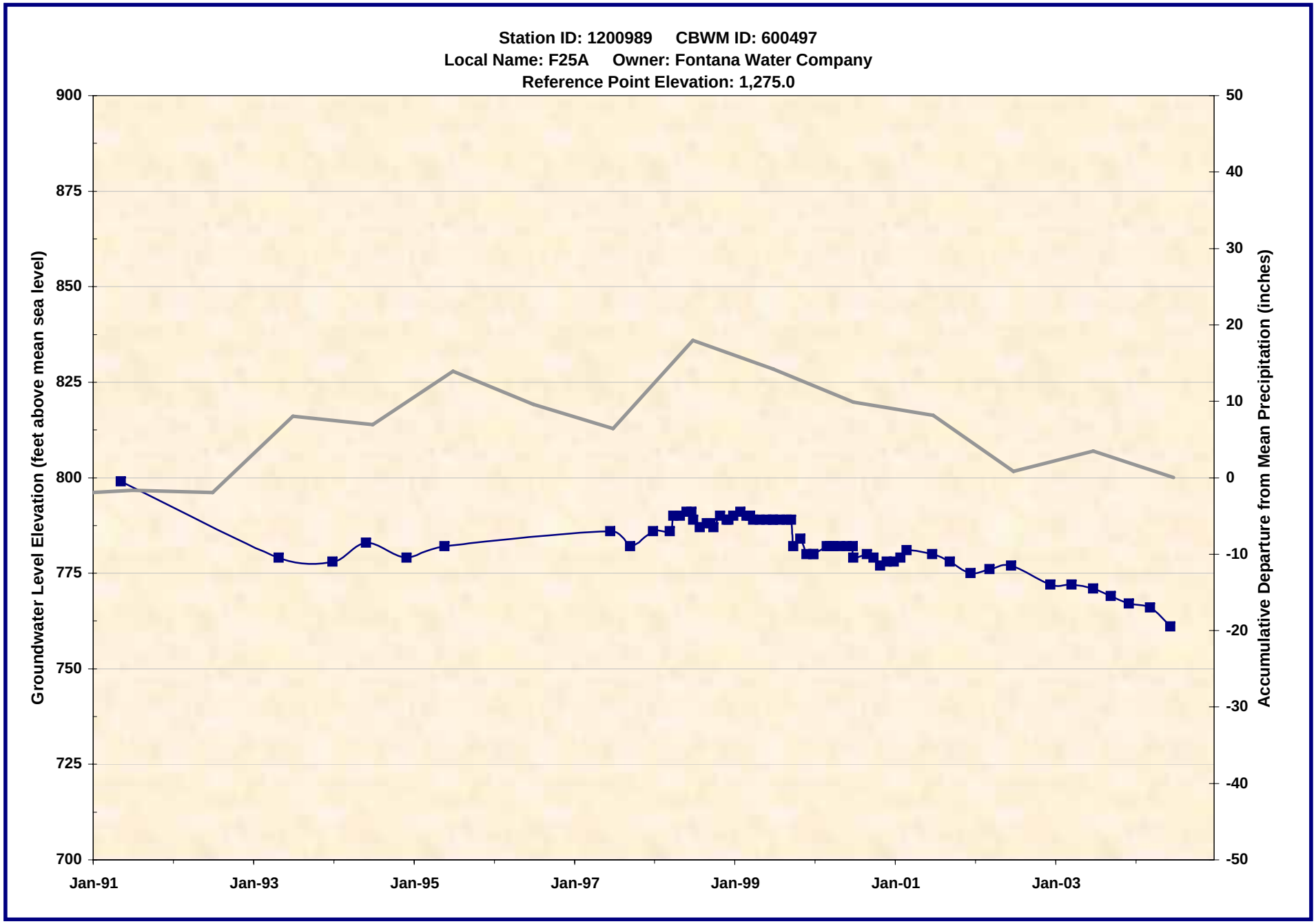

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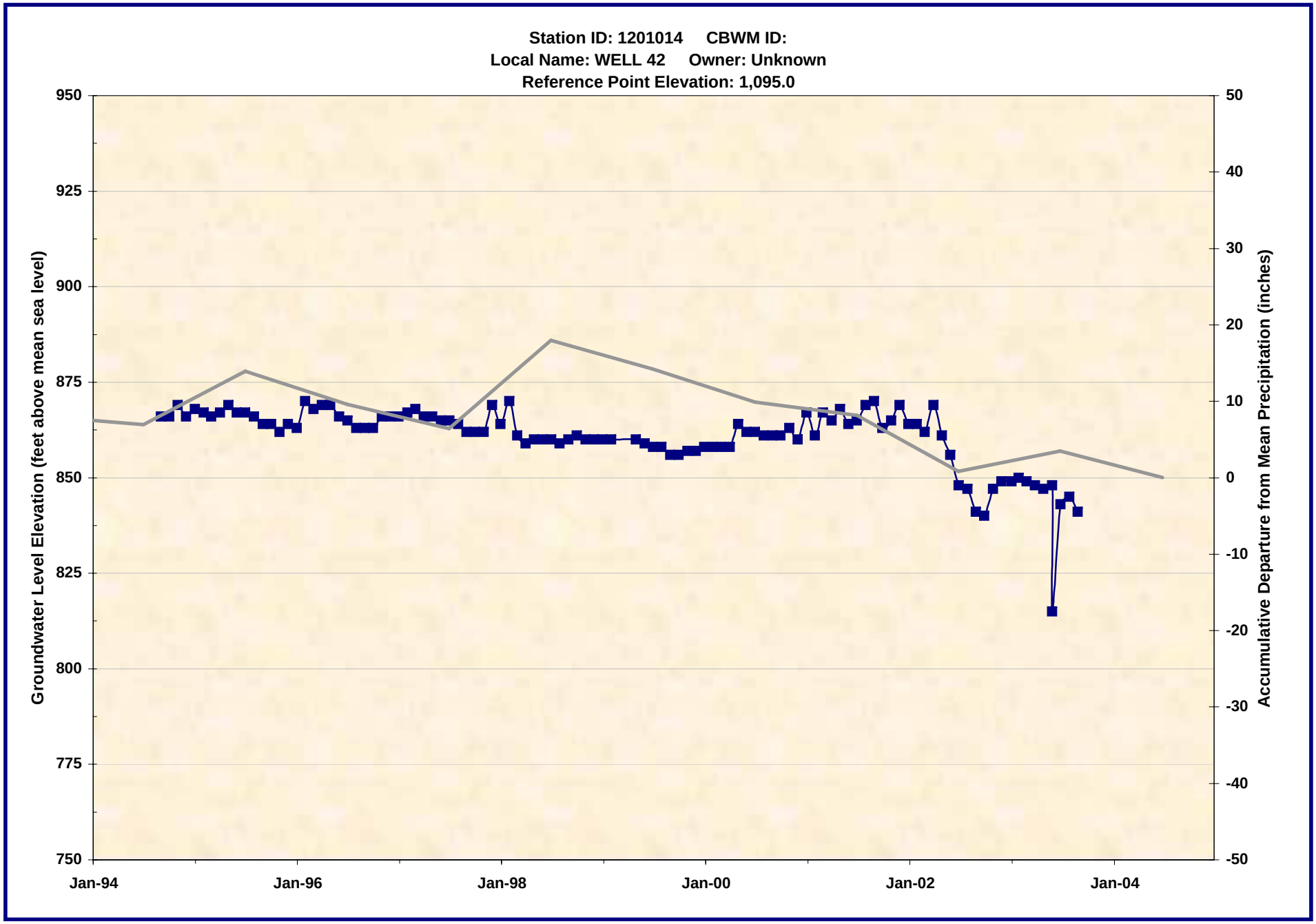

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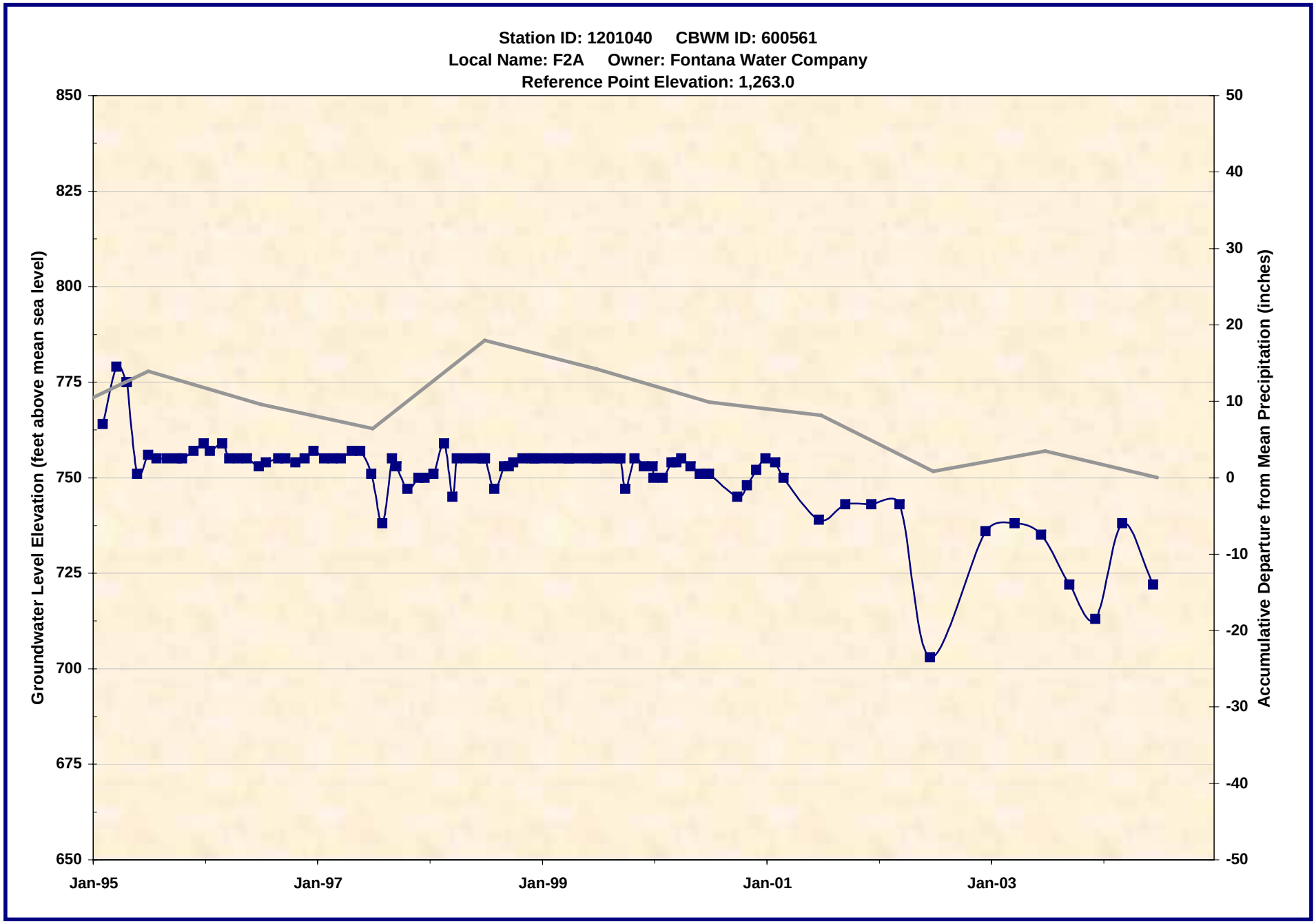

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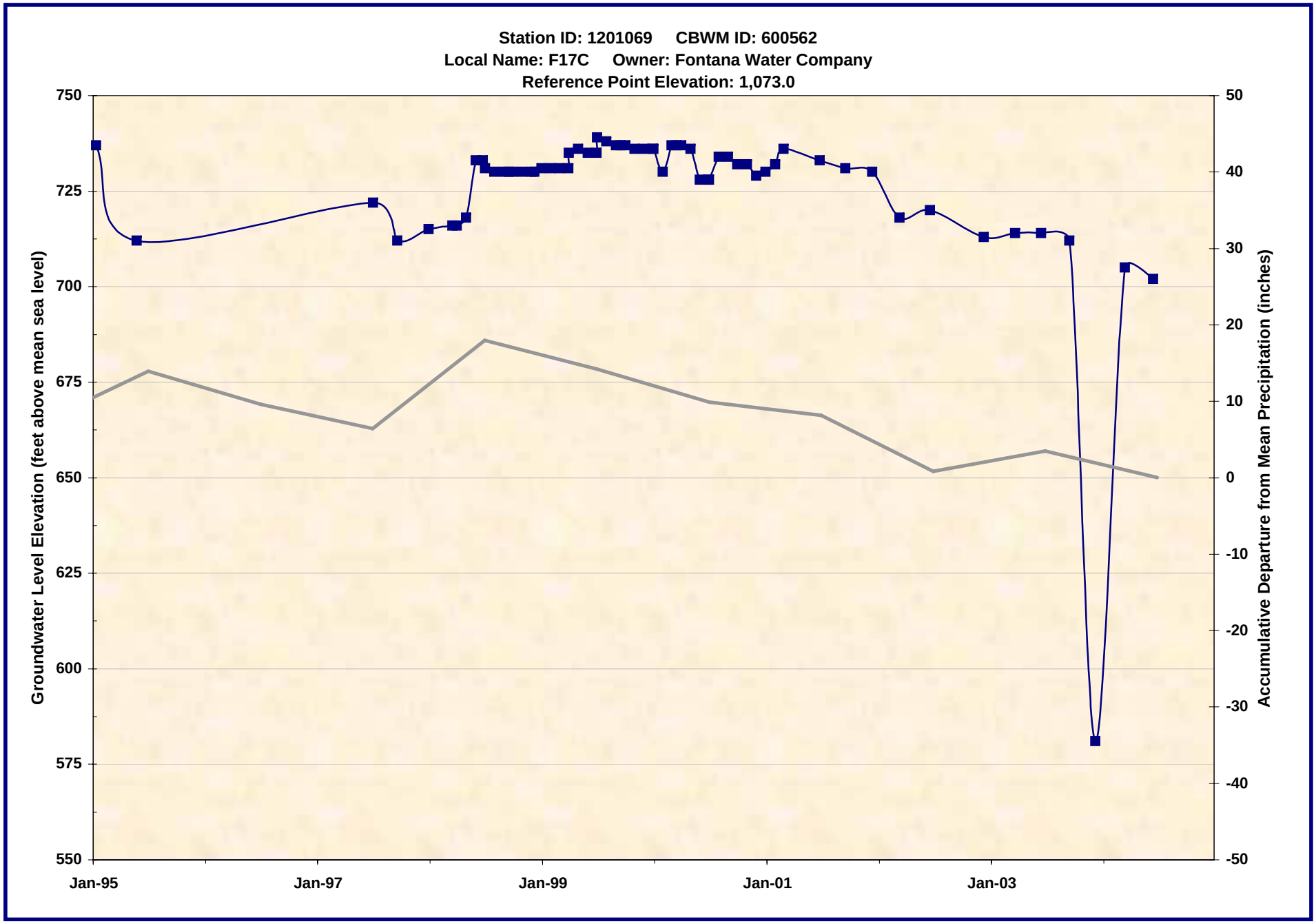

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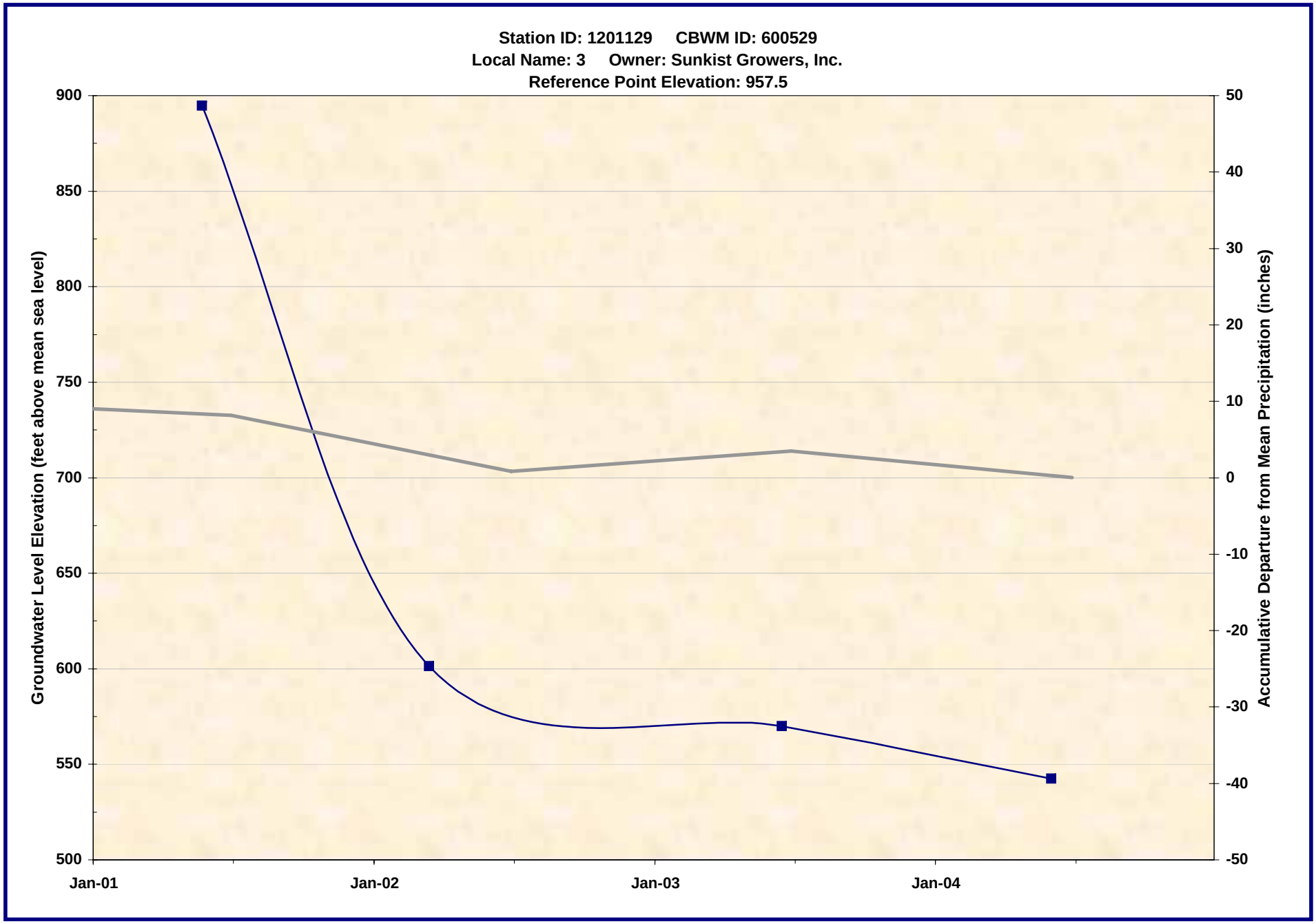
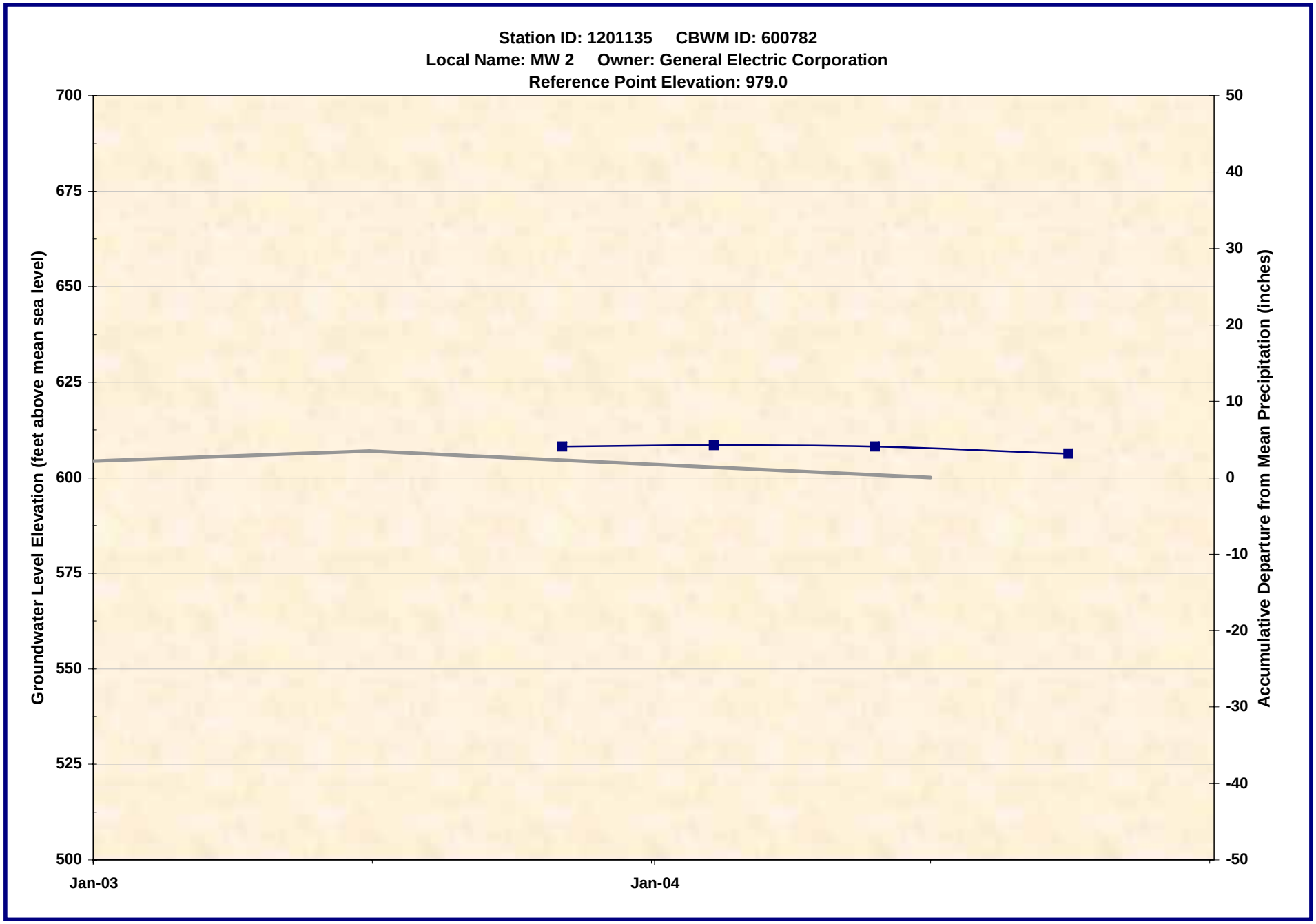

Station ID: 1201129 CBWM ID: 600529
Local Name: 3 Owner: Sunkist Growers, Inc.
Reference Point Elevation: 957.5
Groundwater Level Elevation (feet above mean sea level)
900
850
800
750
700
650
600
550
500
Accumulative Departure from Mean Precipitation (inches)
50
40
30
20
10
0
-10
-20
-30
-40
-50
Jan-01
Jan-02
Jan-03
Jan-04



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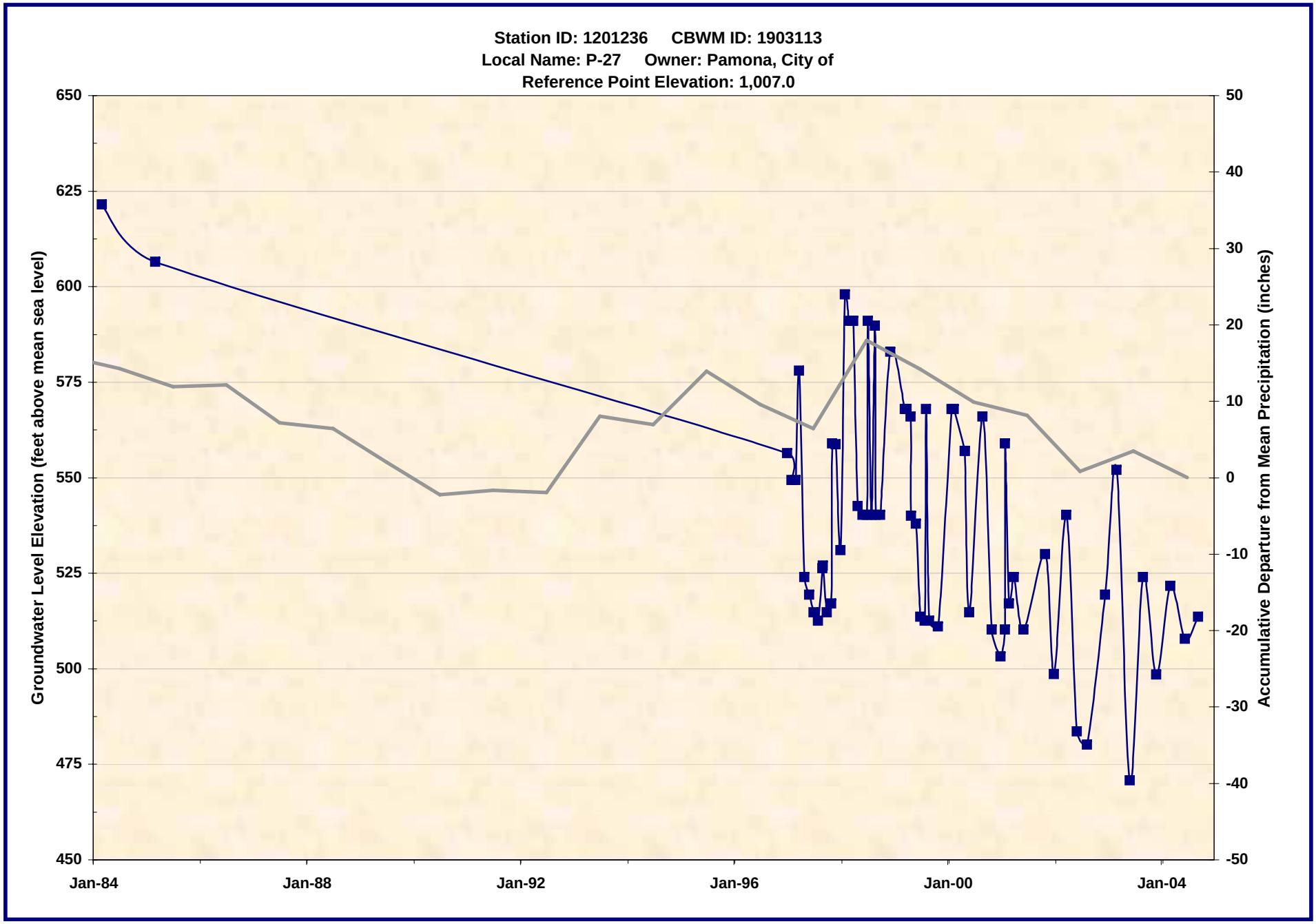

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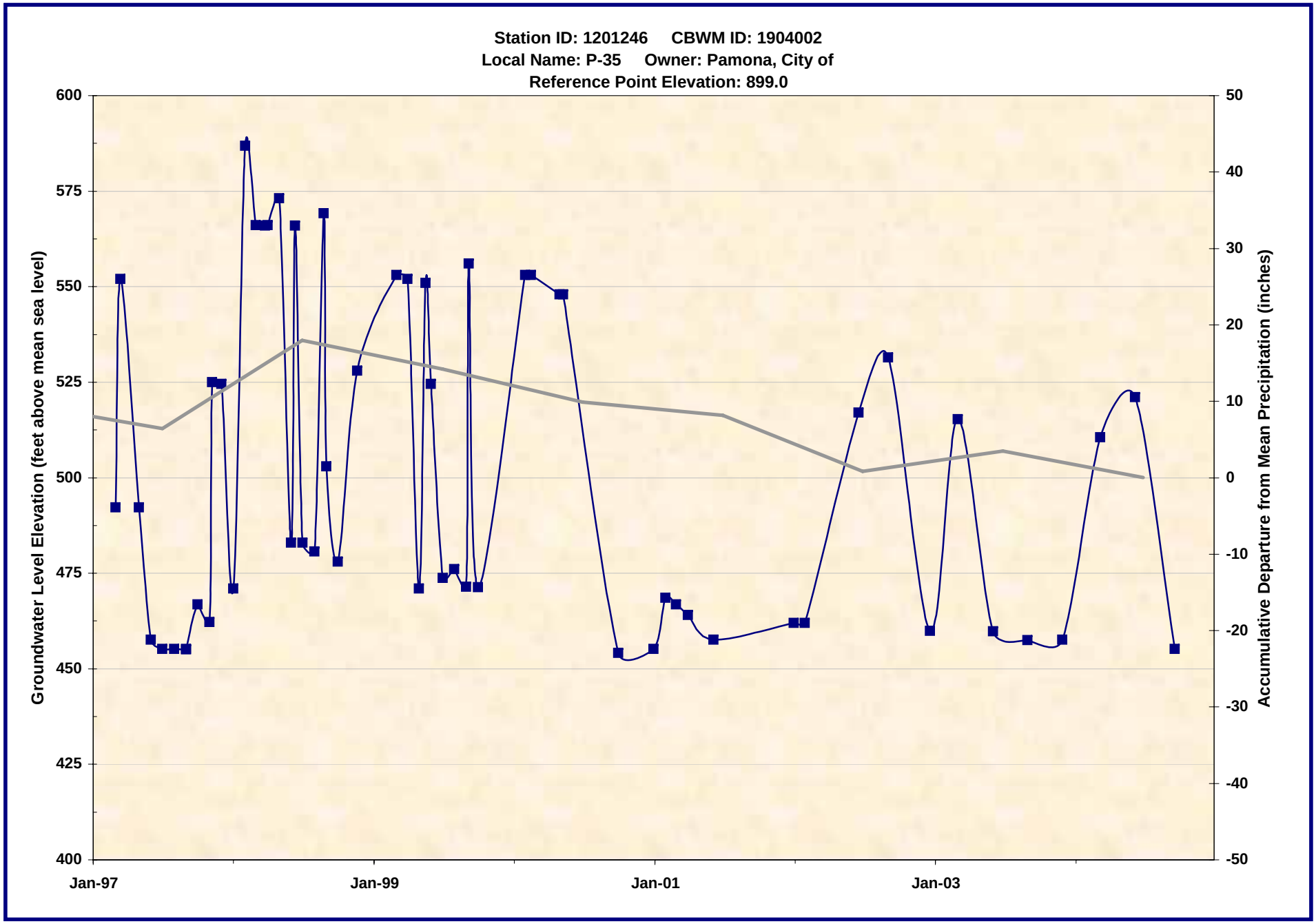

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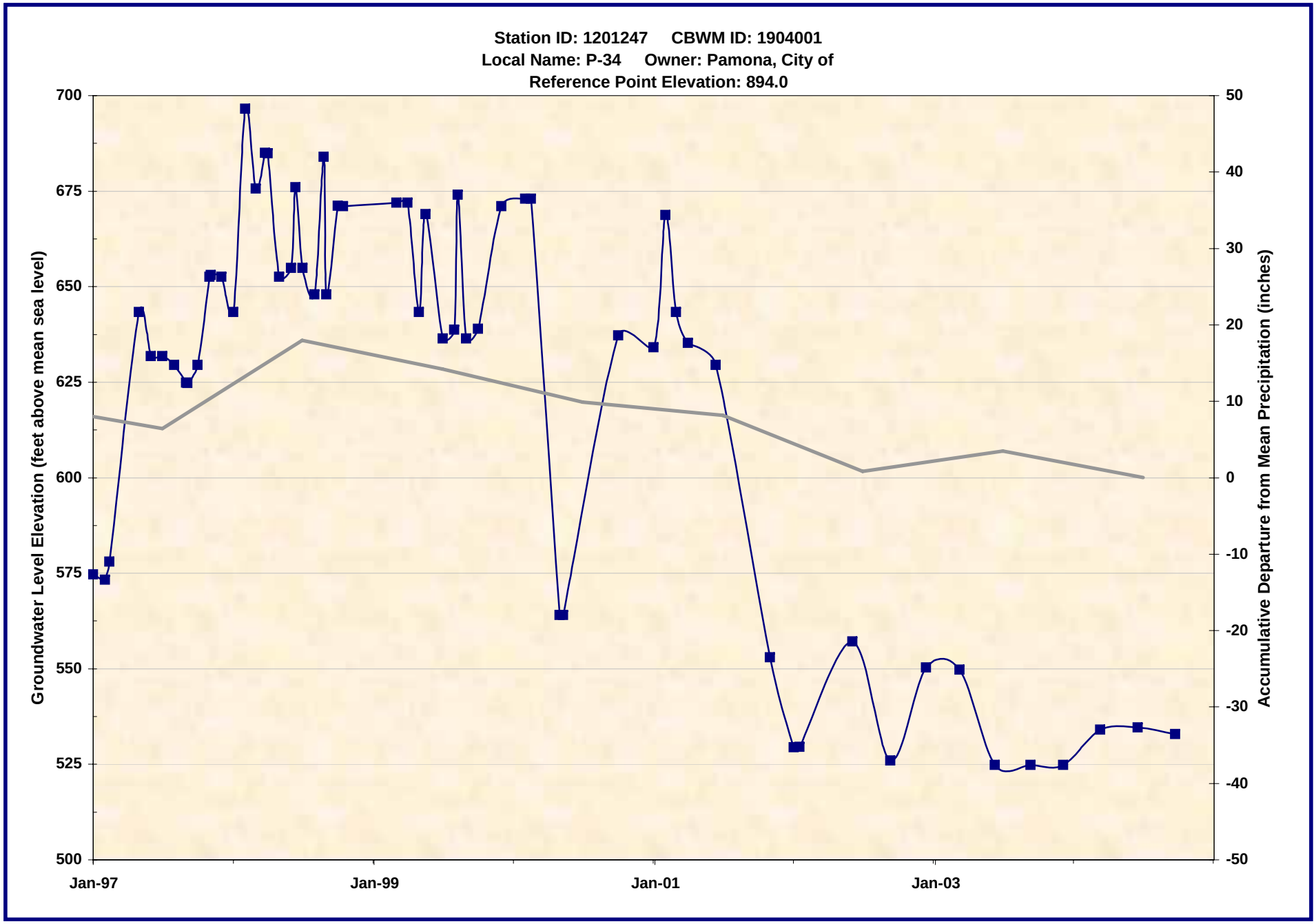

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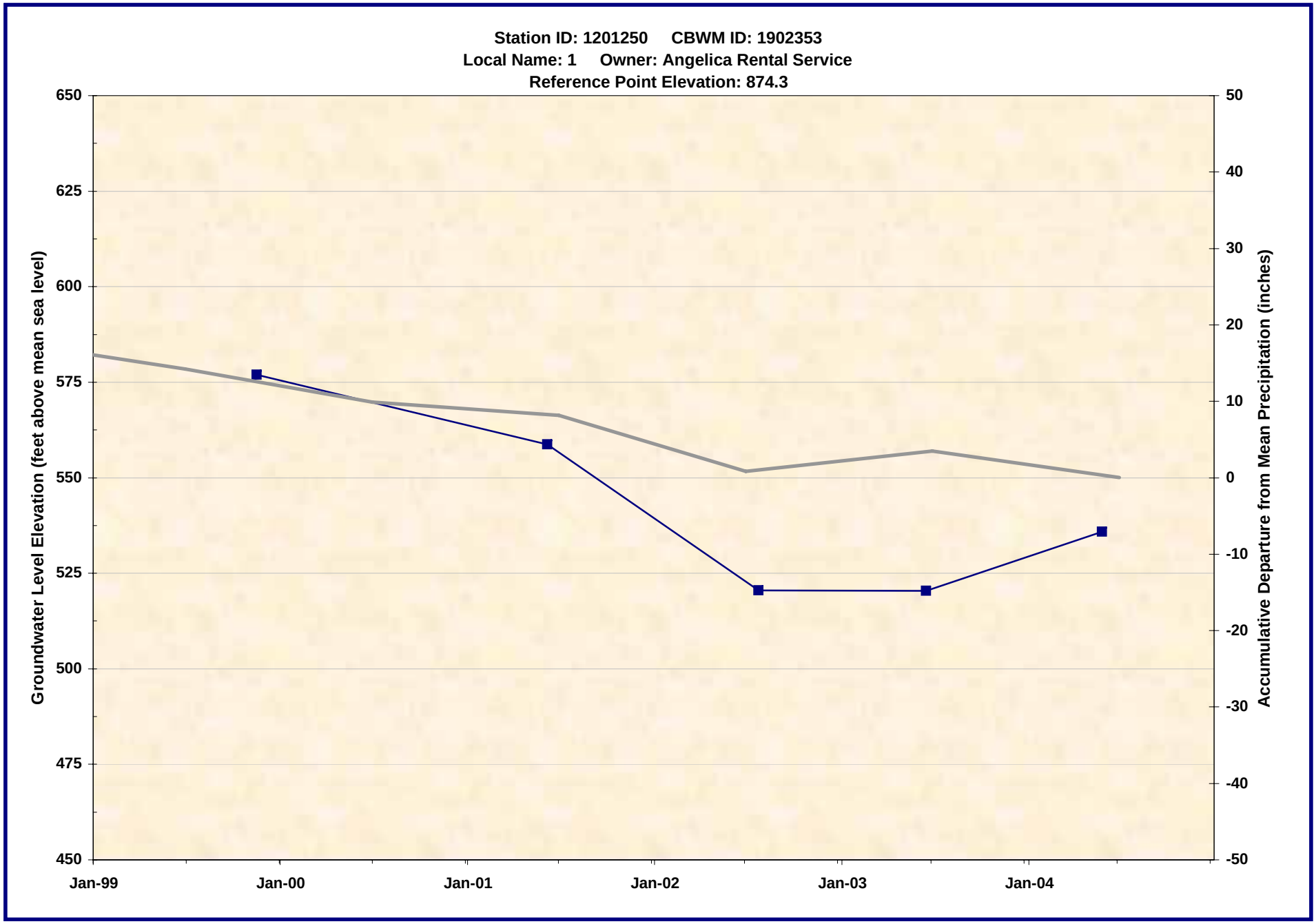

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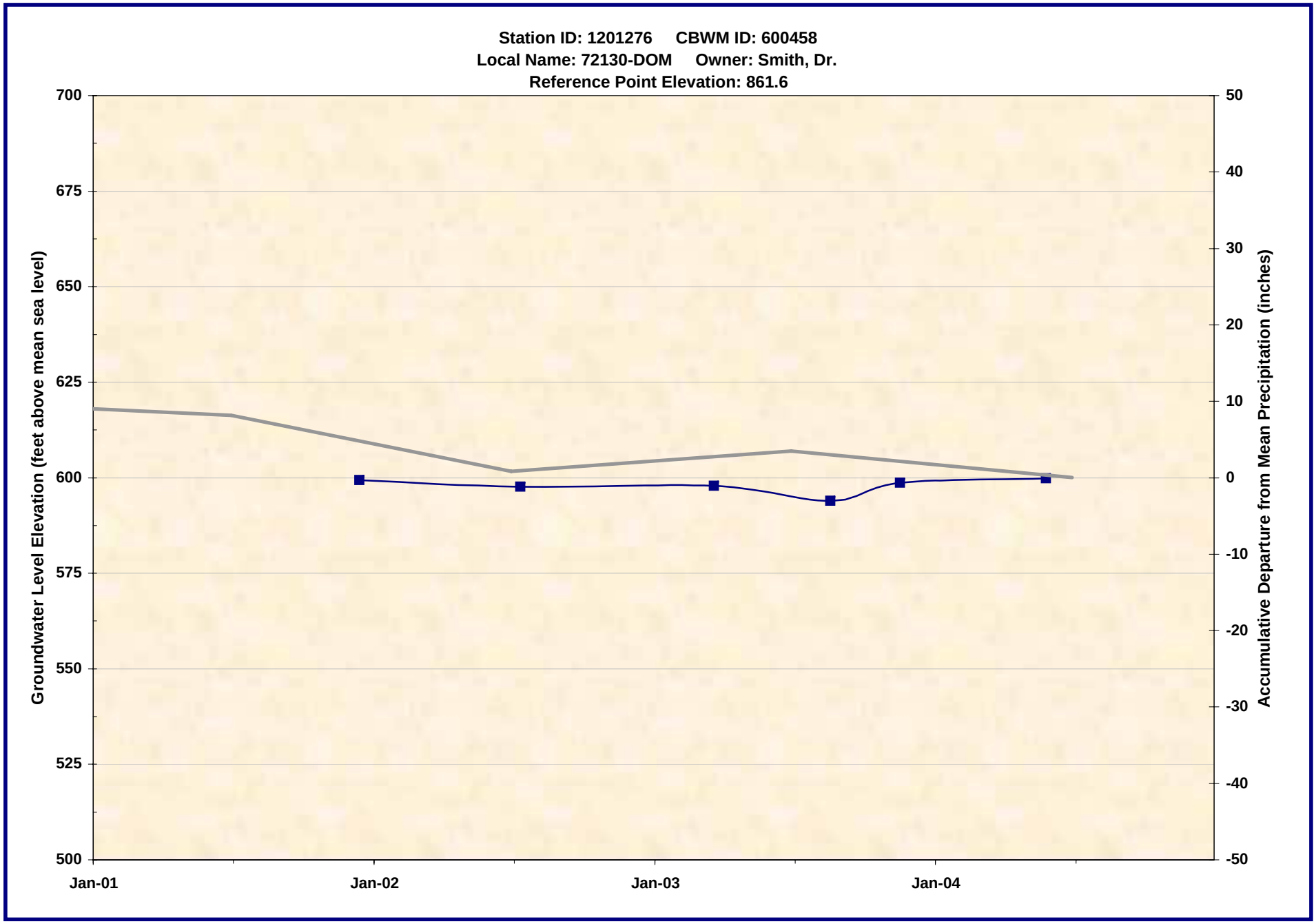

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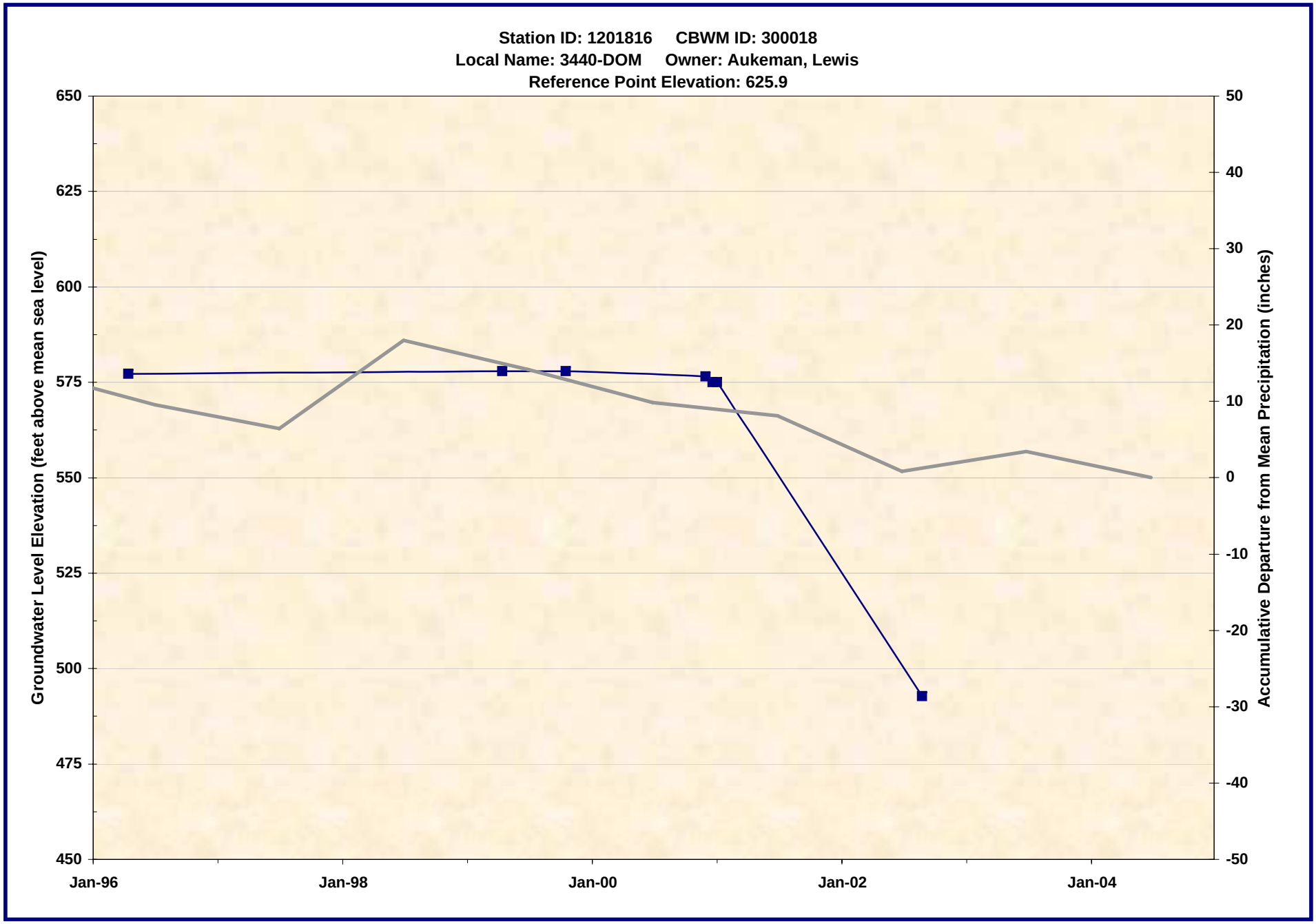

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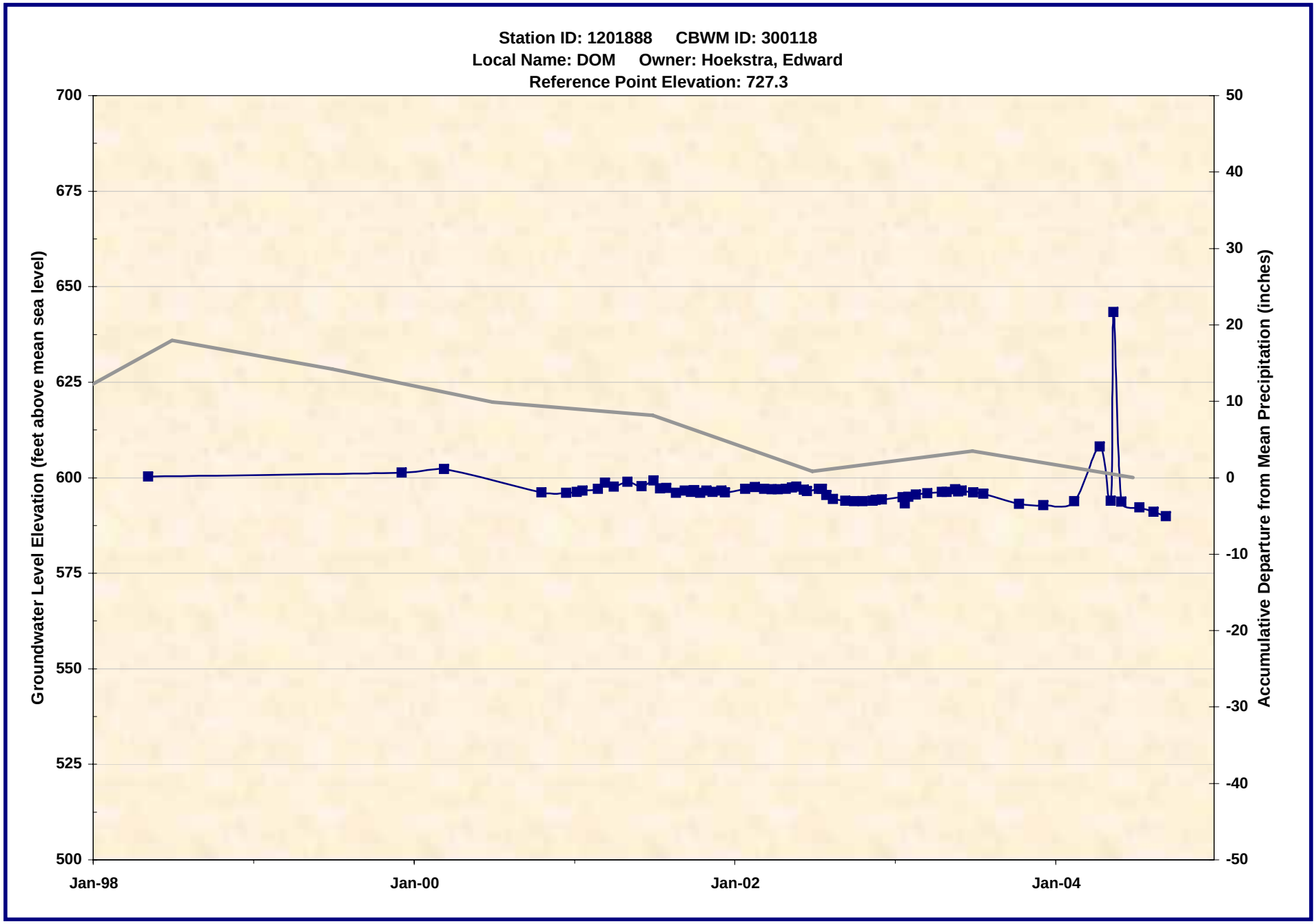

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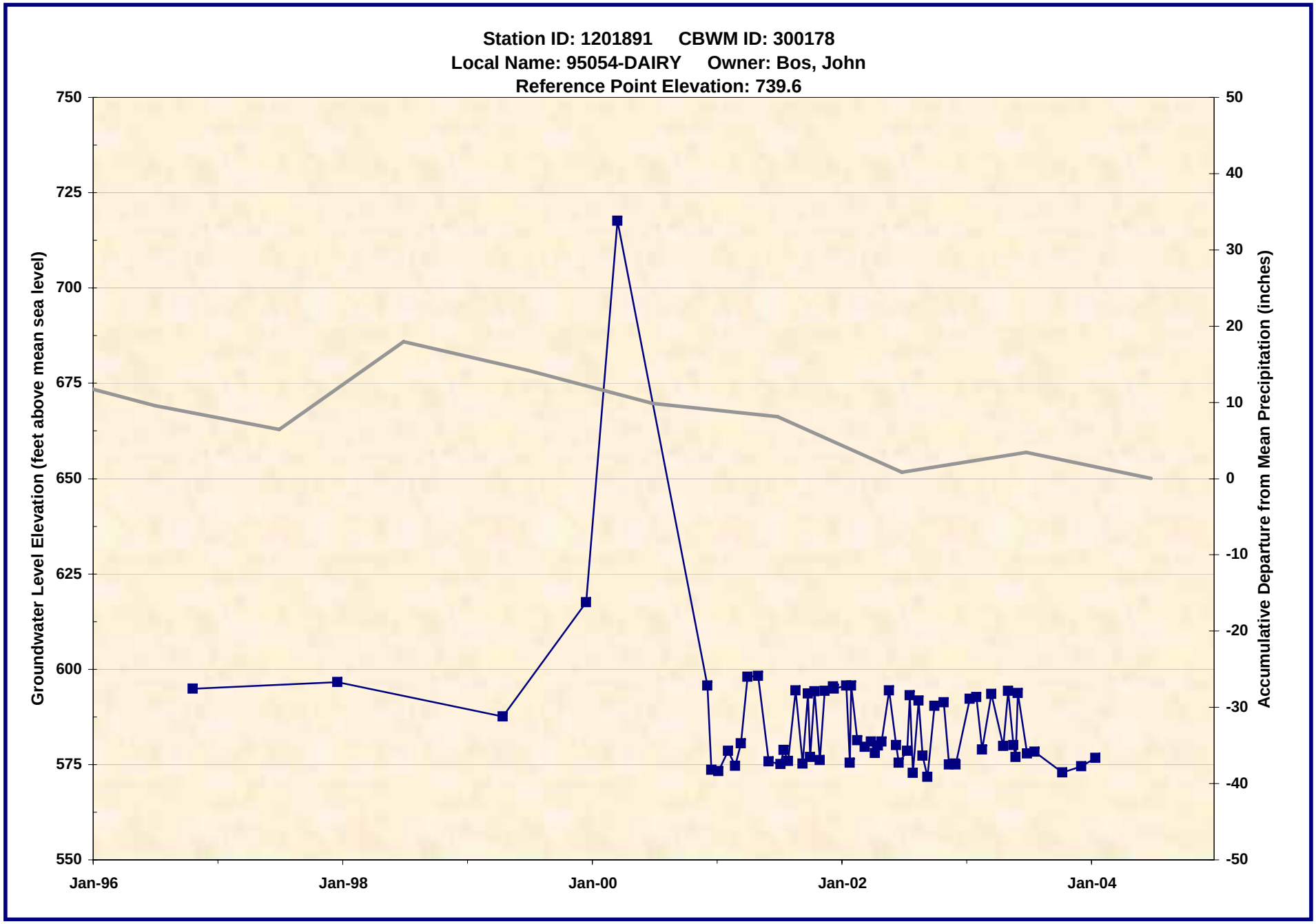

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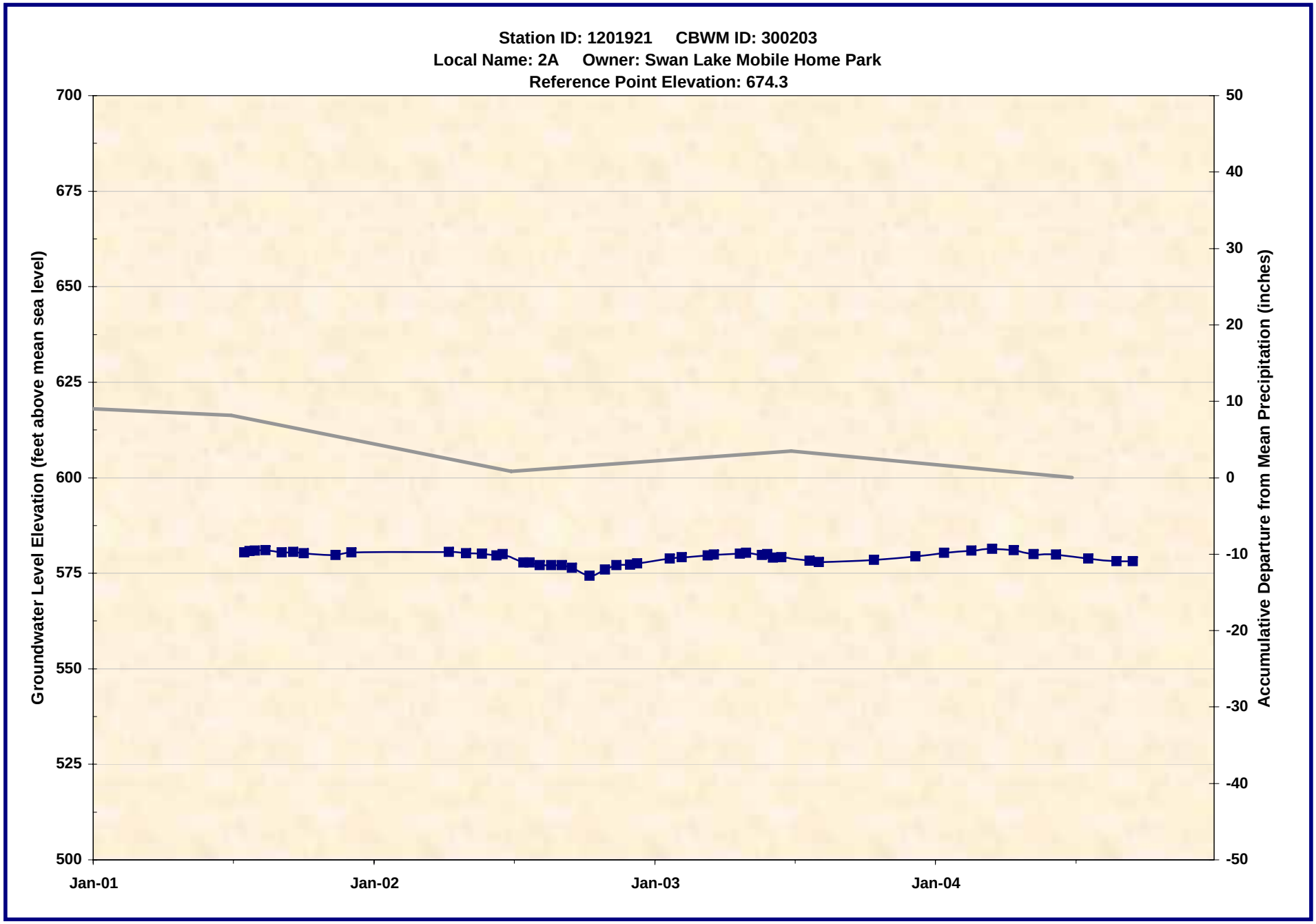

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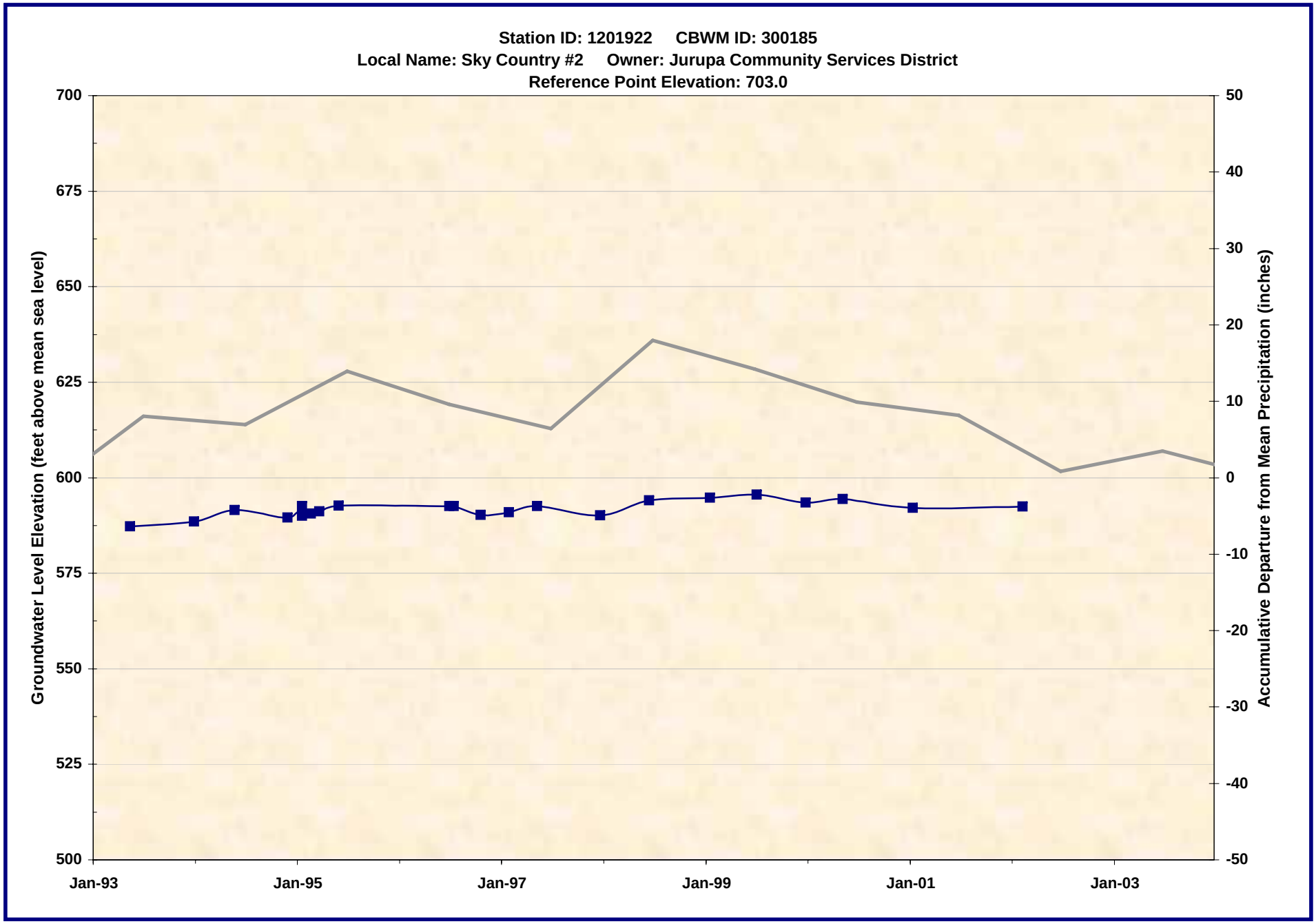

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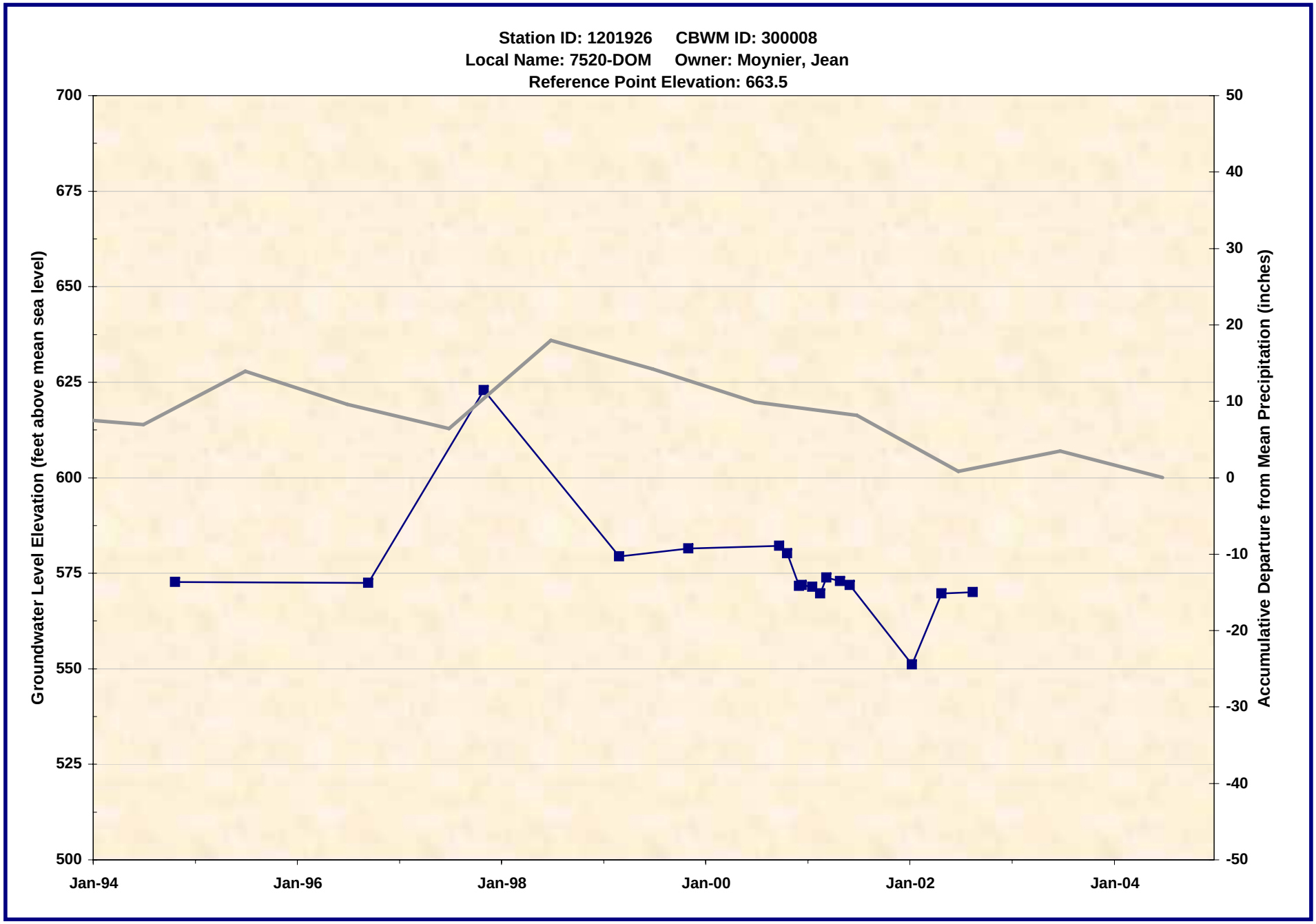

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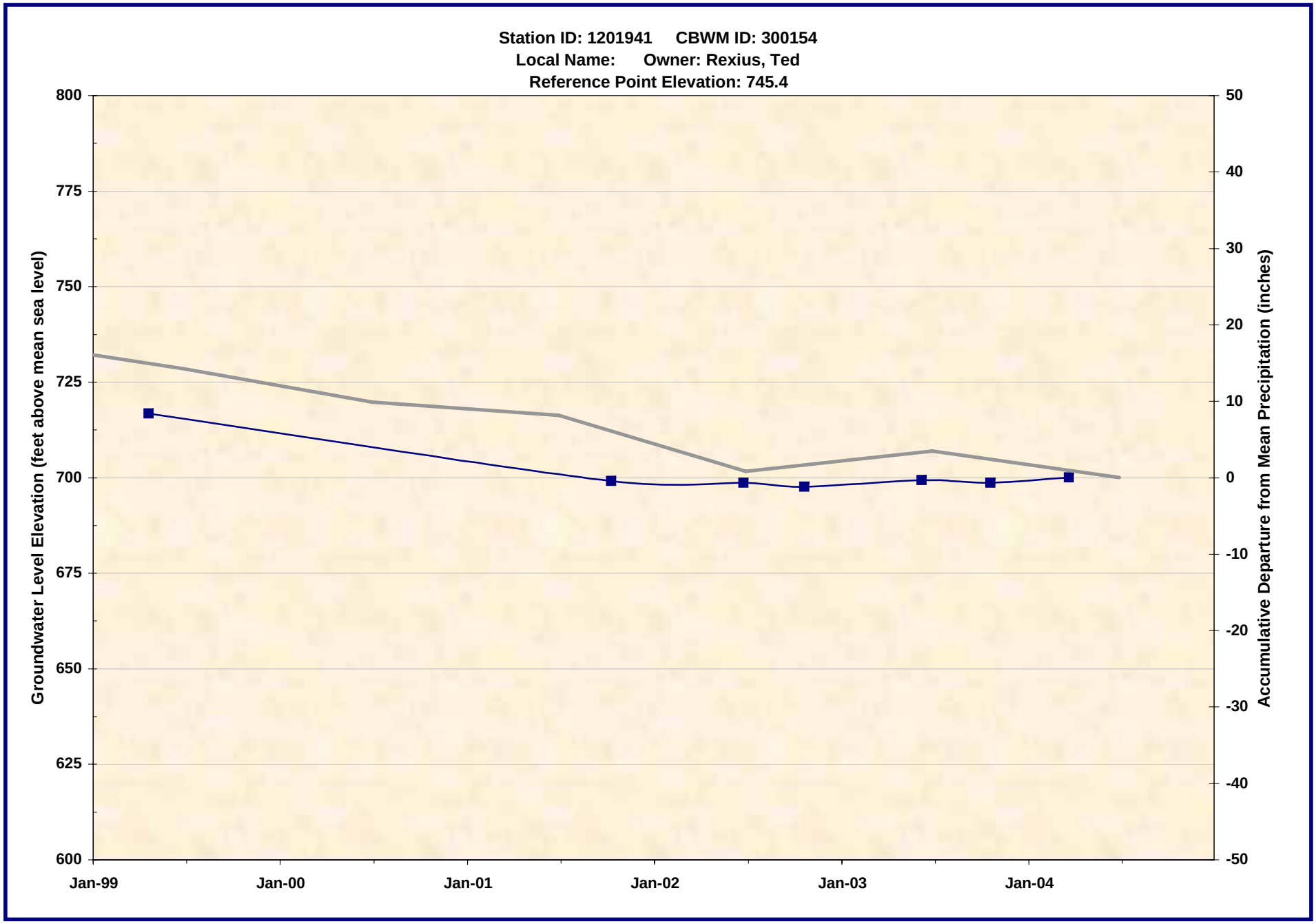

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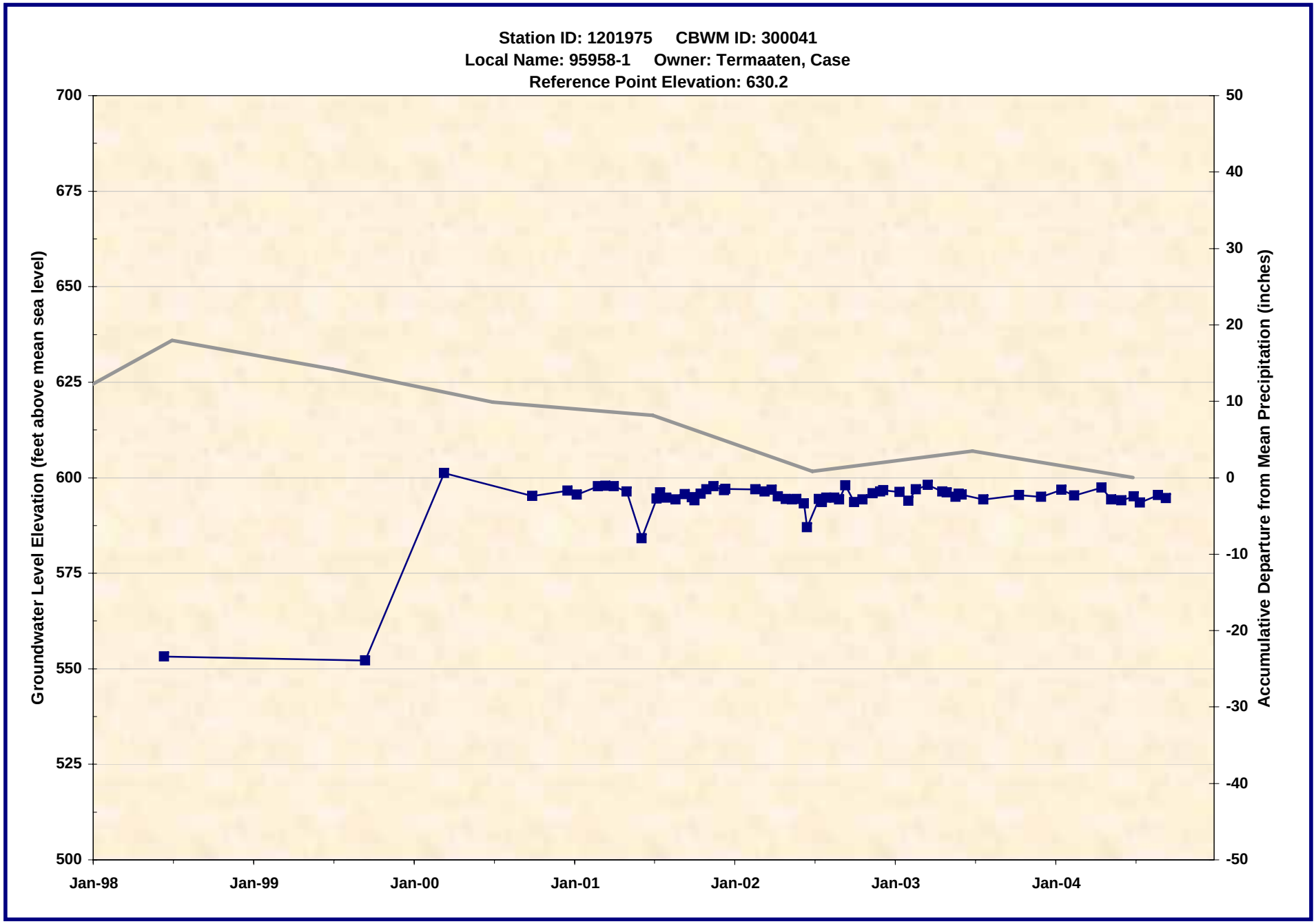

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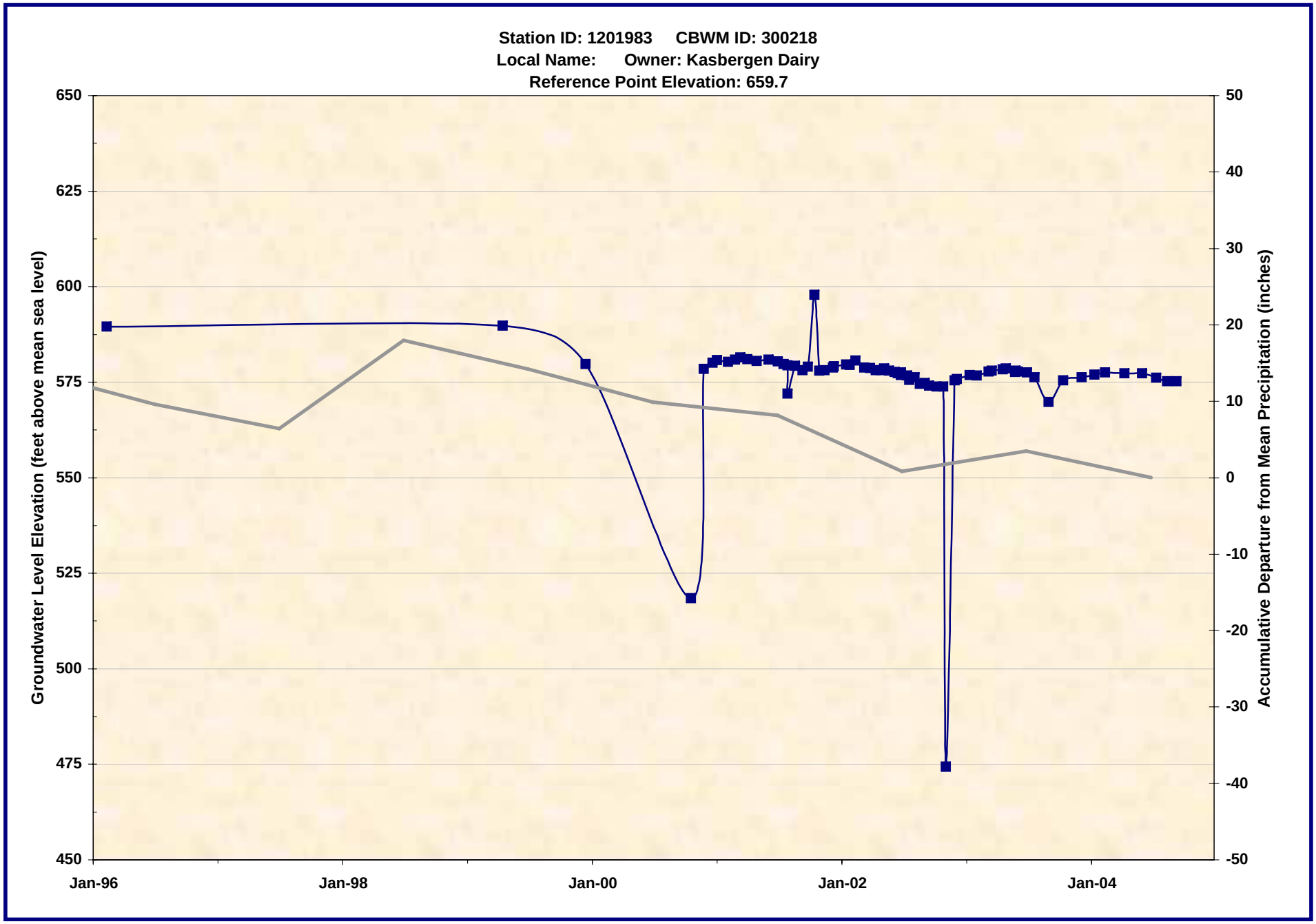

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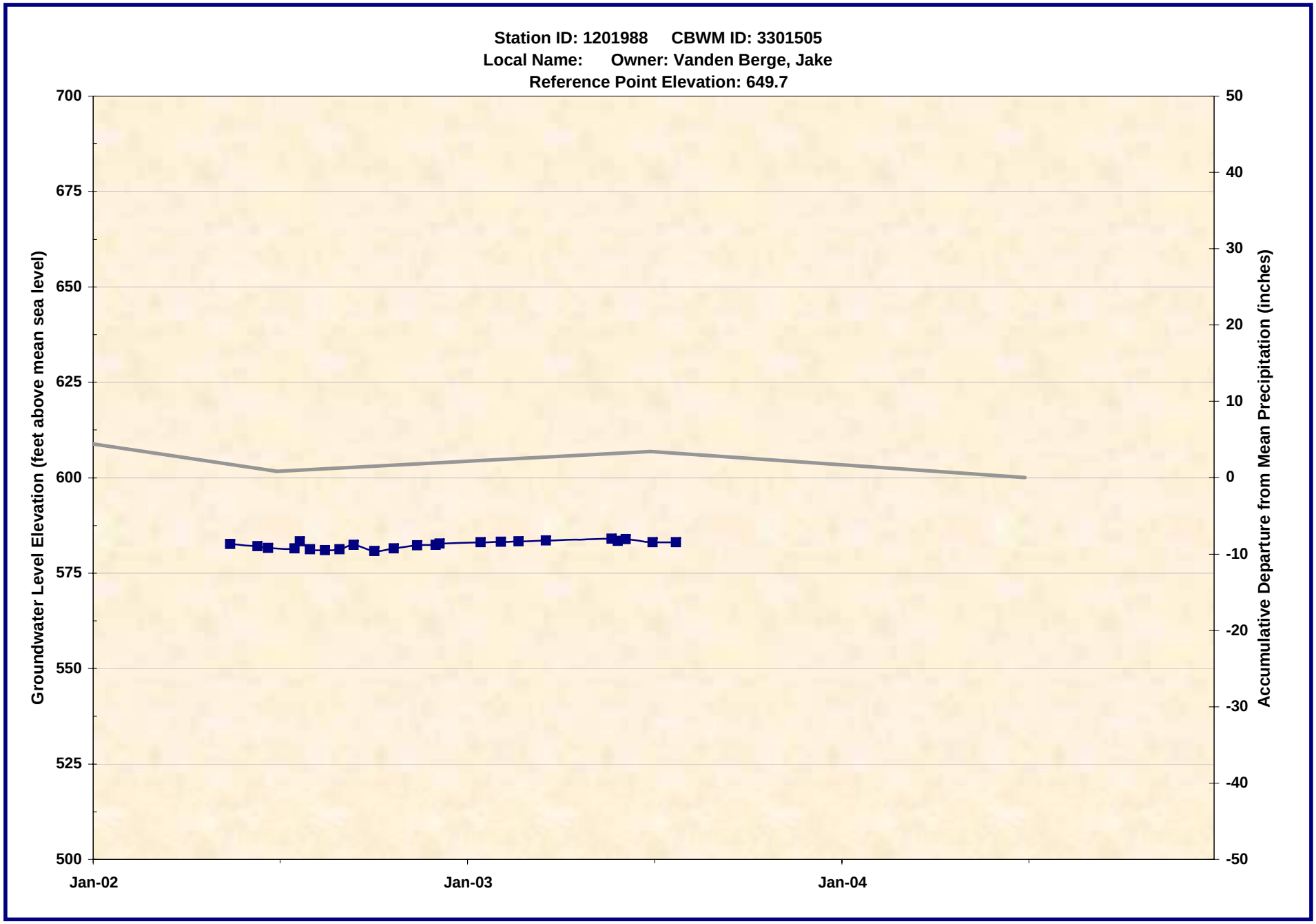

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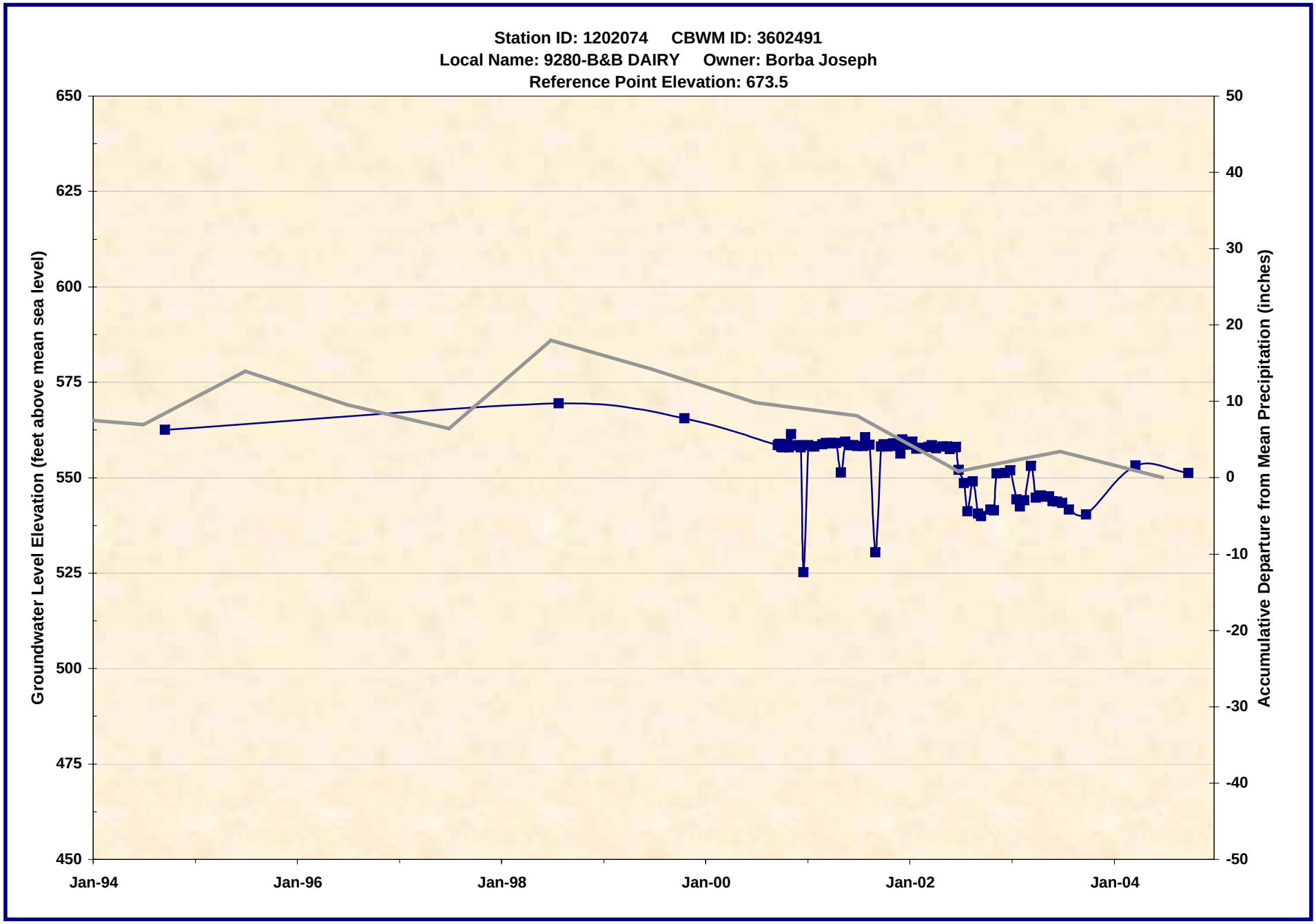

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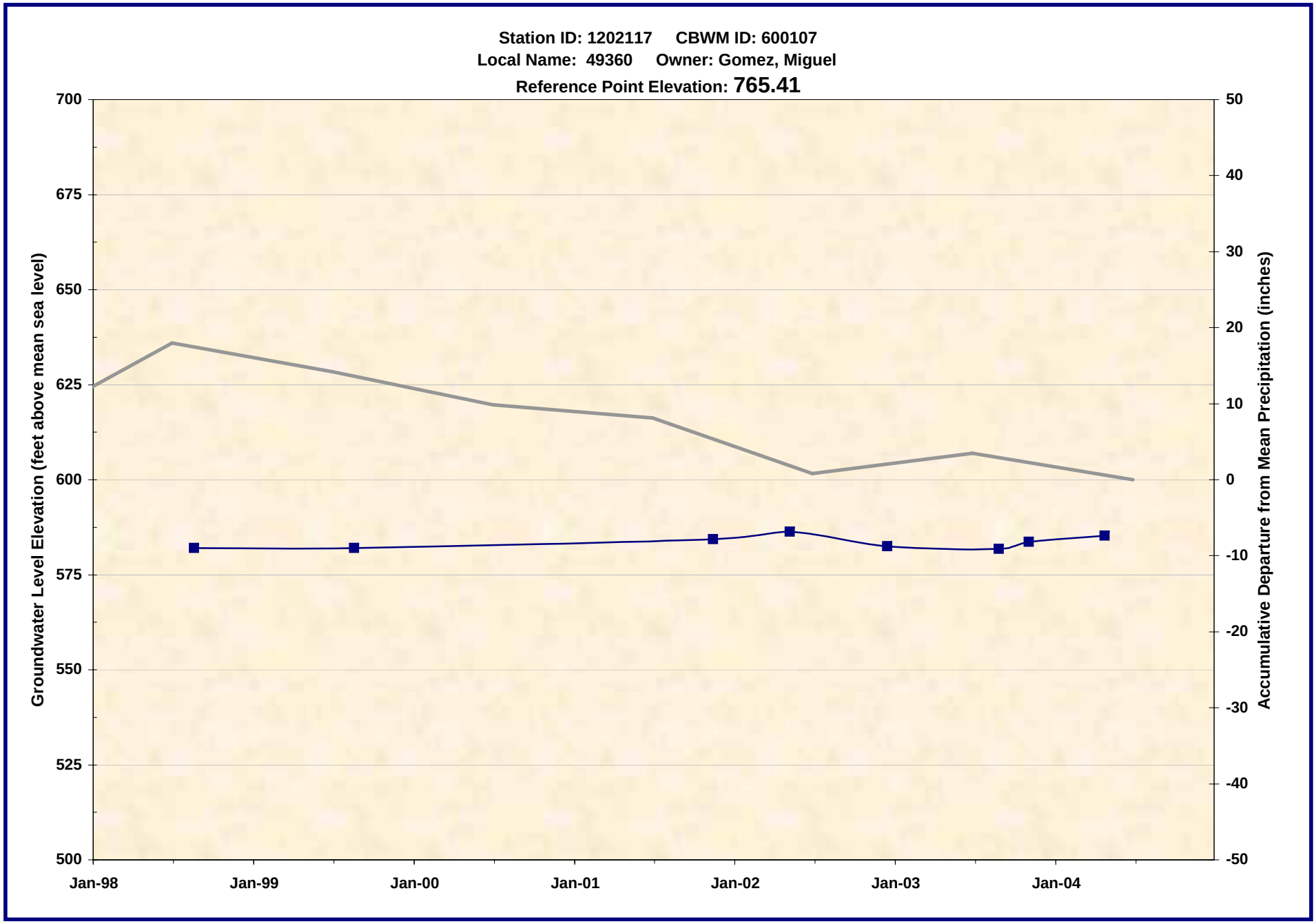

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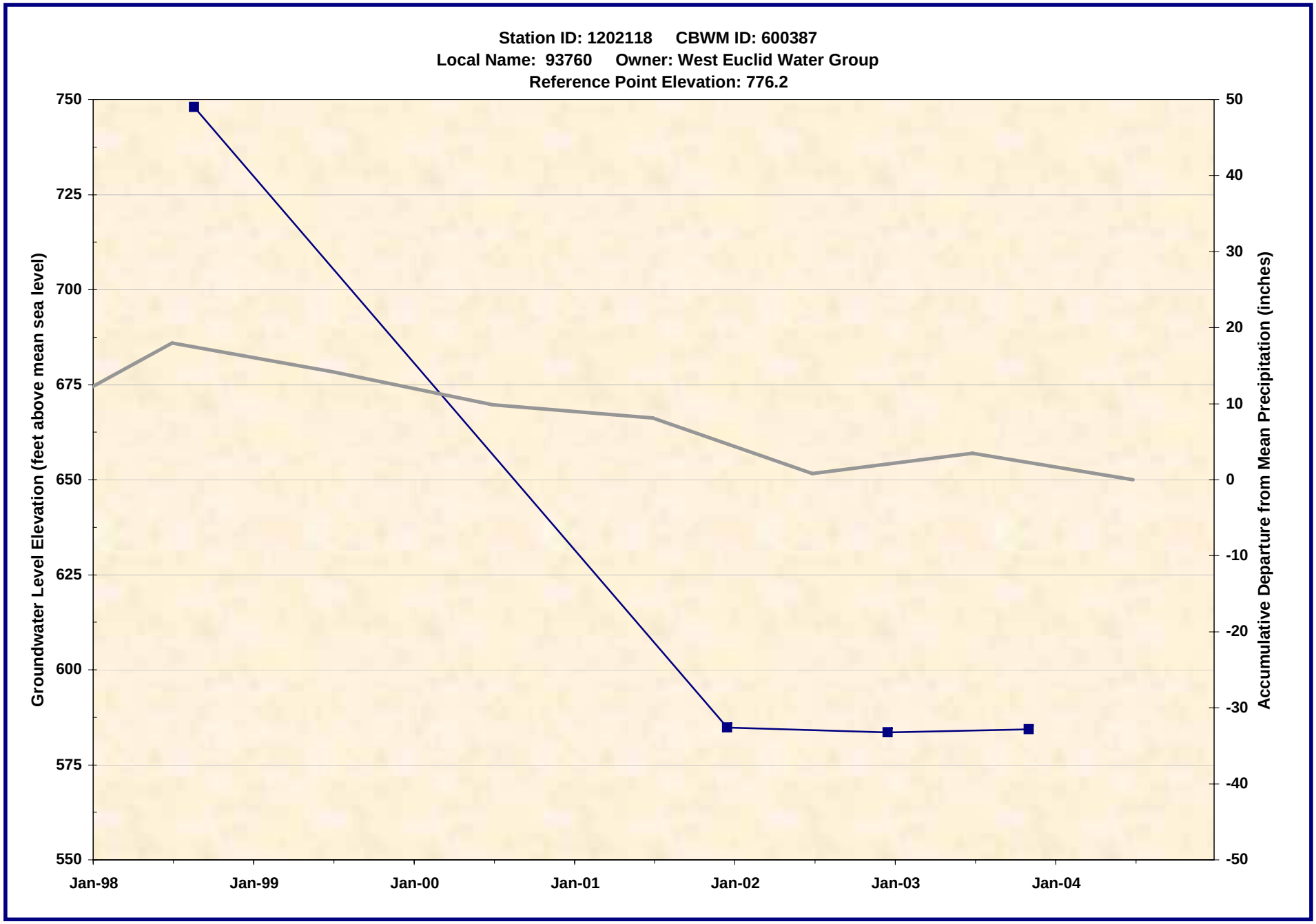

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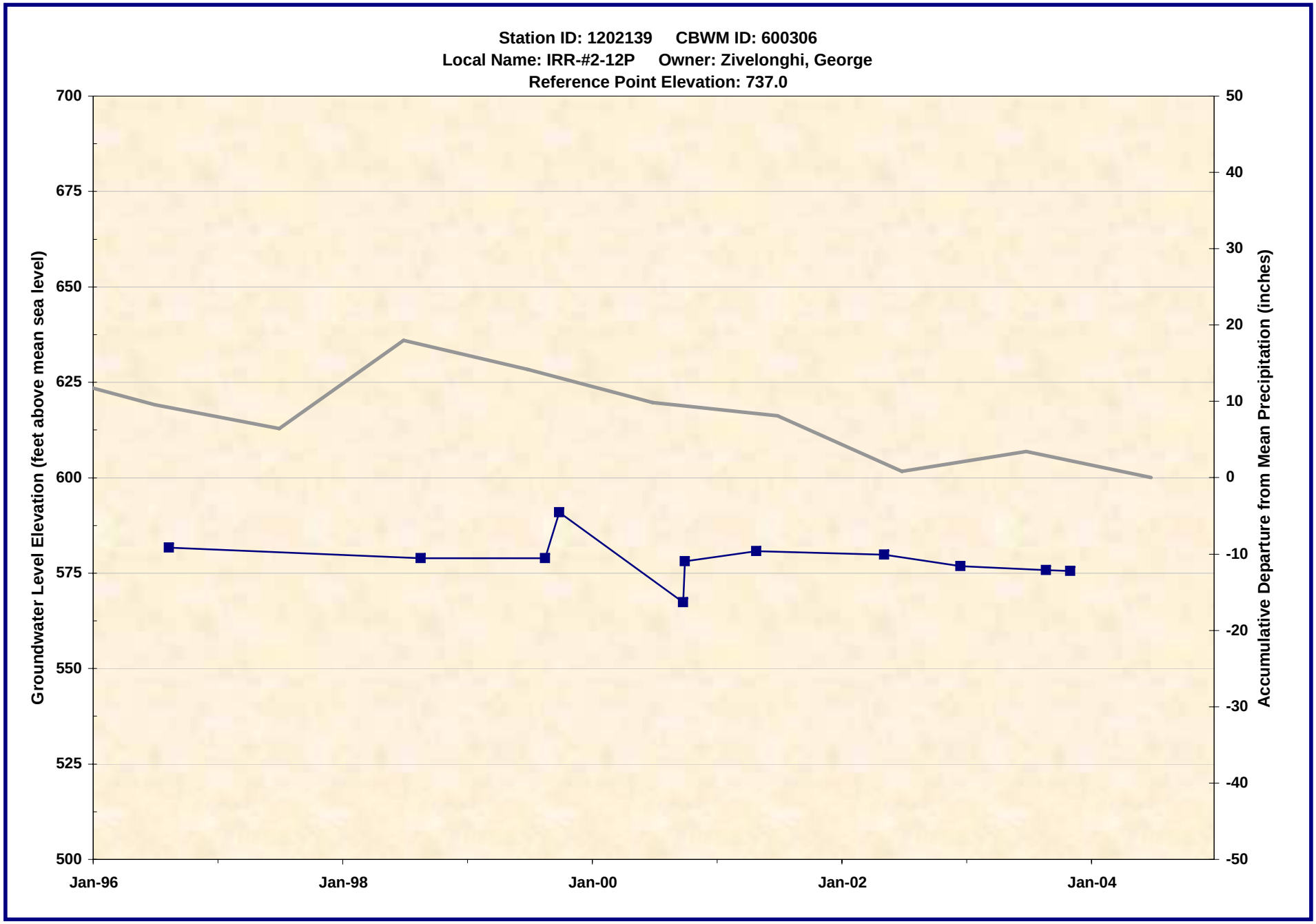

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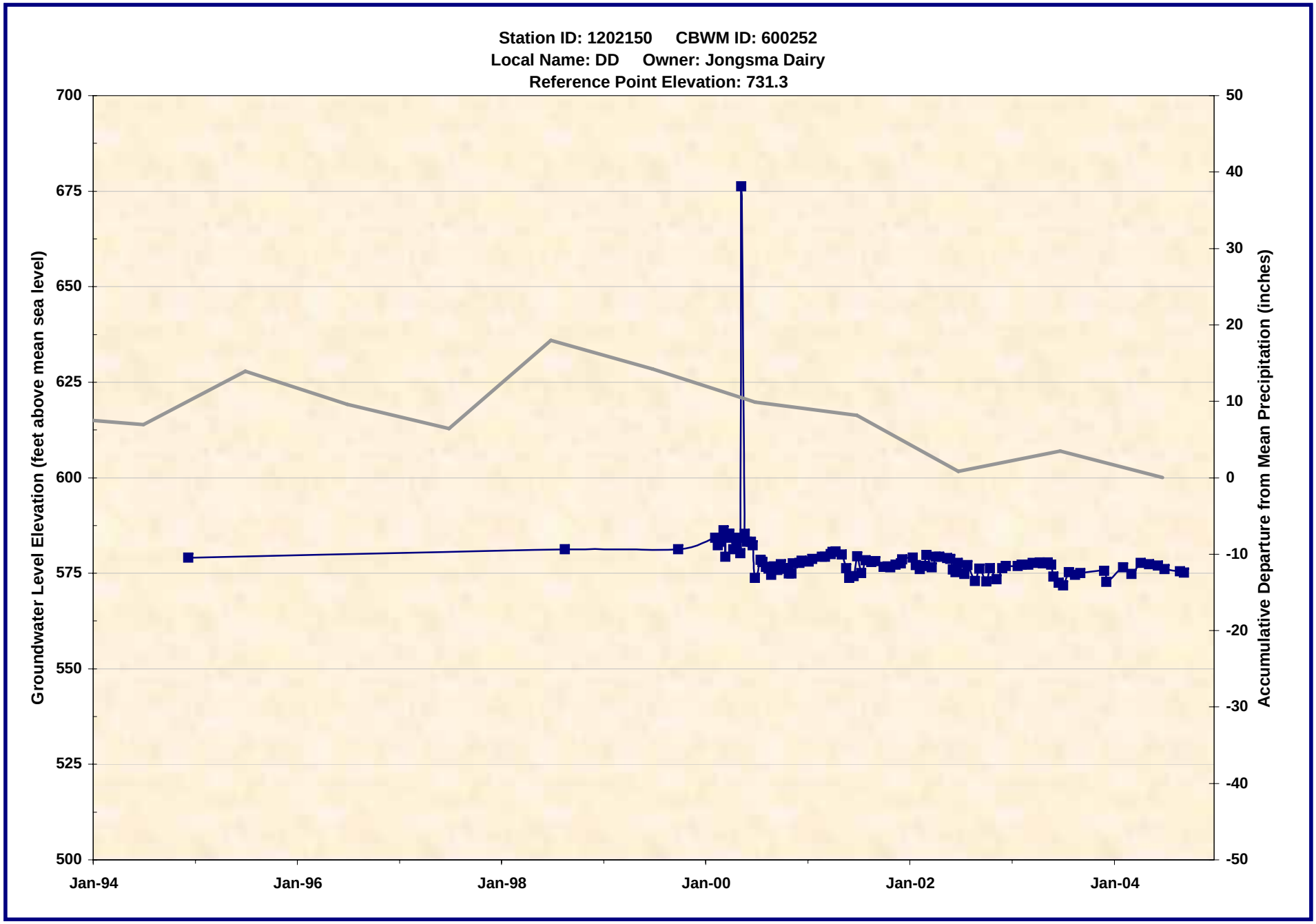
Wildermuth Environmental, Inc.



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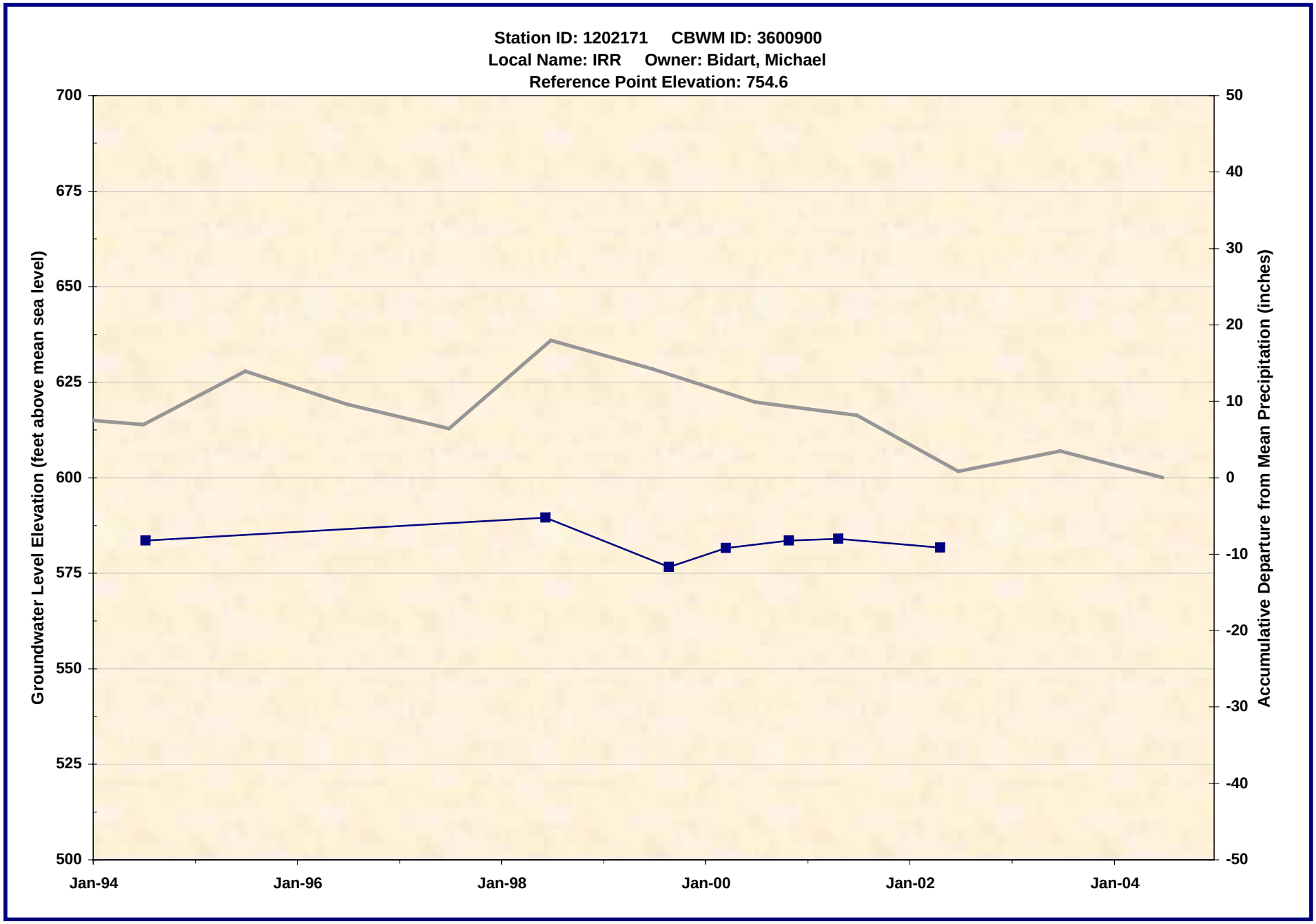

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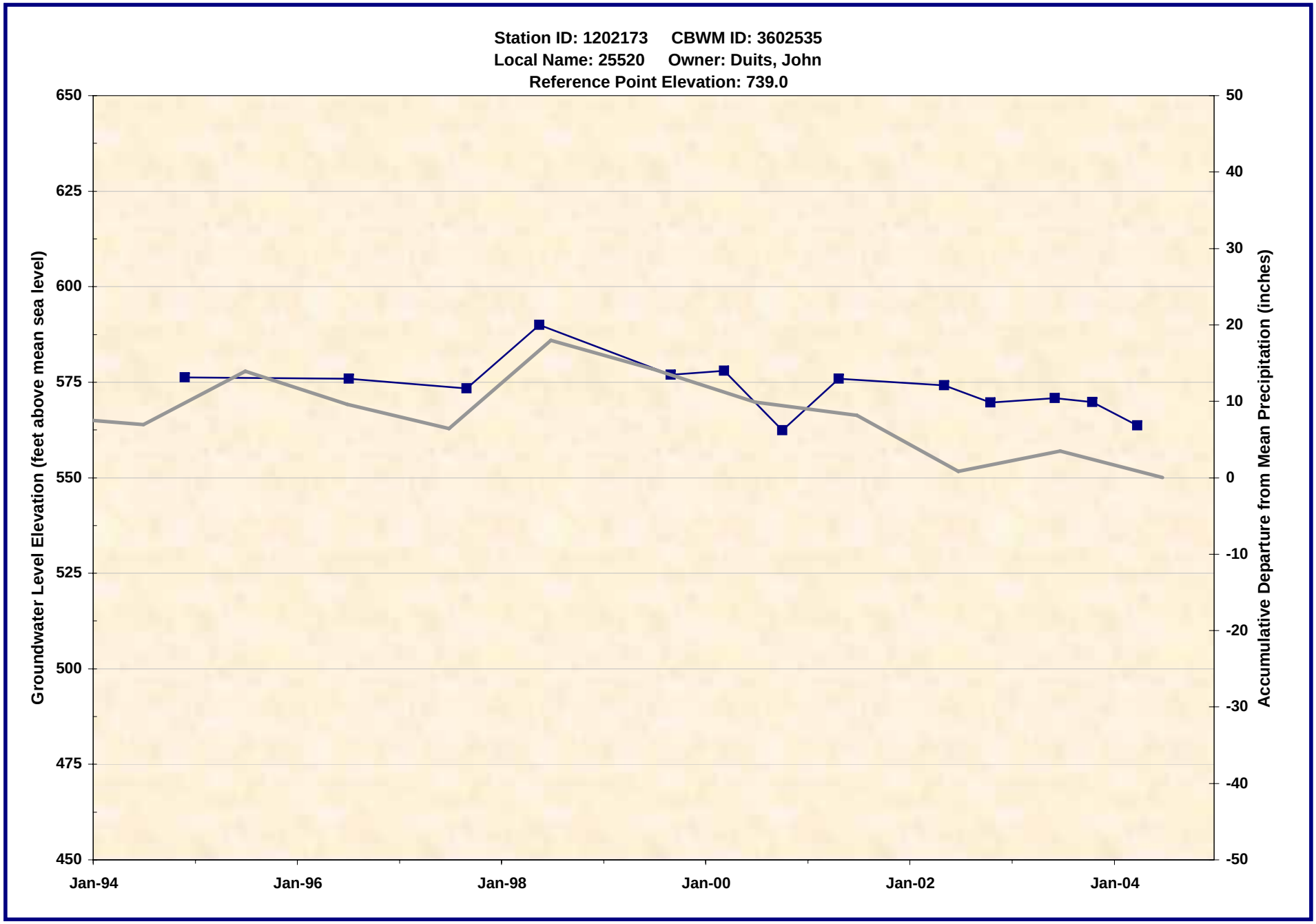

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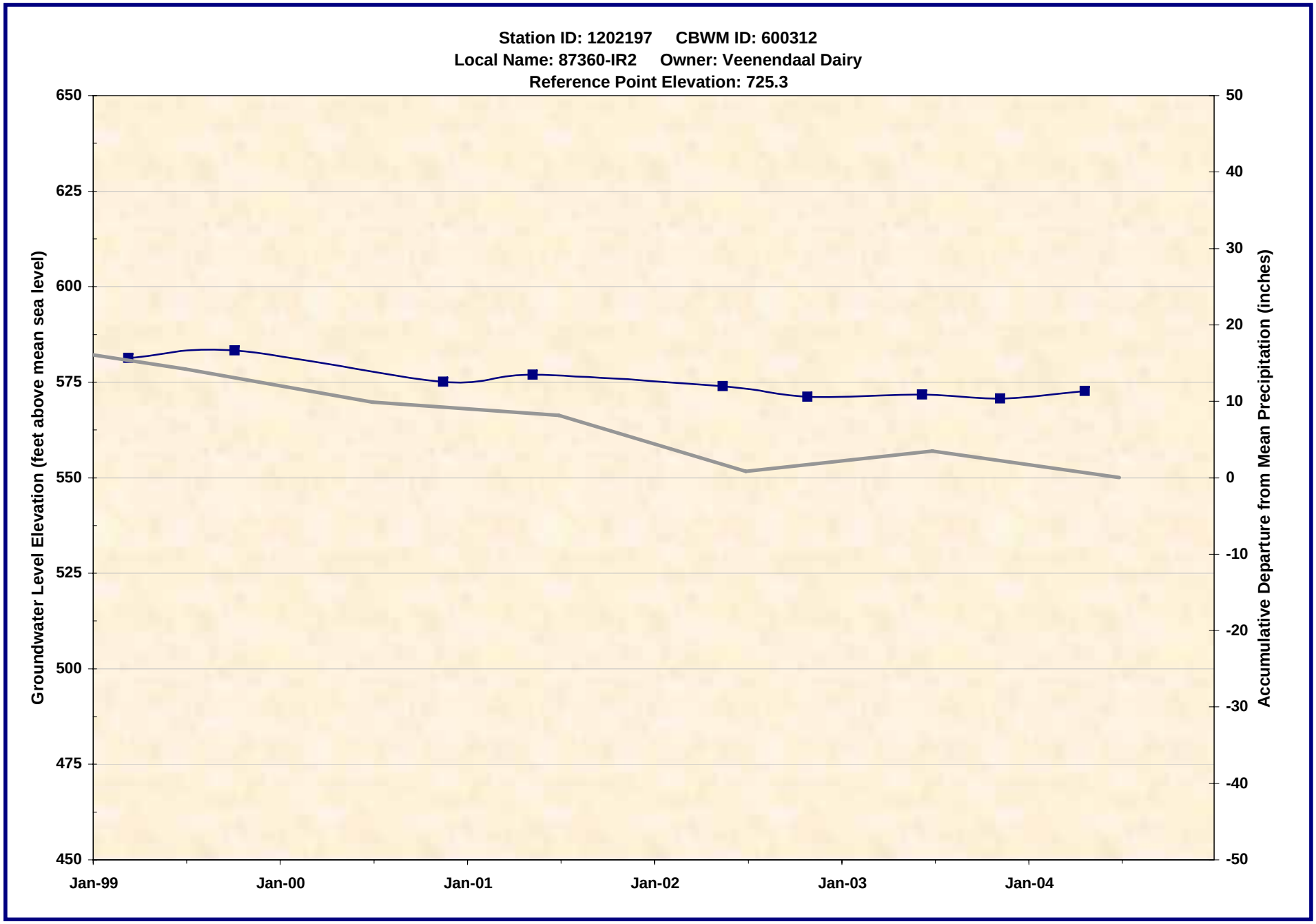

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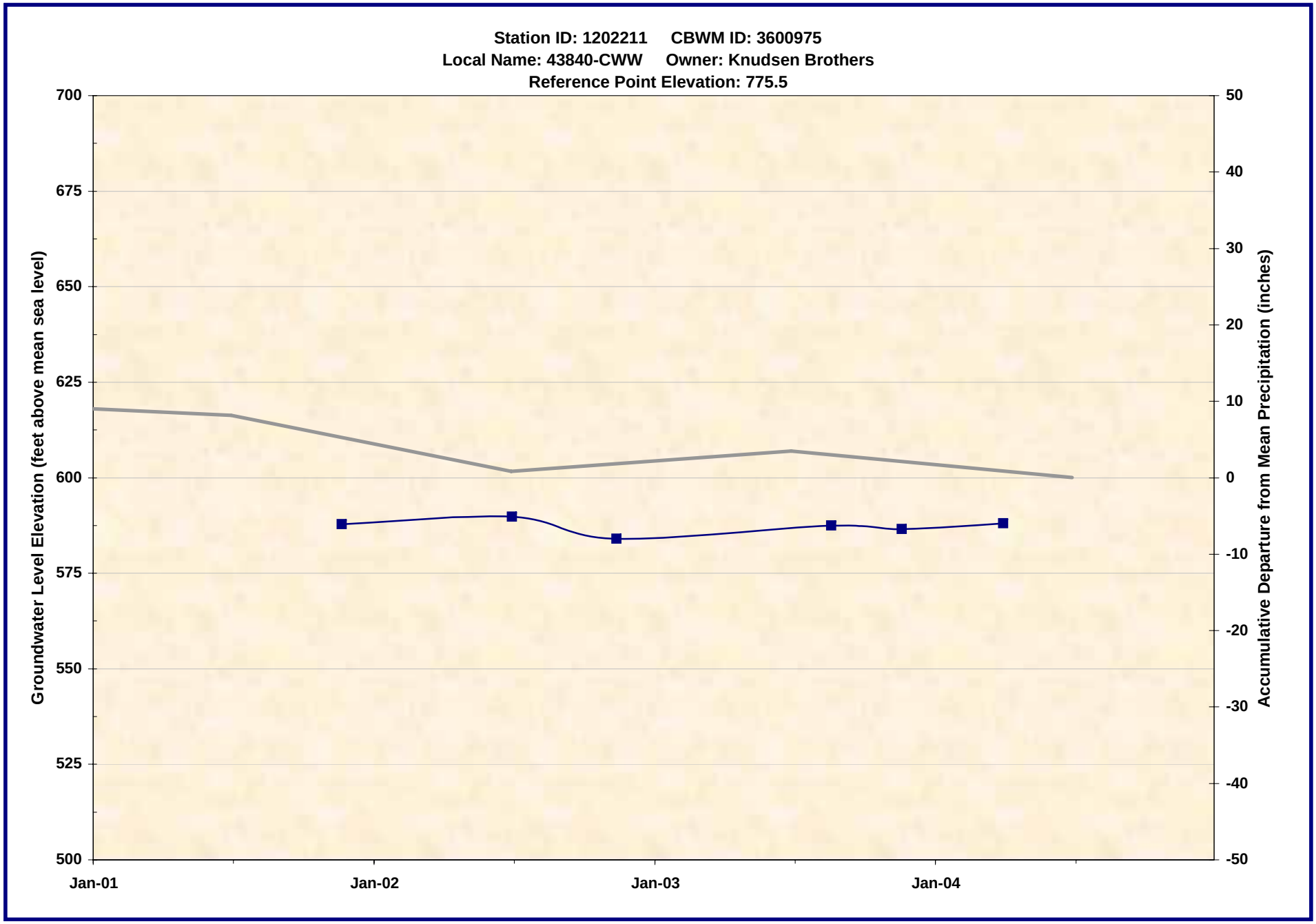

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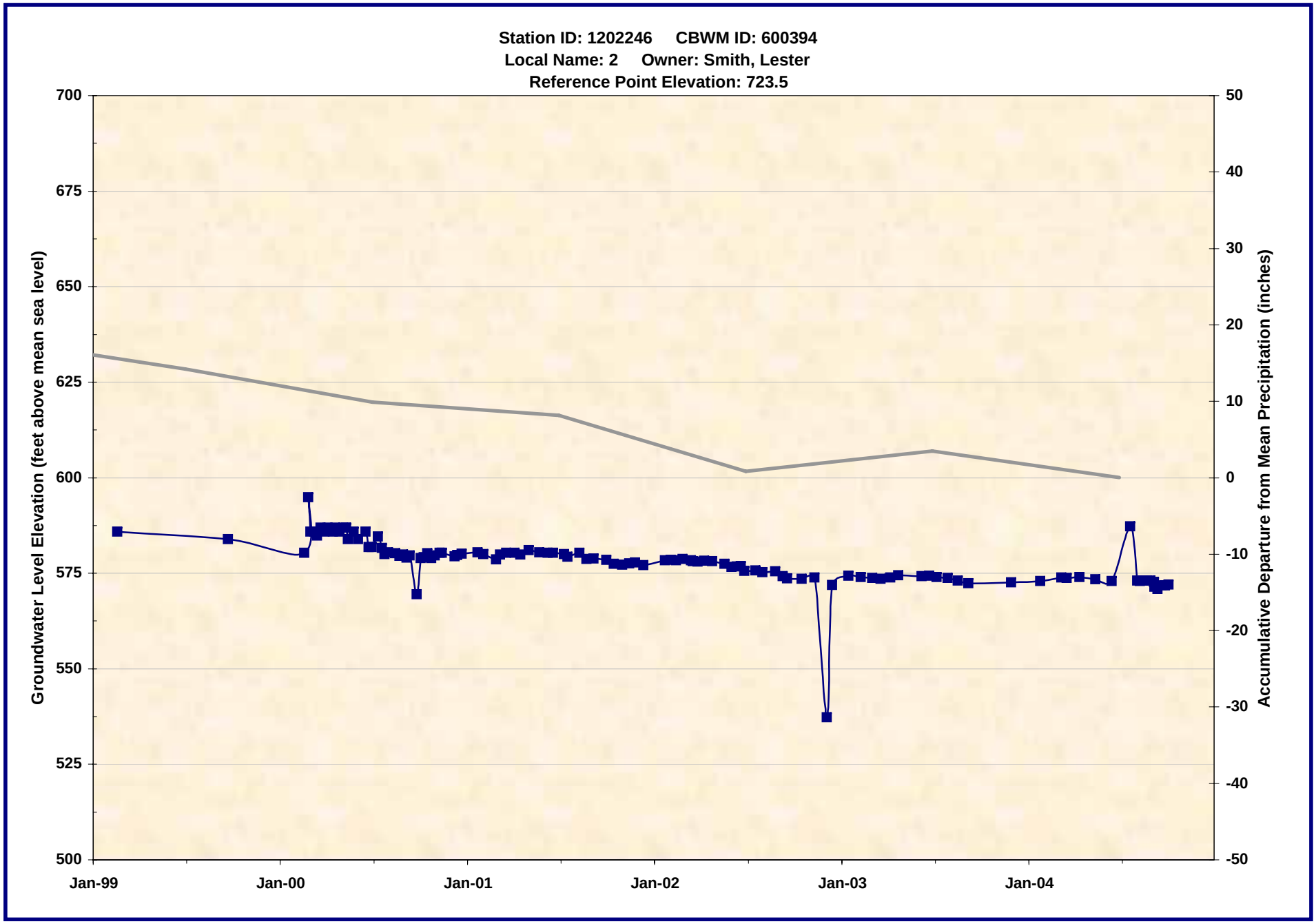

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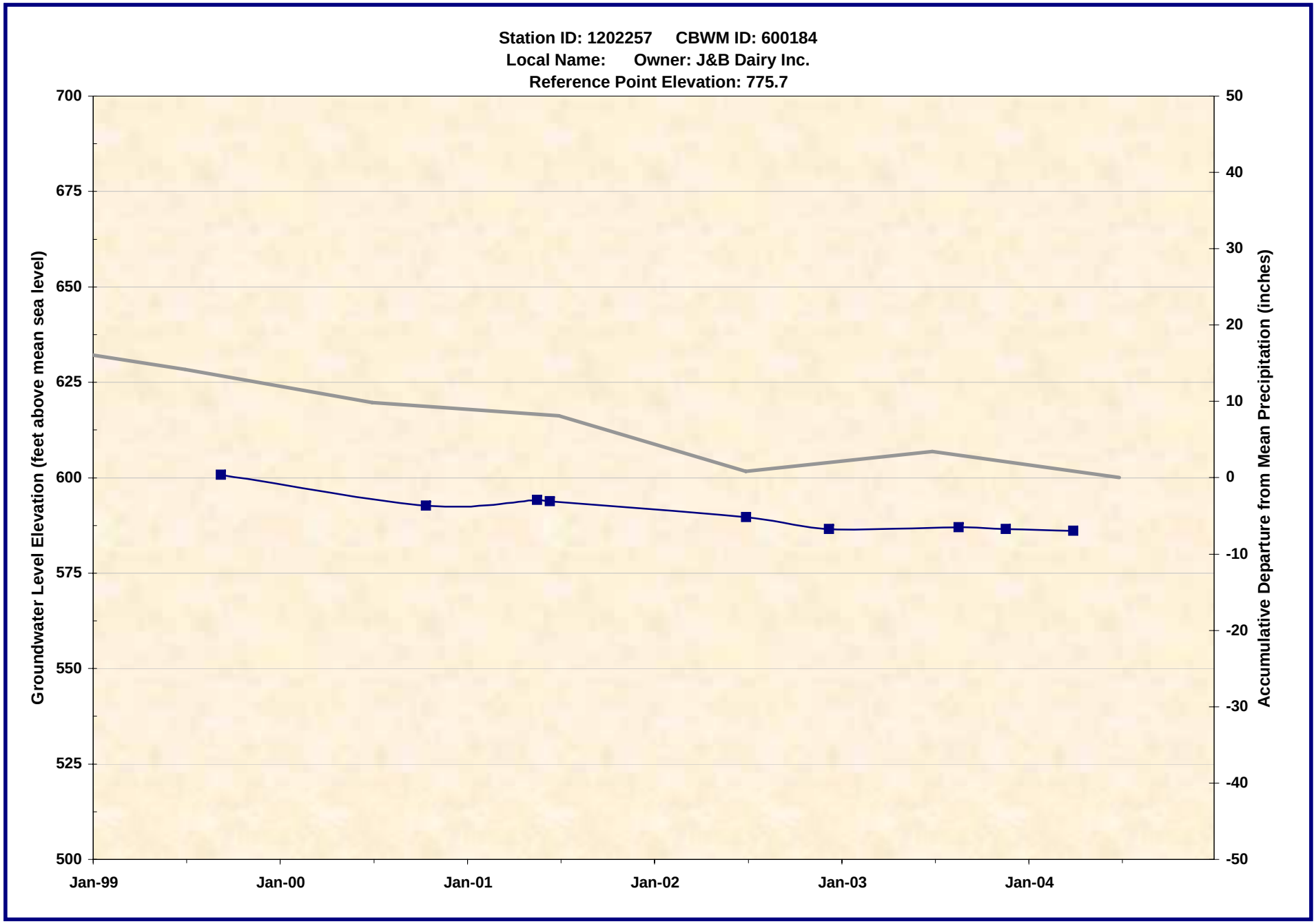

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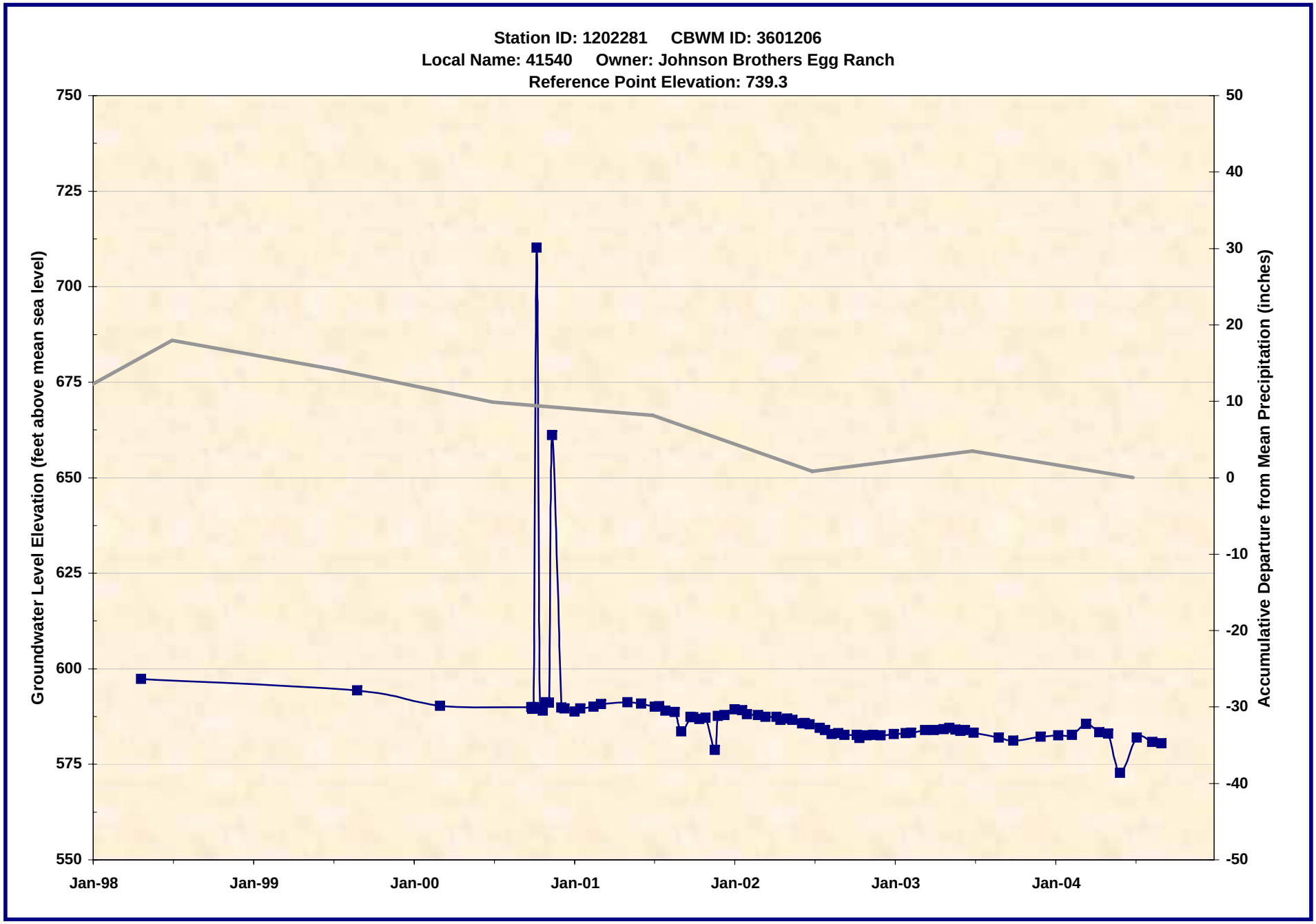

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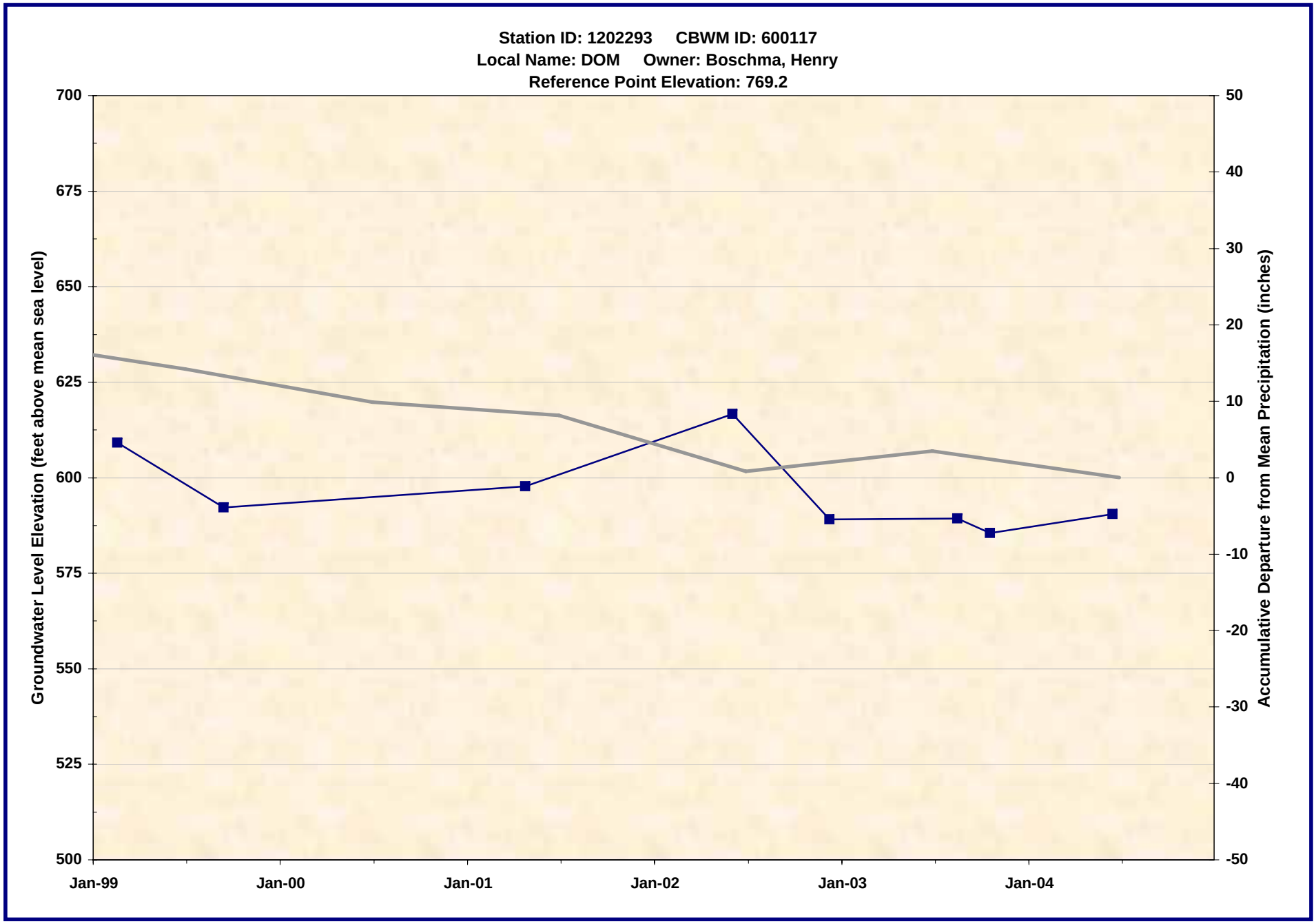

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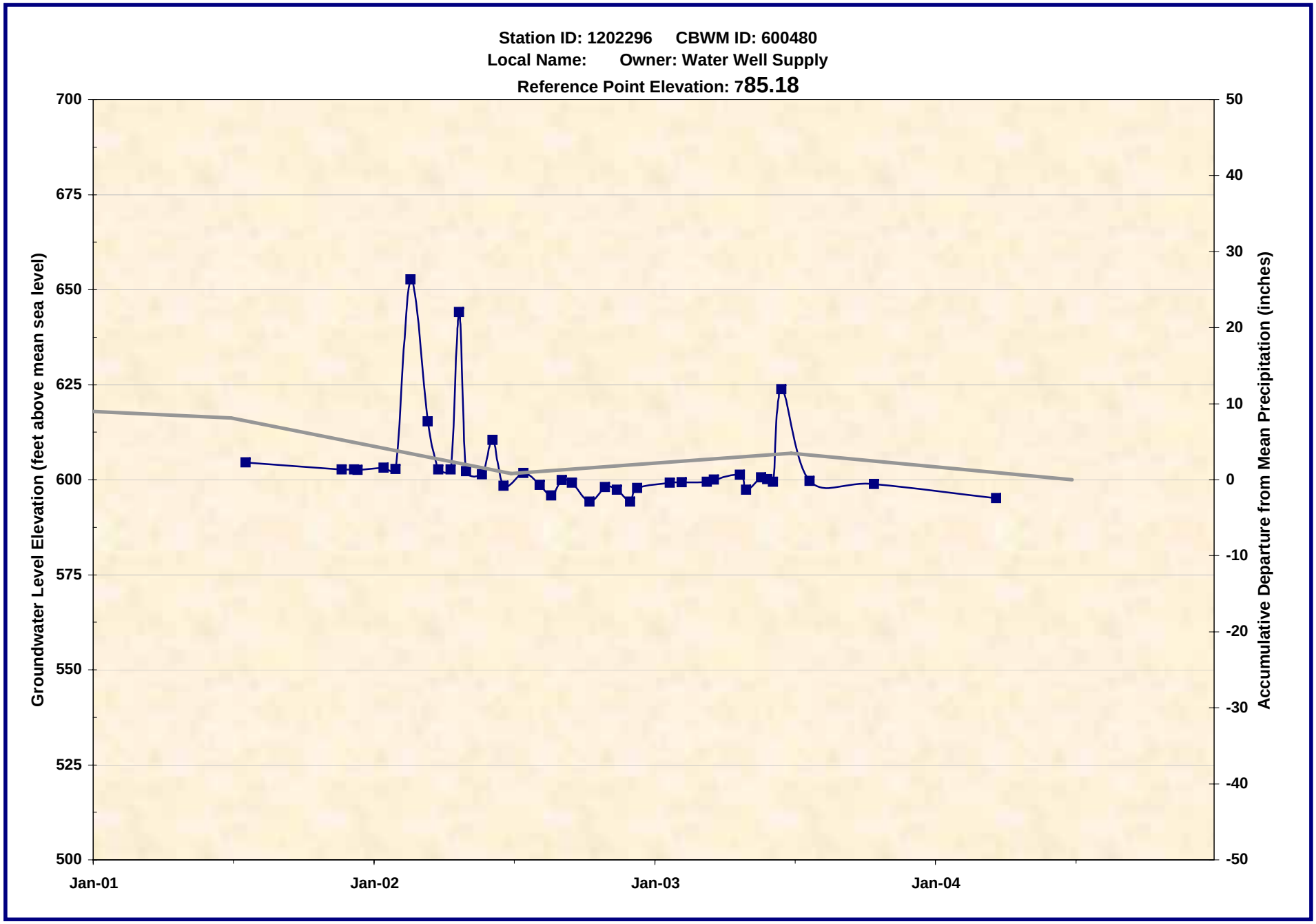

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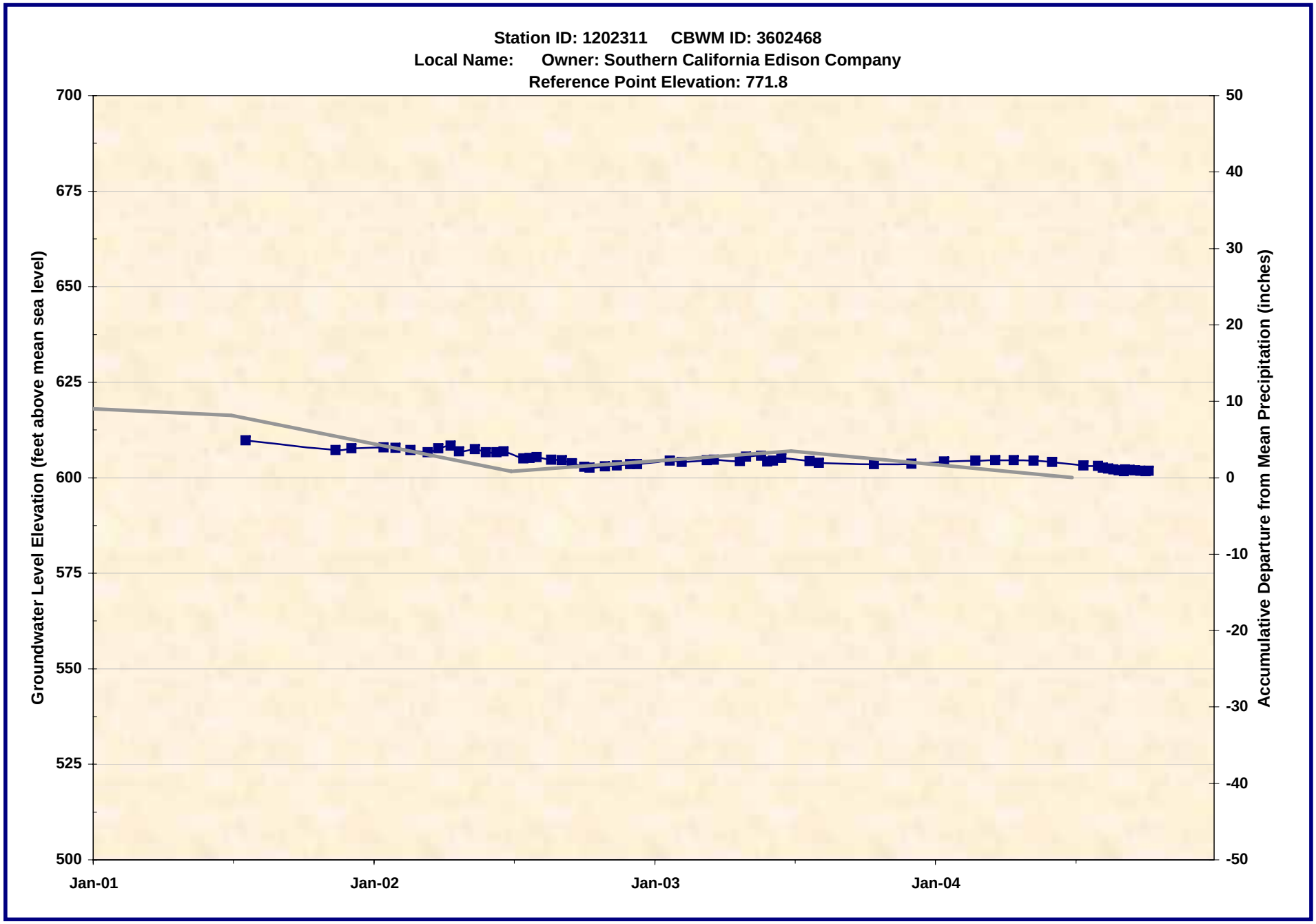

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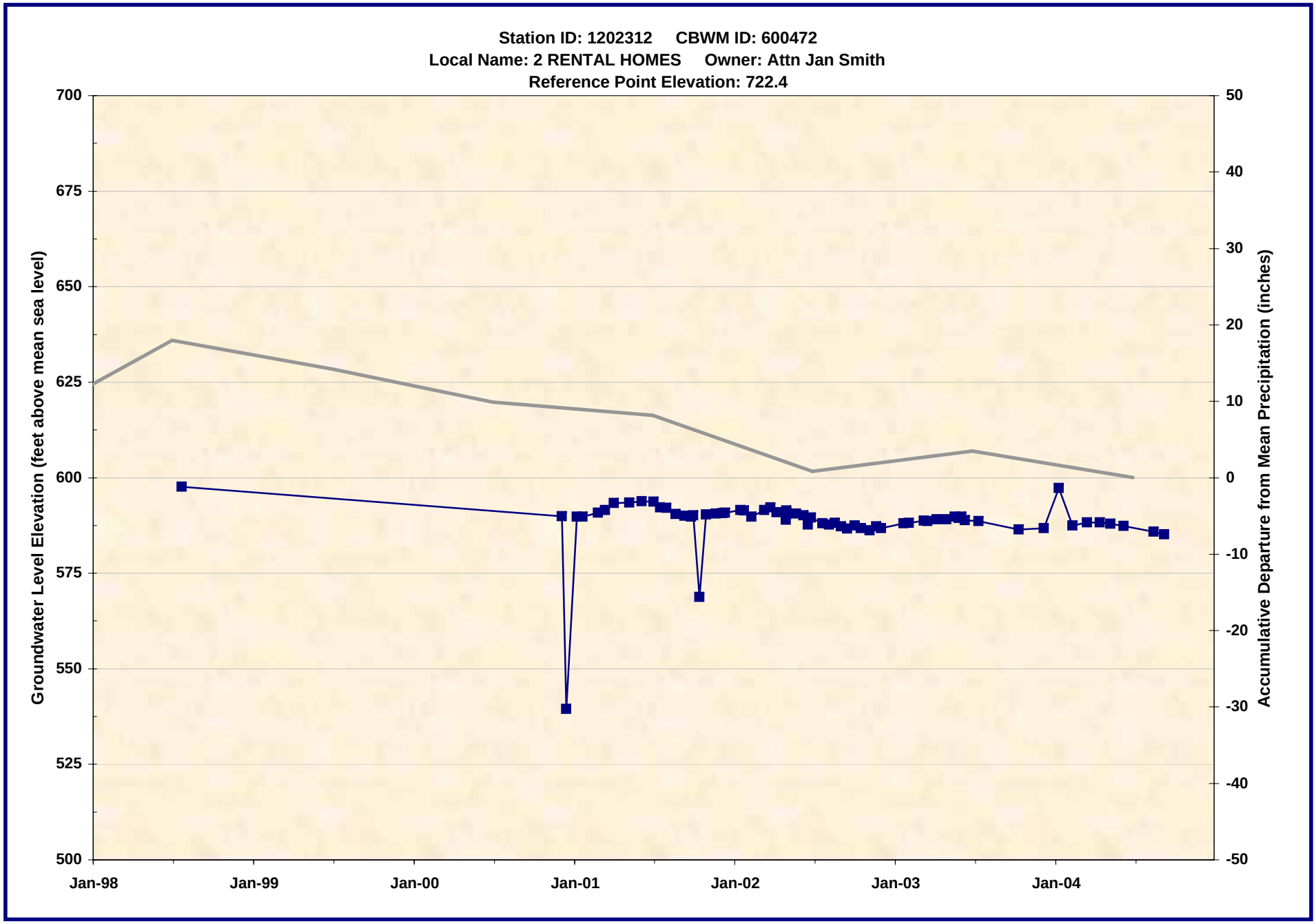

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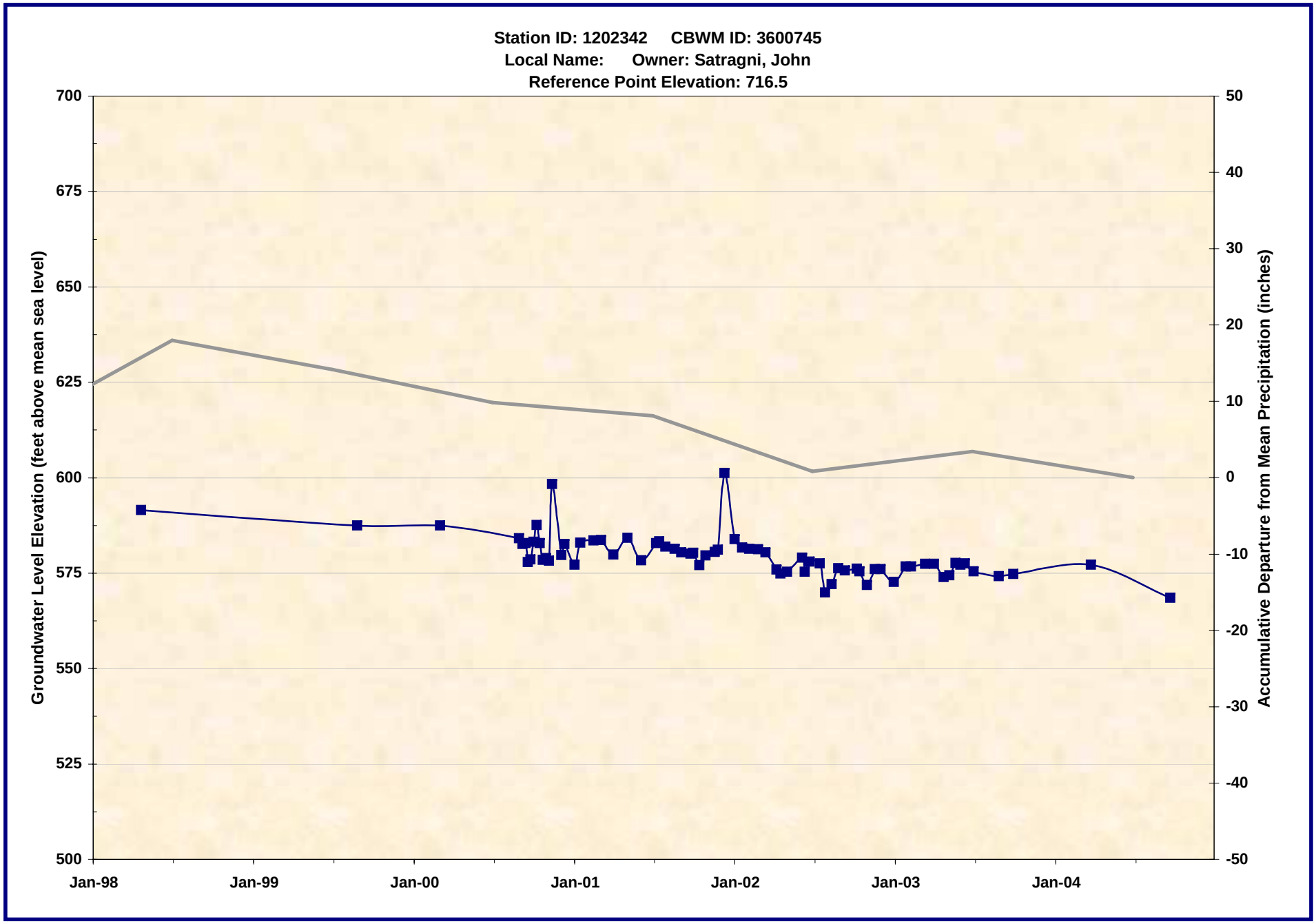

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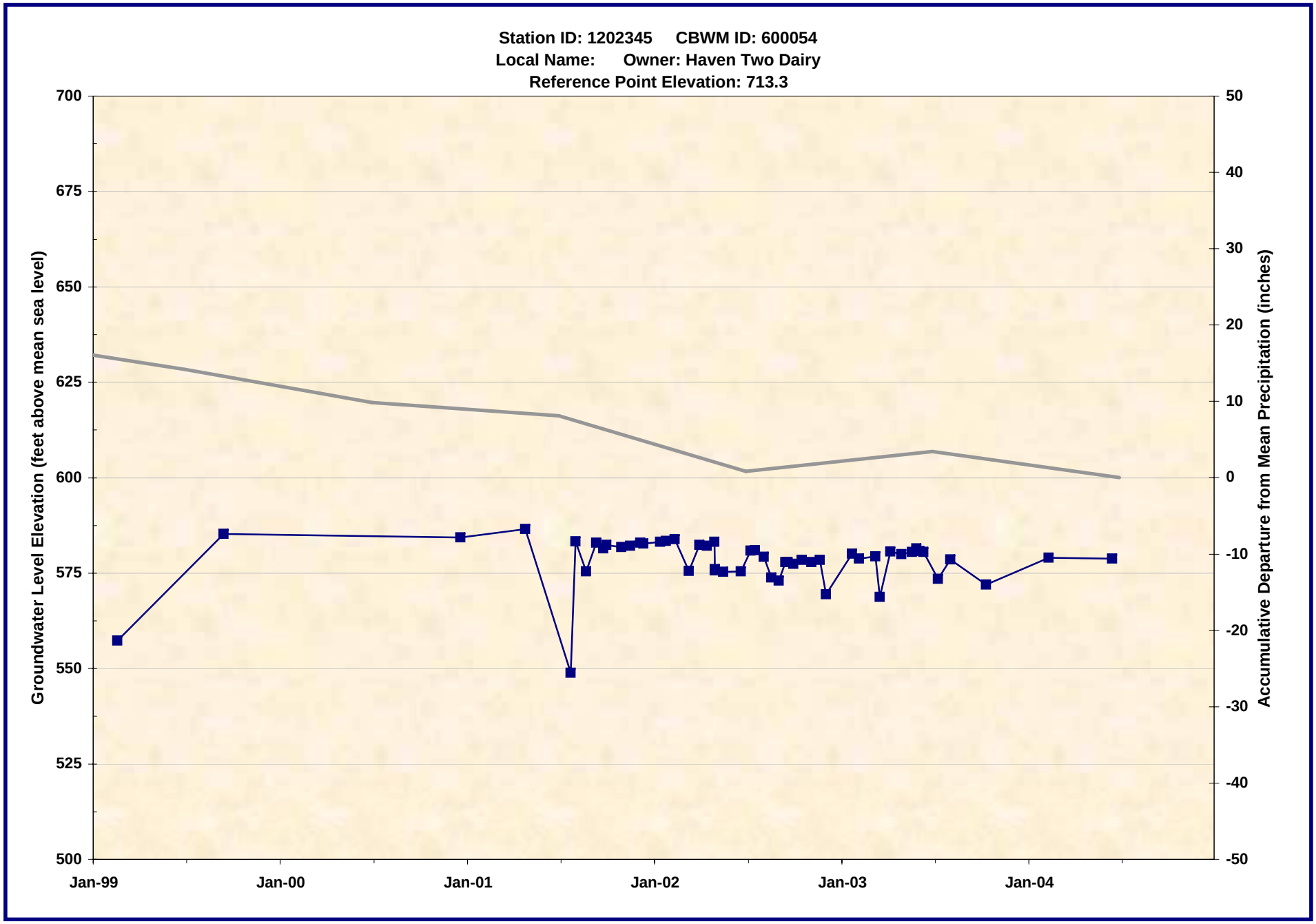

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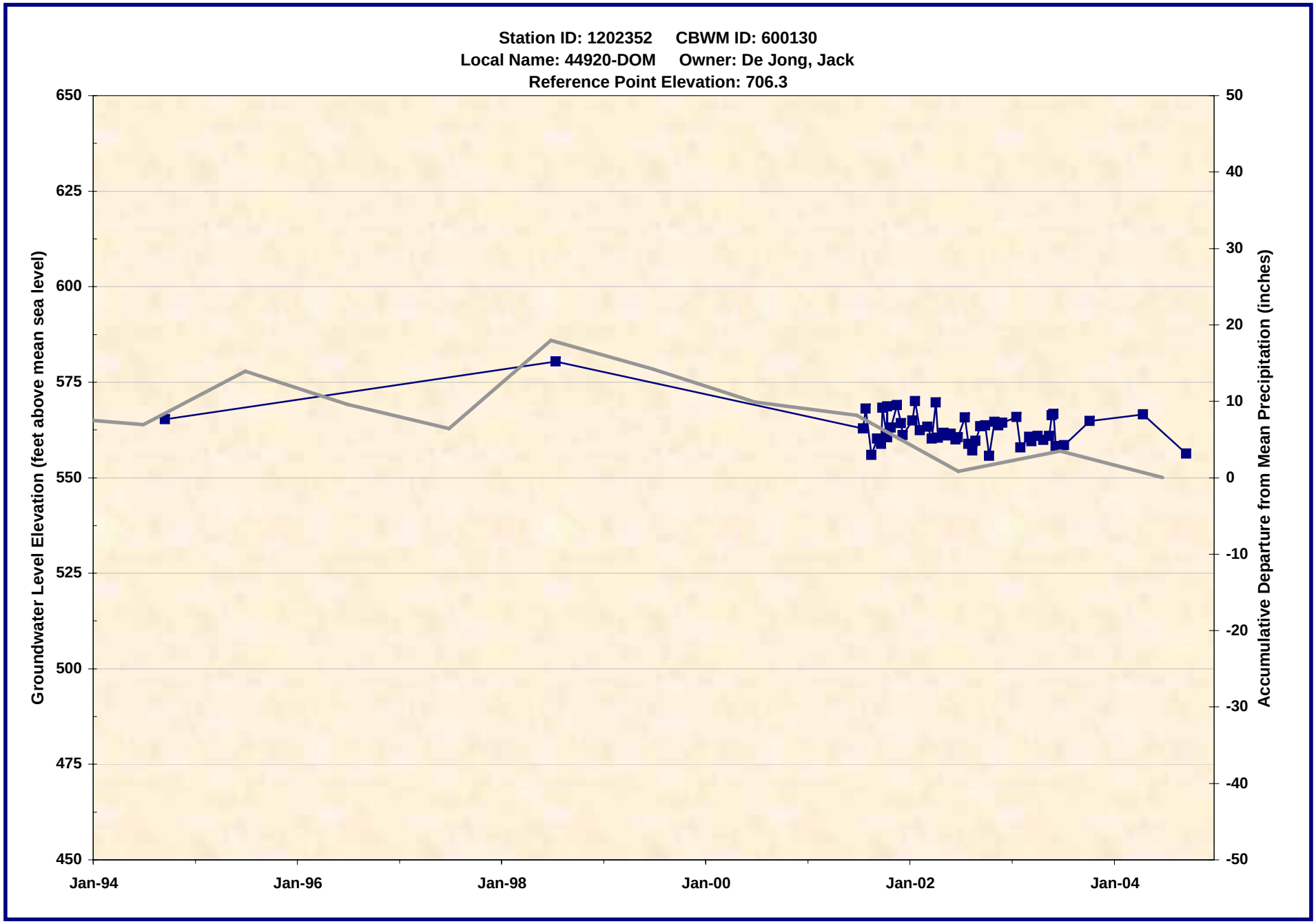

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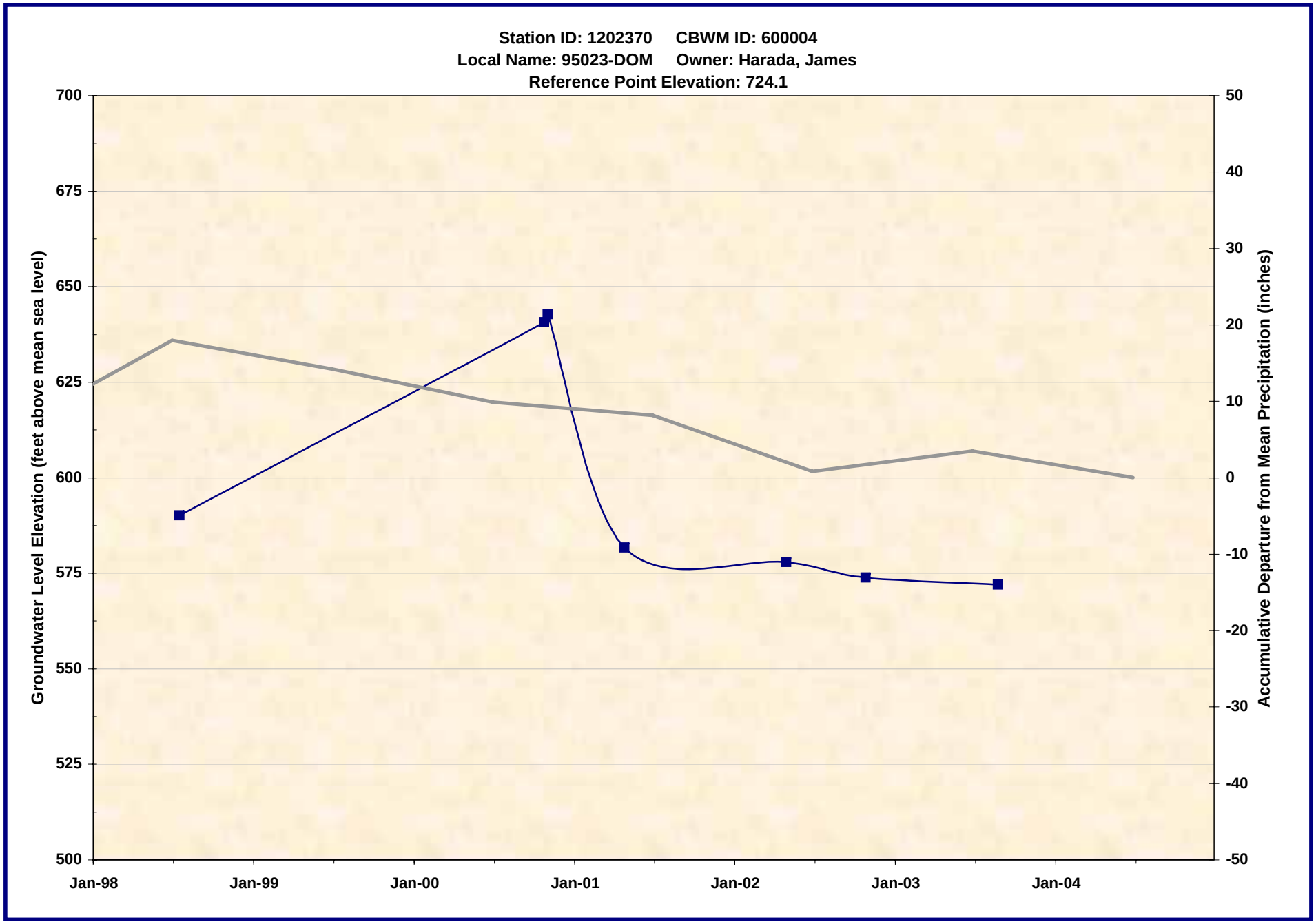

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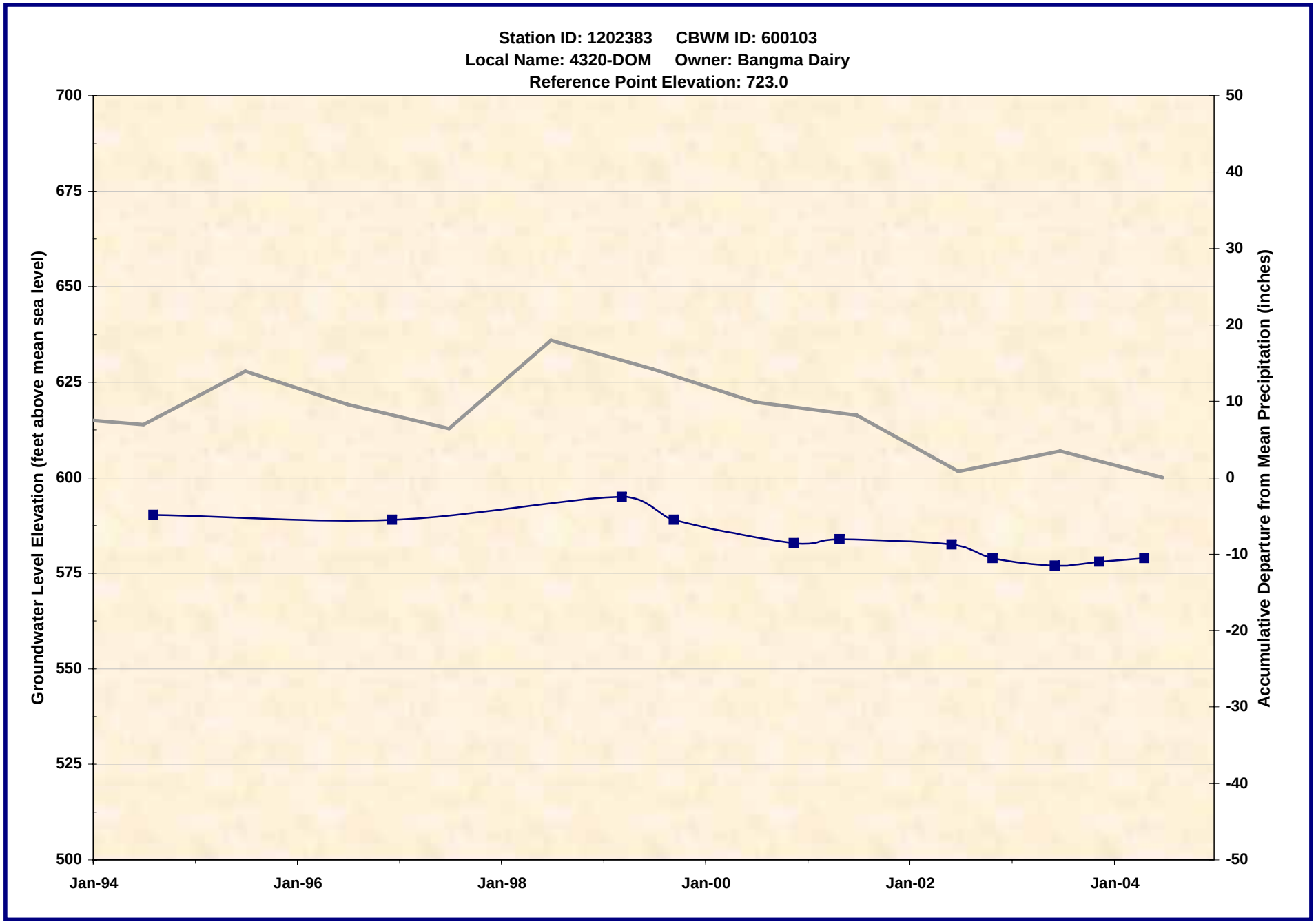

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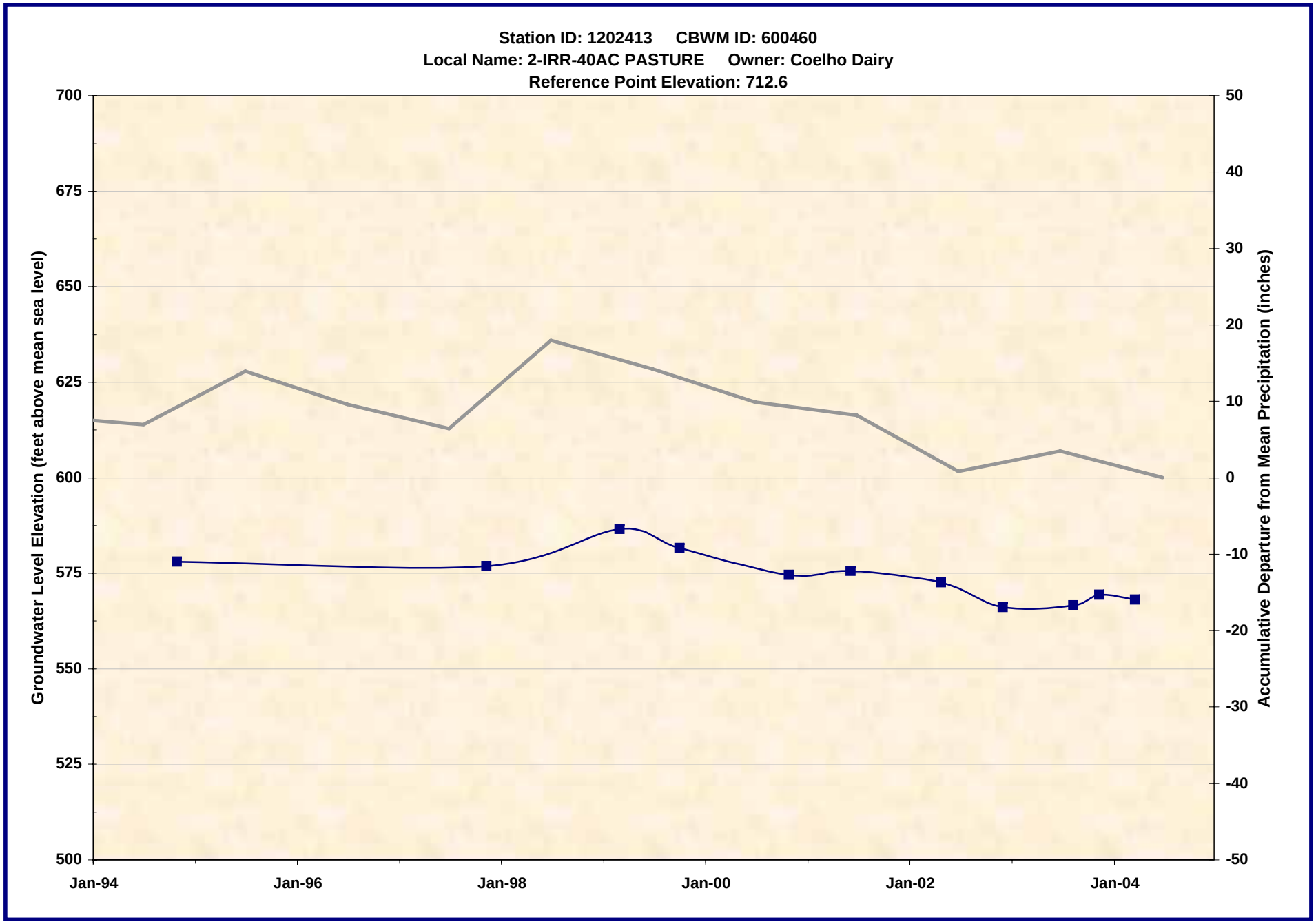

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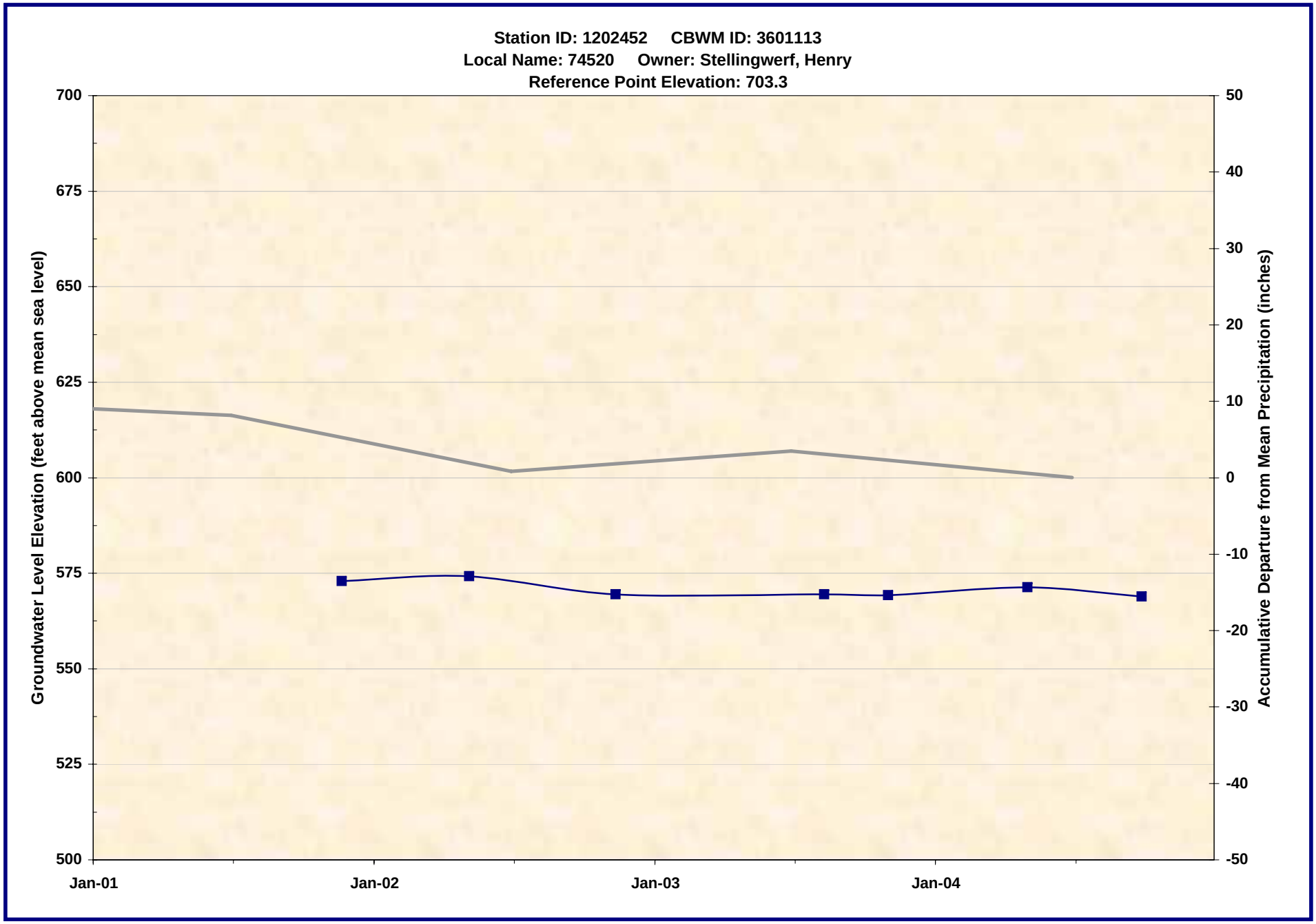

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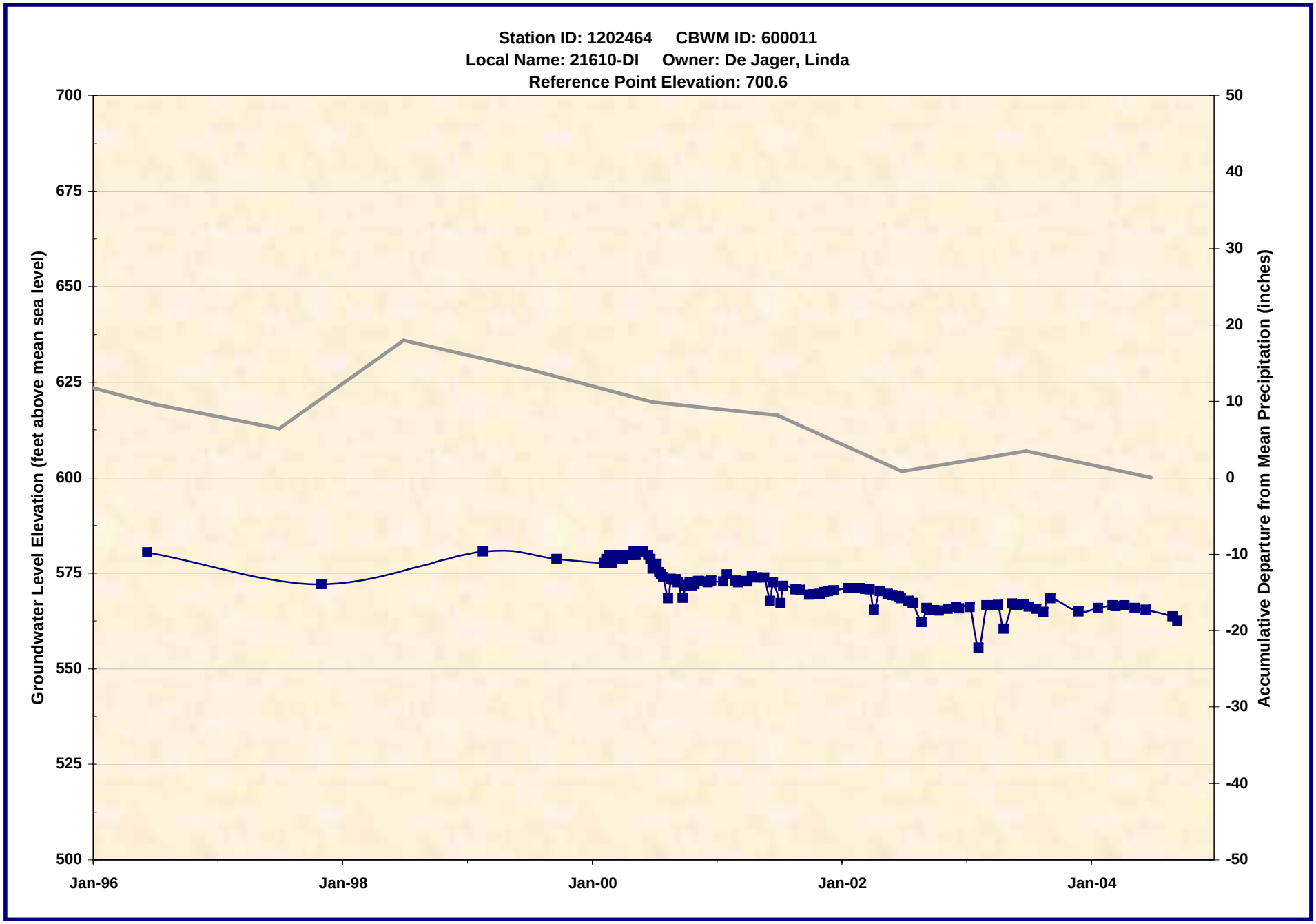

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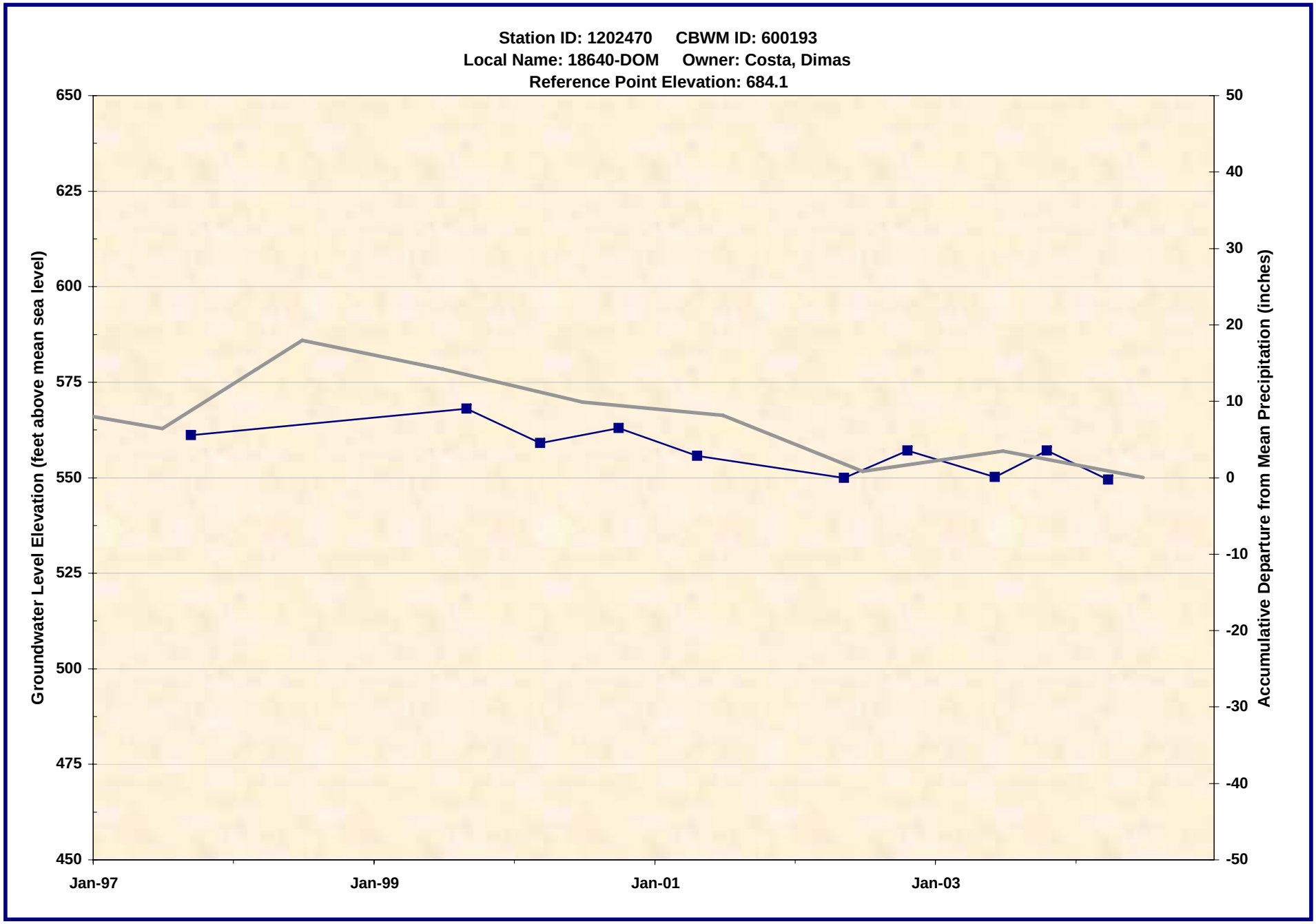

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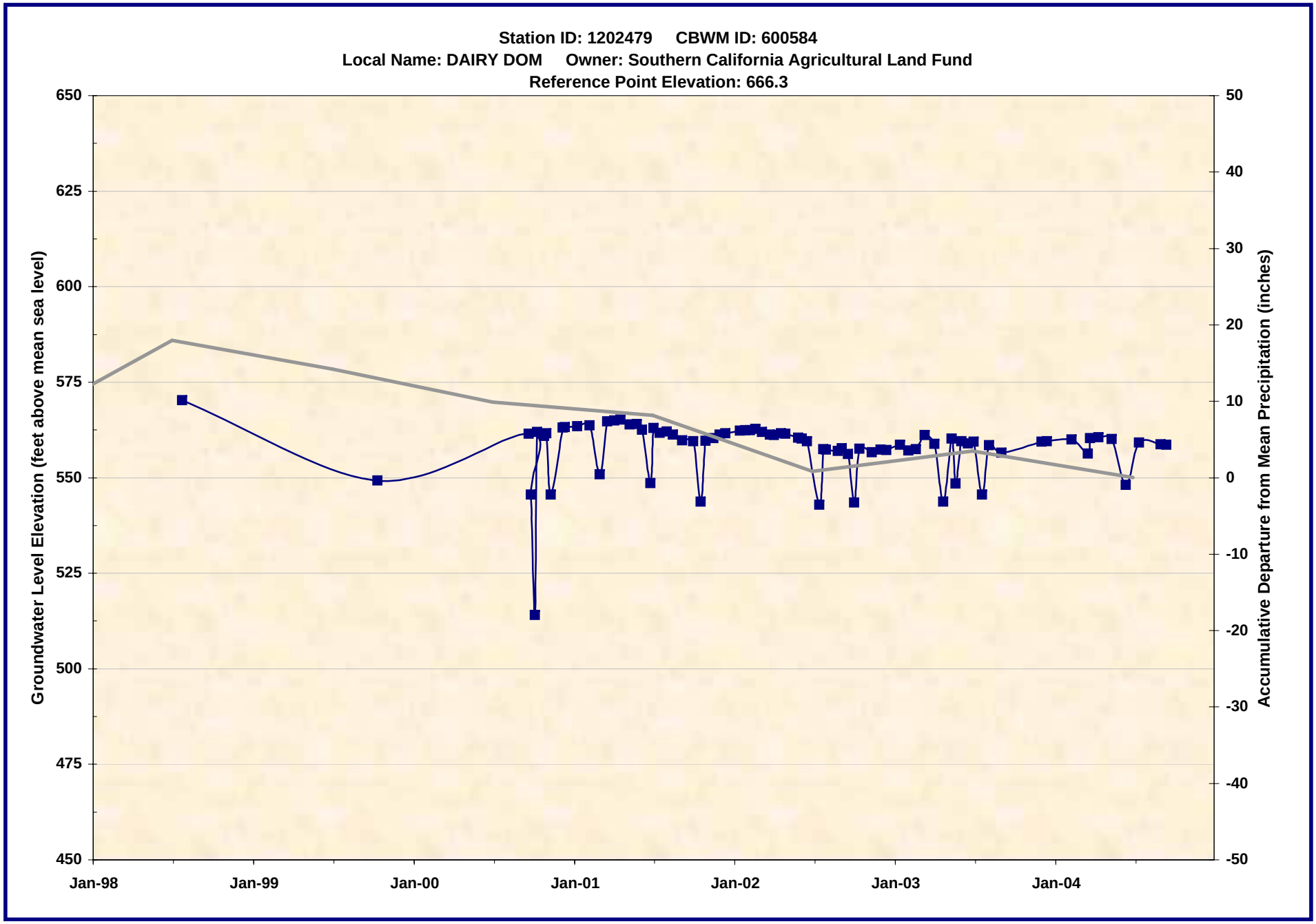

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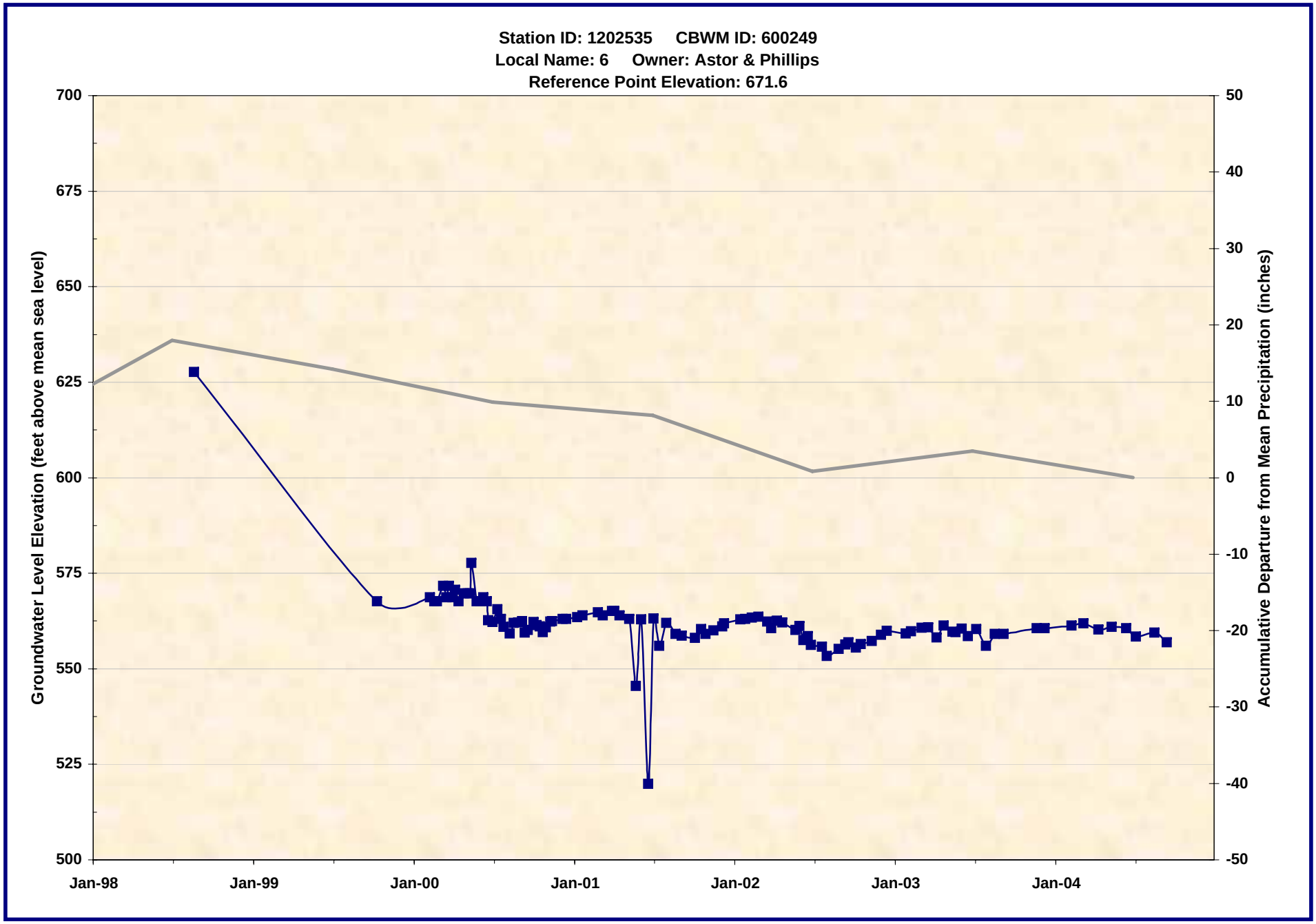

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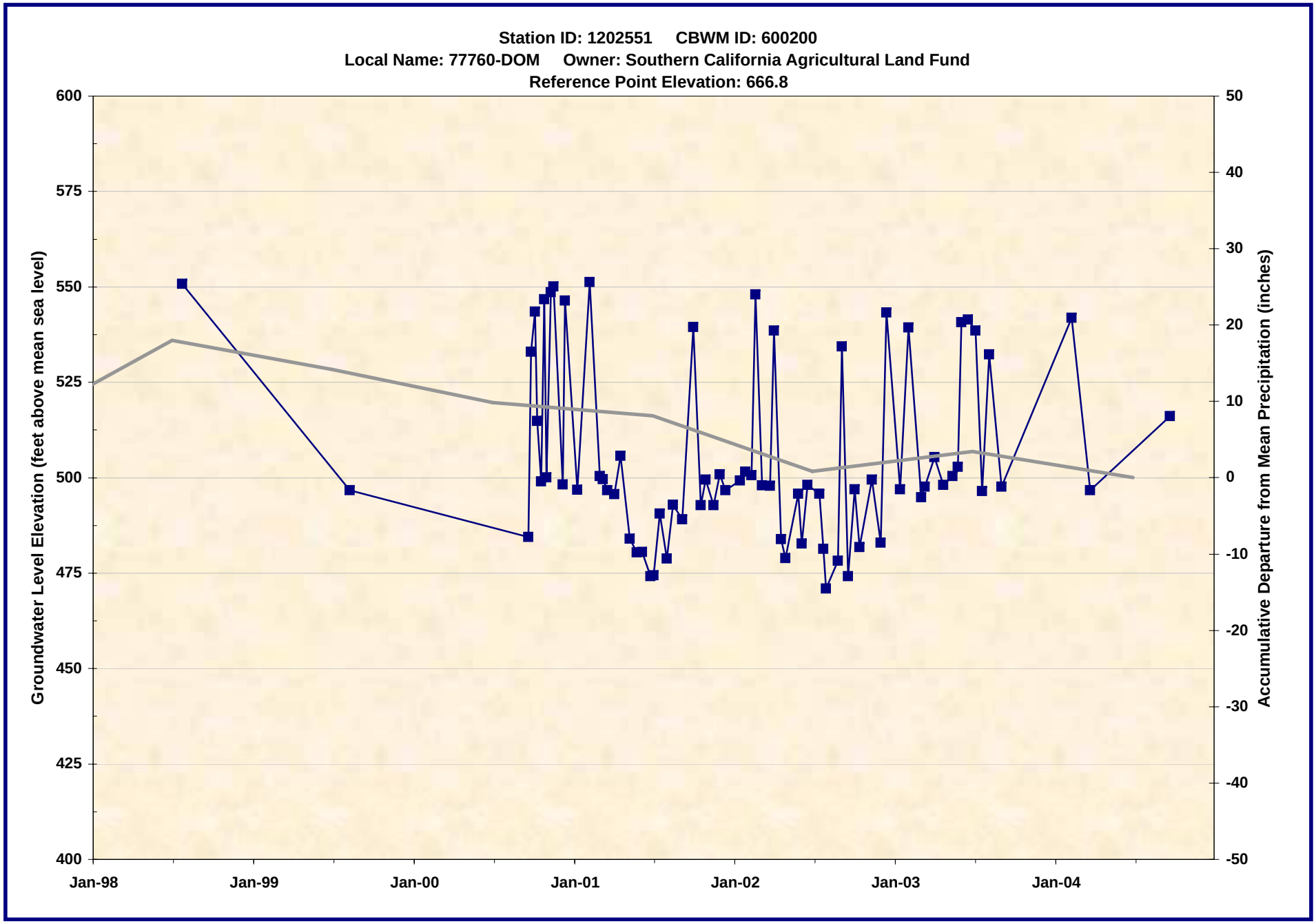

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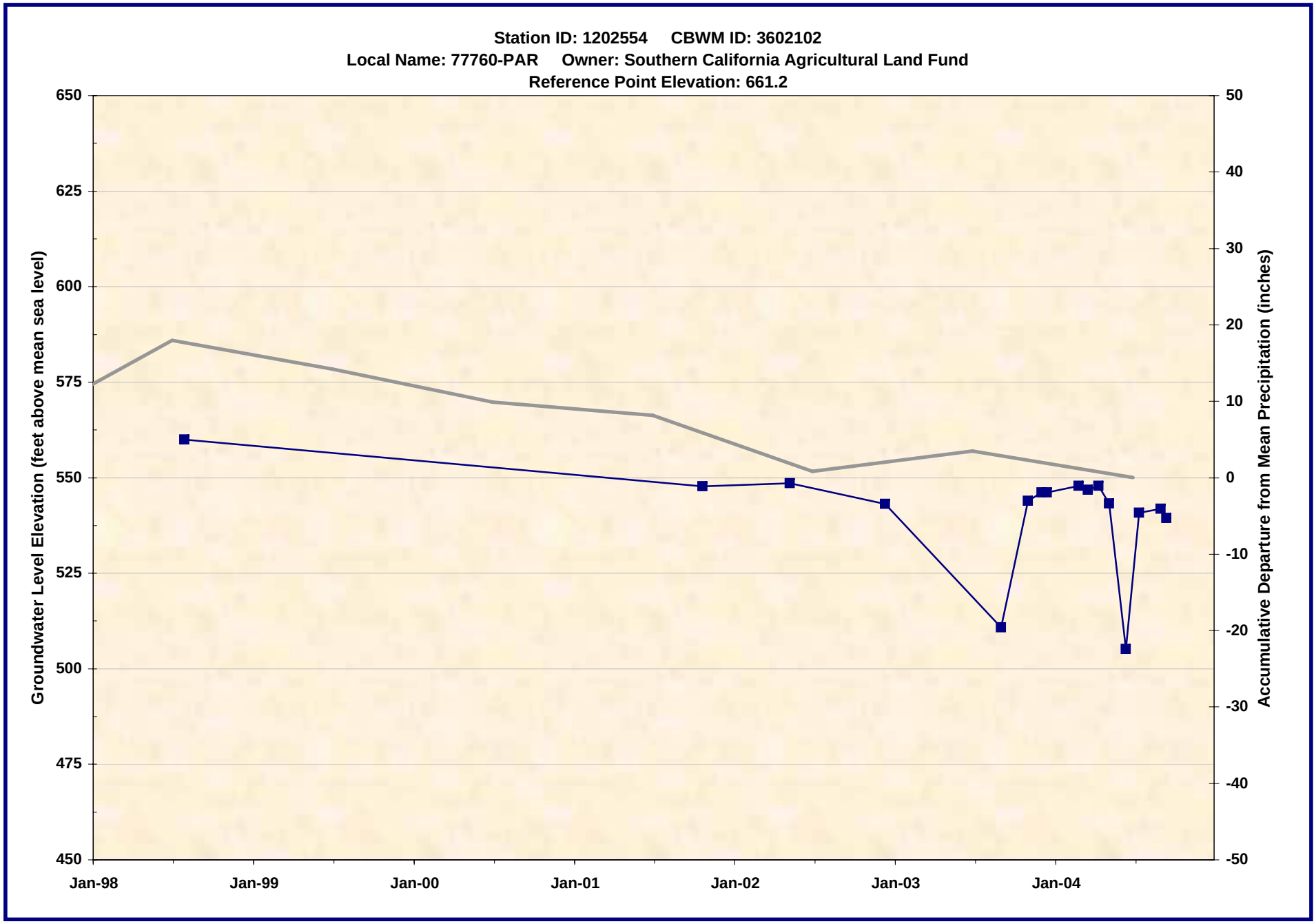

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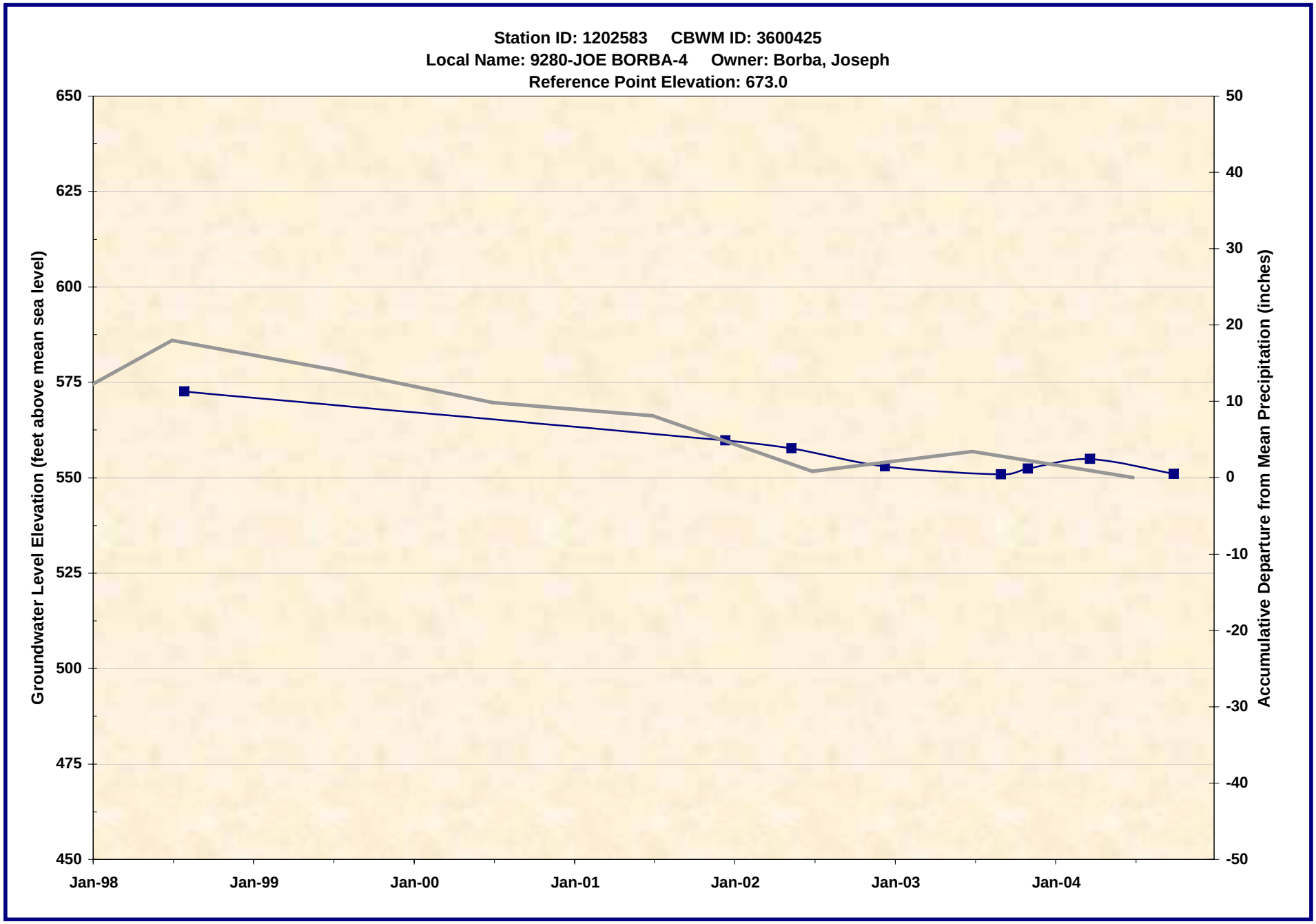

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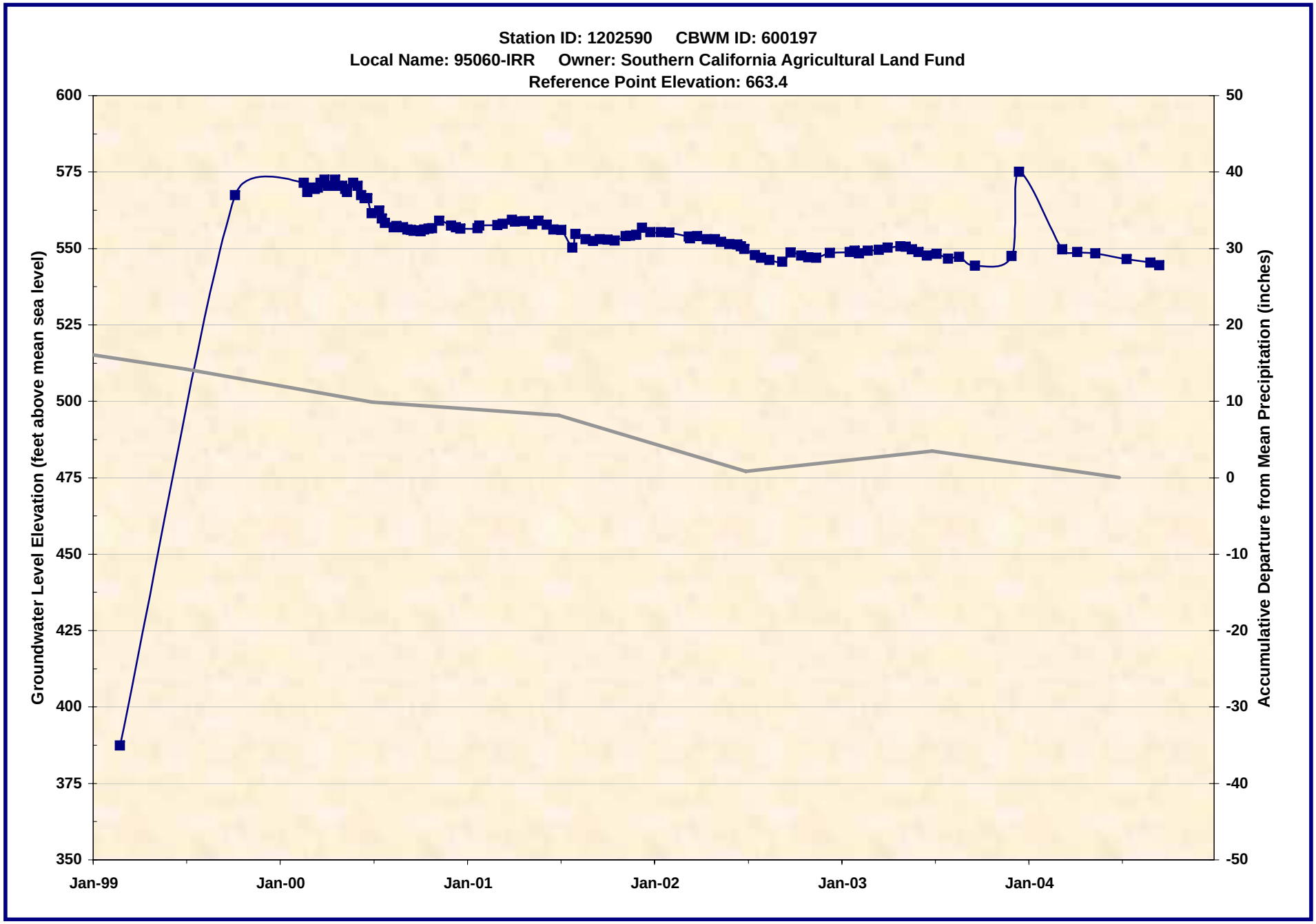

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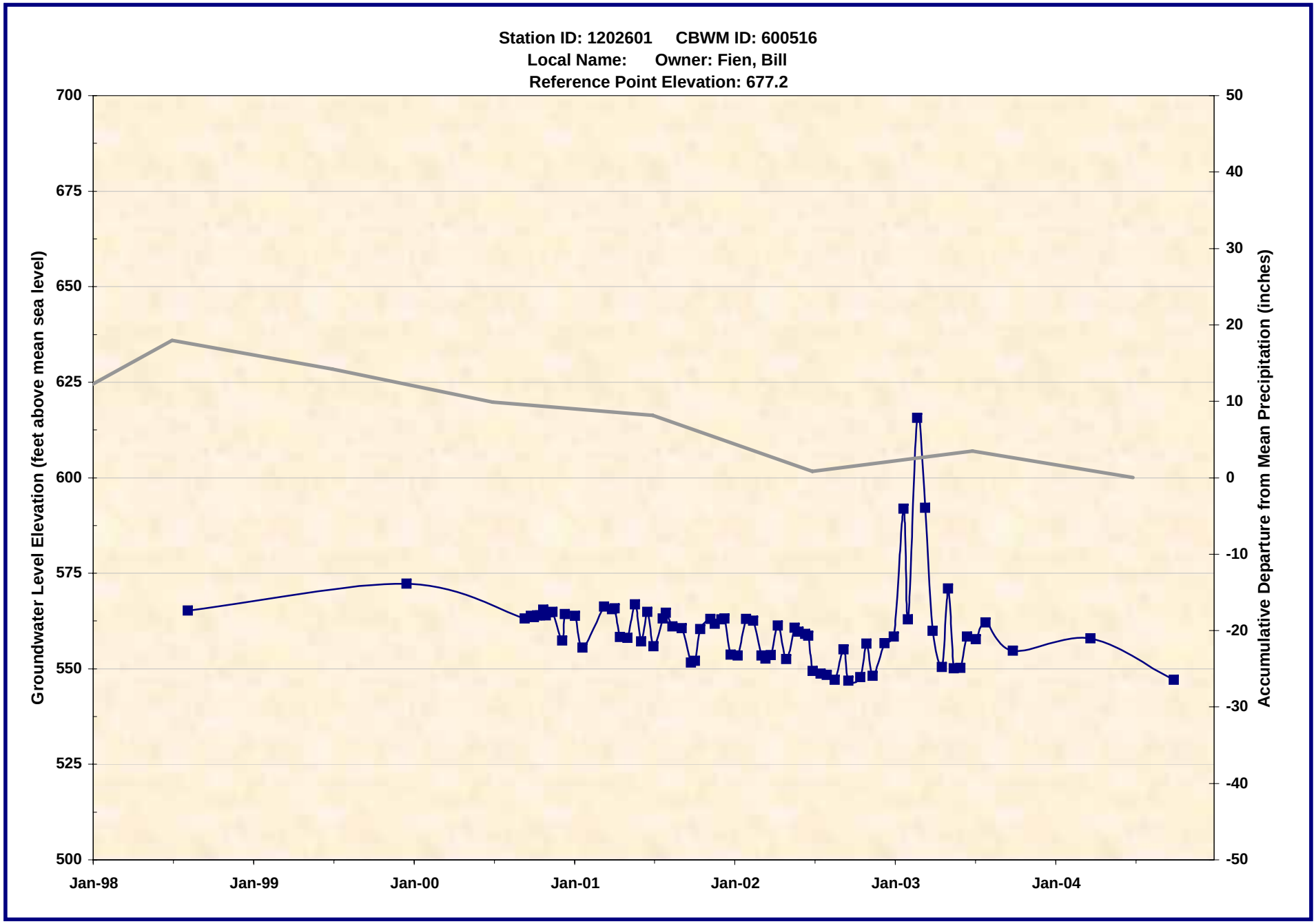

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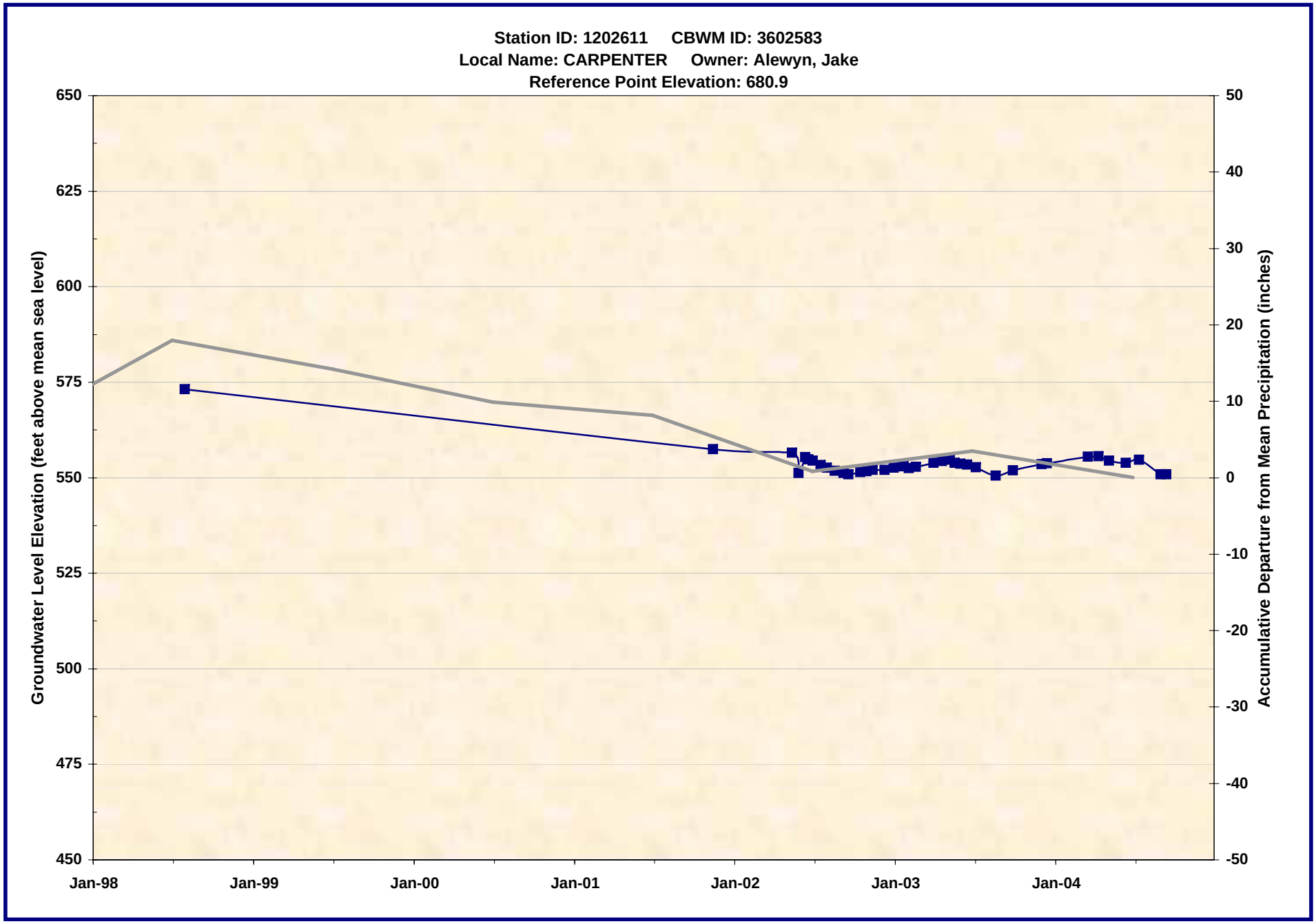

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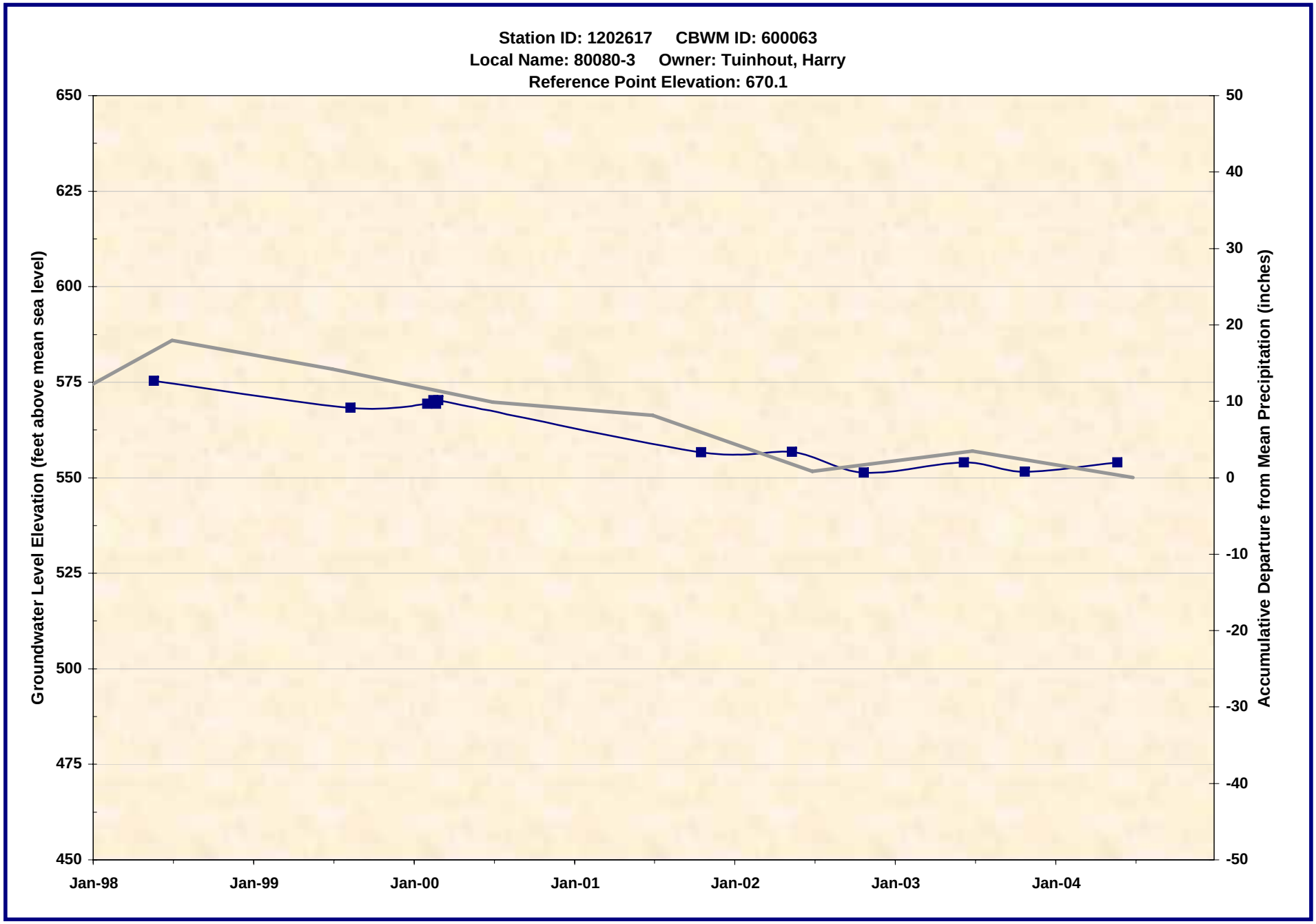

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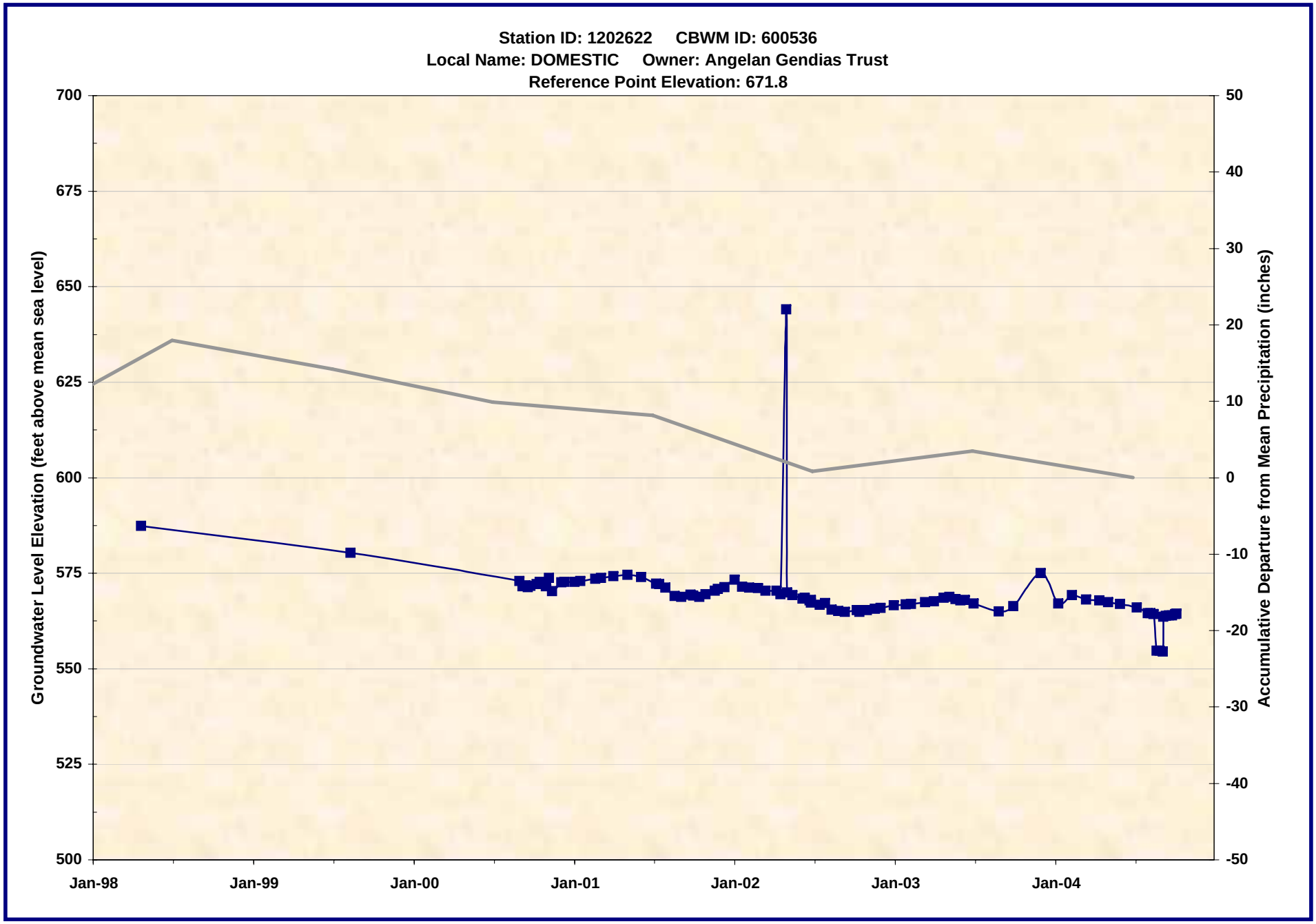

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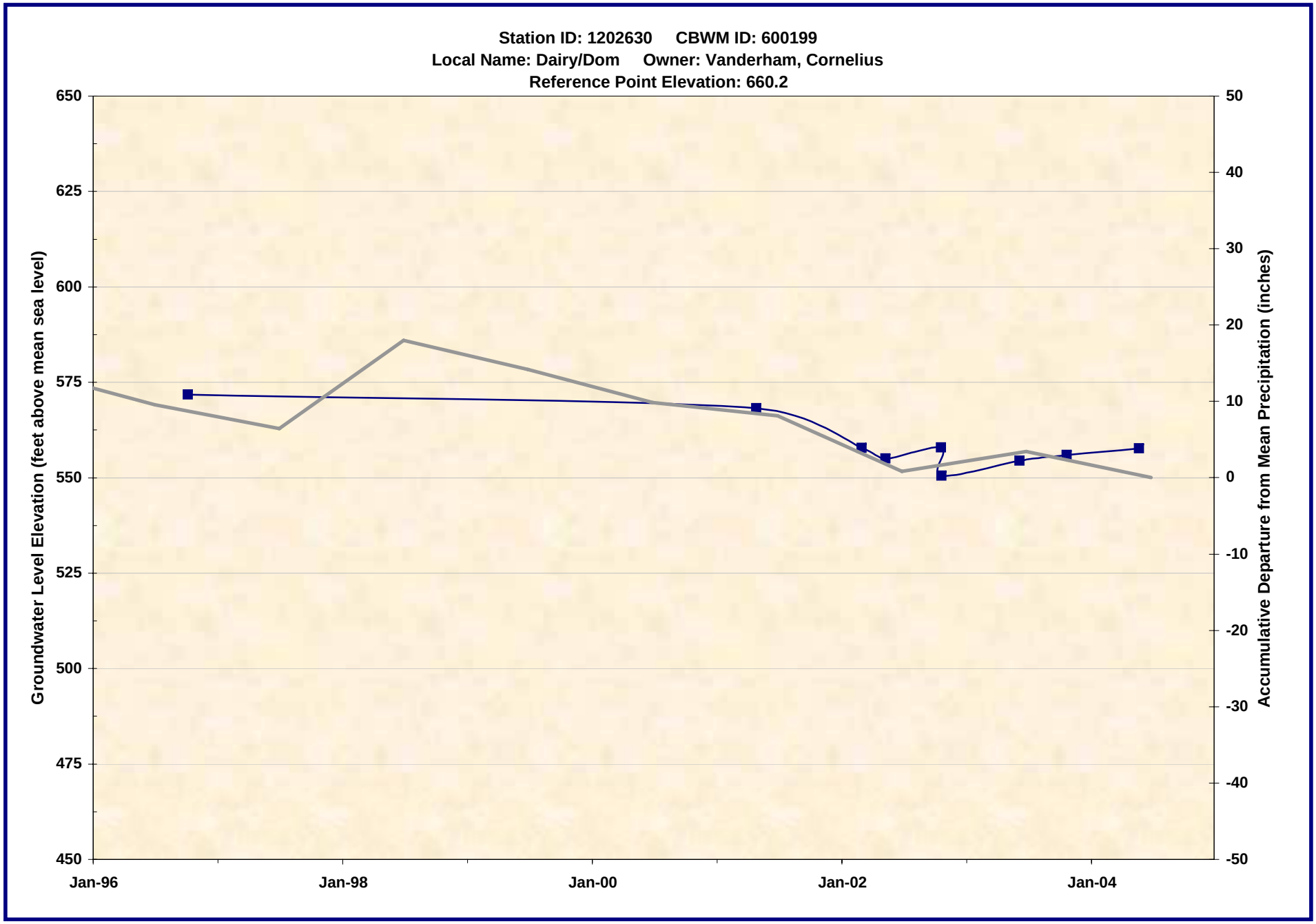

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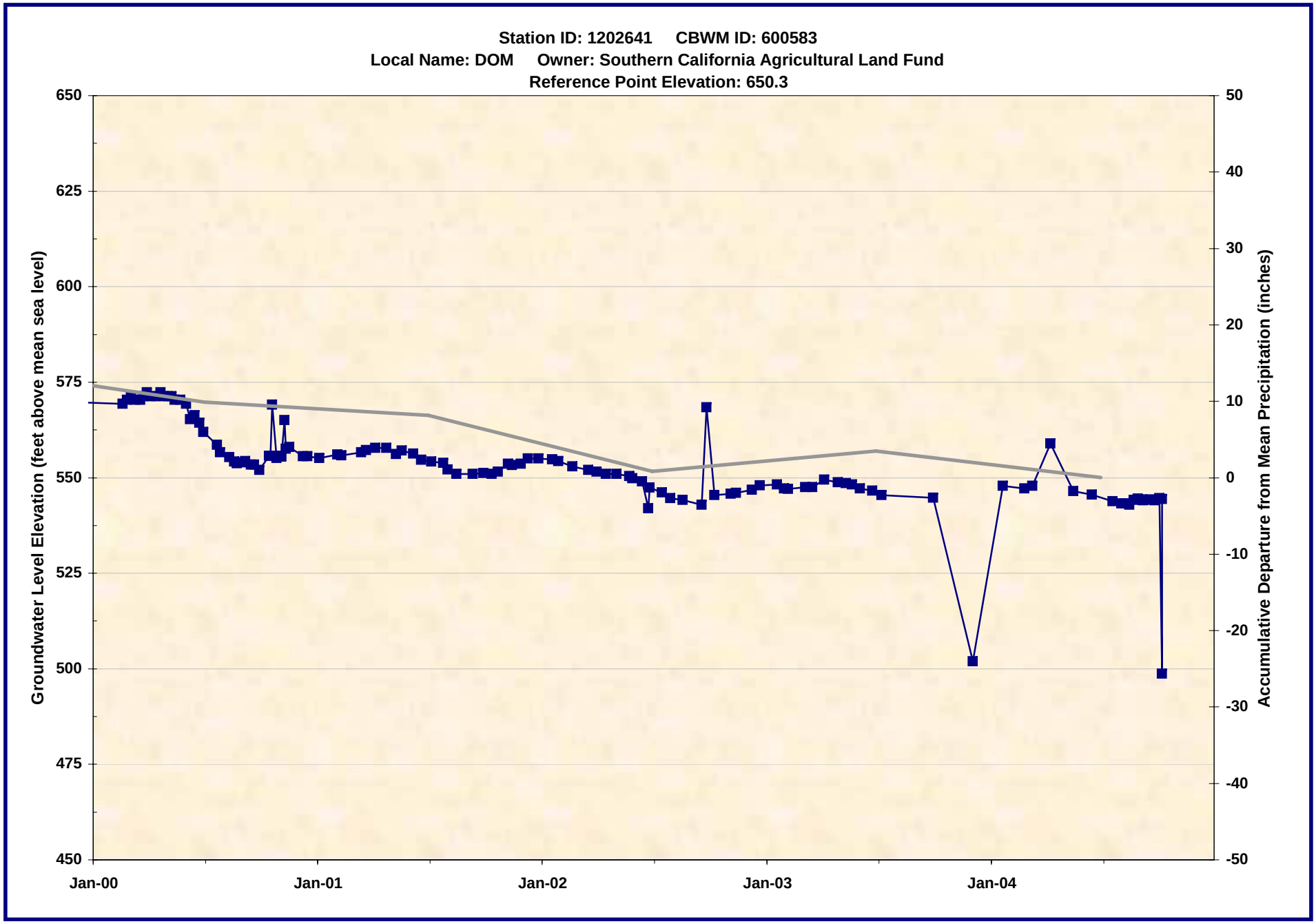

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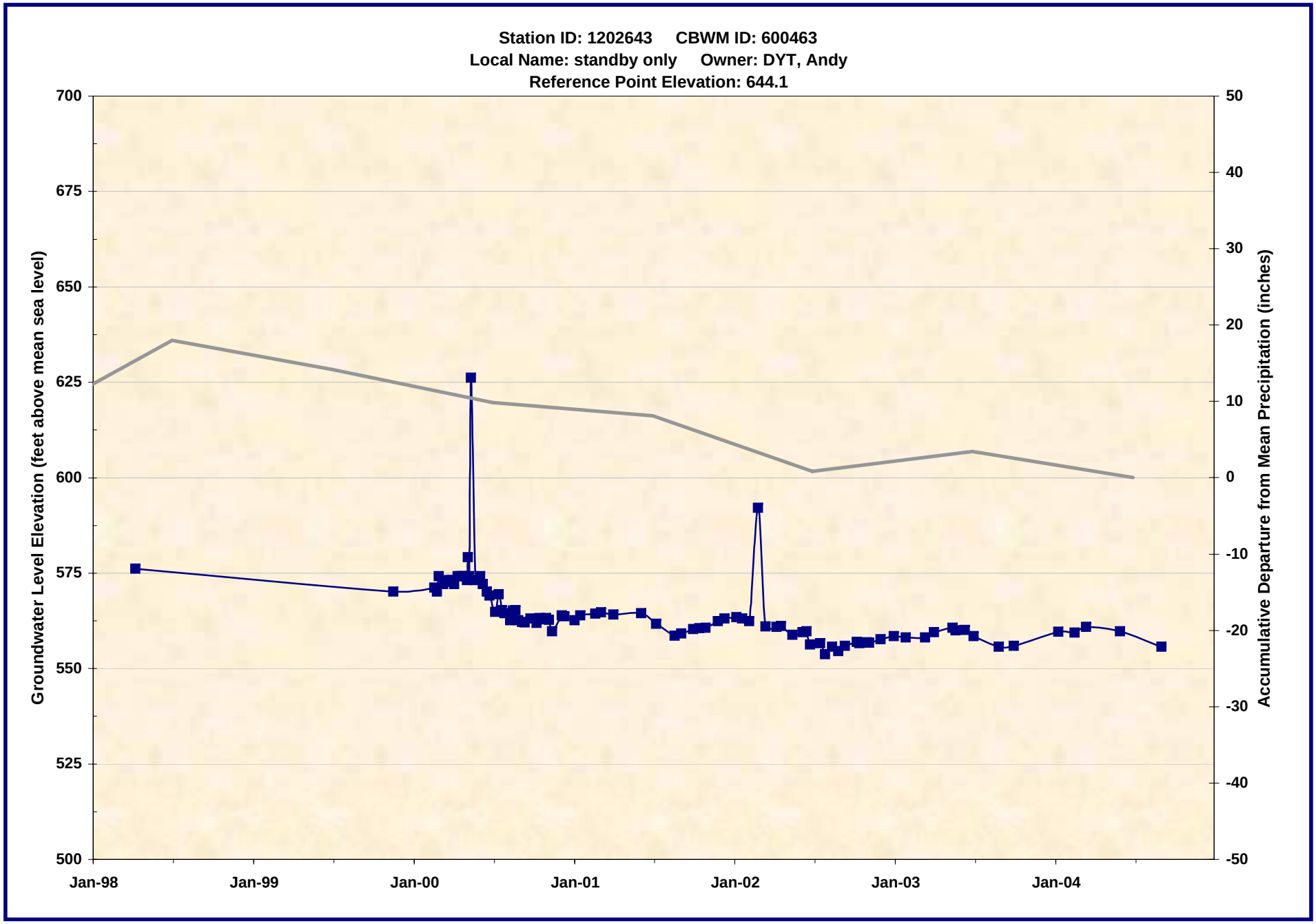

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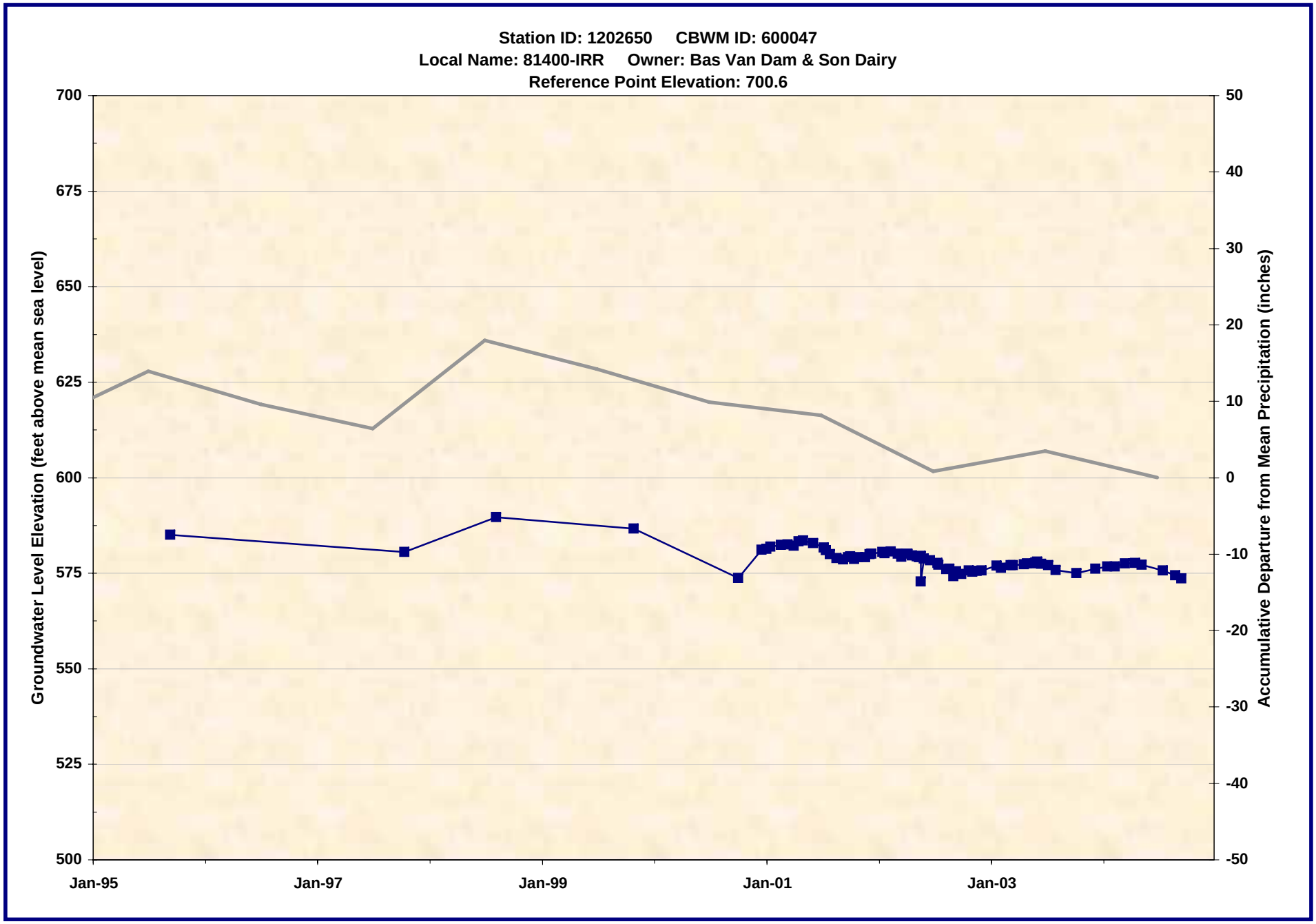

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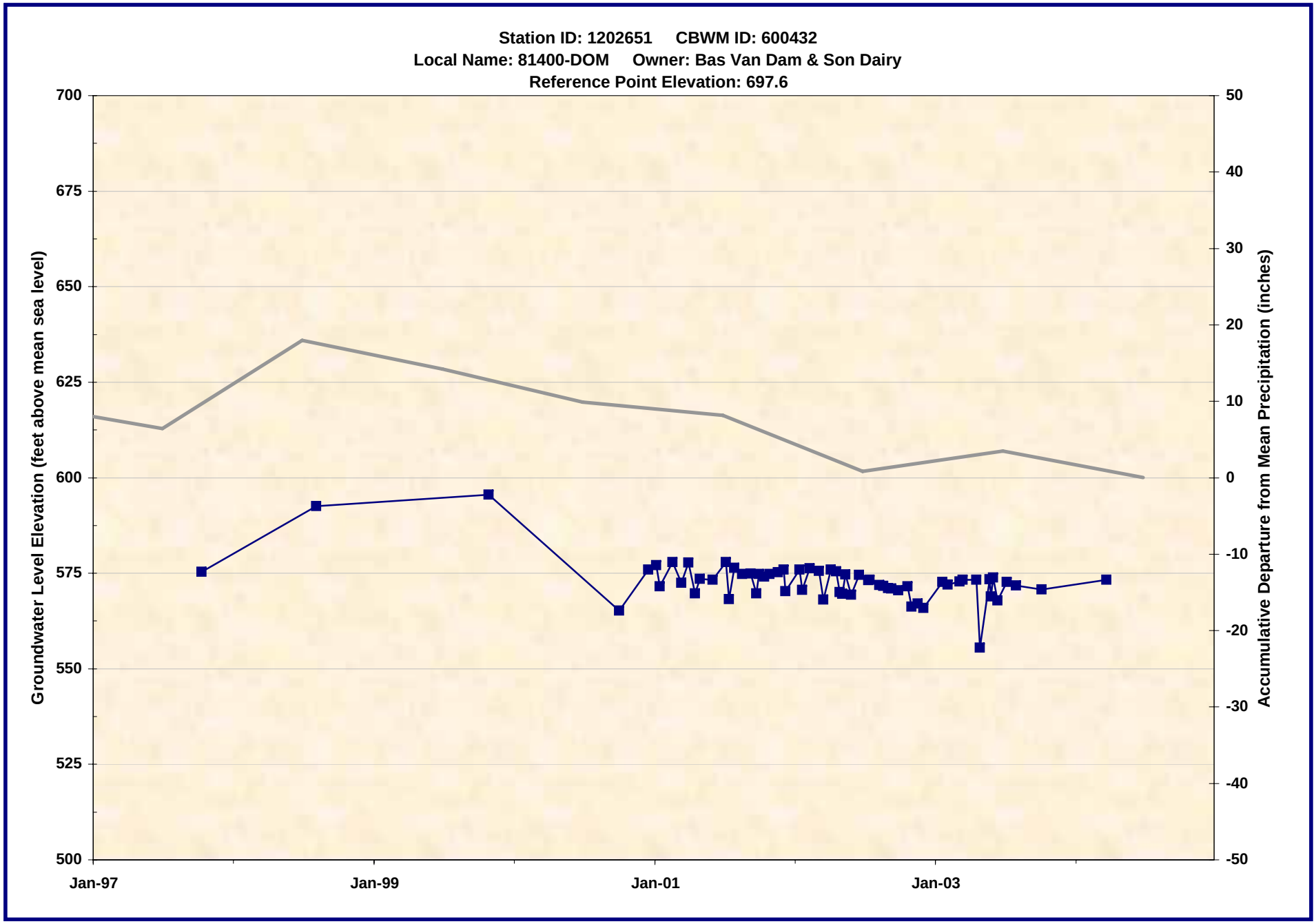

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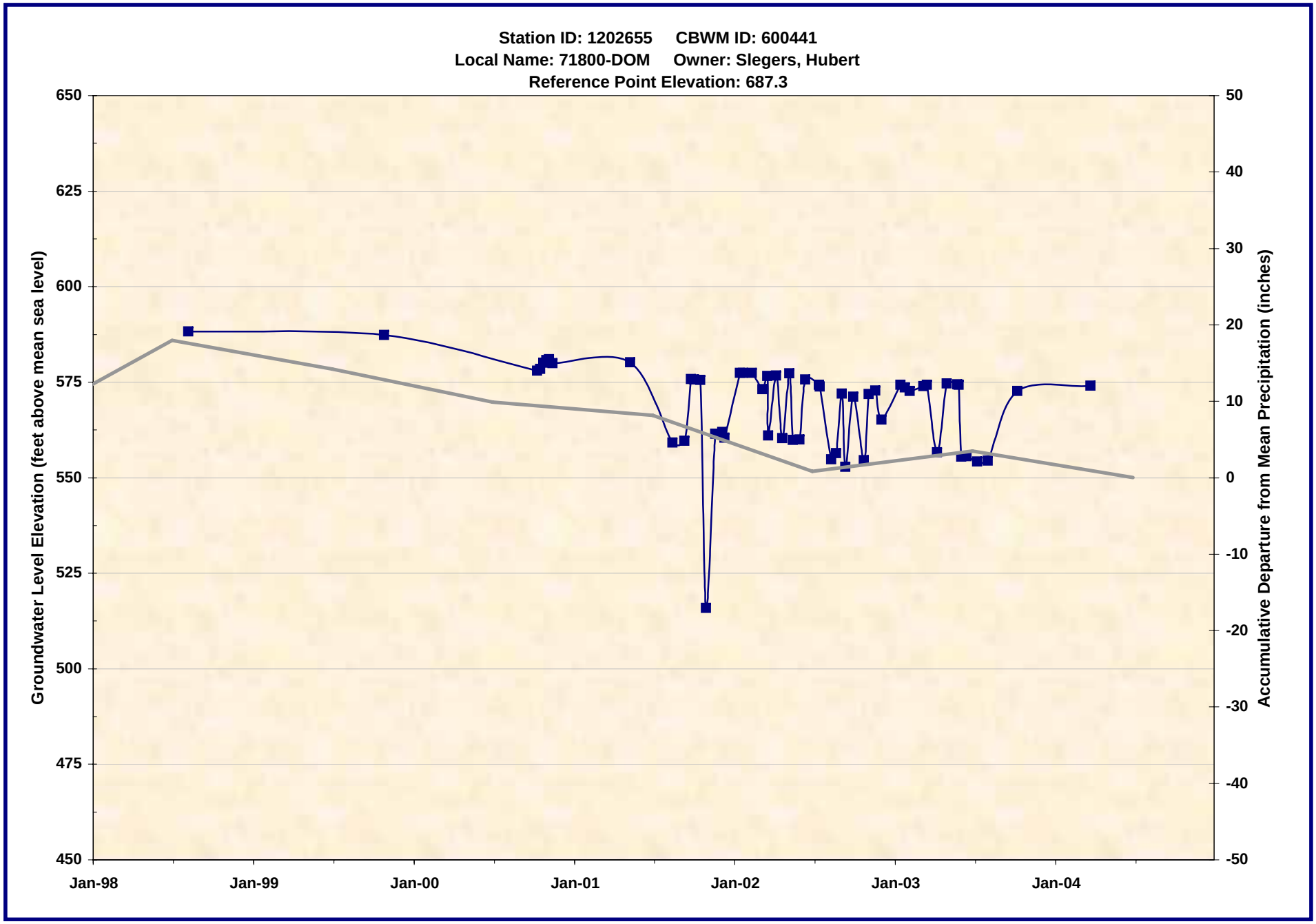

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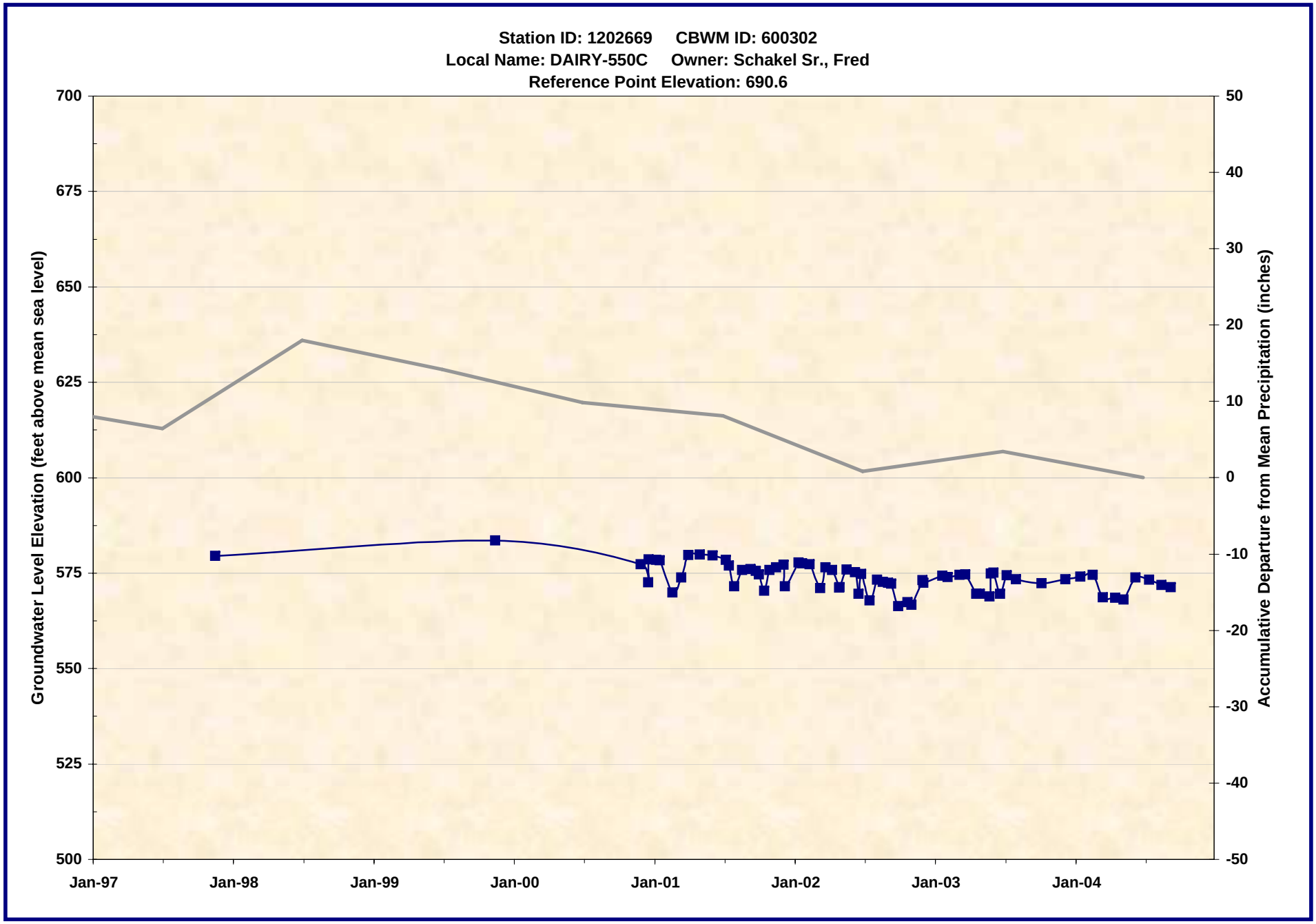

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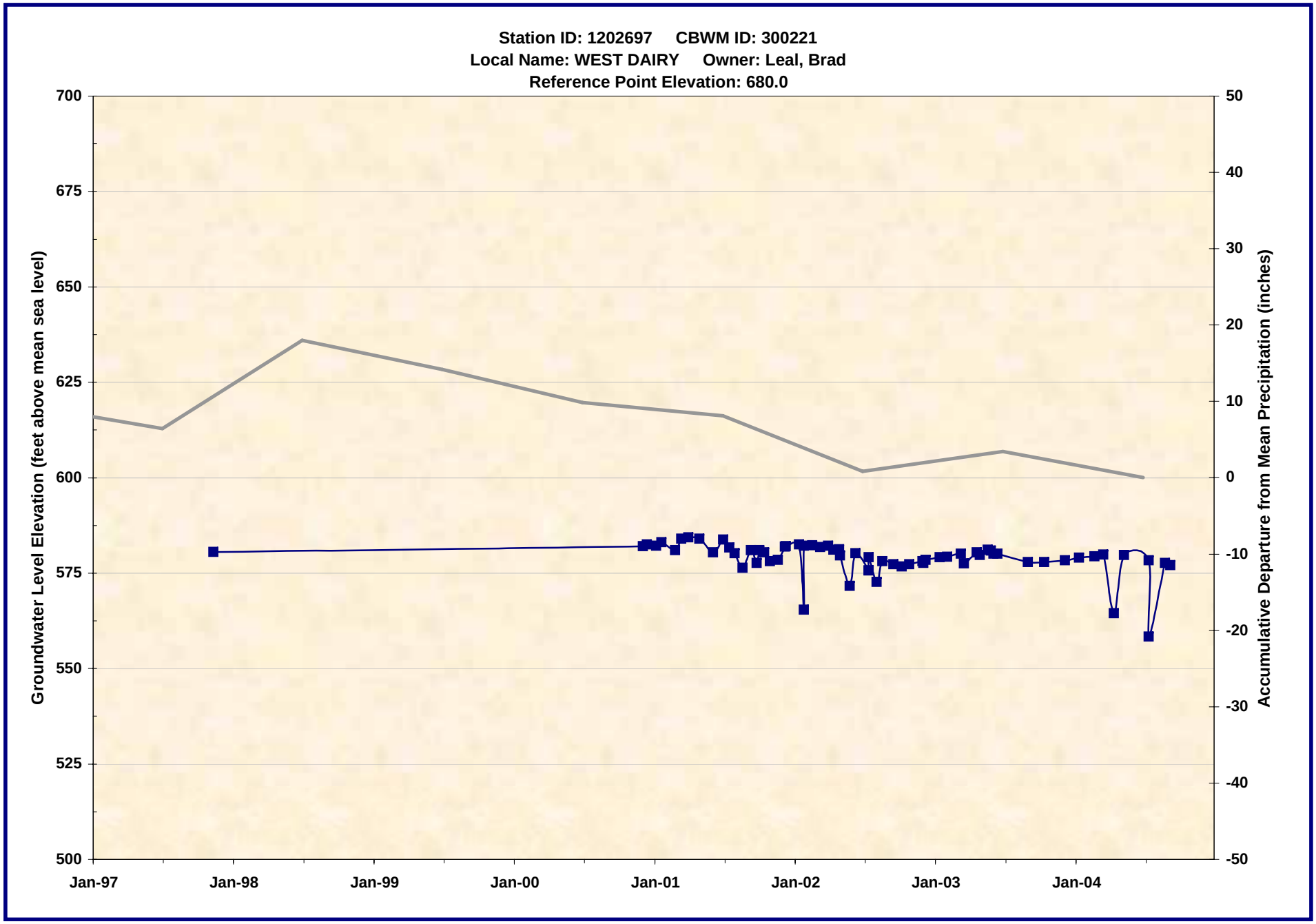

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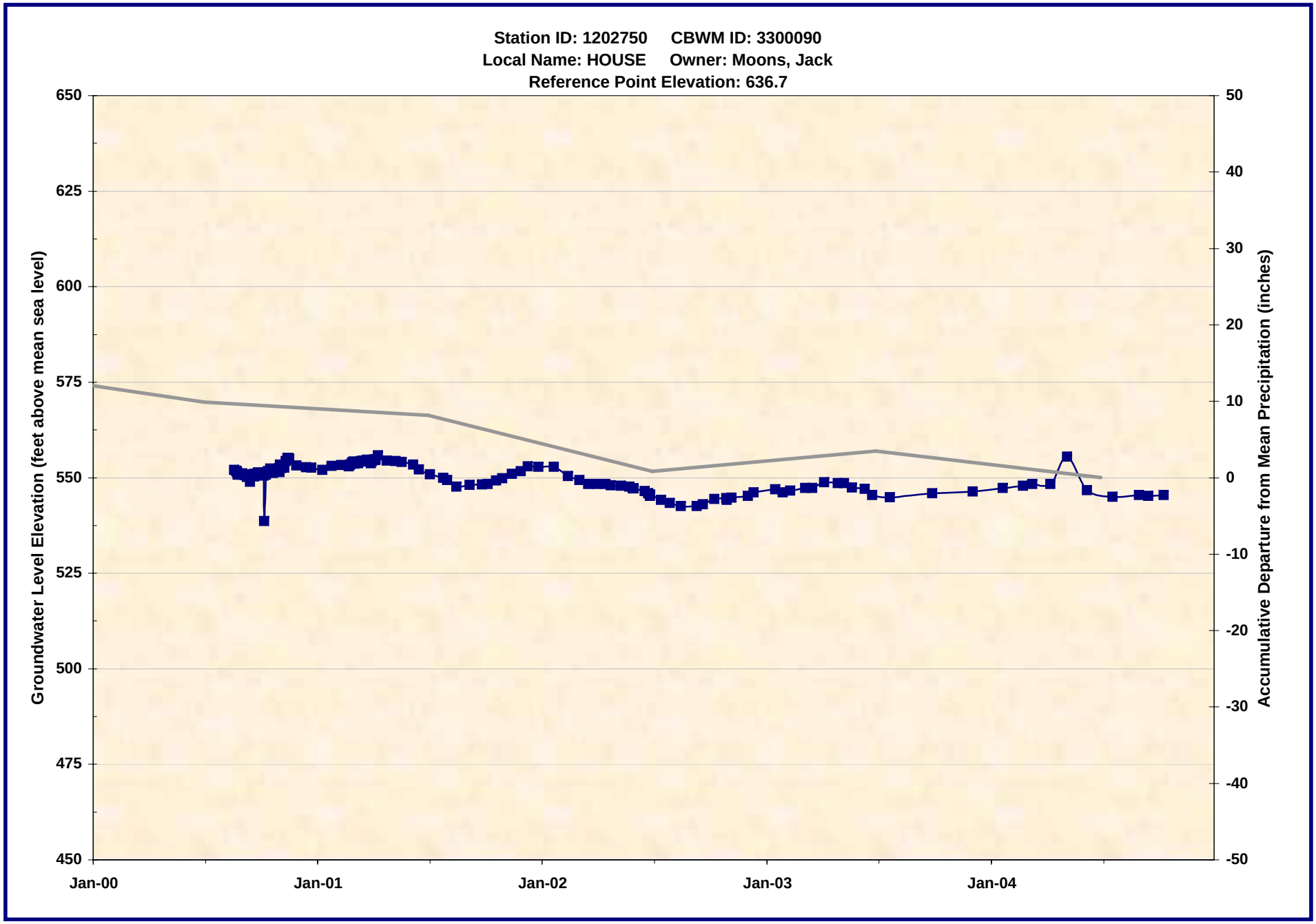

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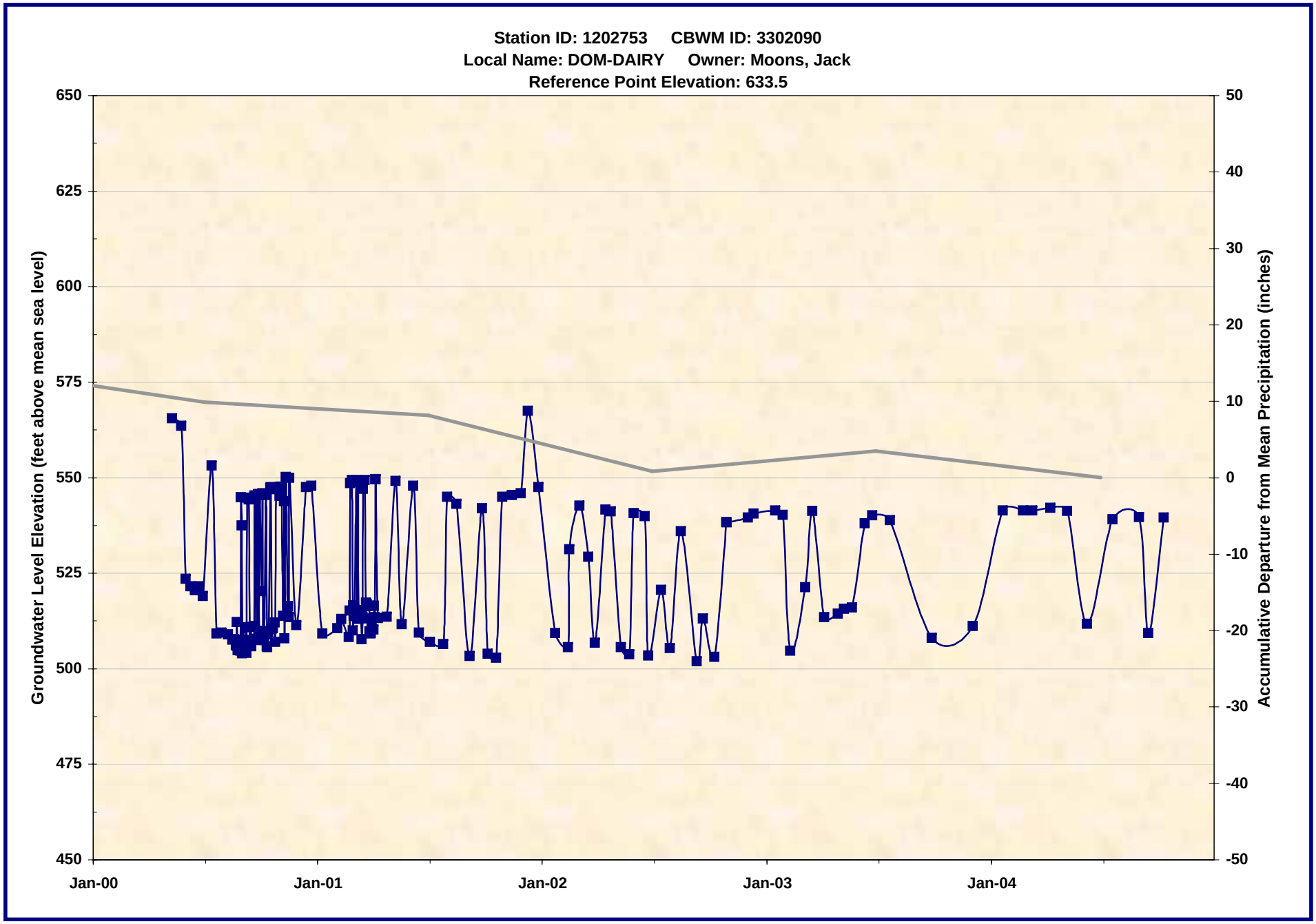

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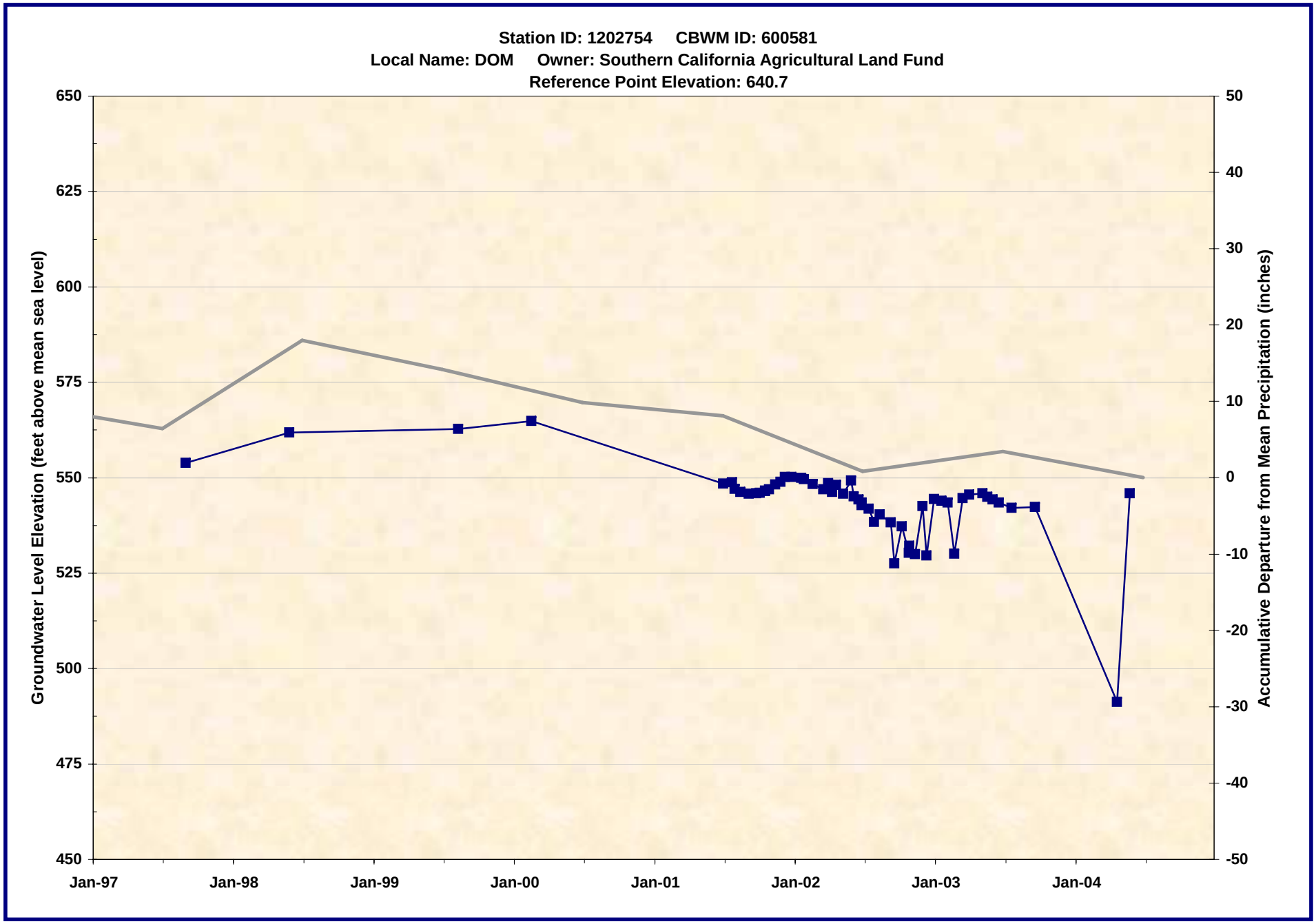

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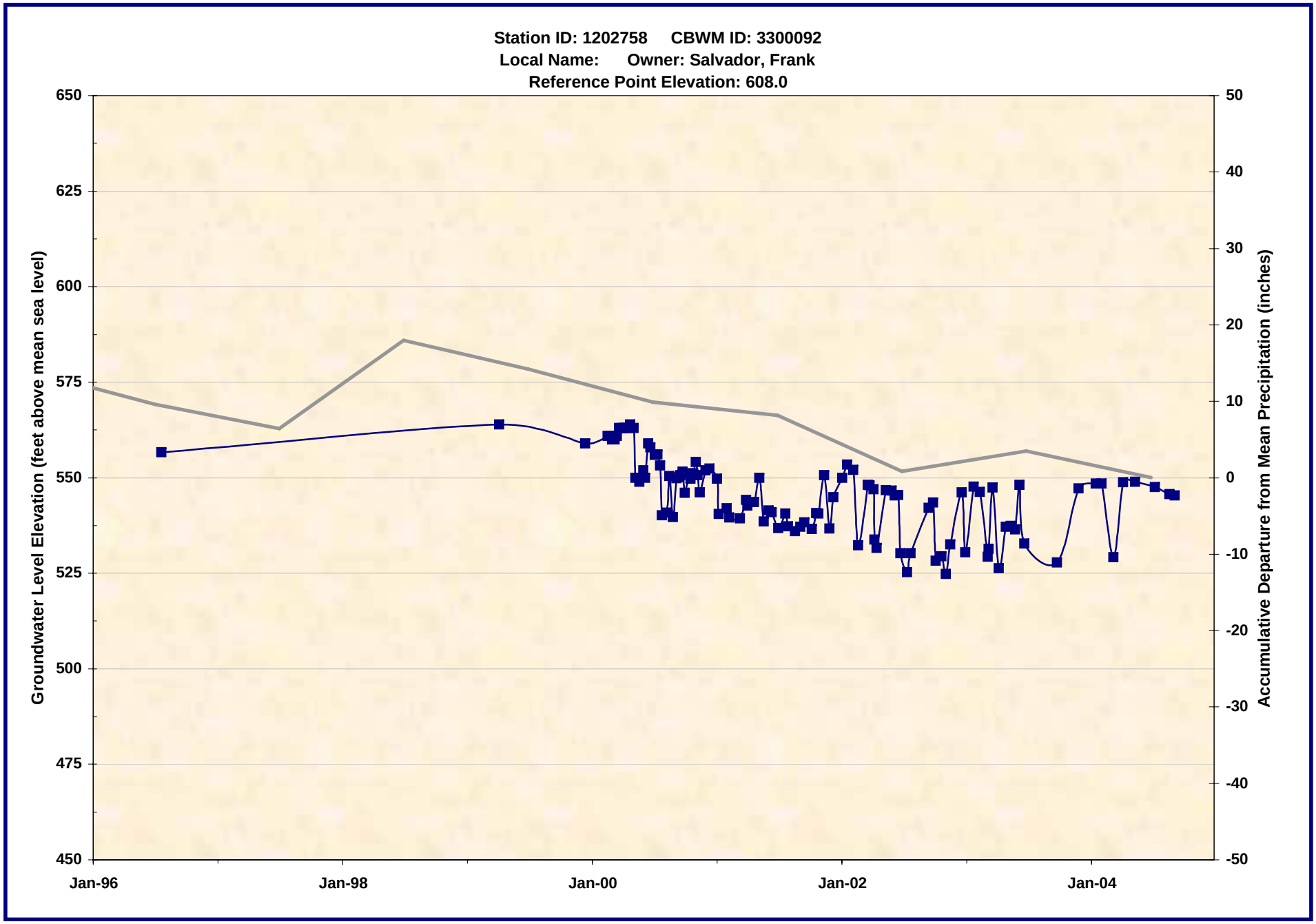

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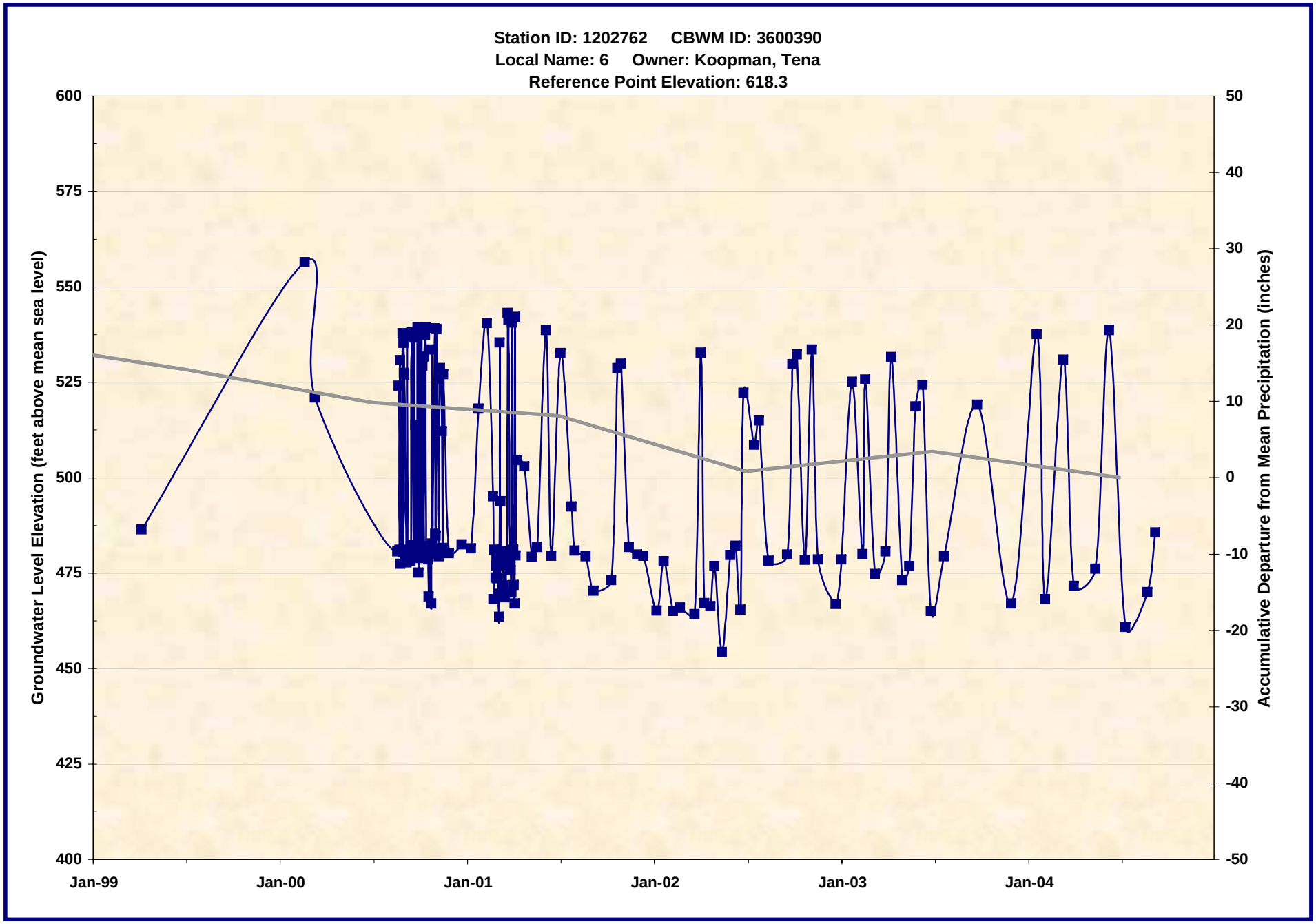

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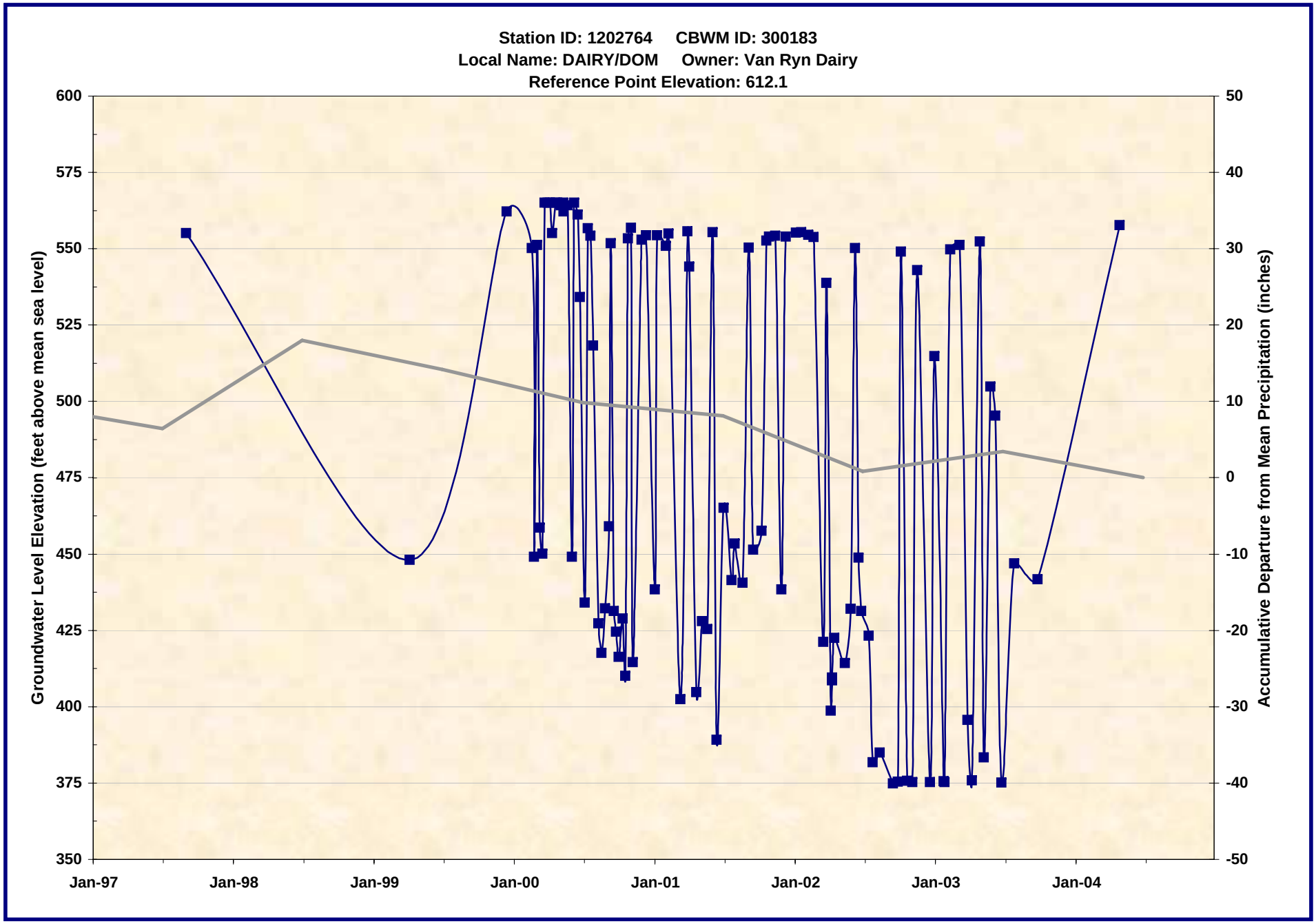

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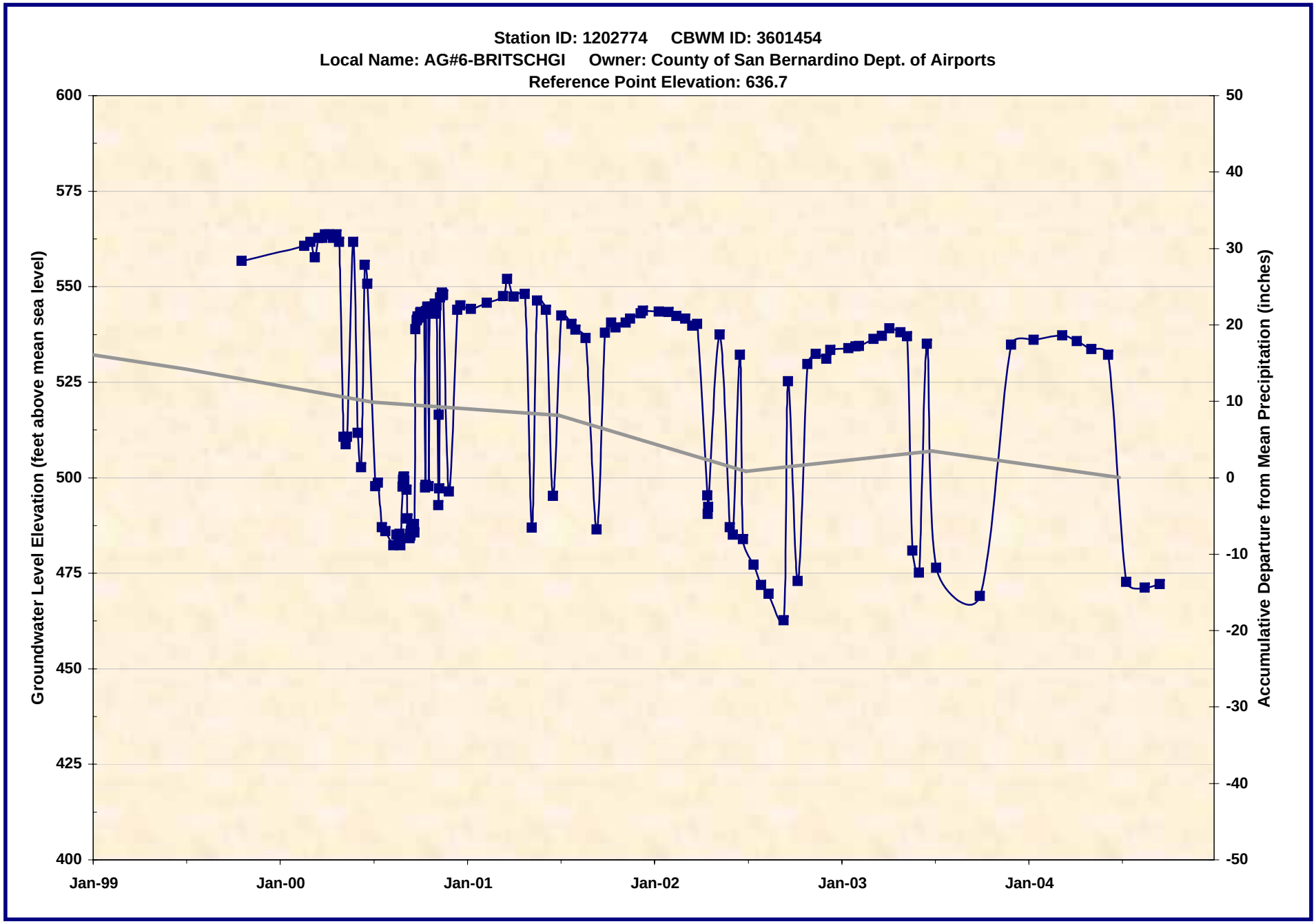

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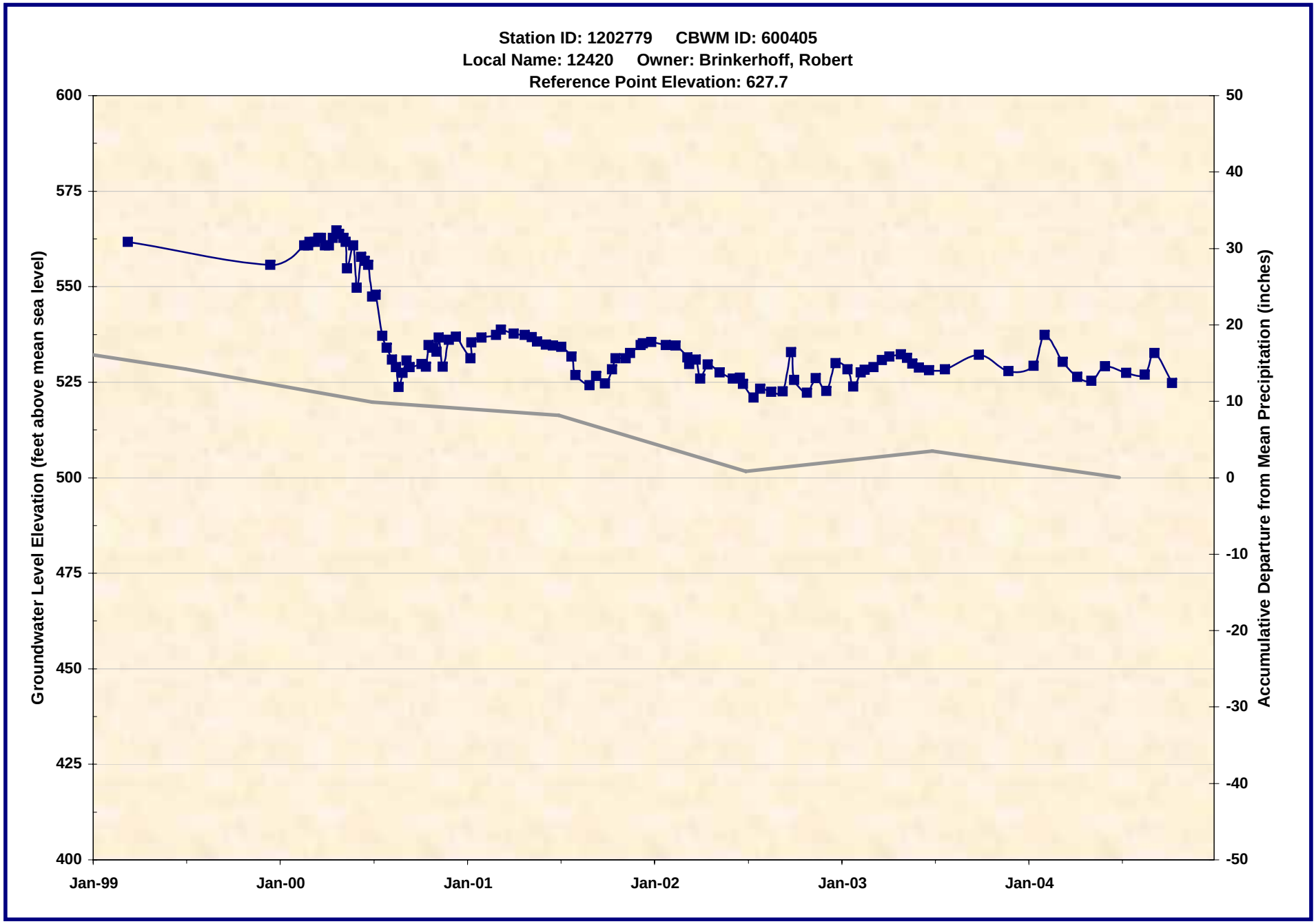

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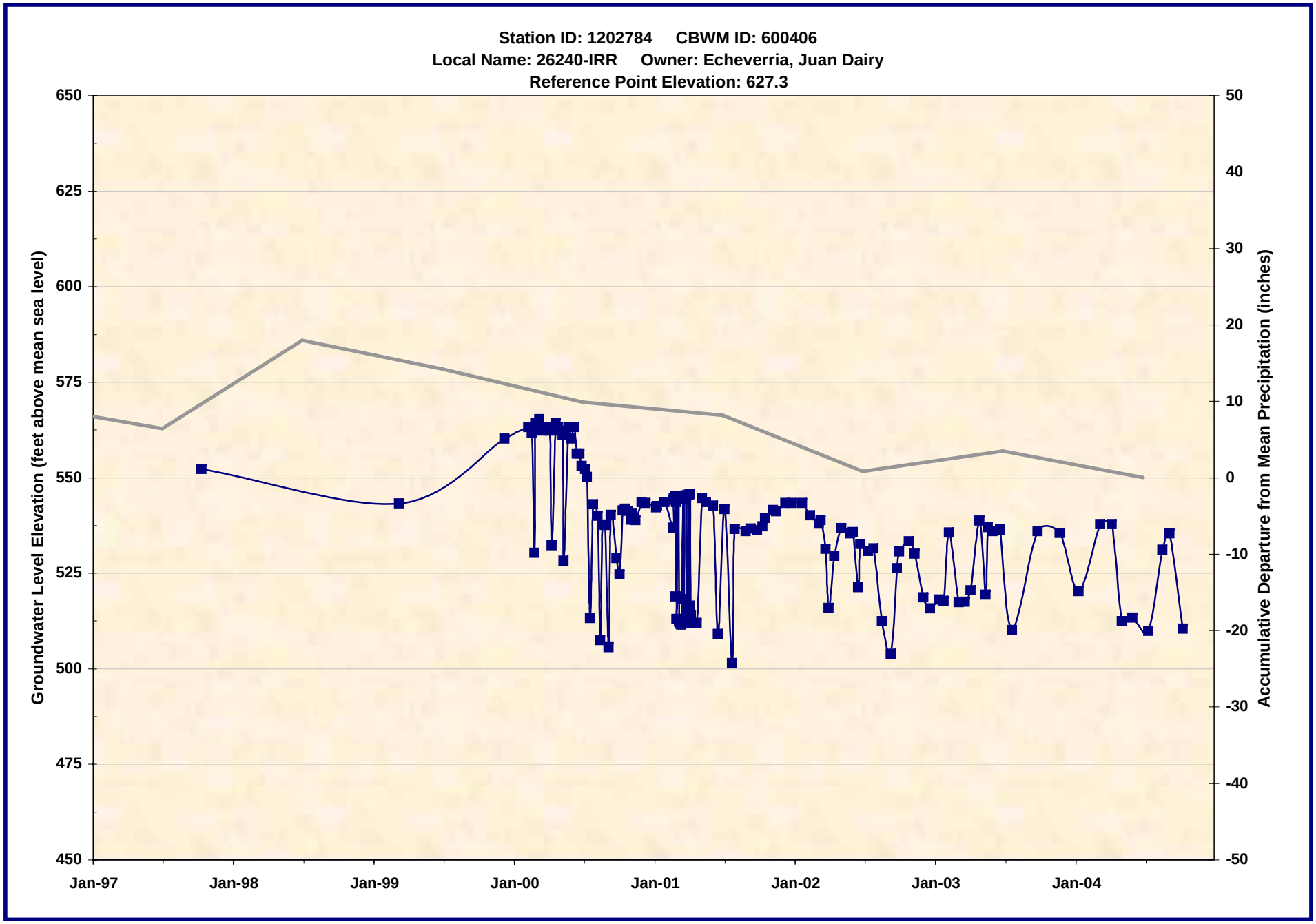

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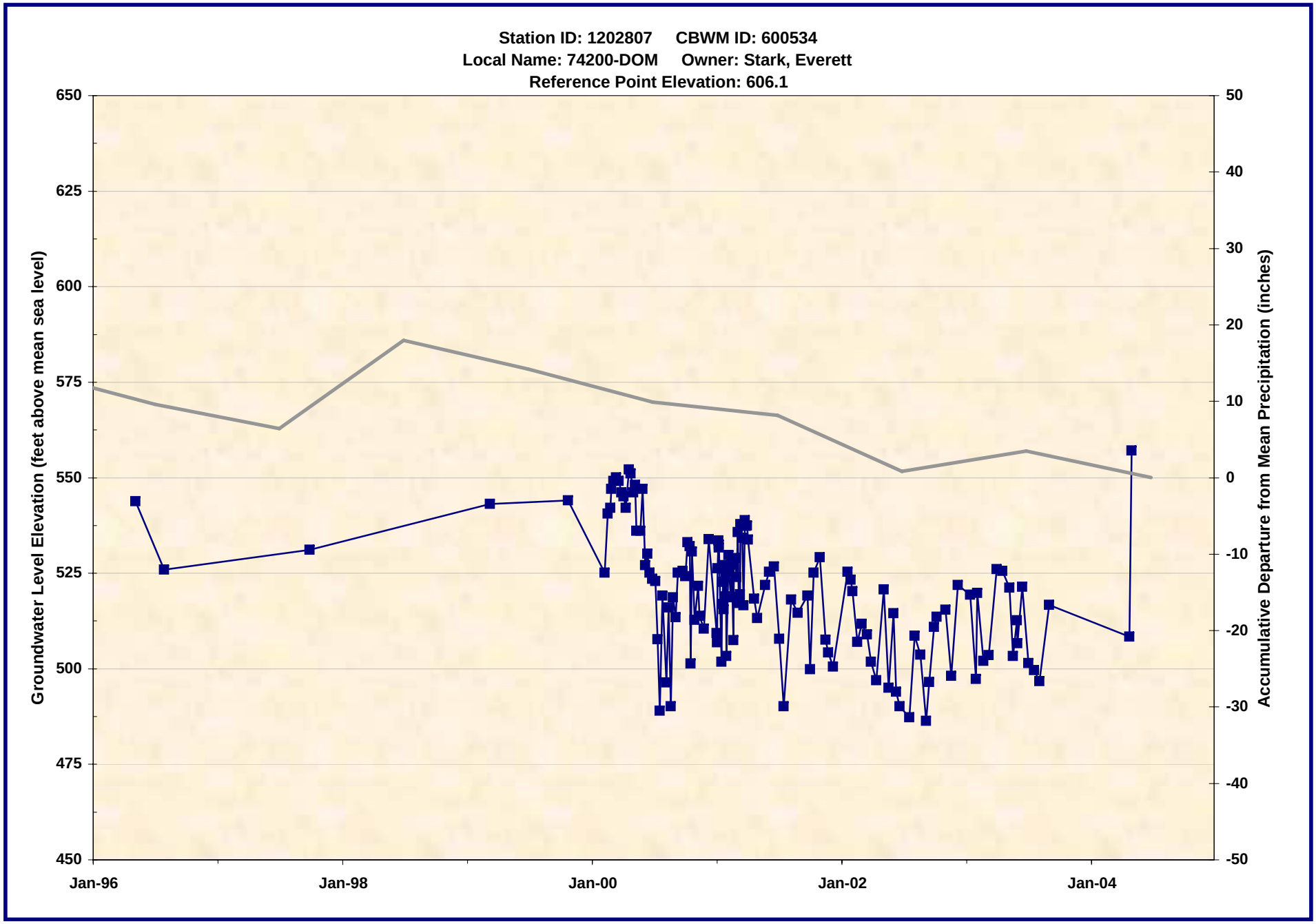

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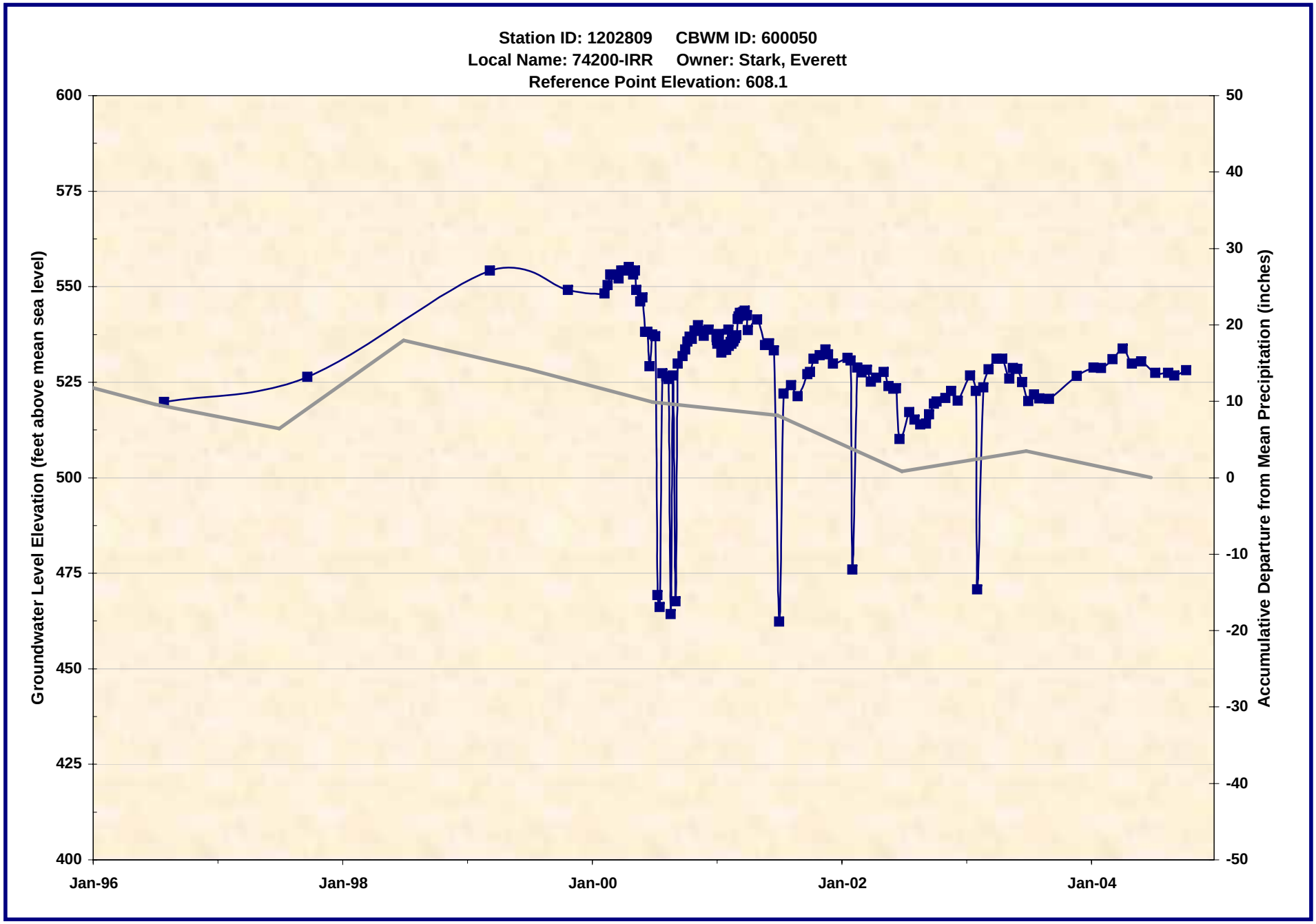

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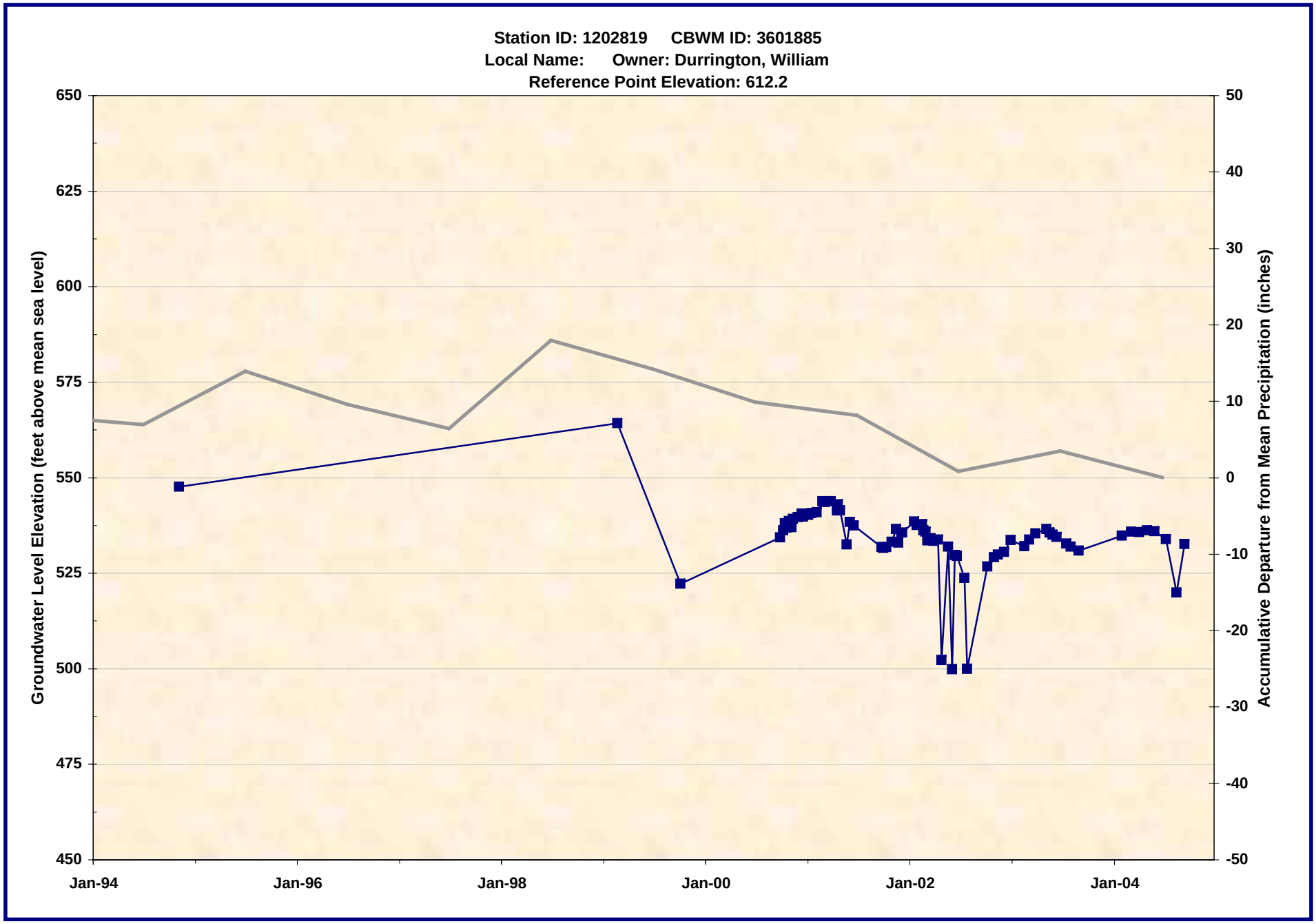

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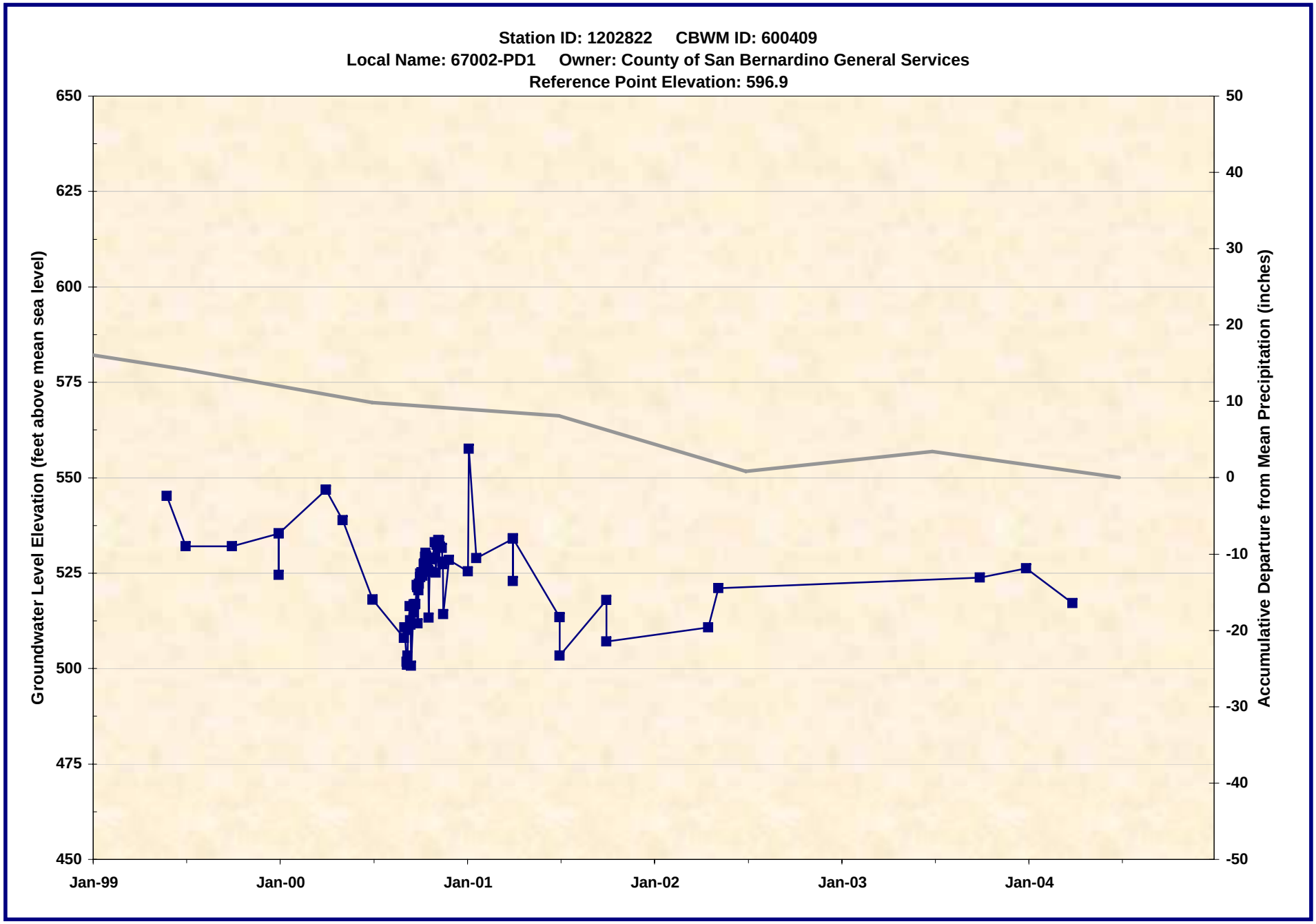

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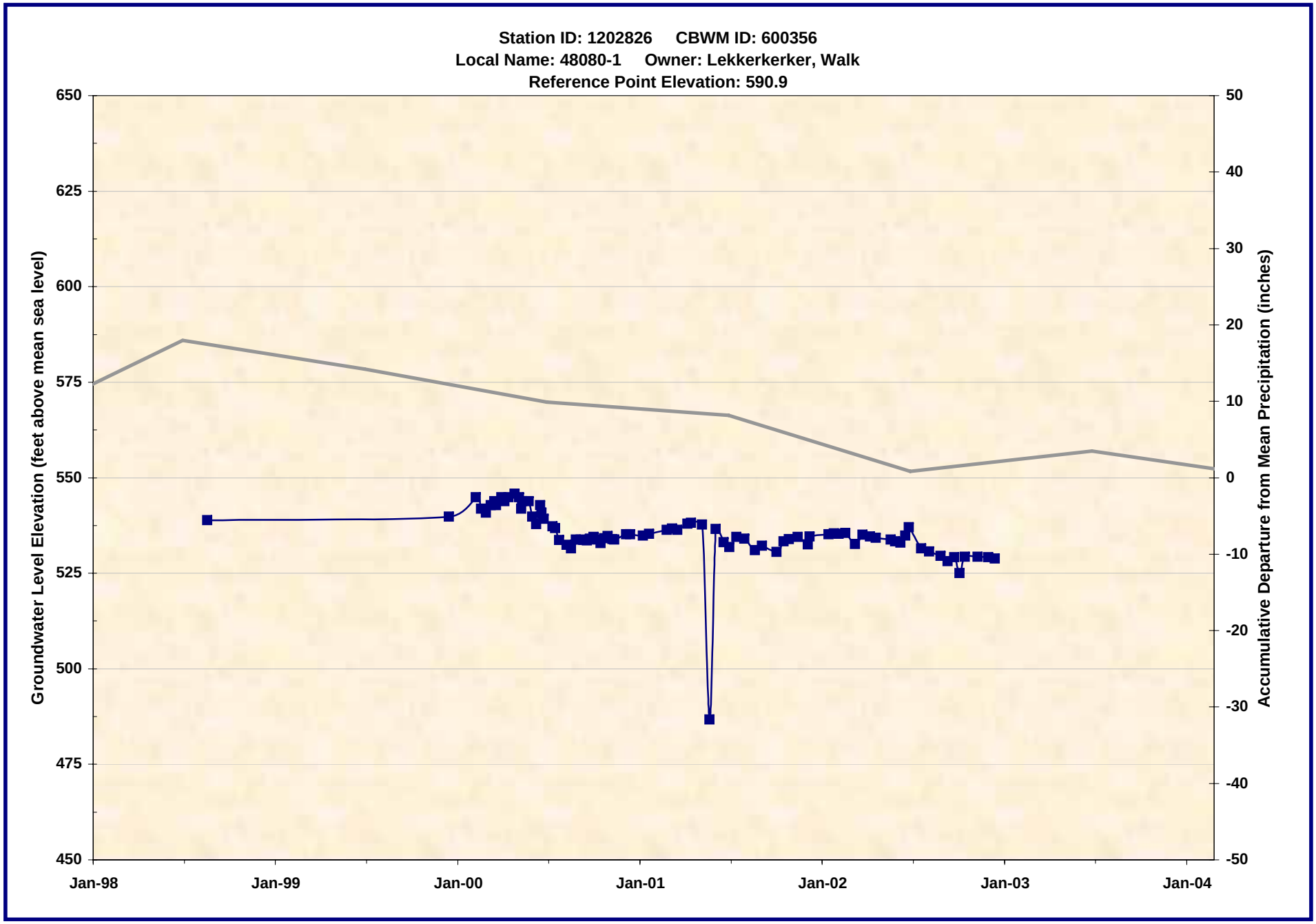

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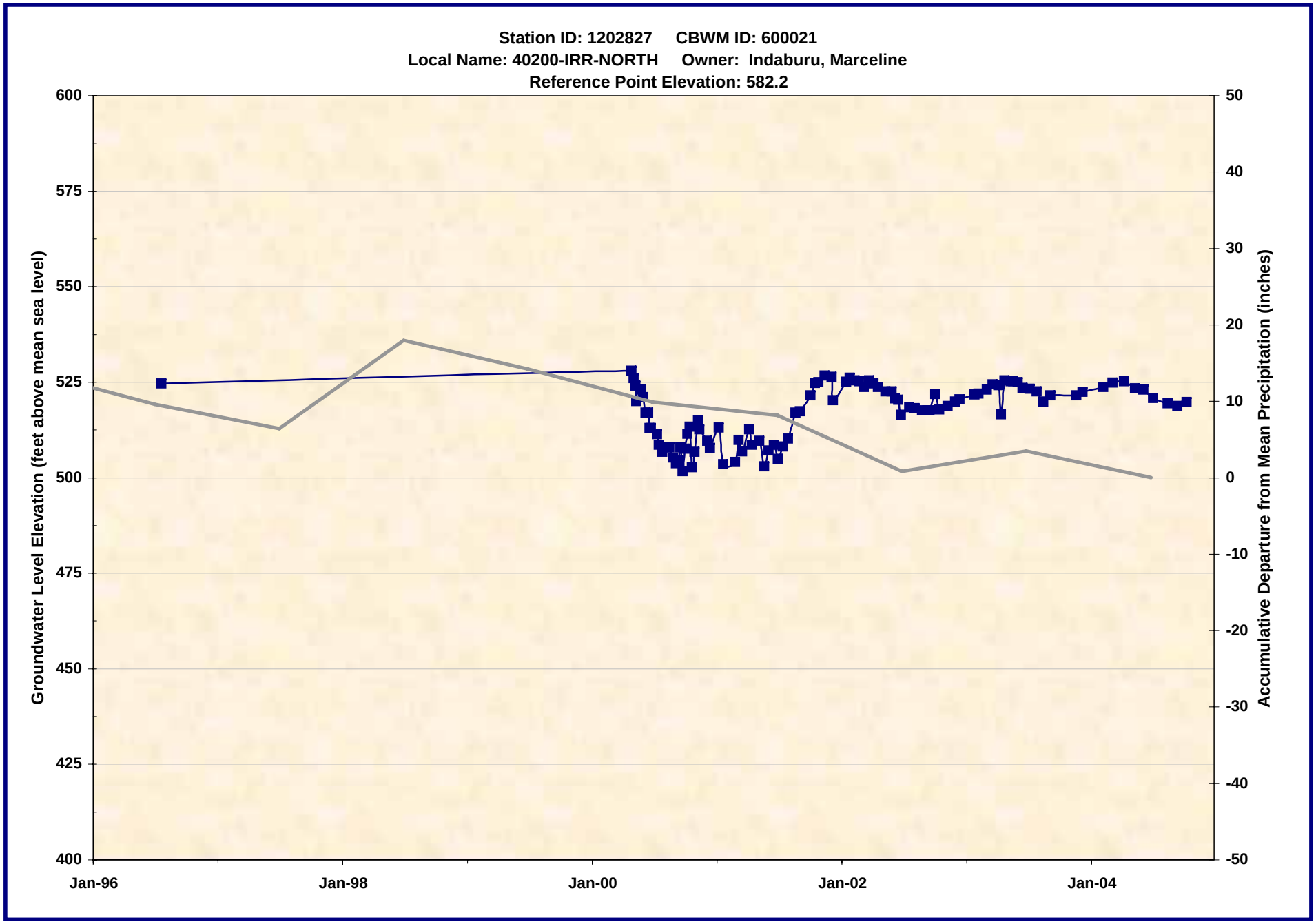

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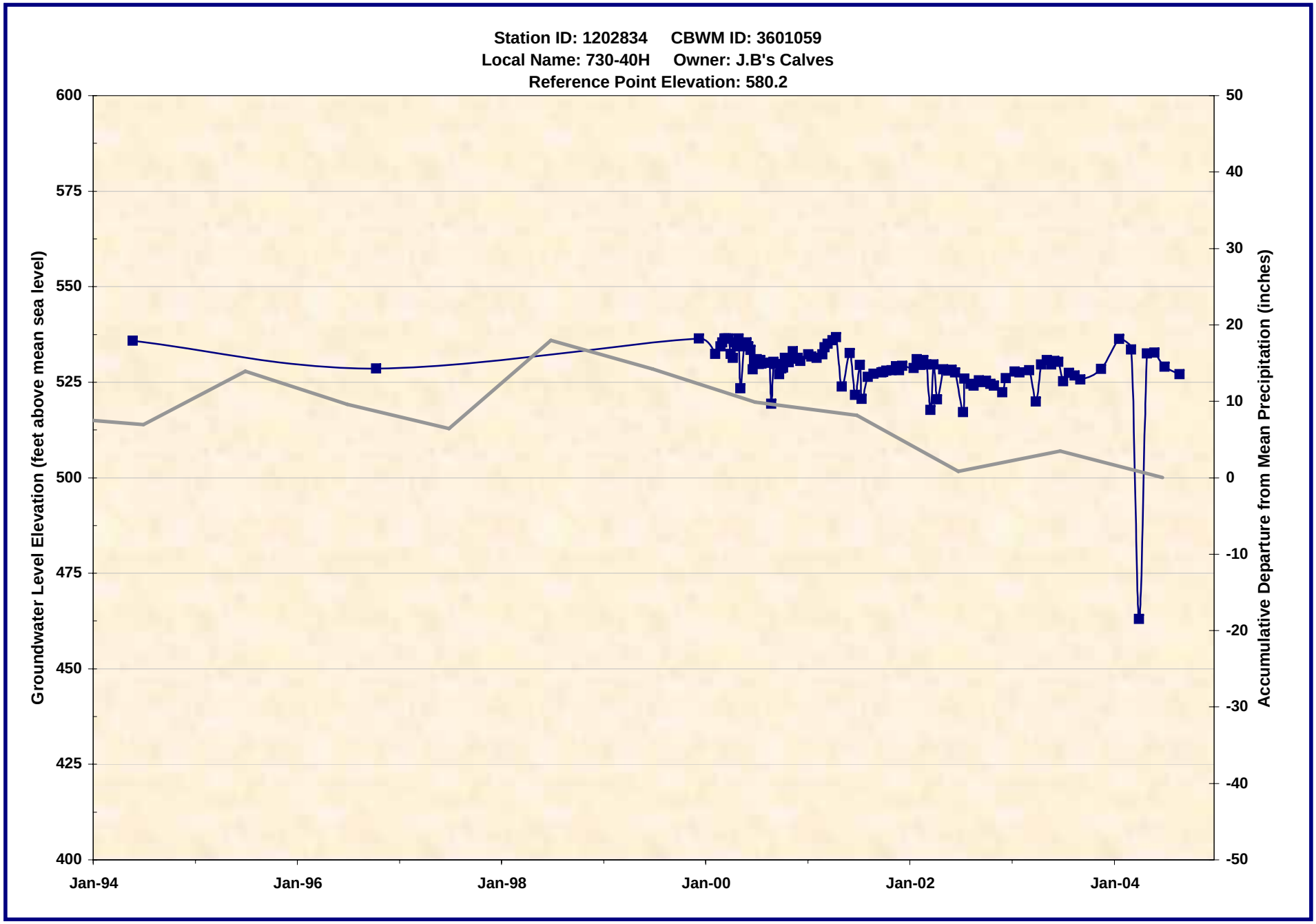

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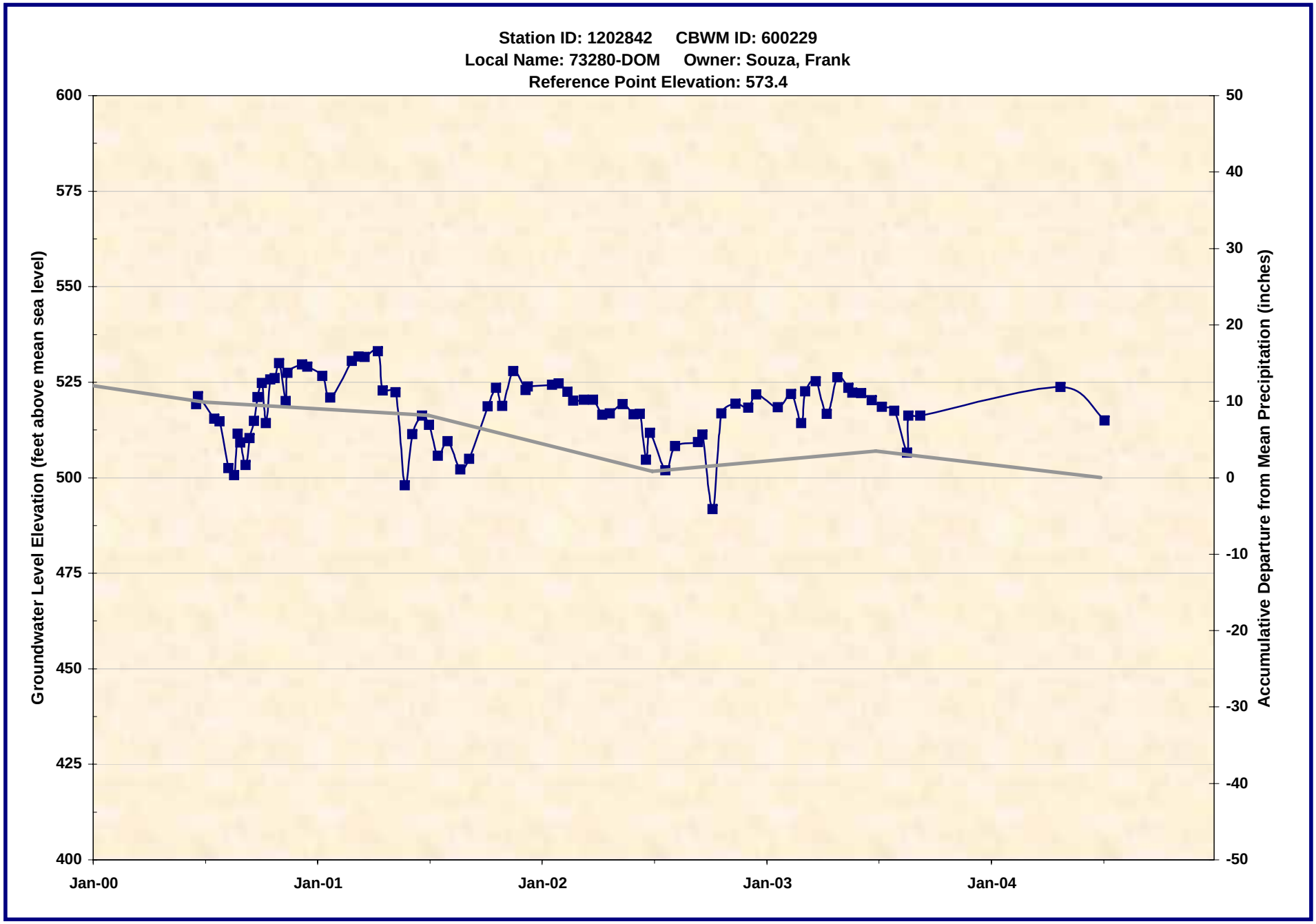

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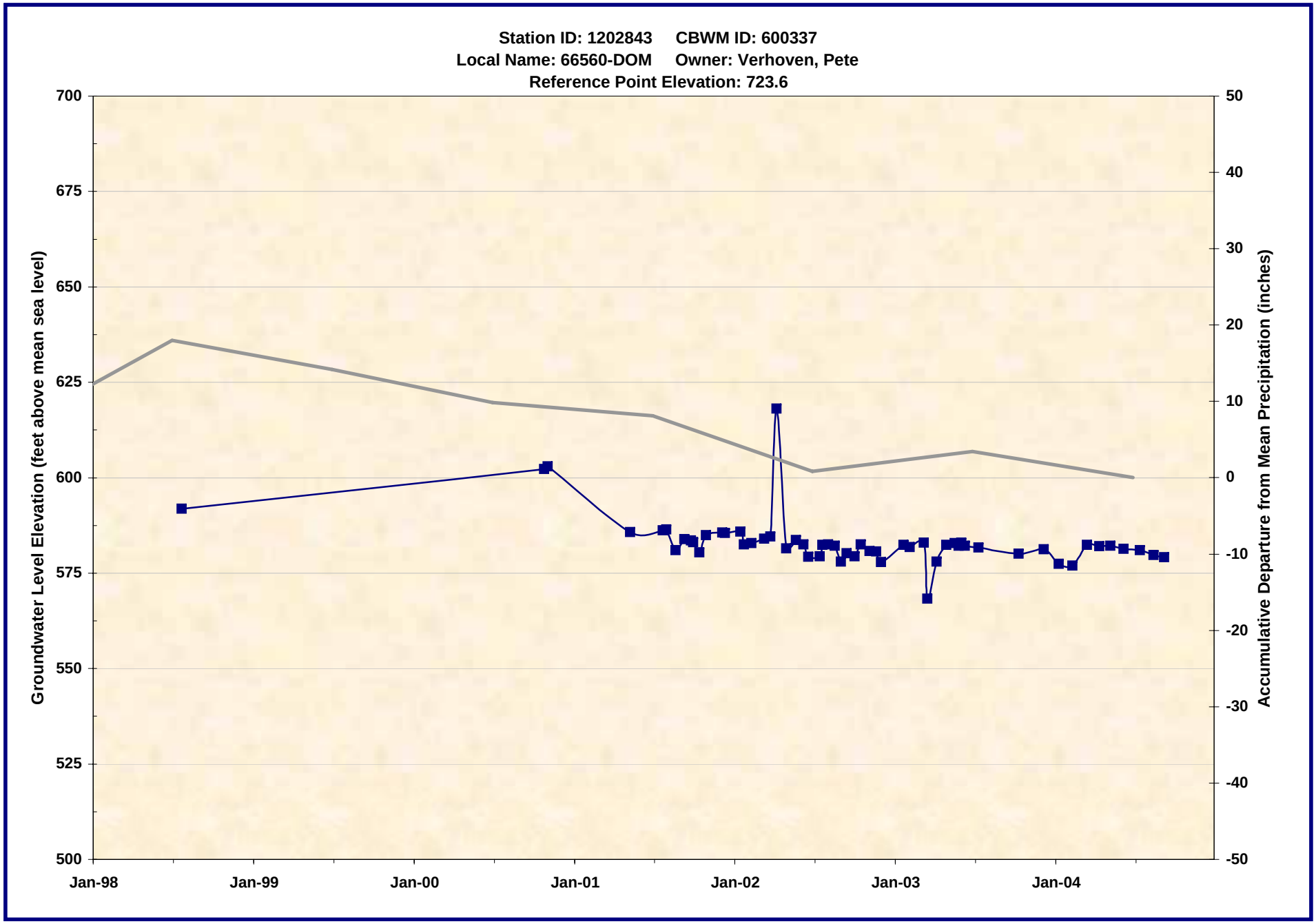

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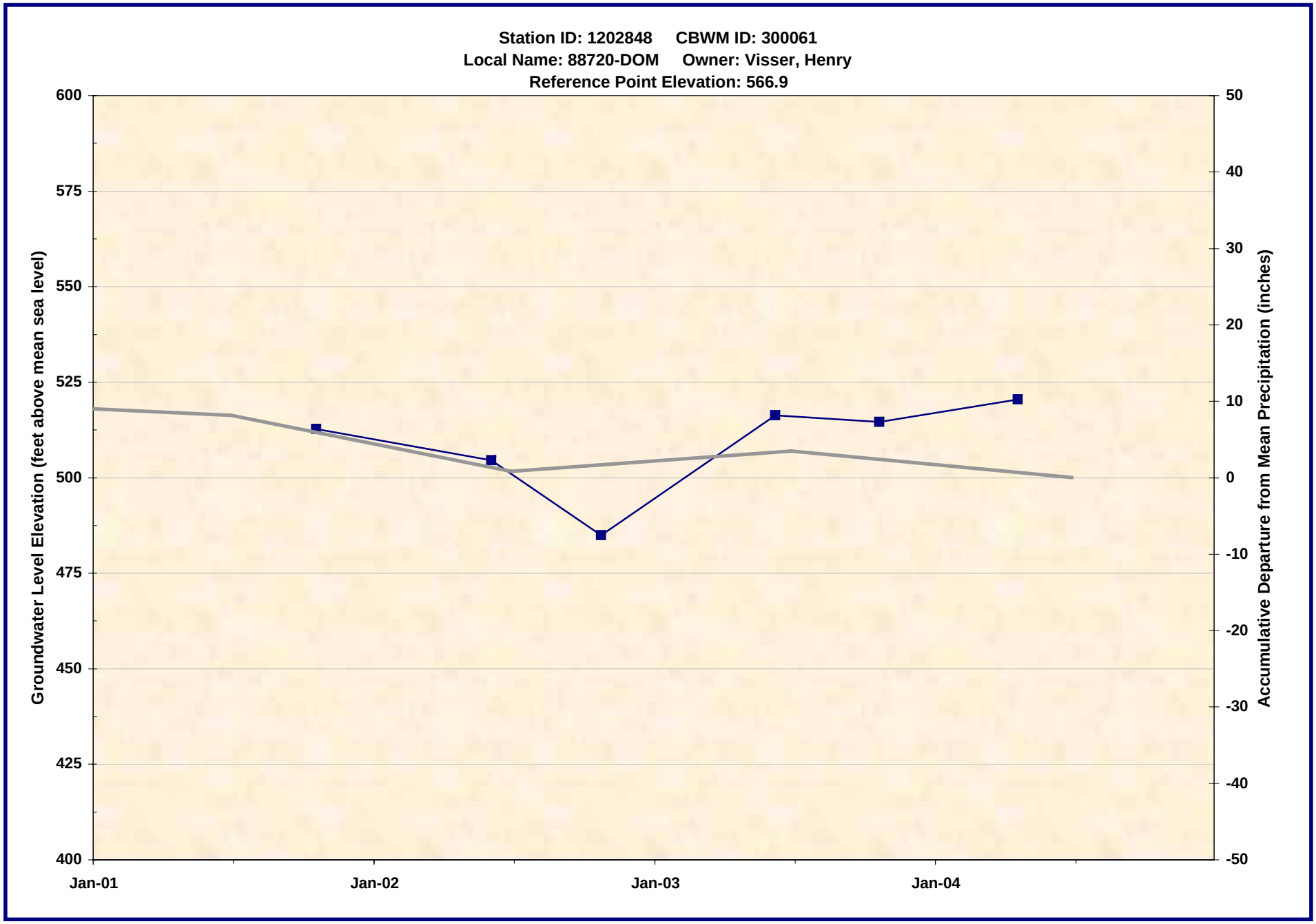

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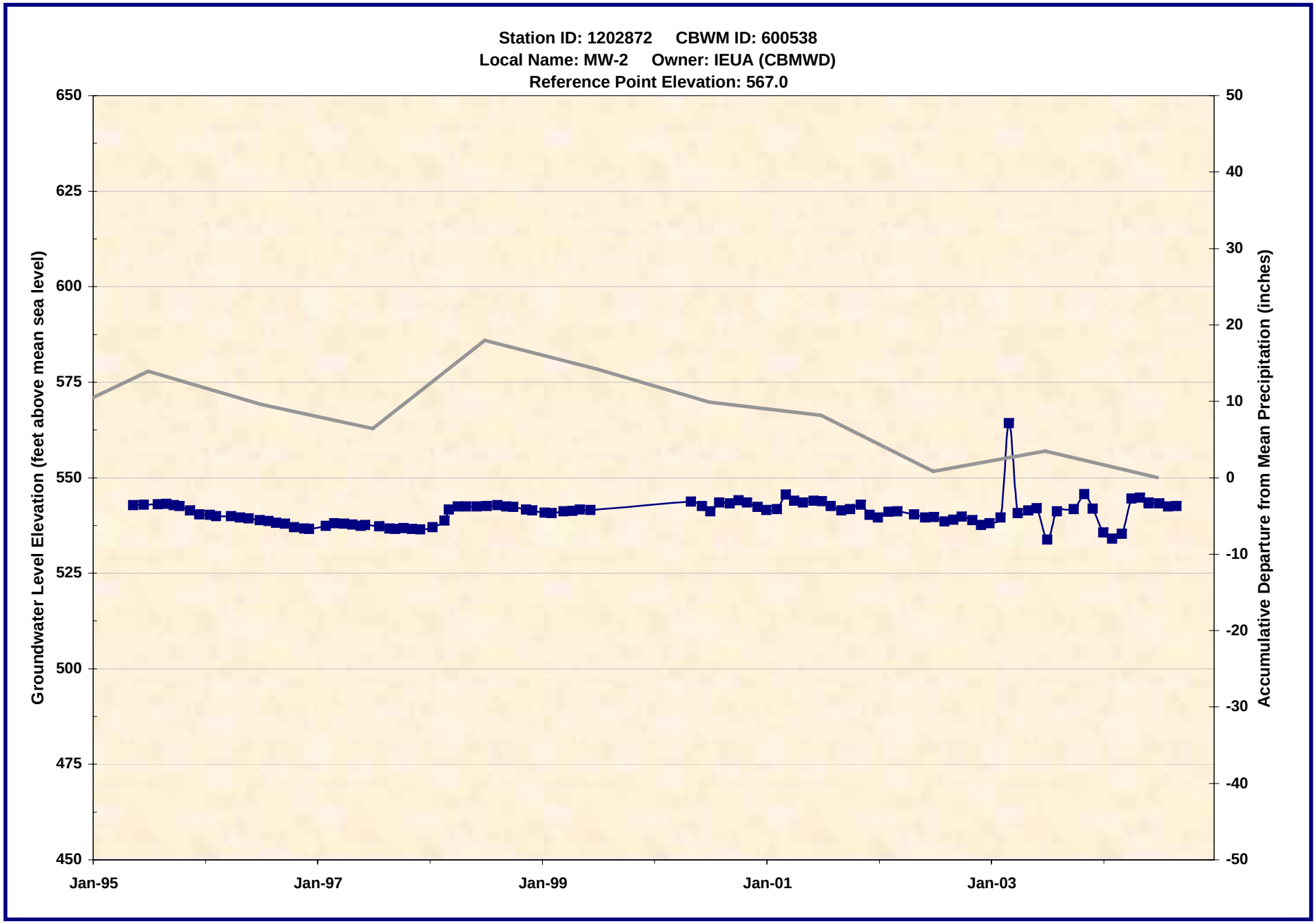

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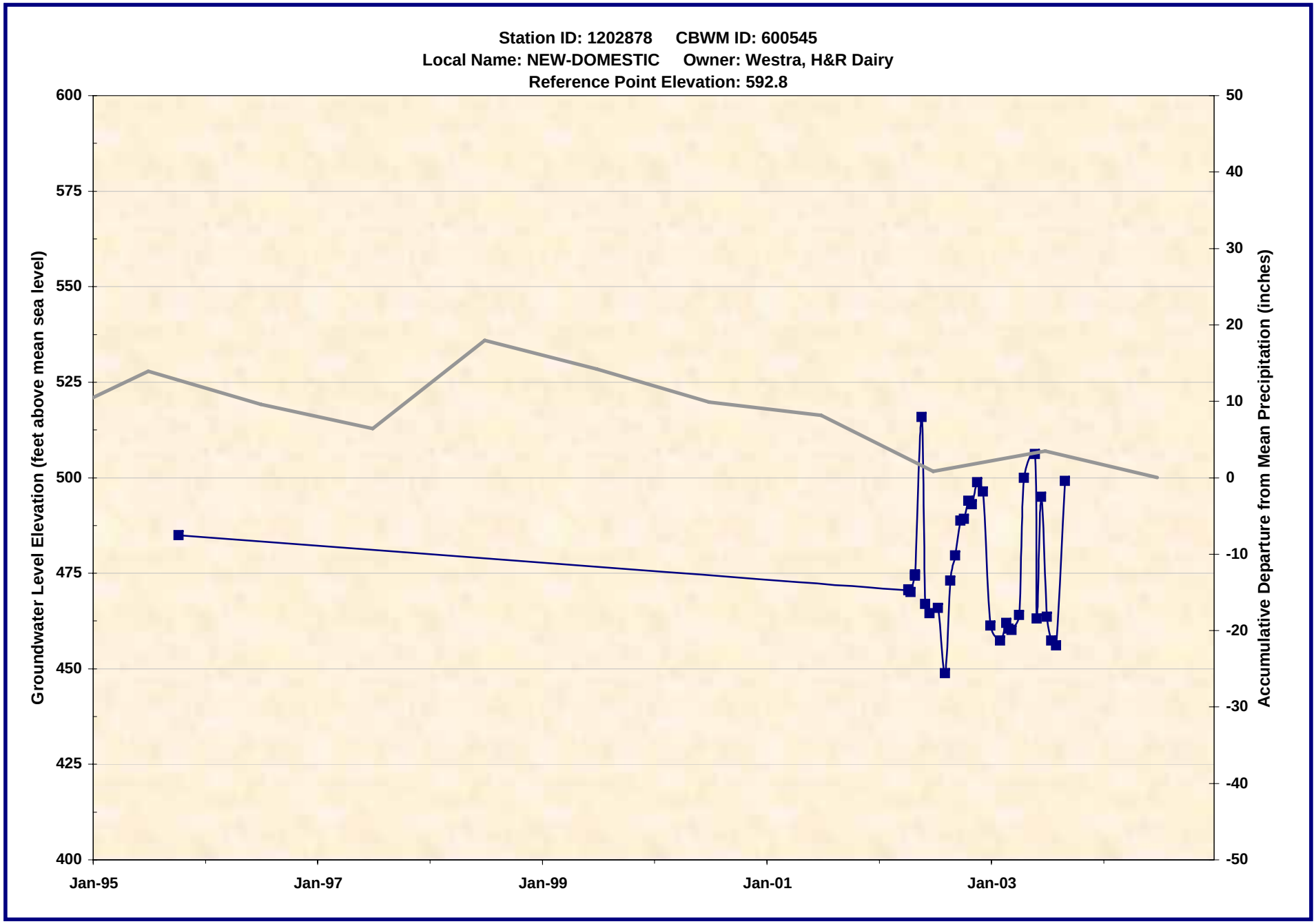

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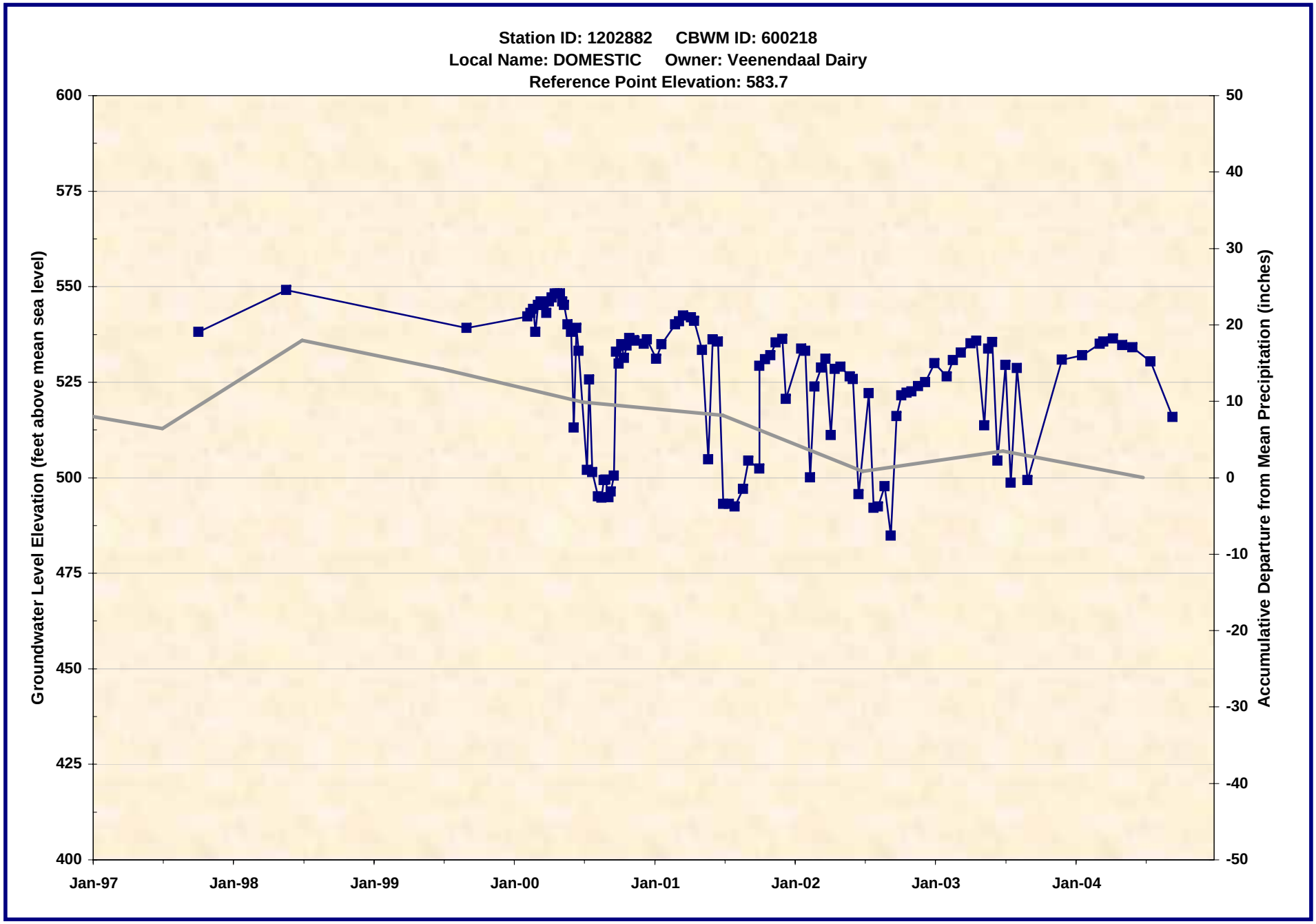

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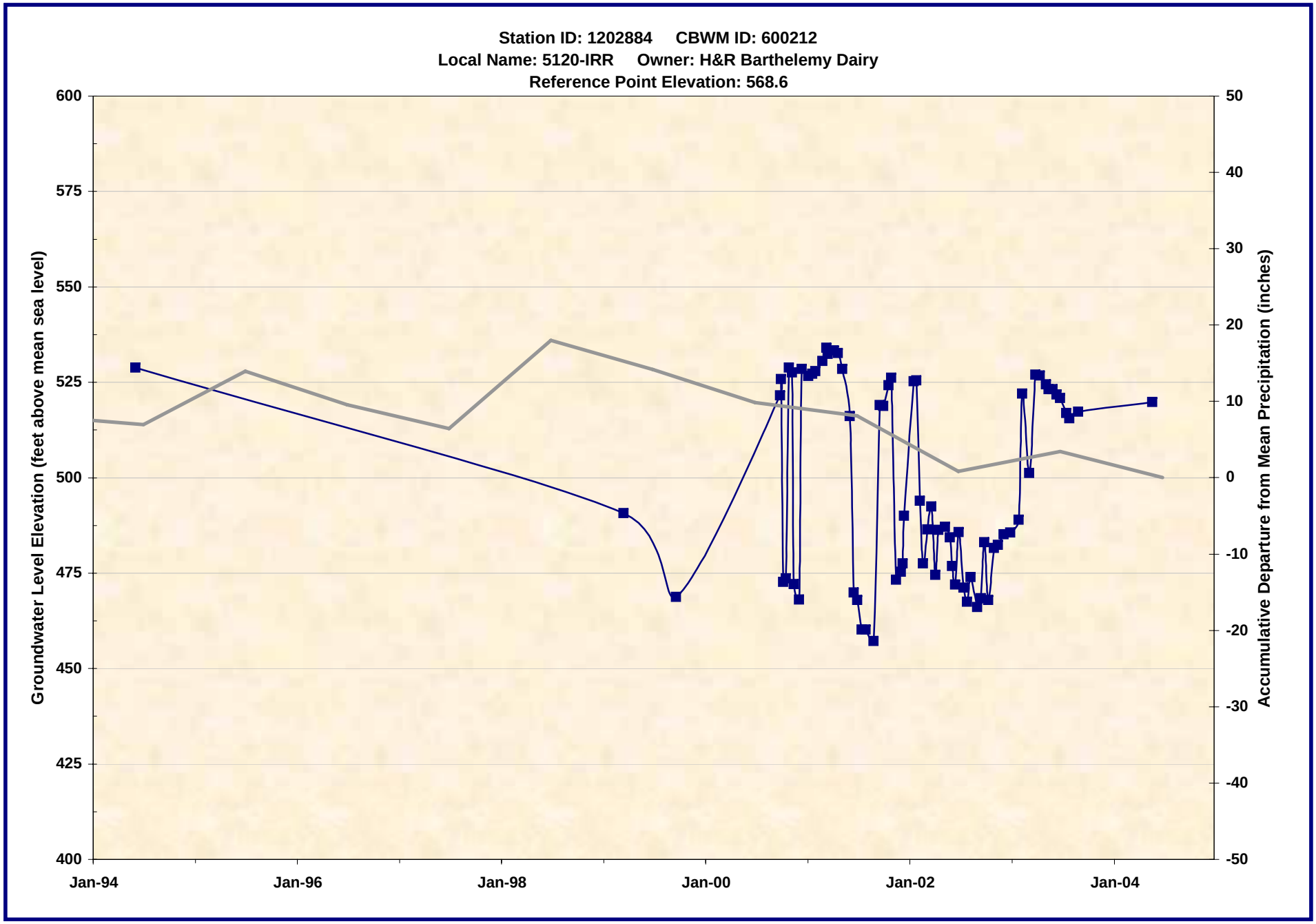

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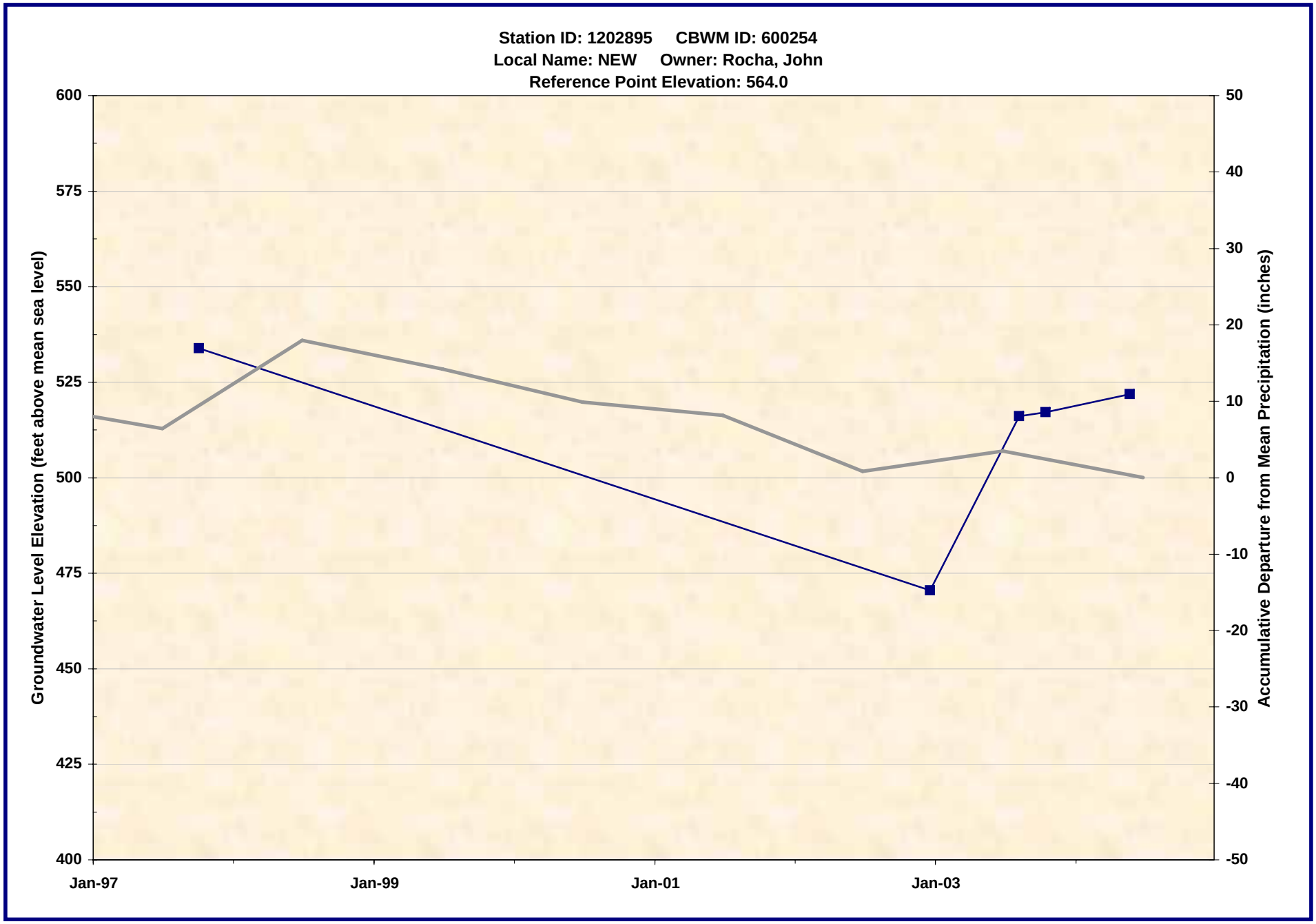

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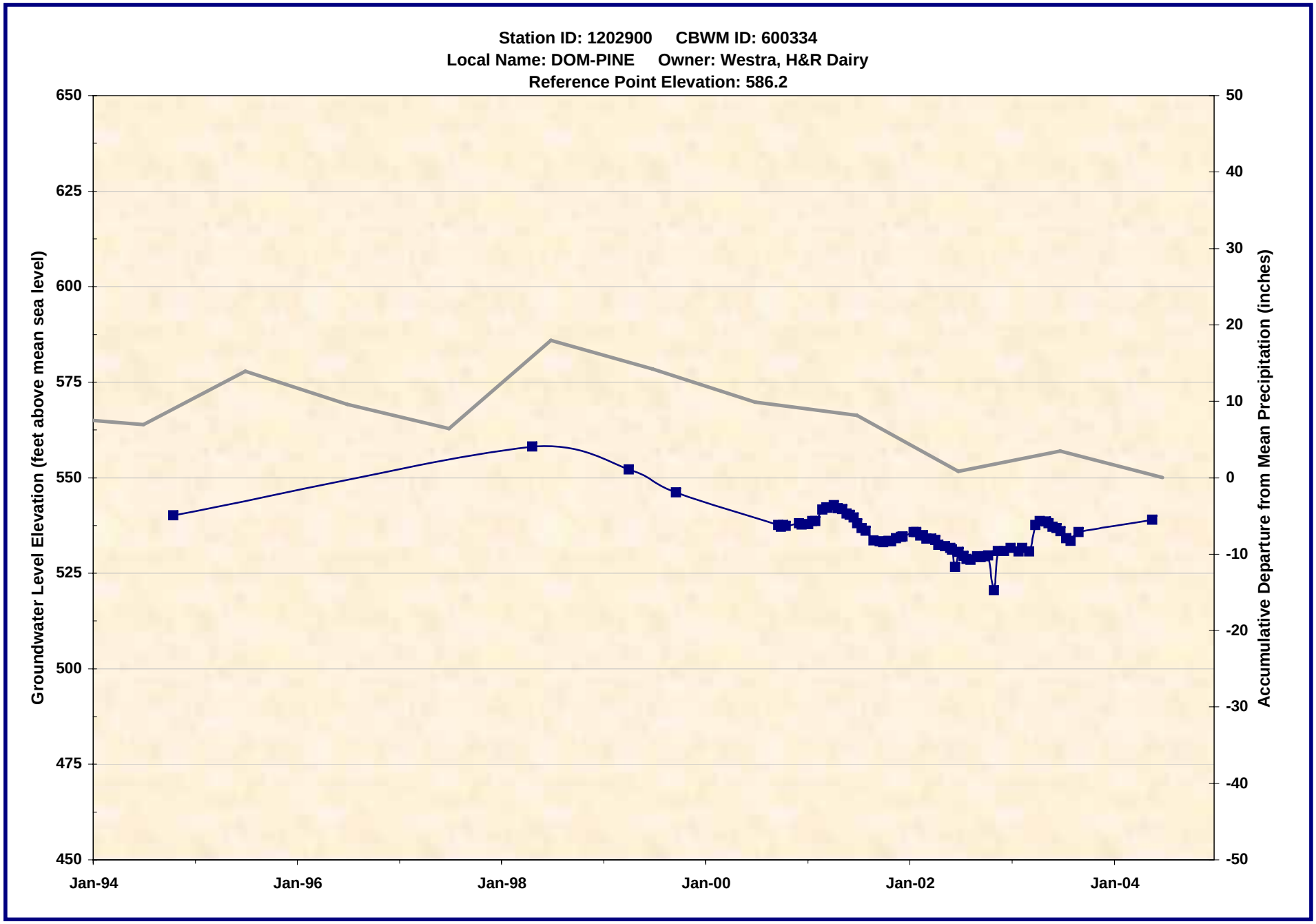

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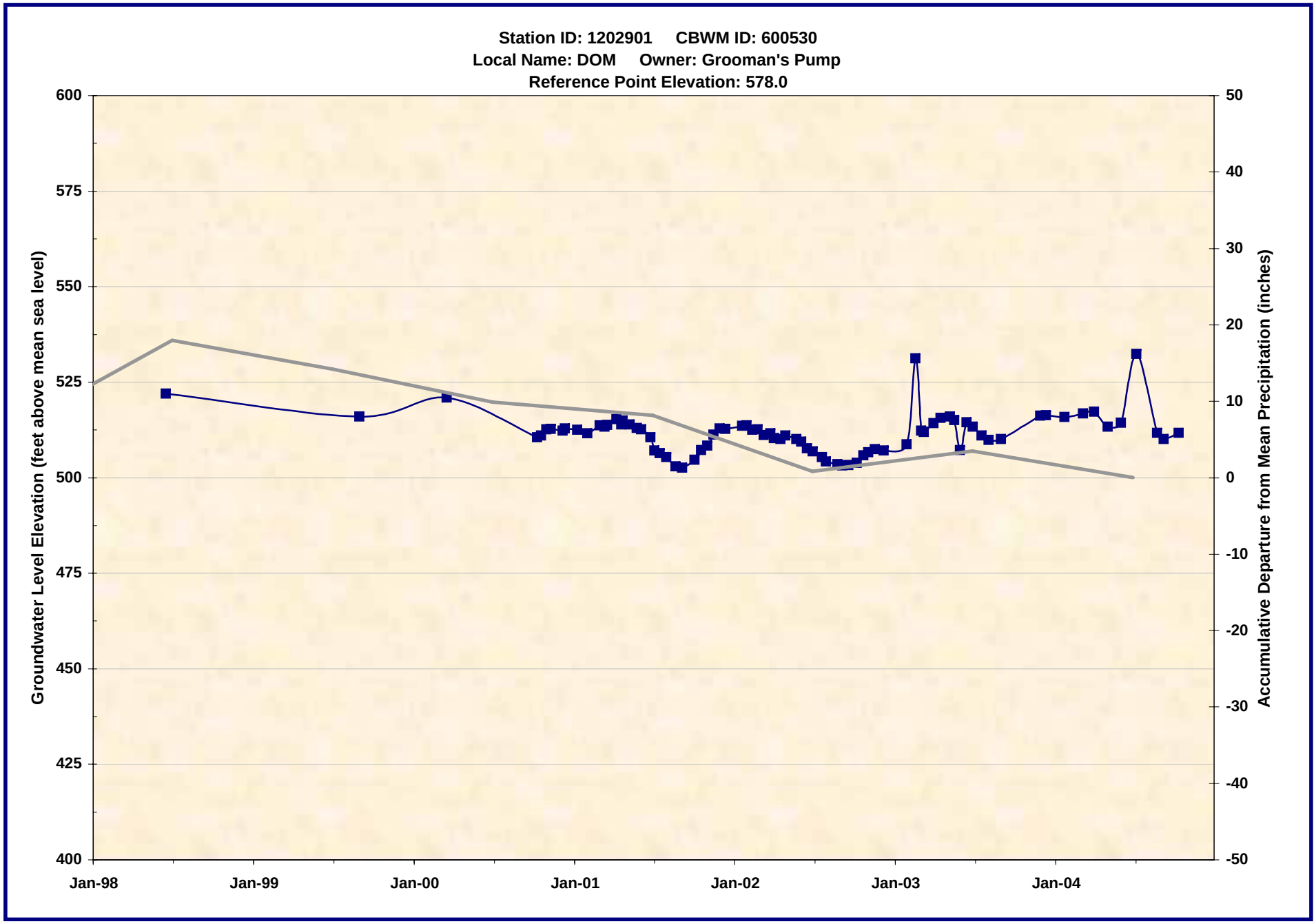

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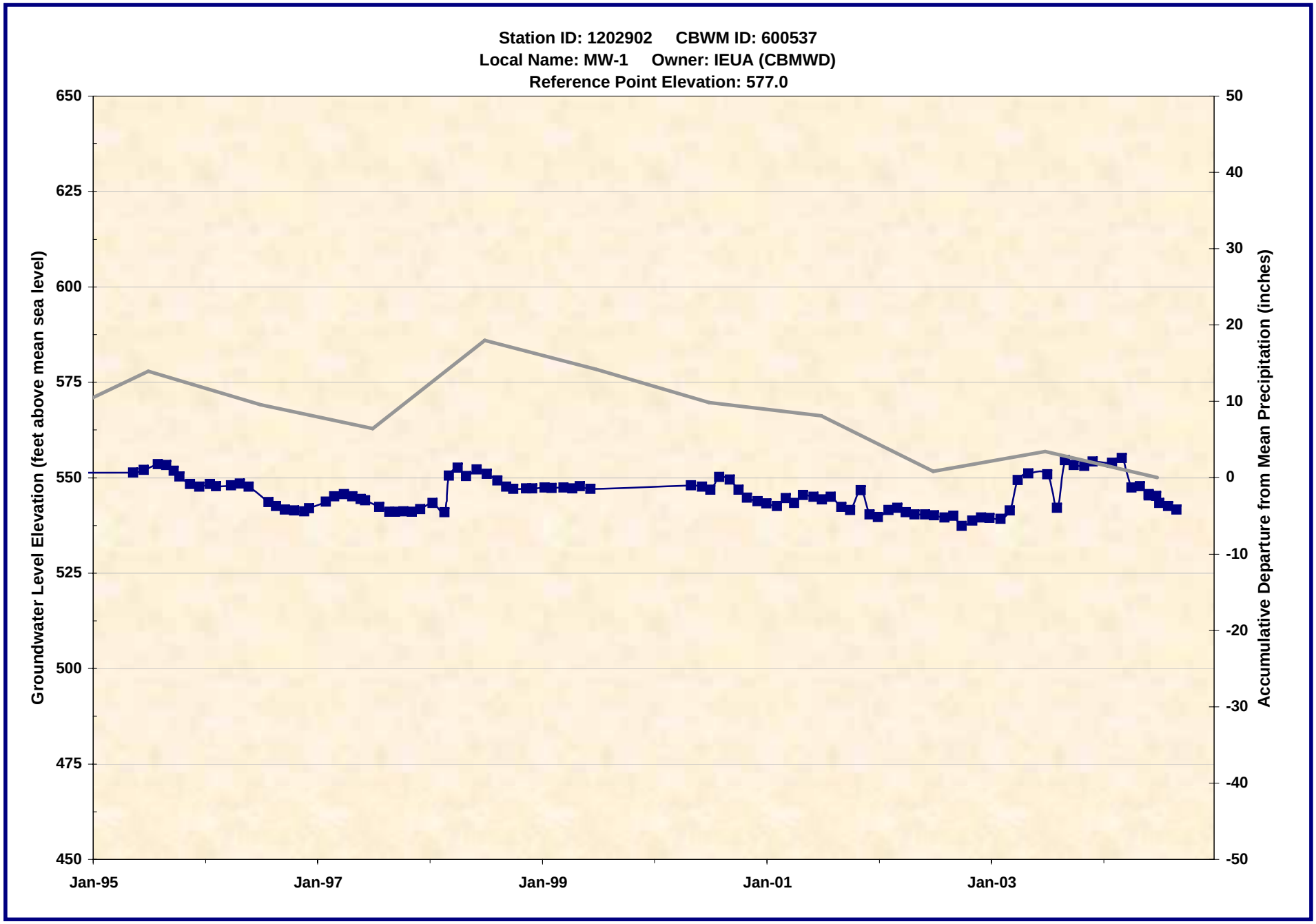

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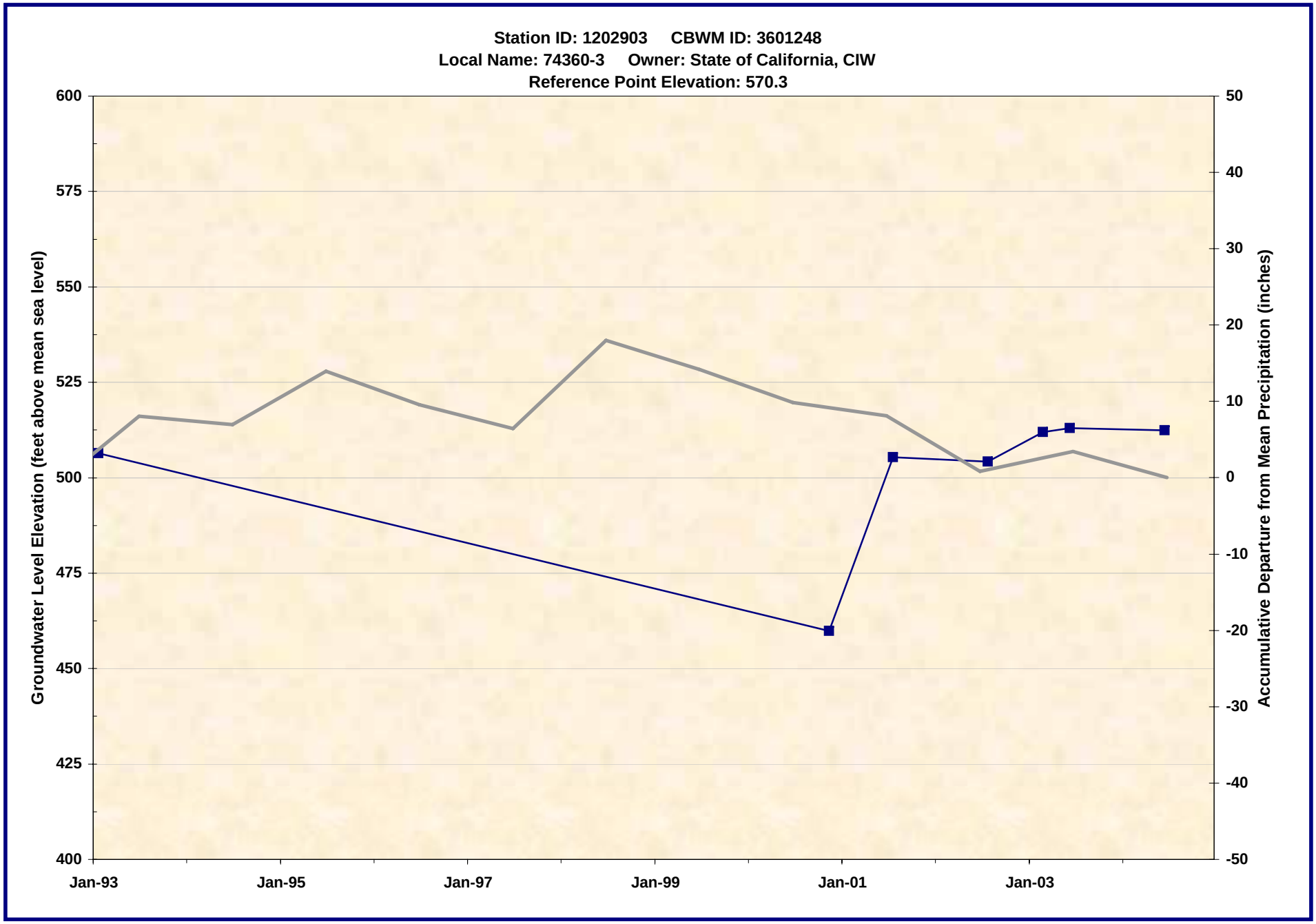

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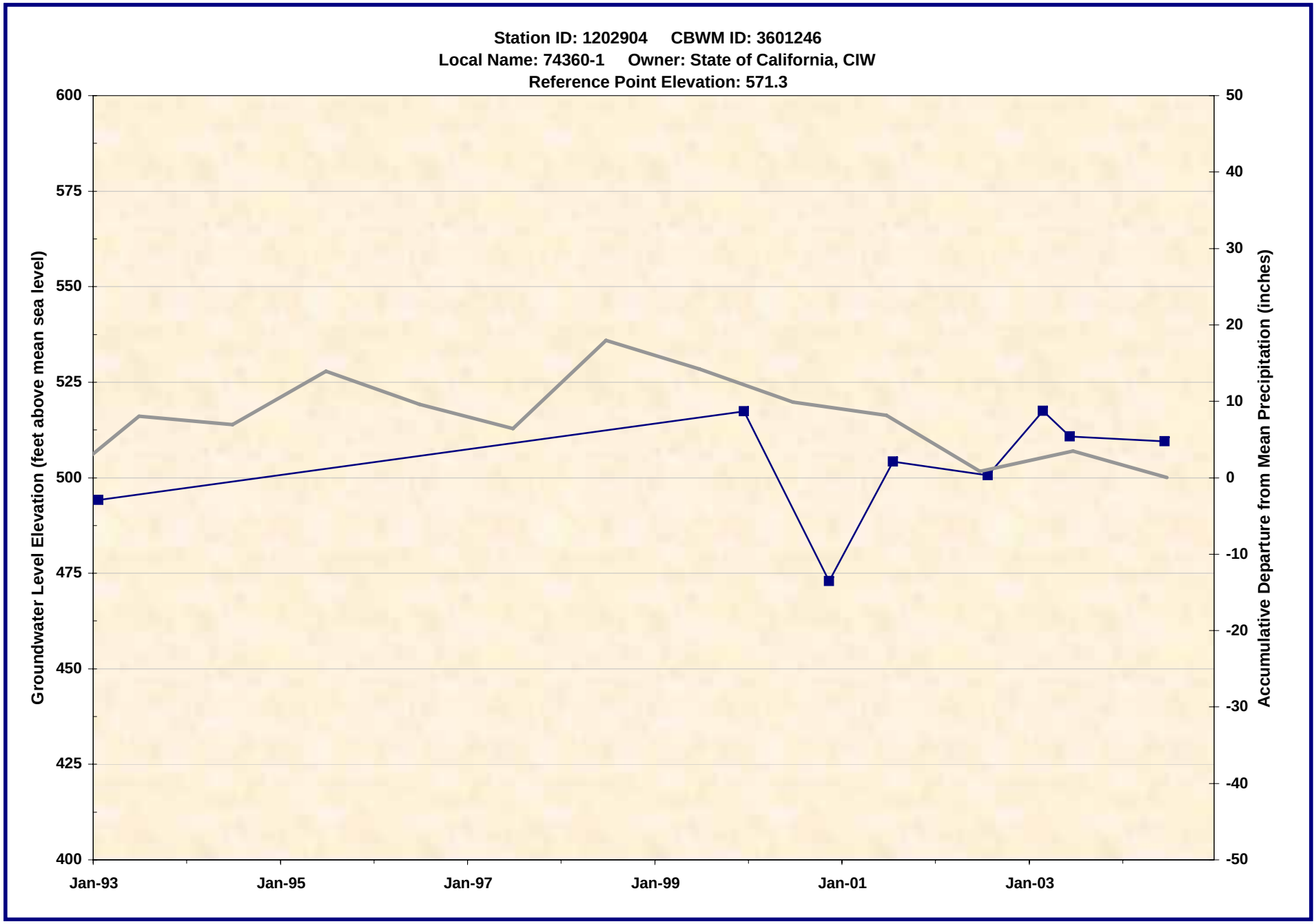

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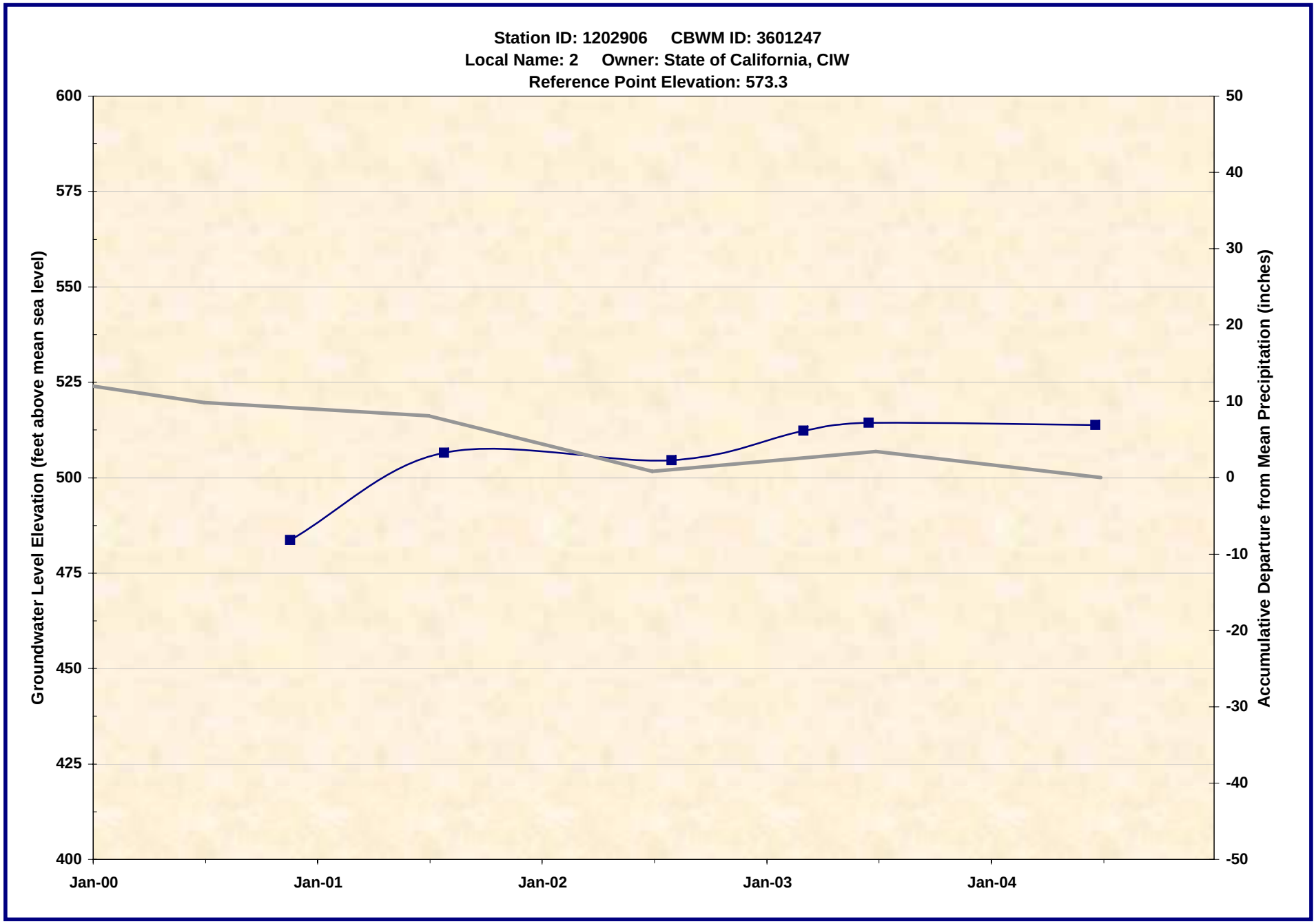

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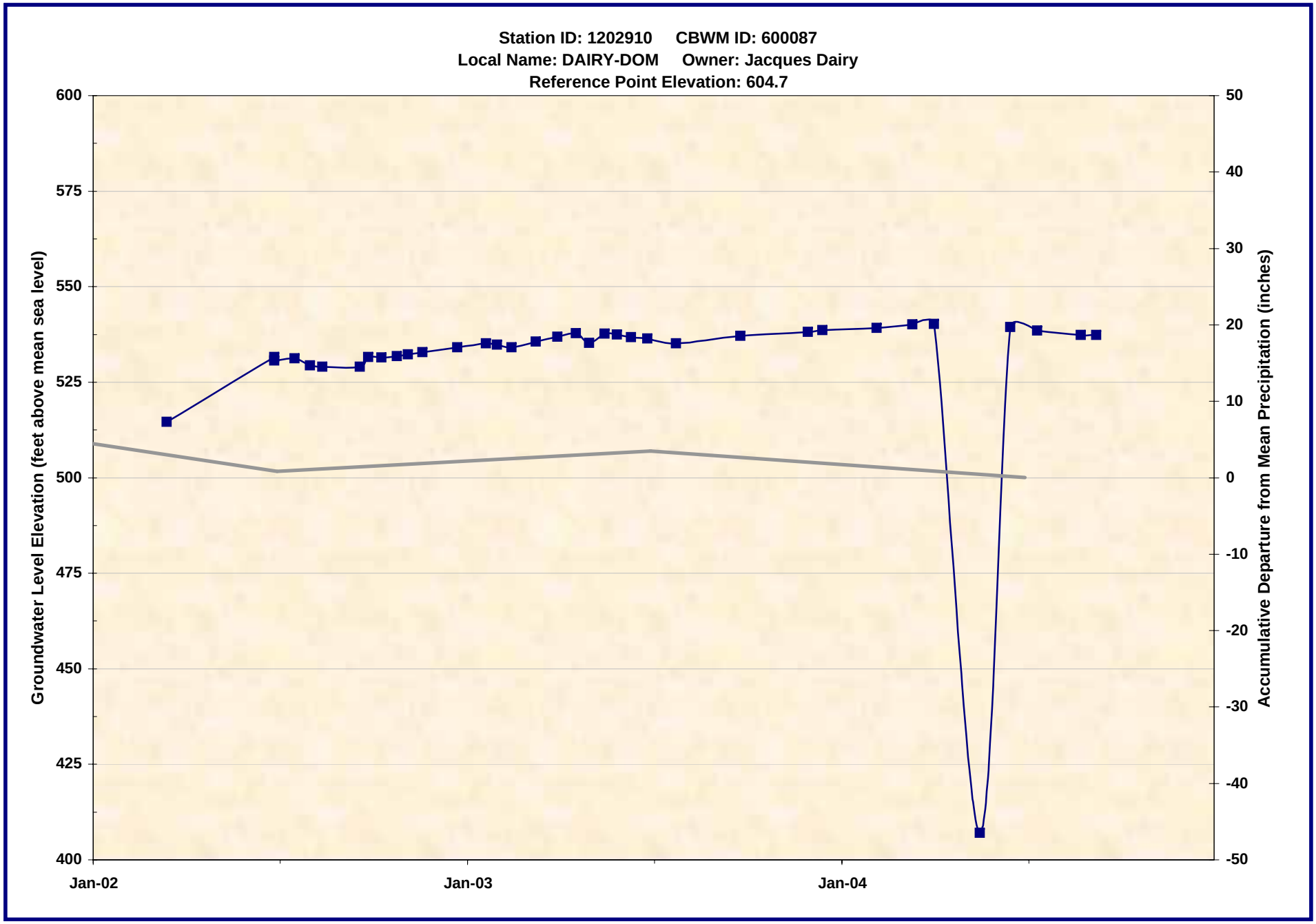

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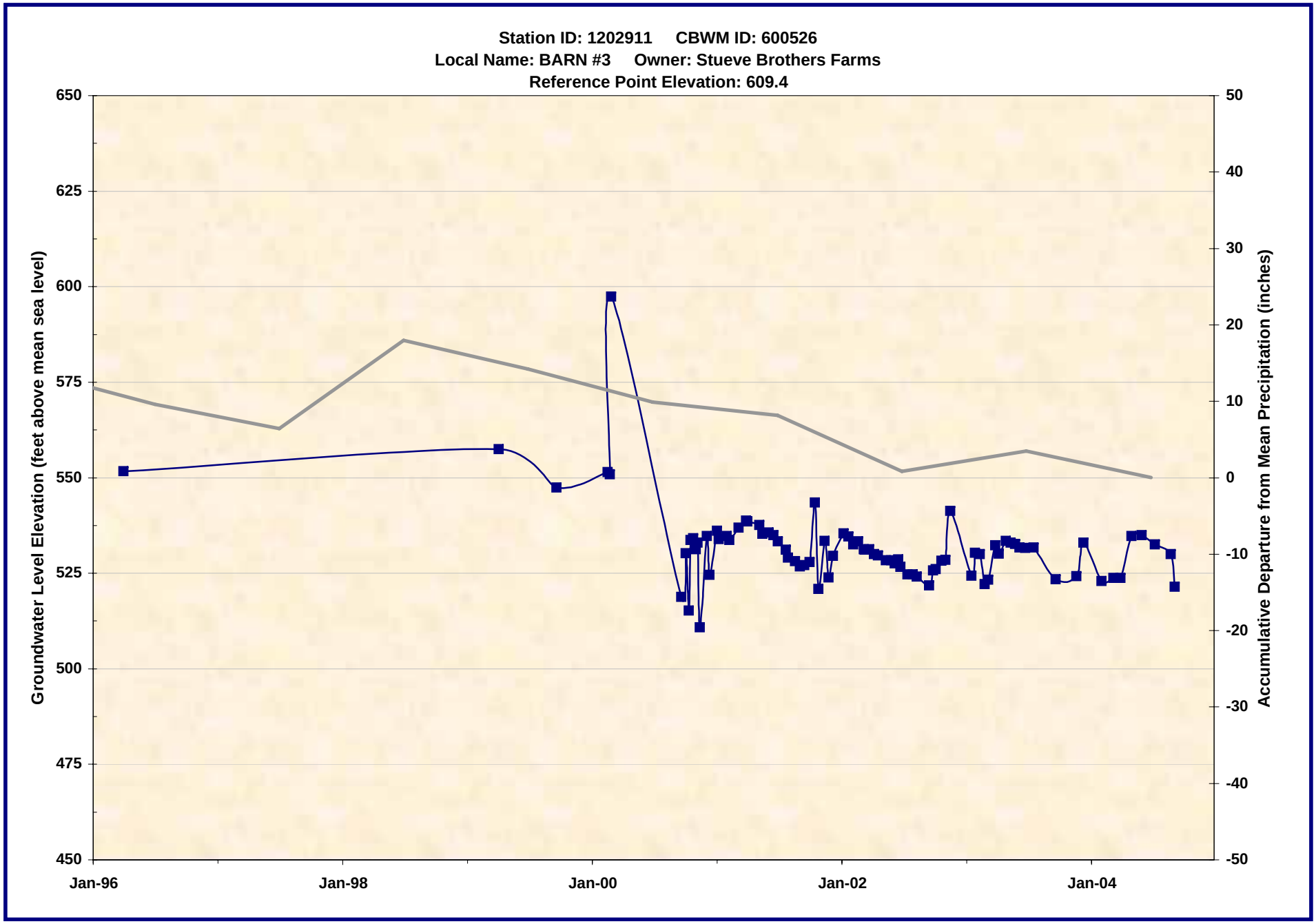

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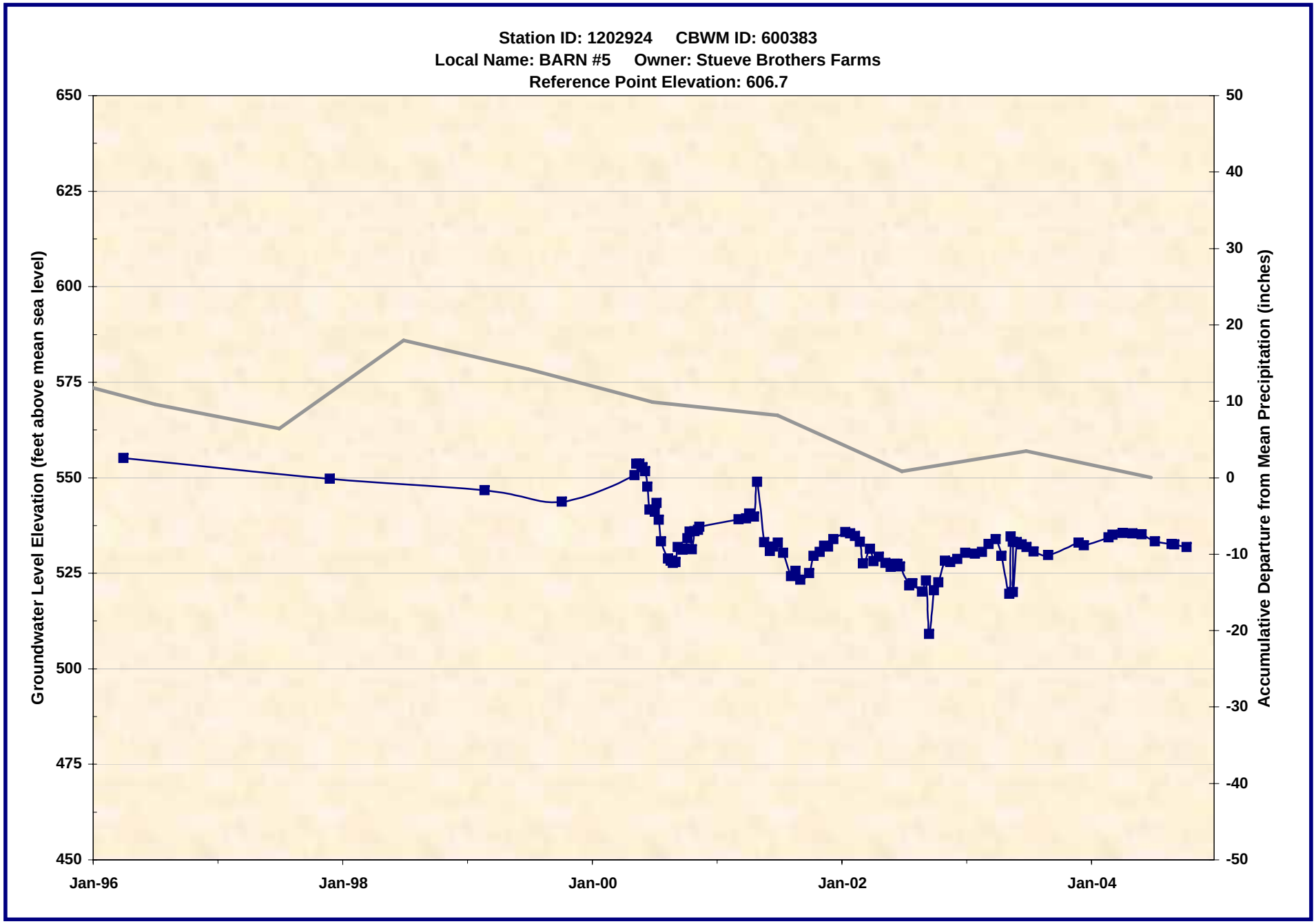

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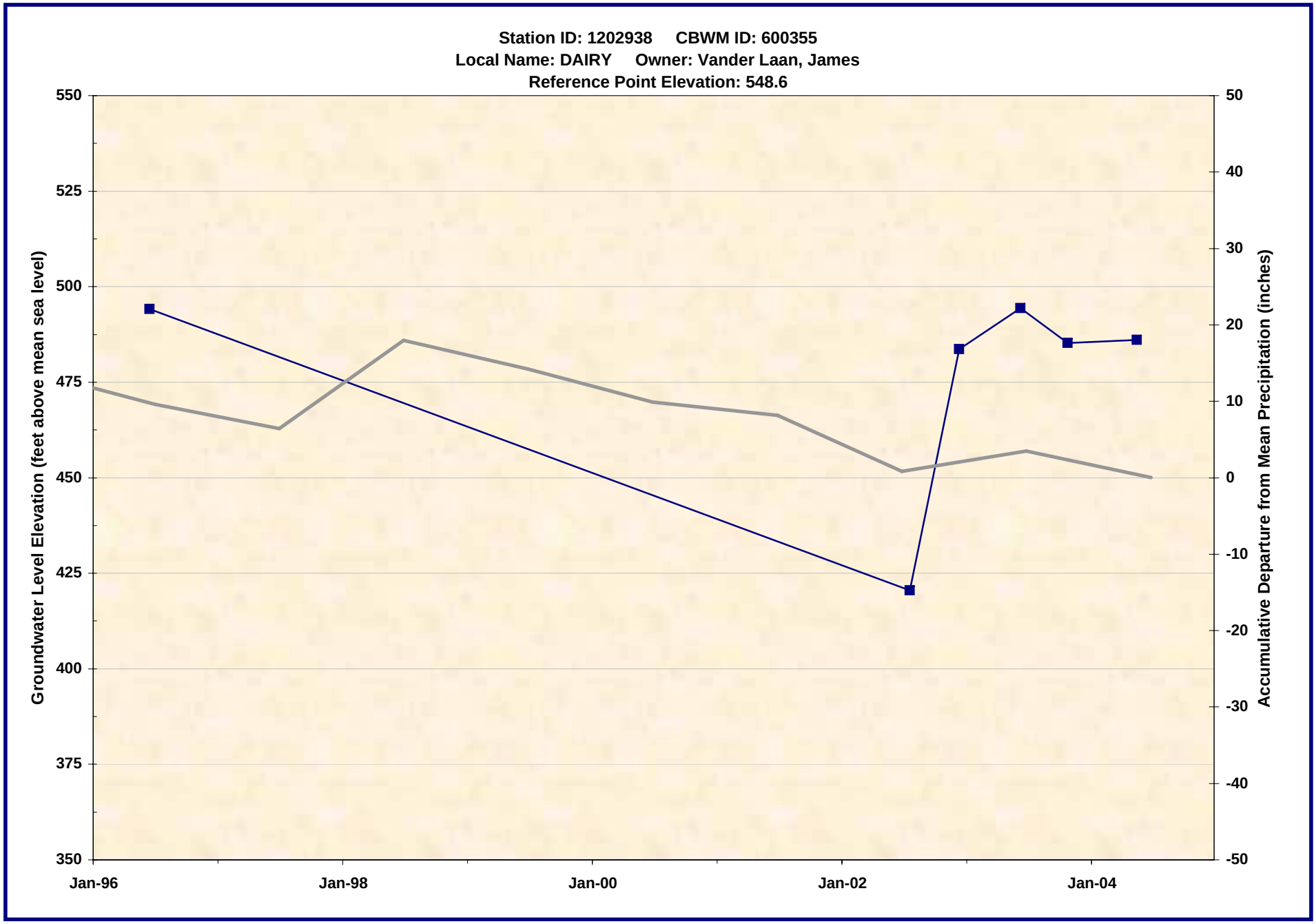

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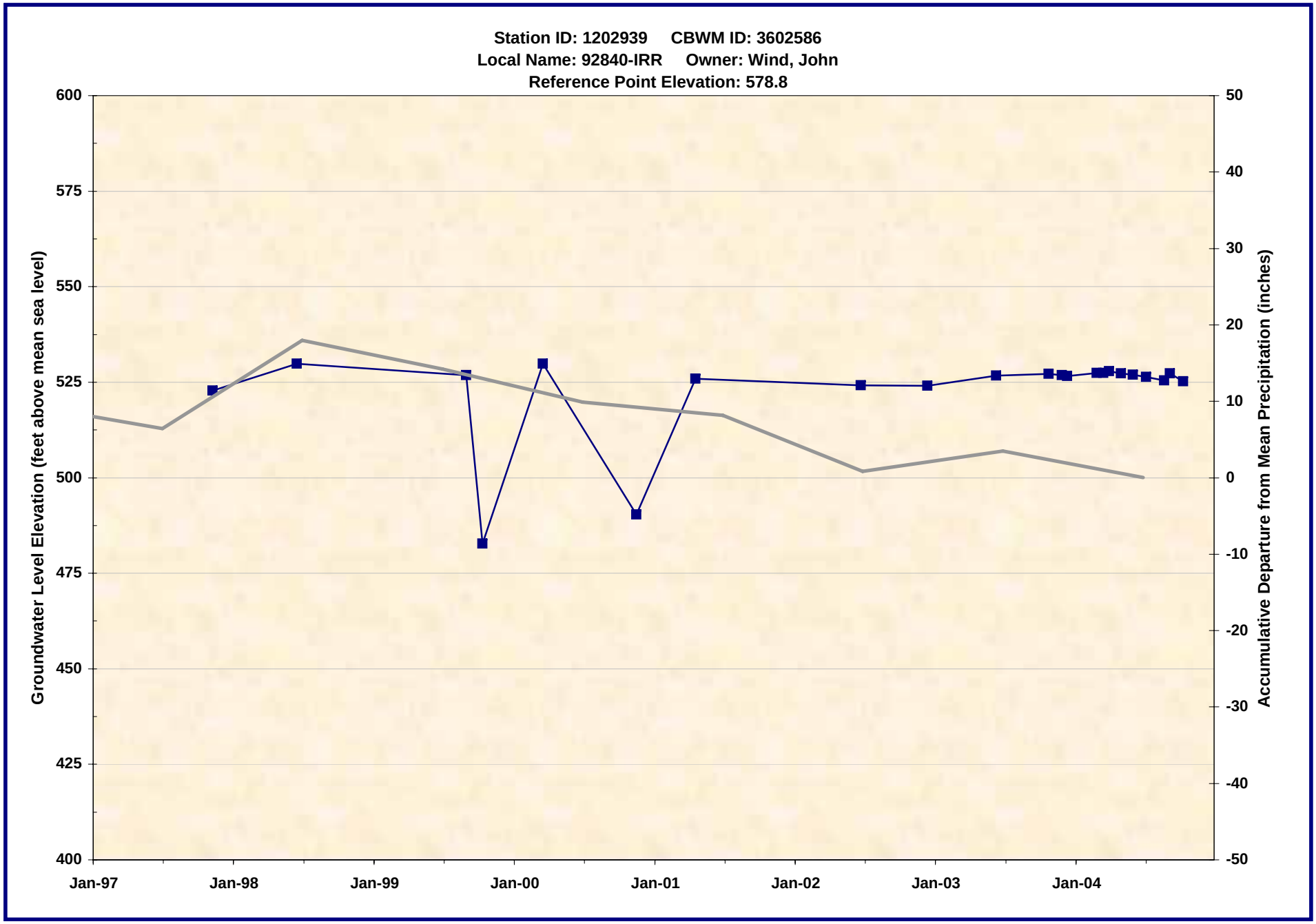

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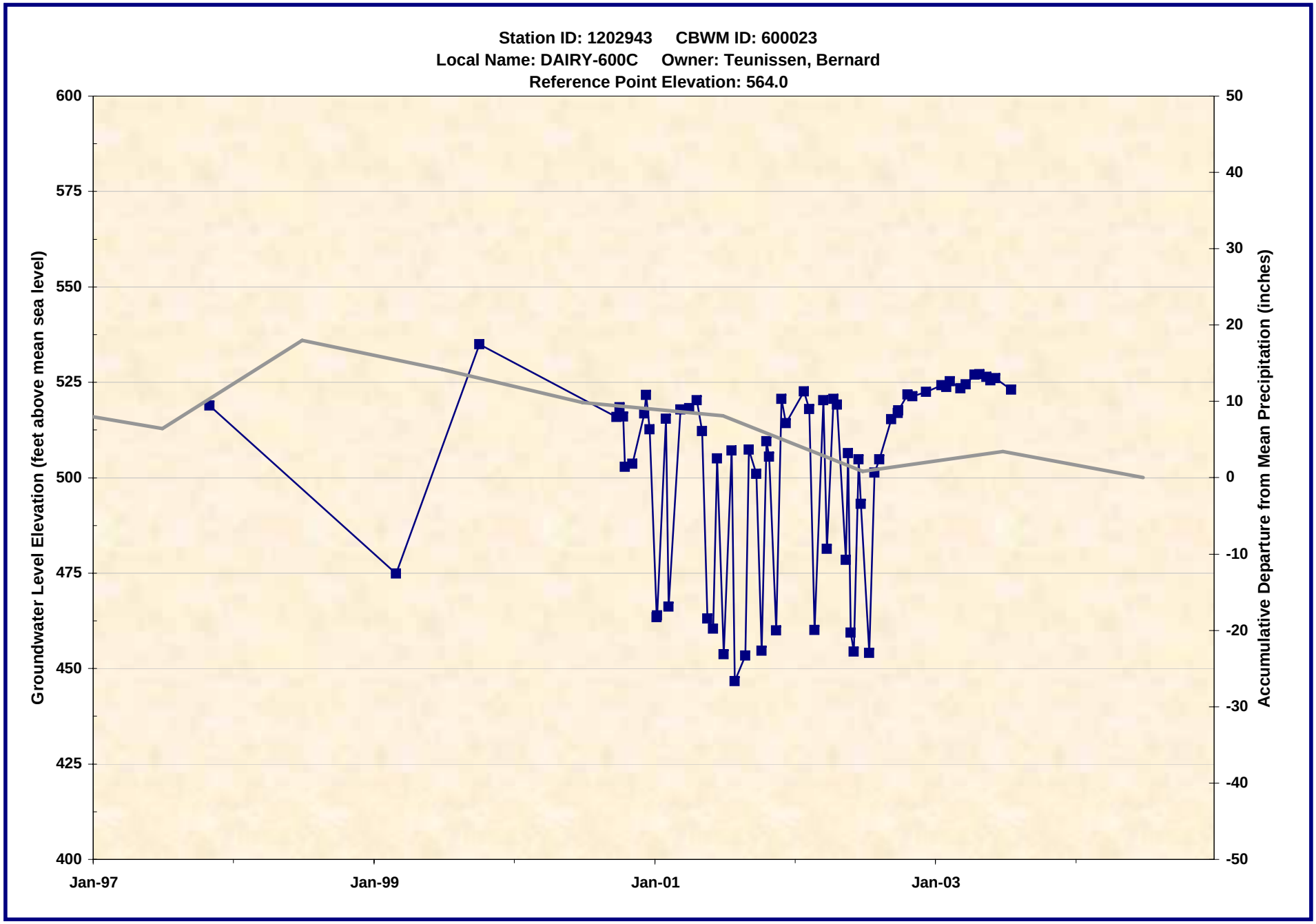

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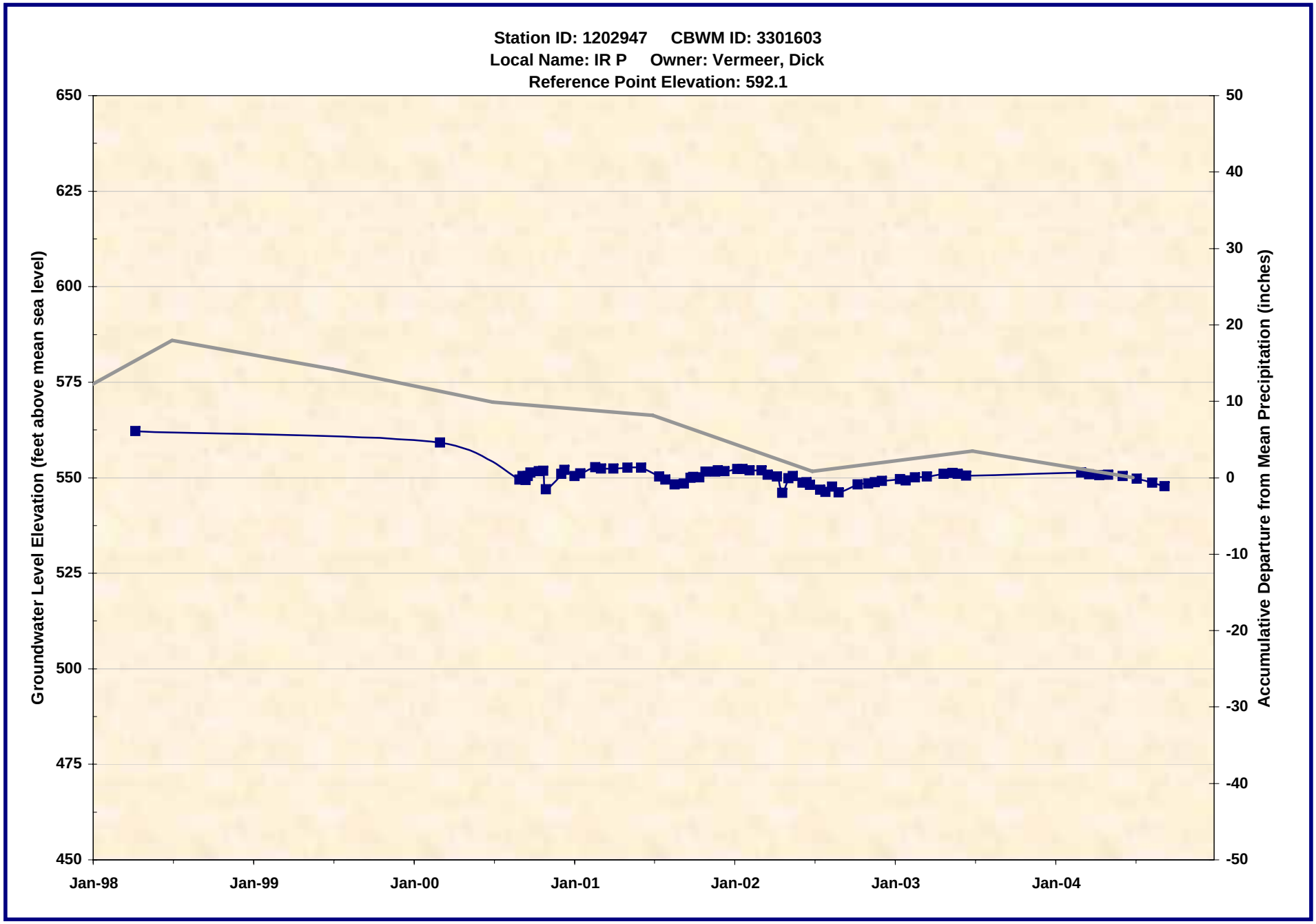

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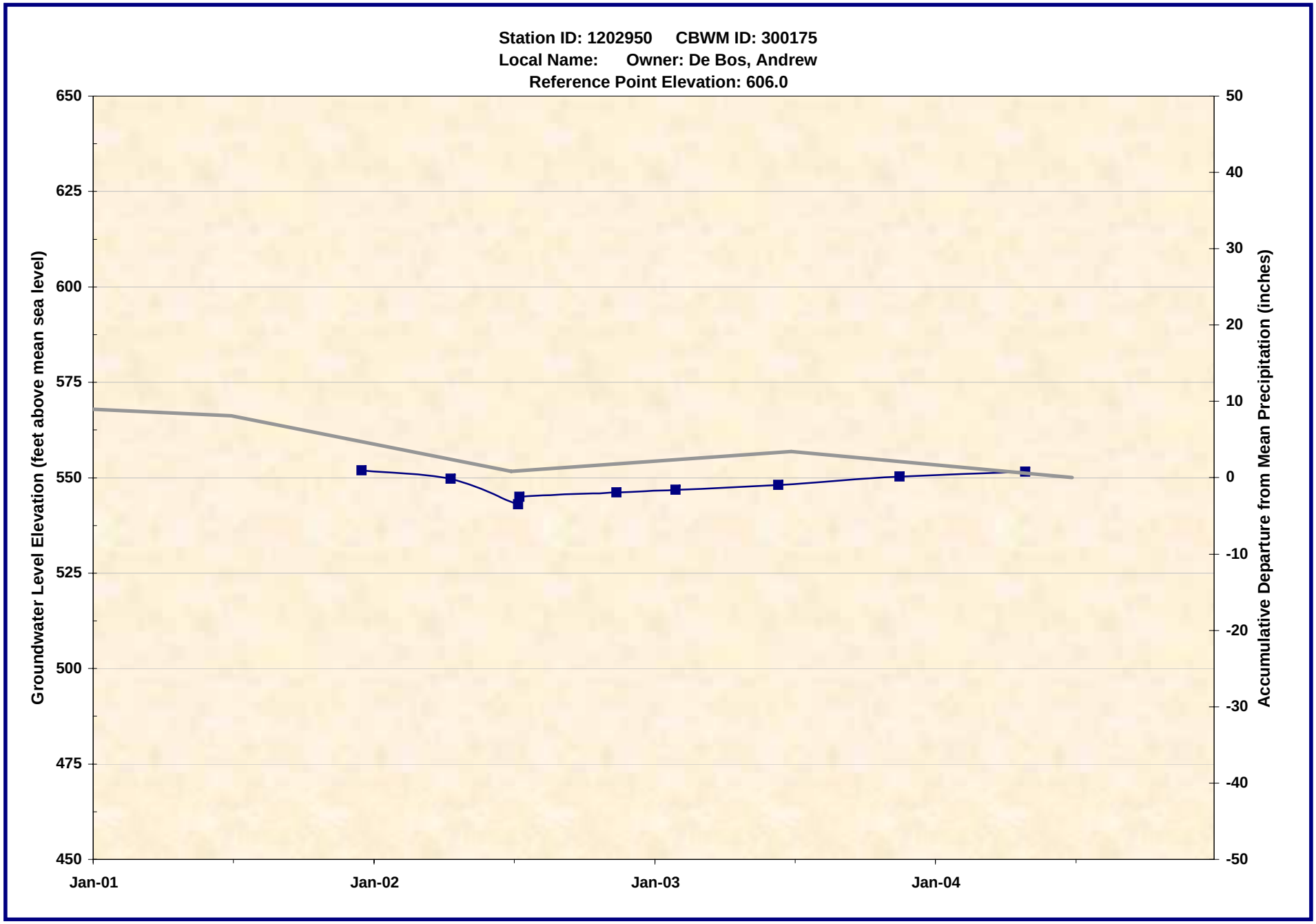

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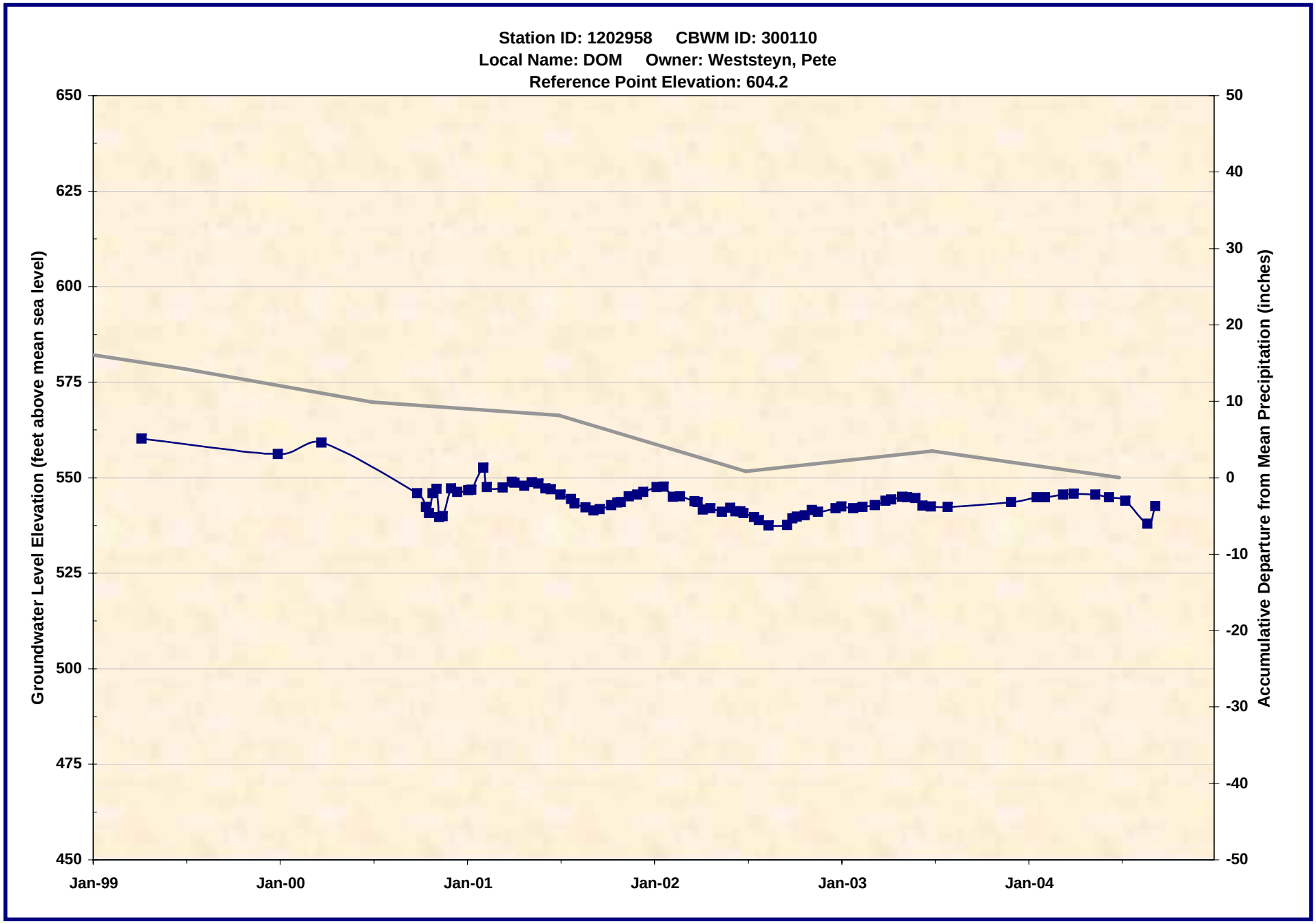

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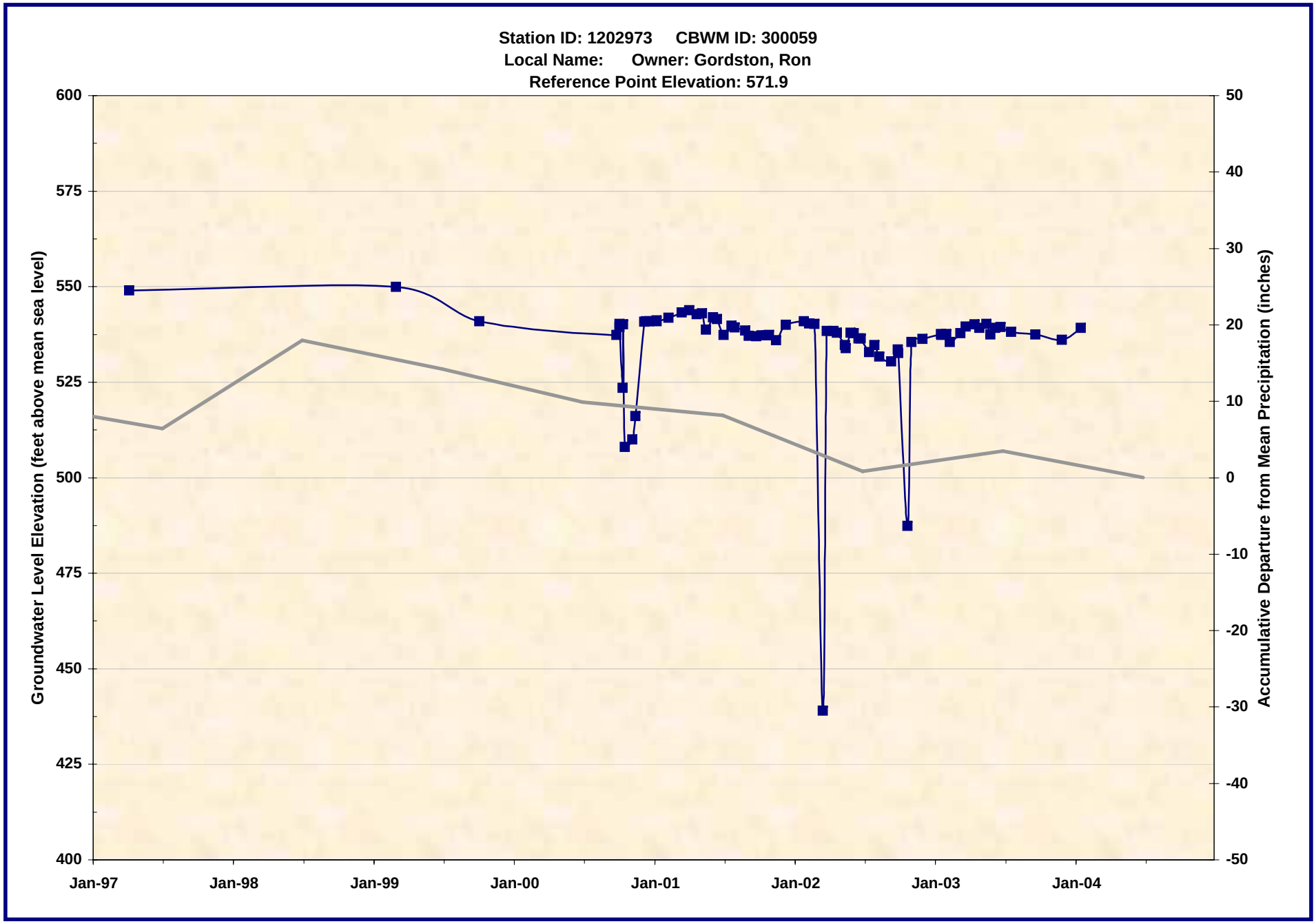

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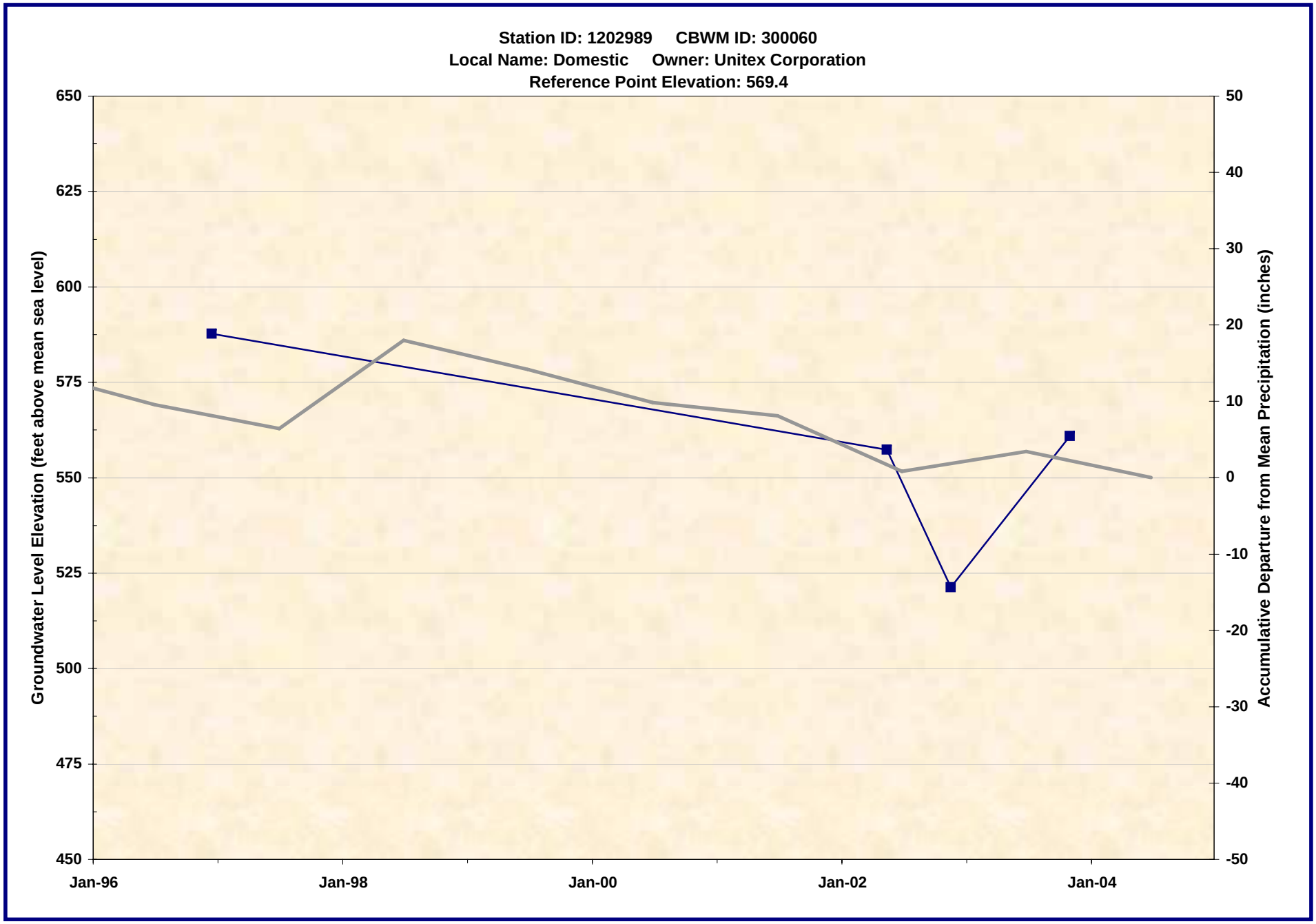

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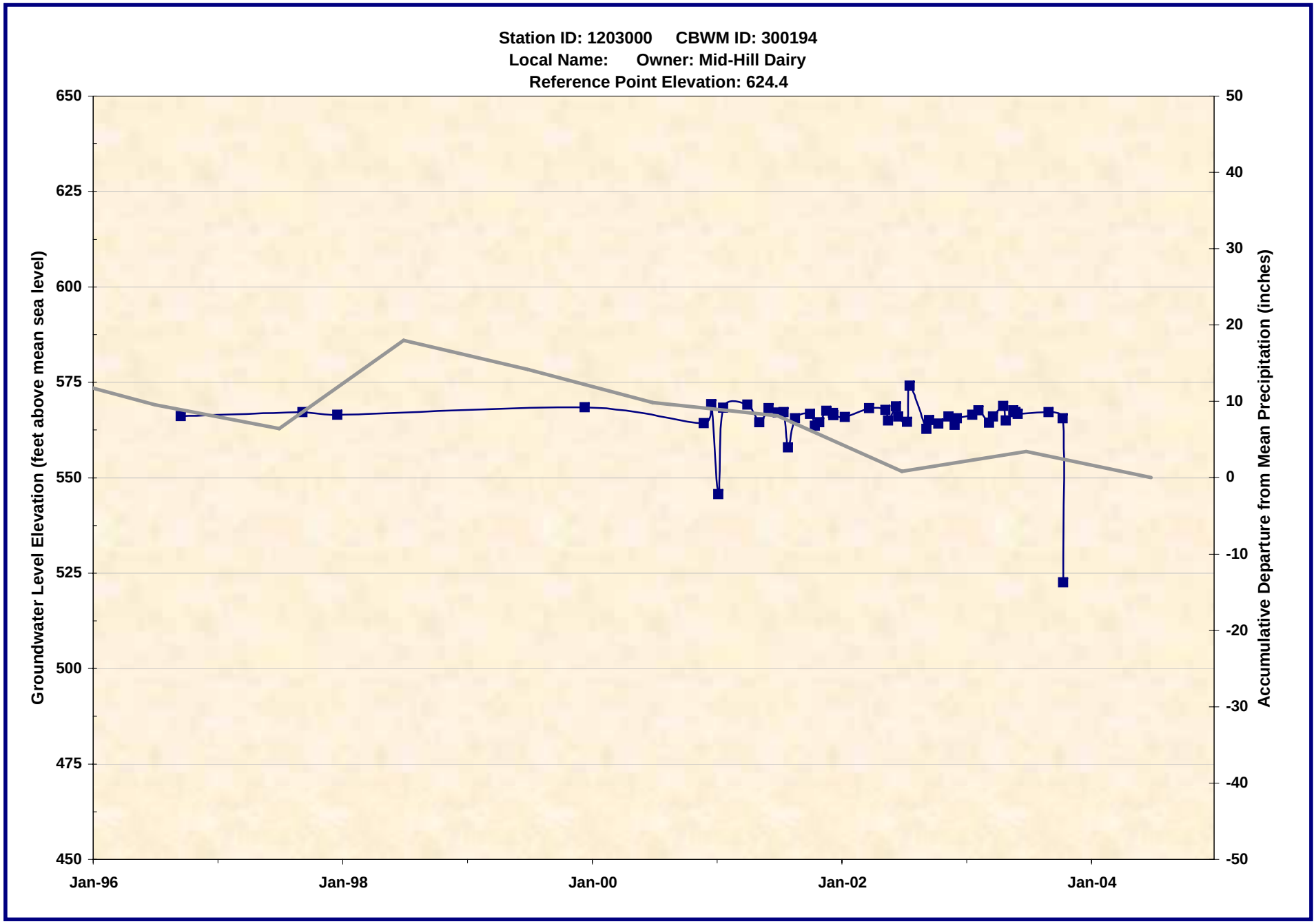

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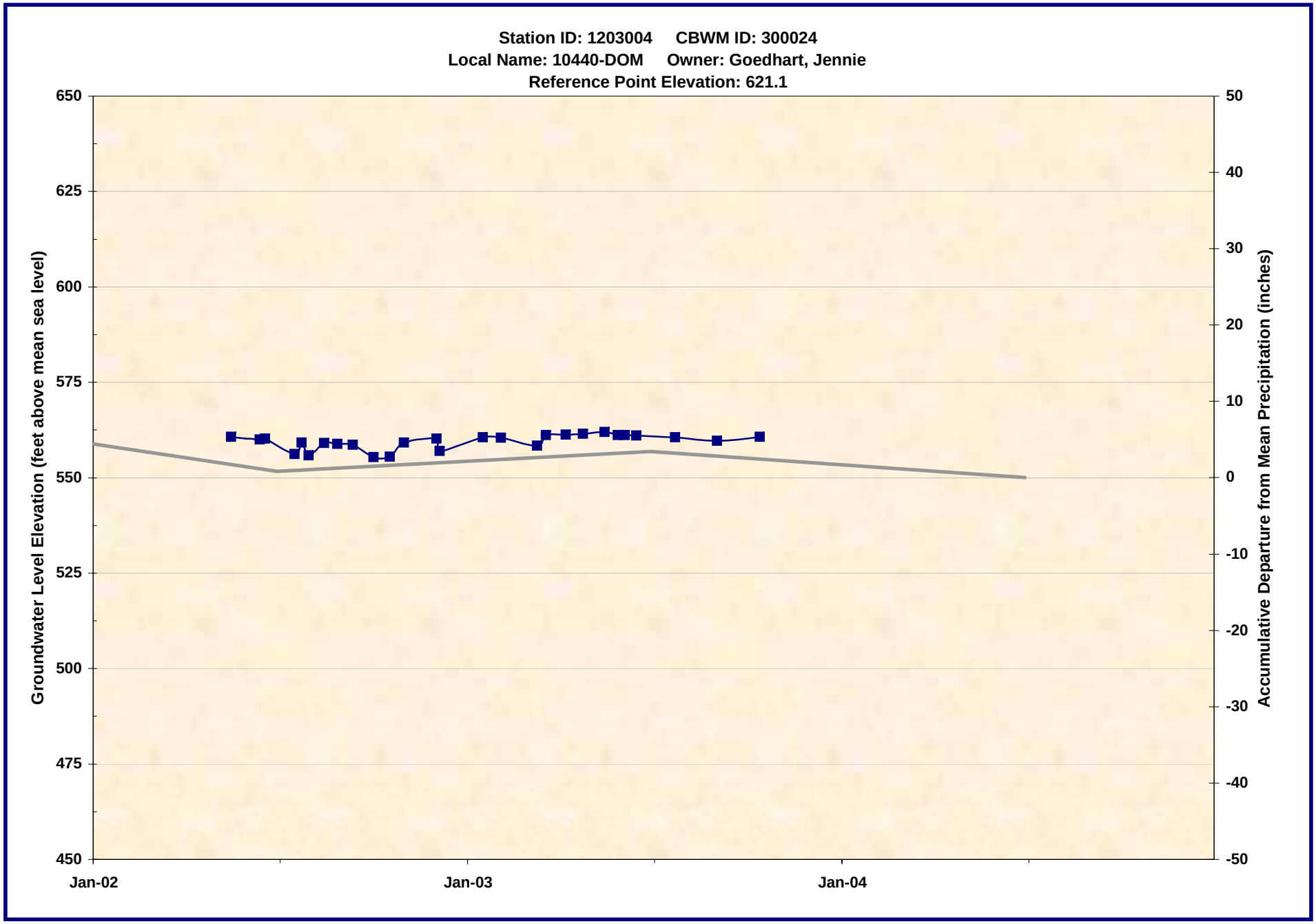

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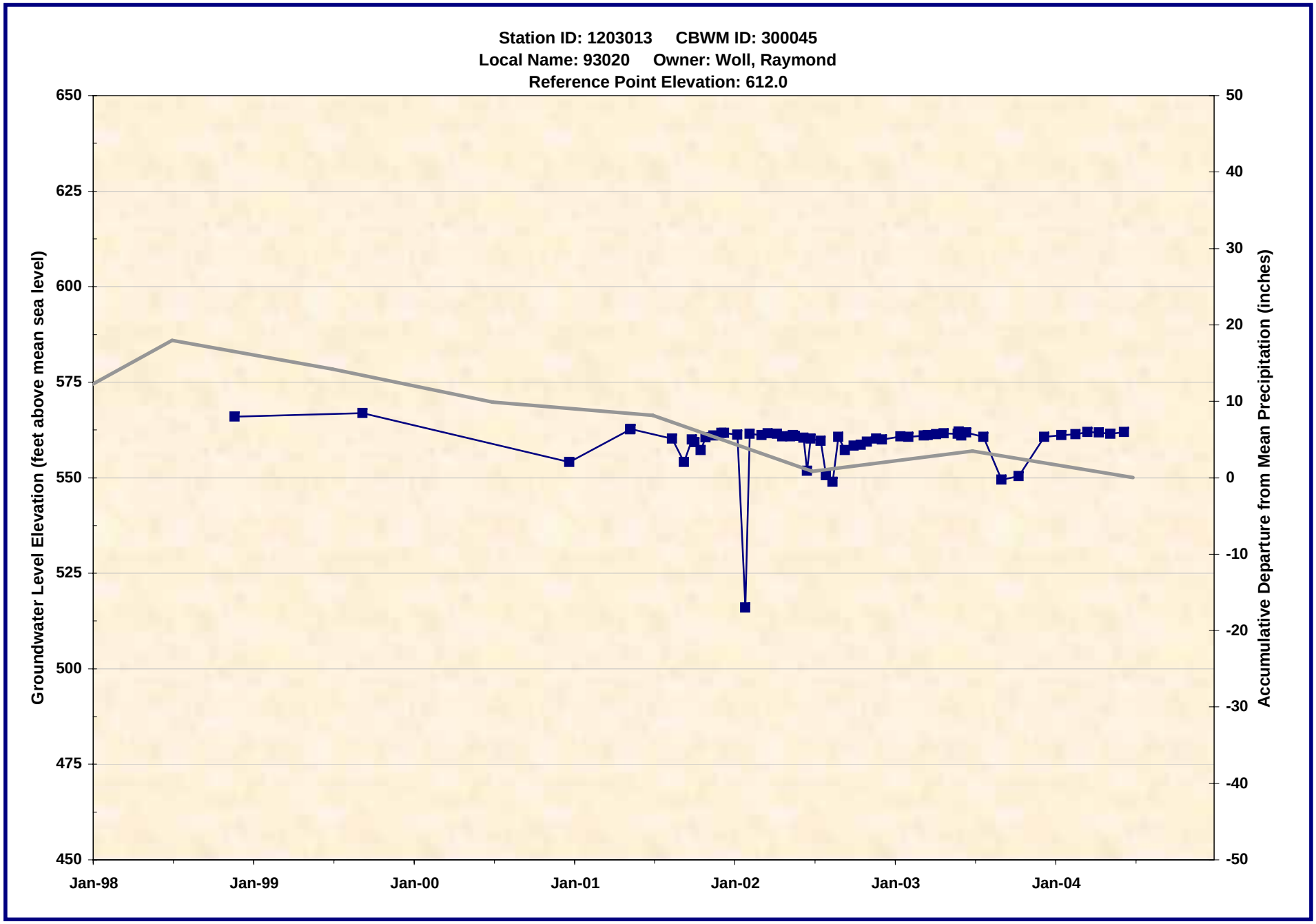

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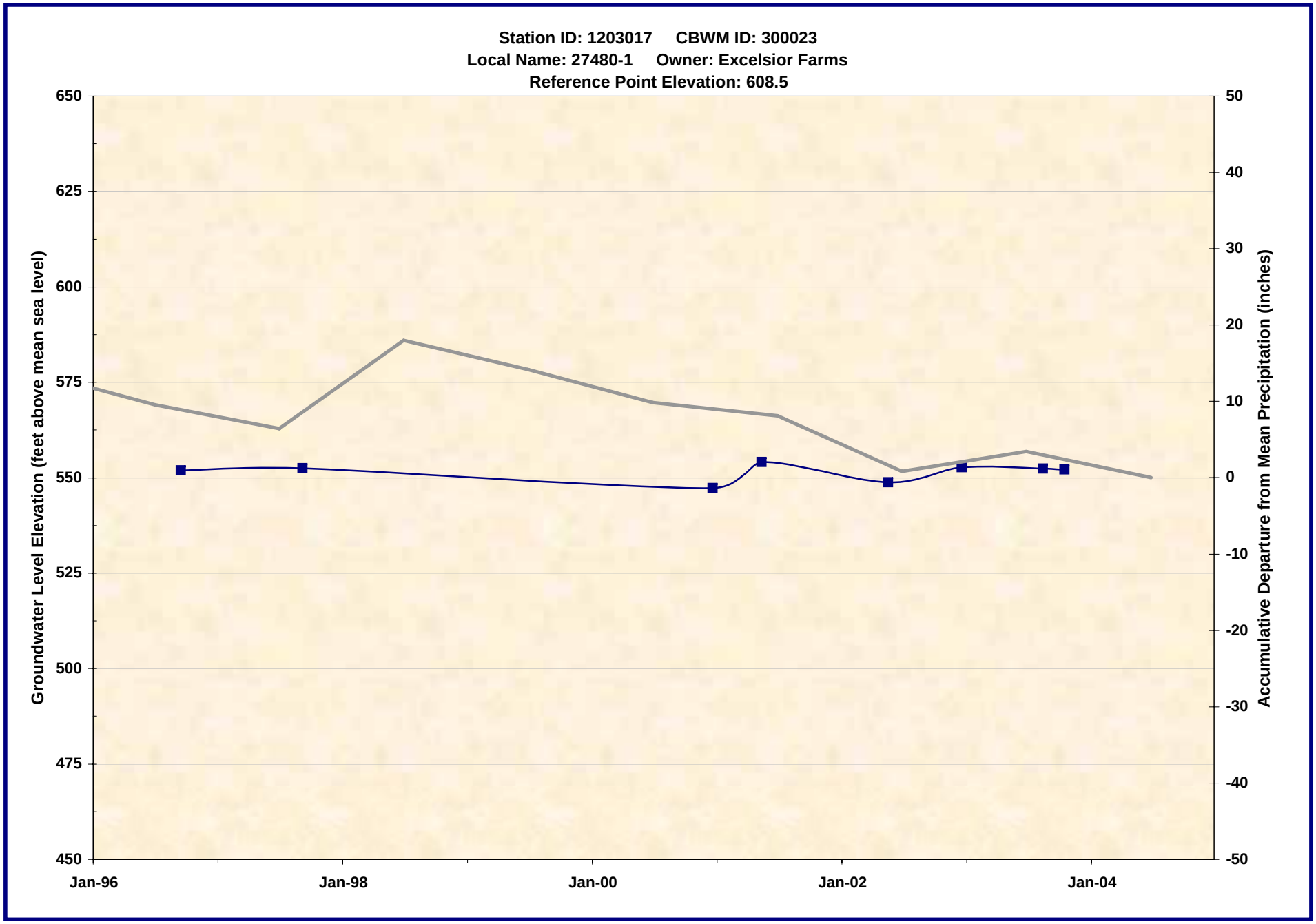

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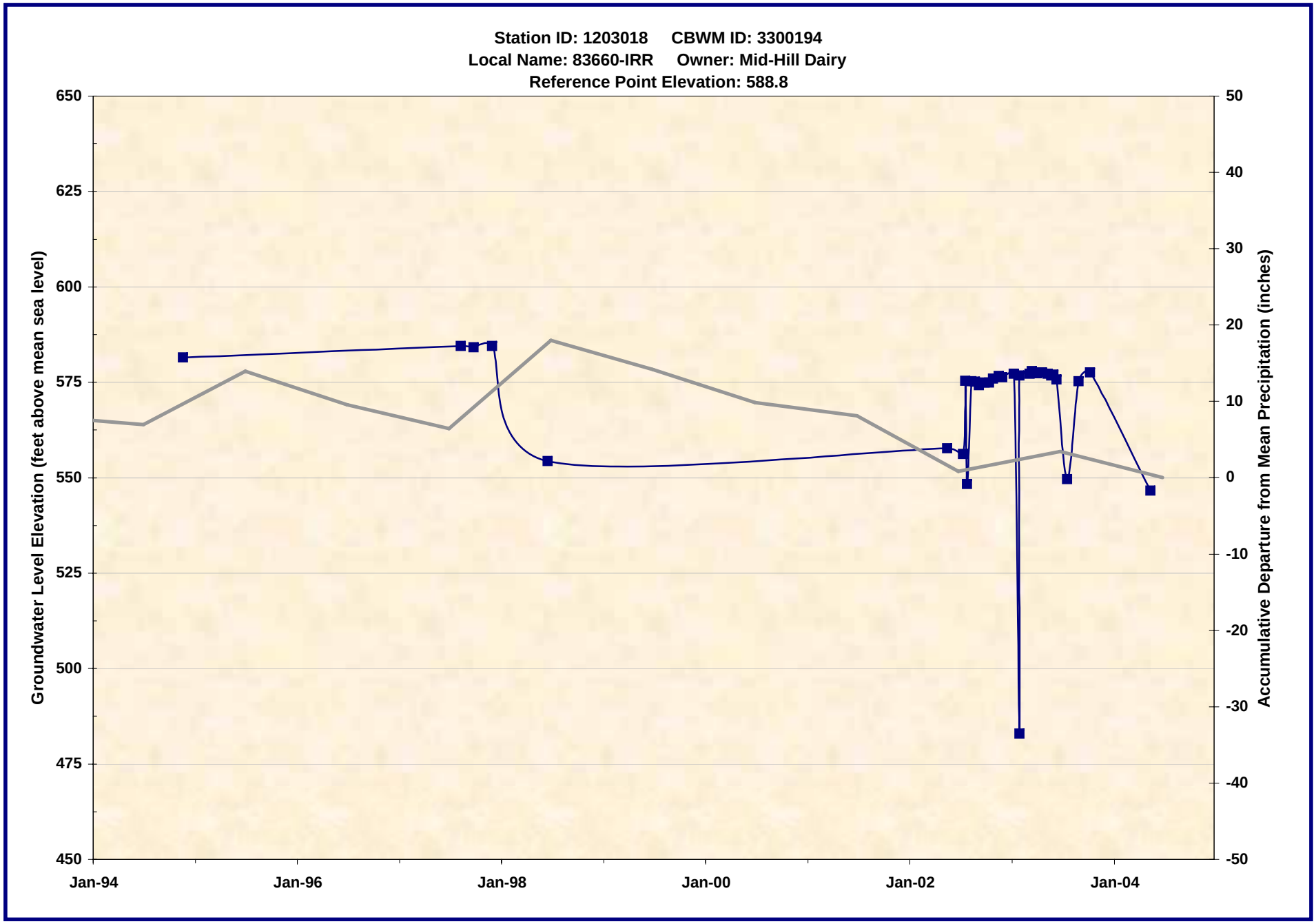

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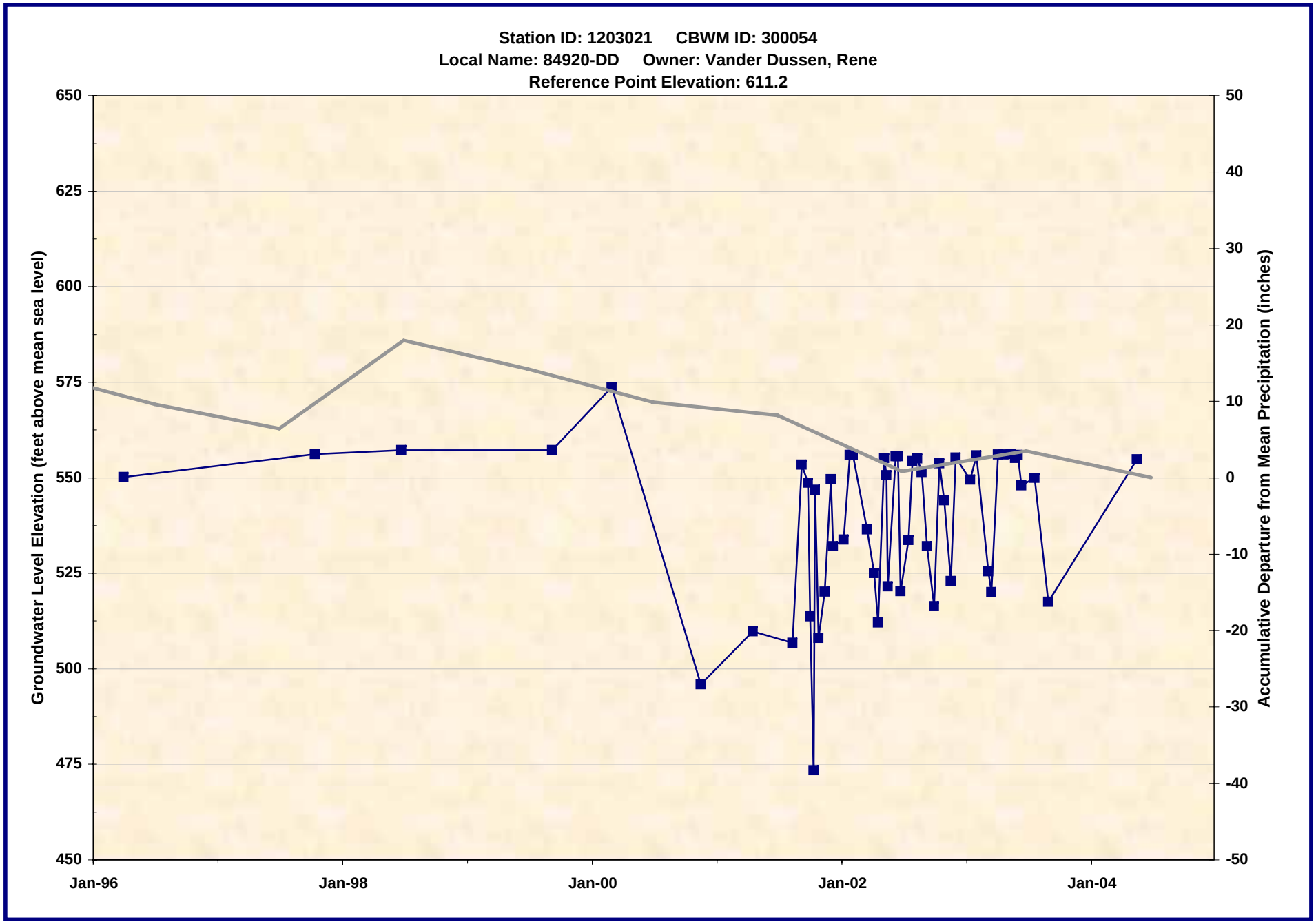

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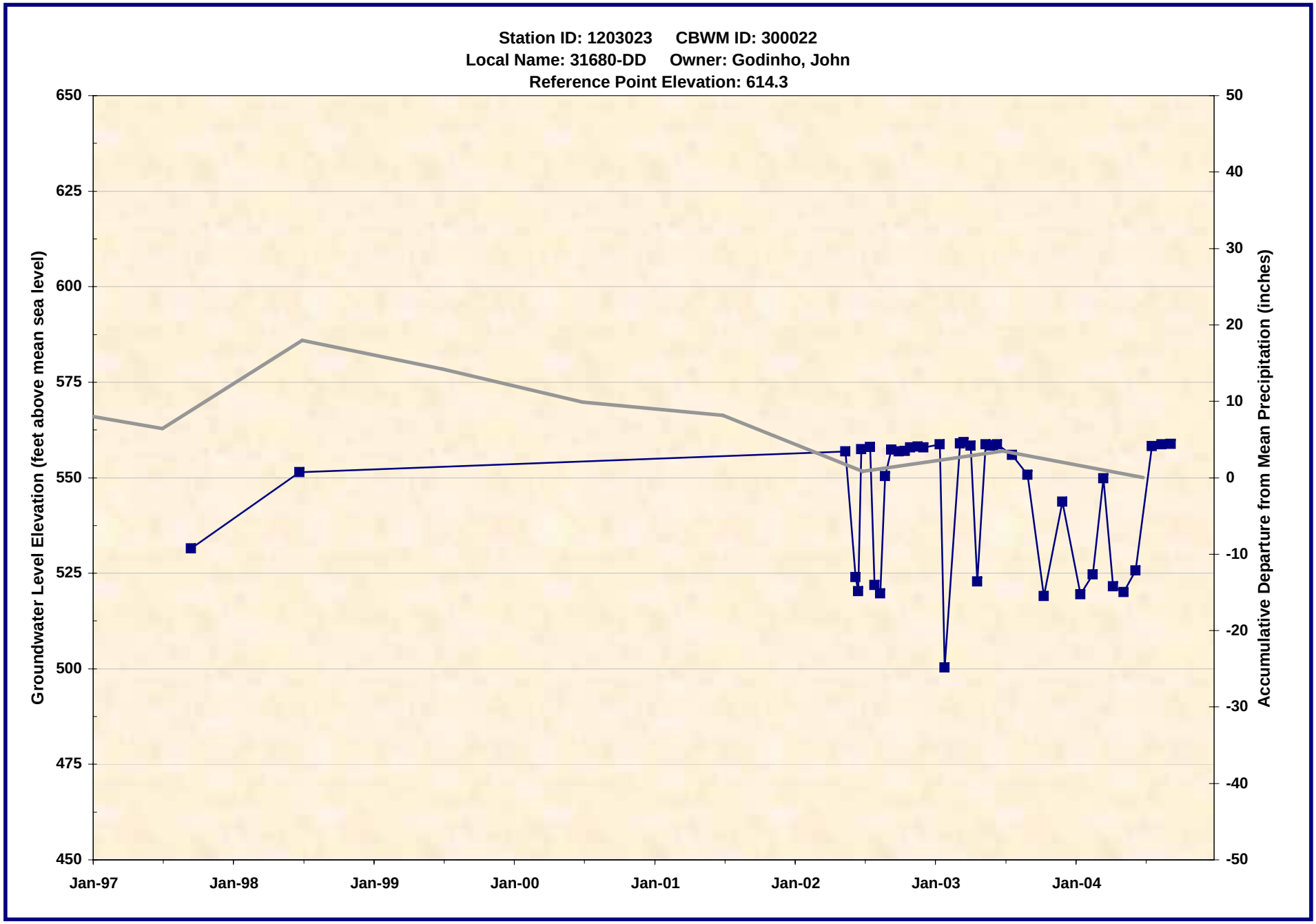

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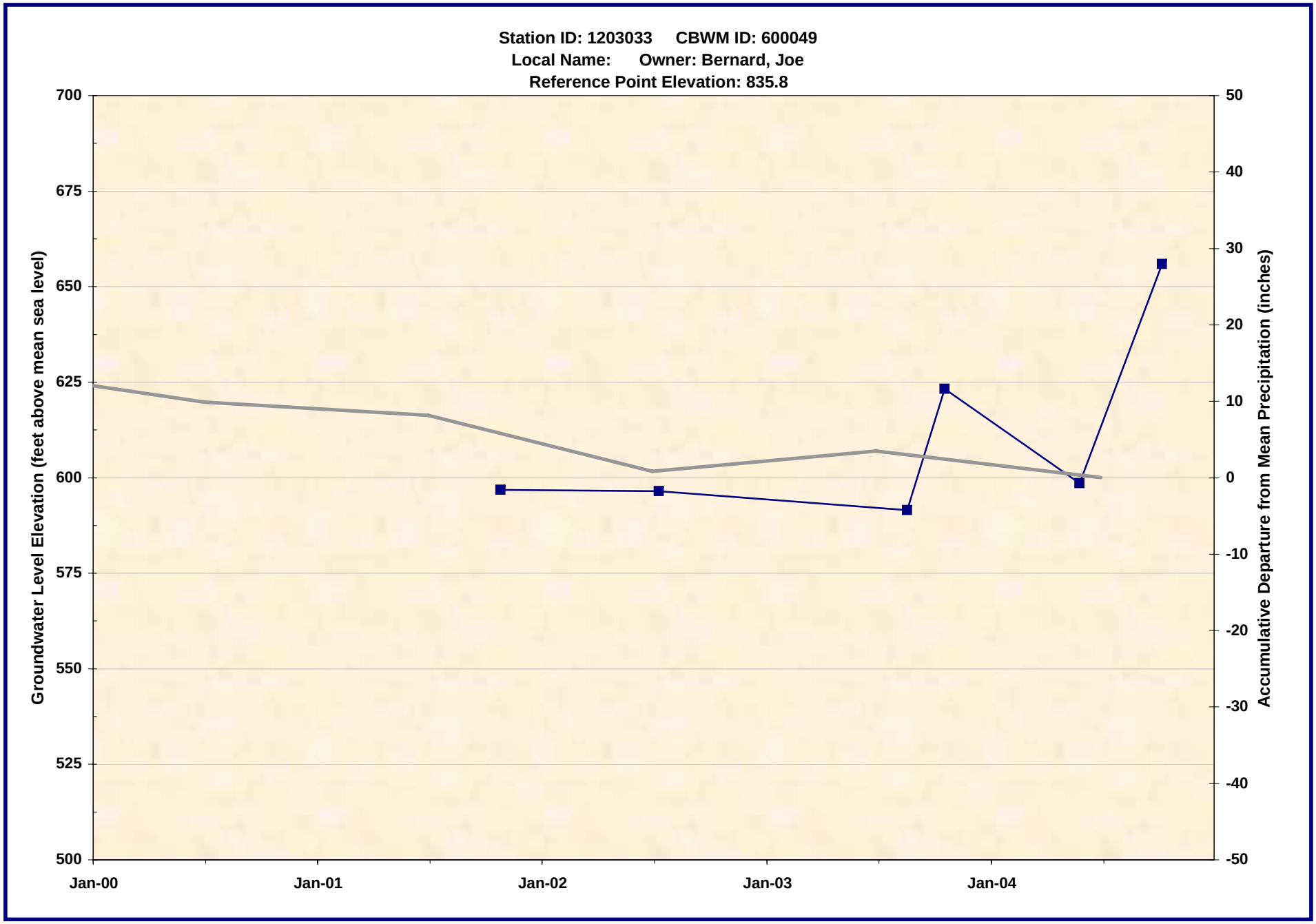

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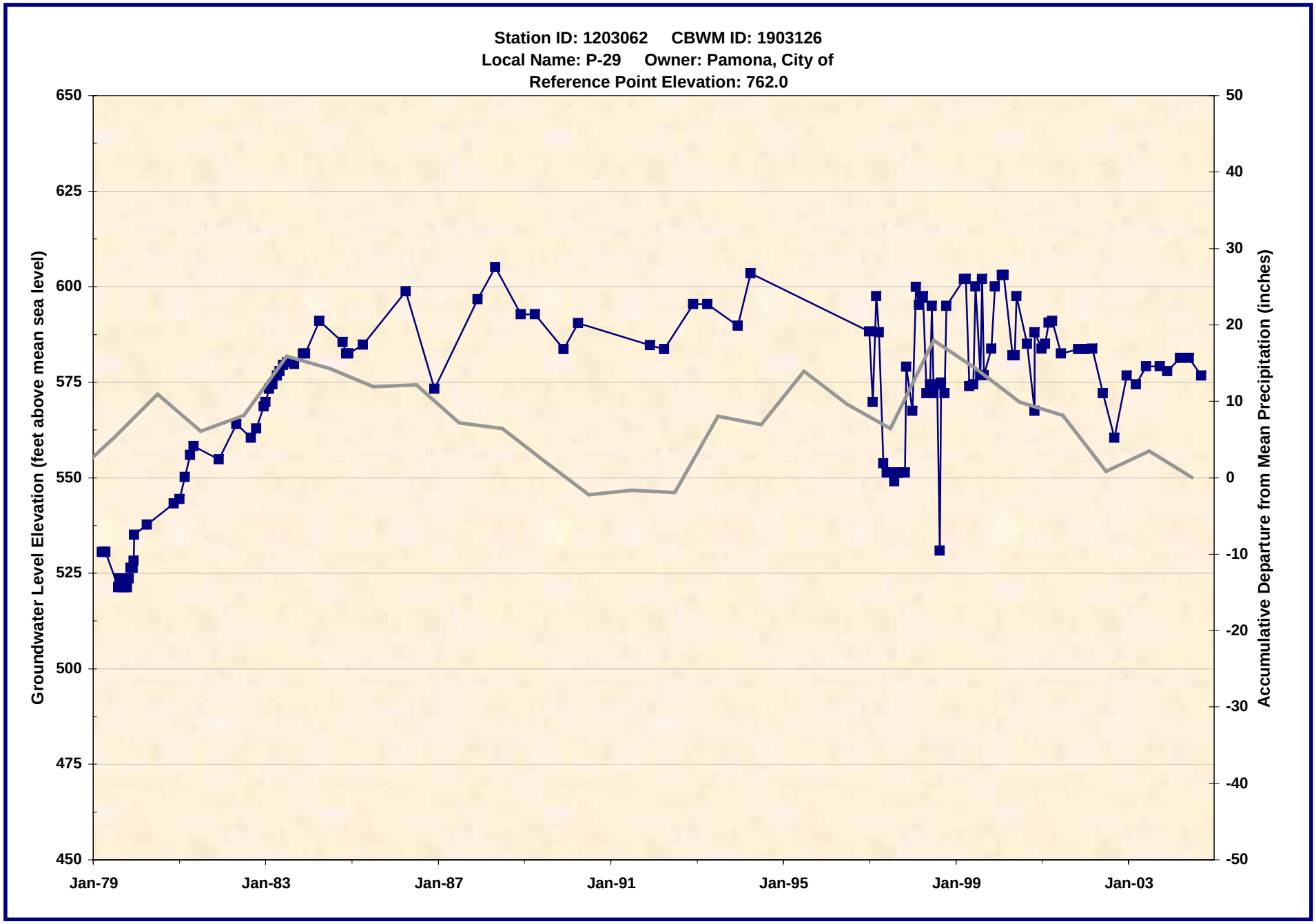

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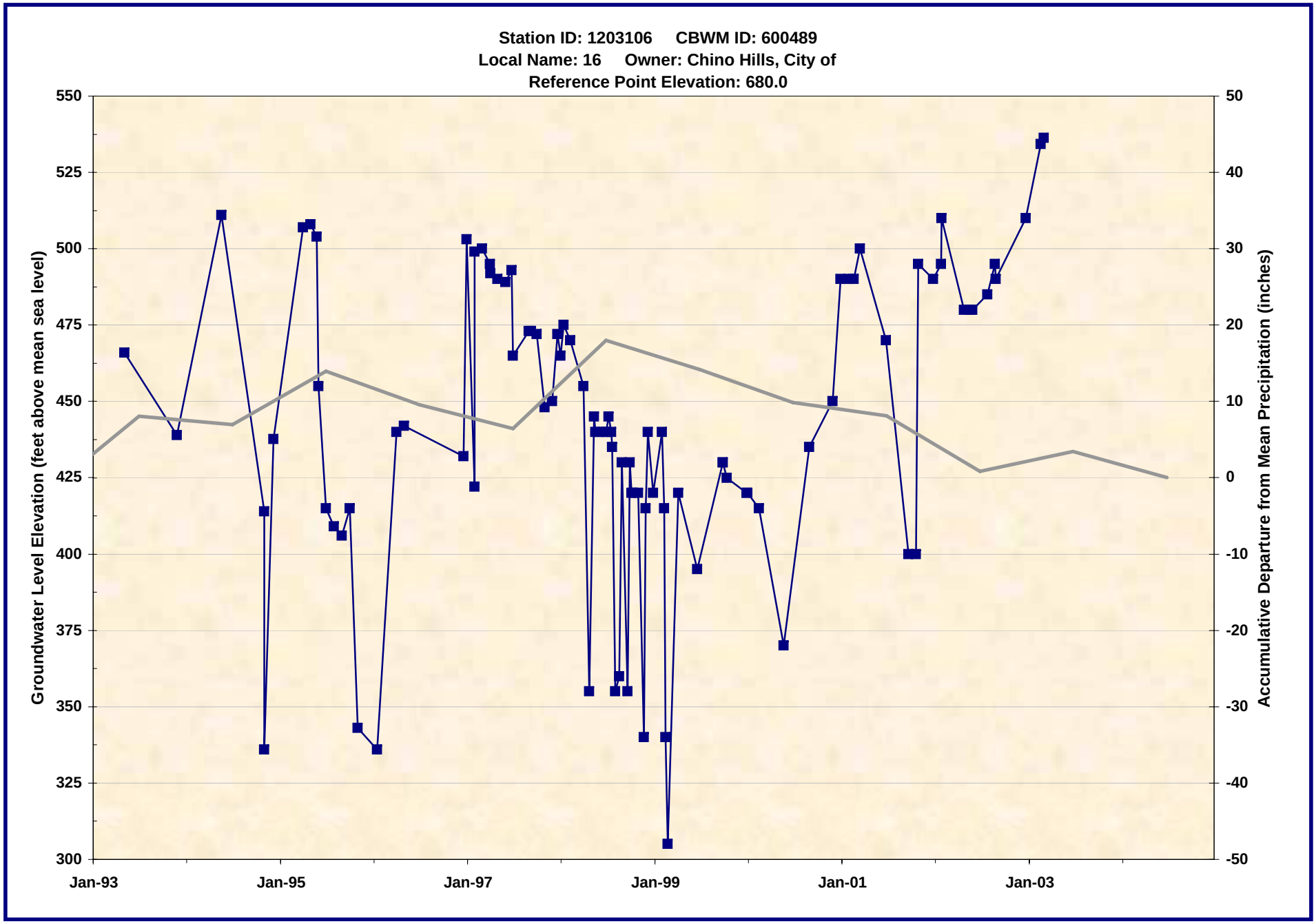

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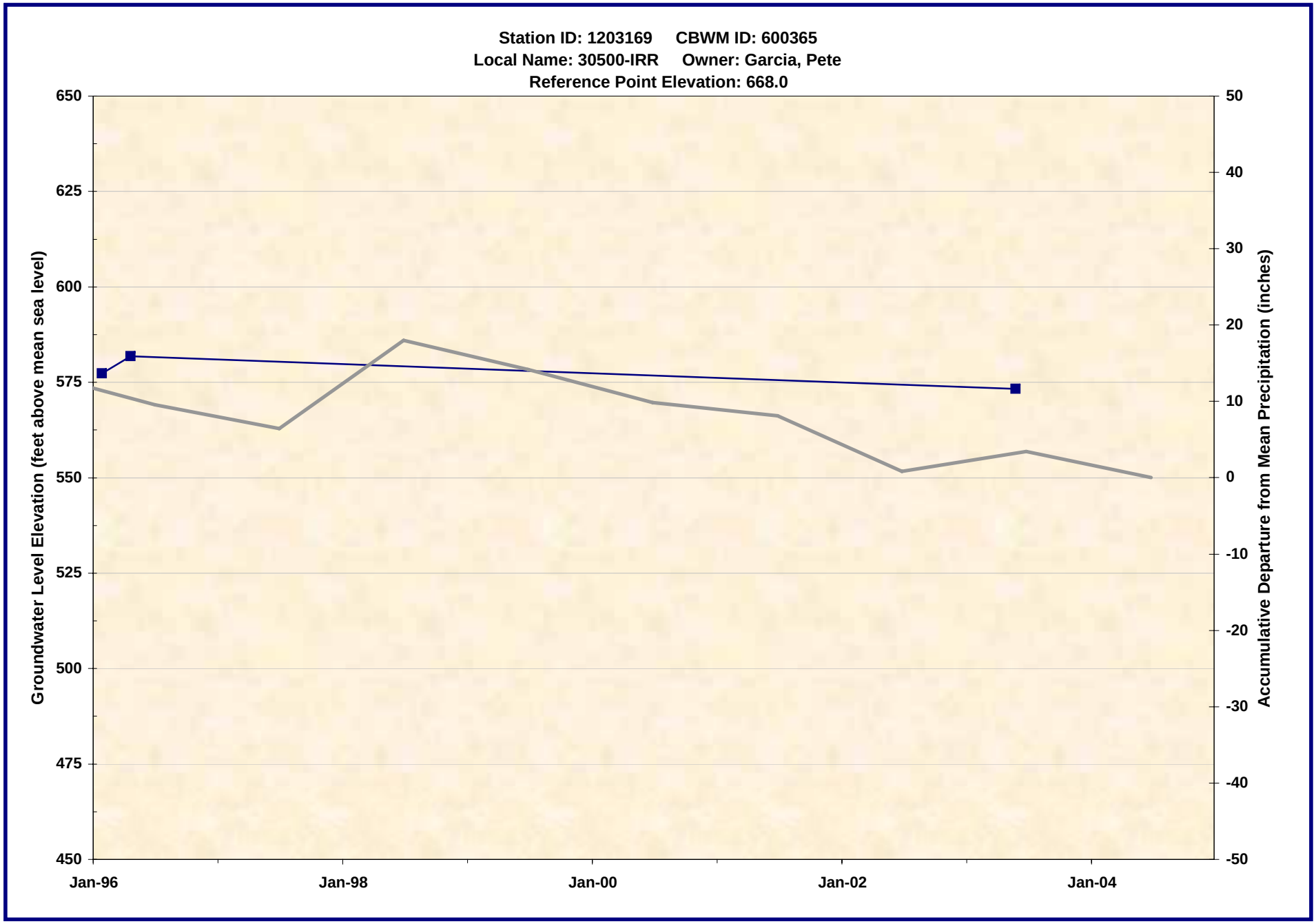

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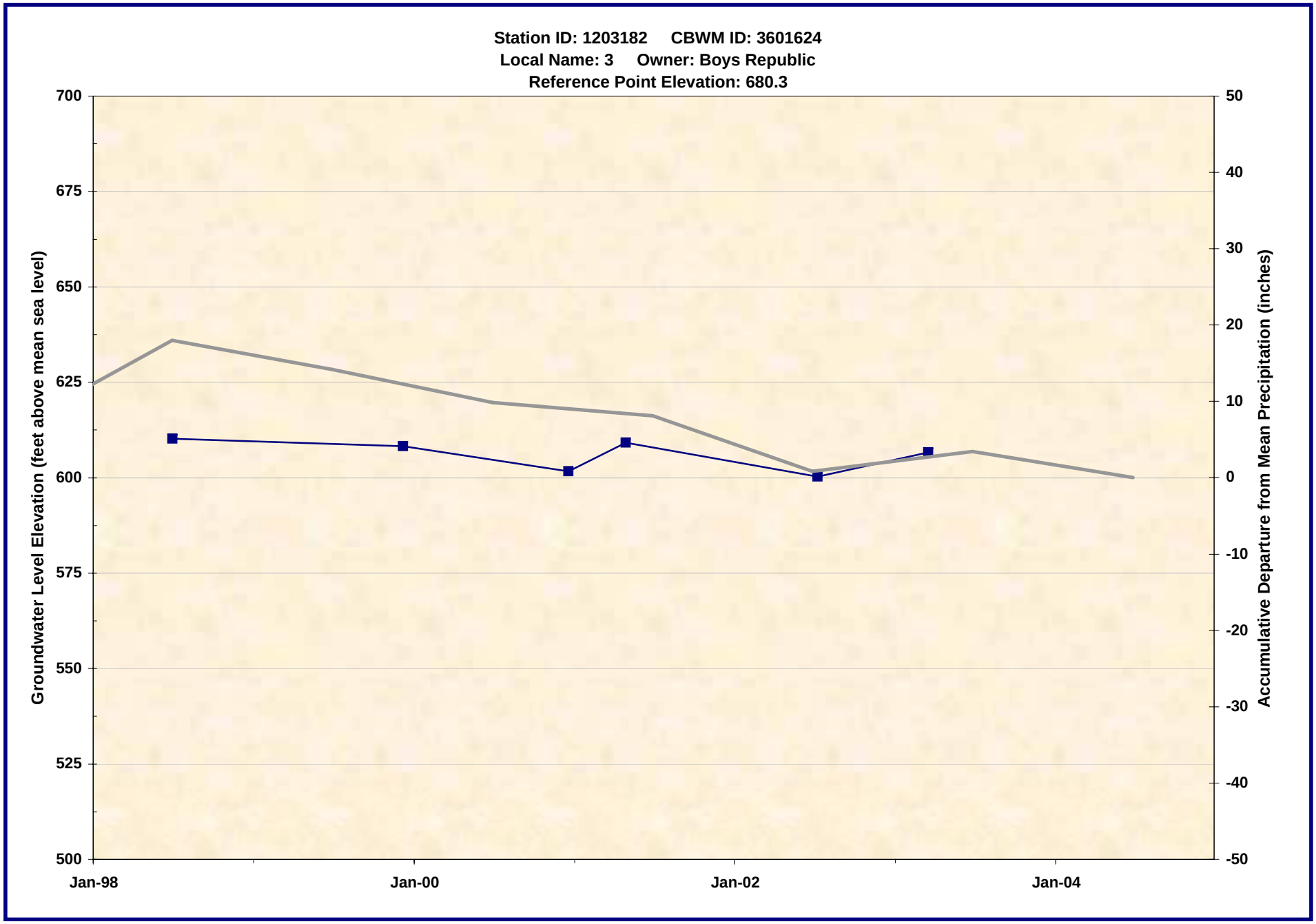

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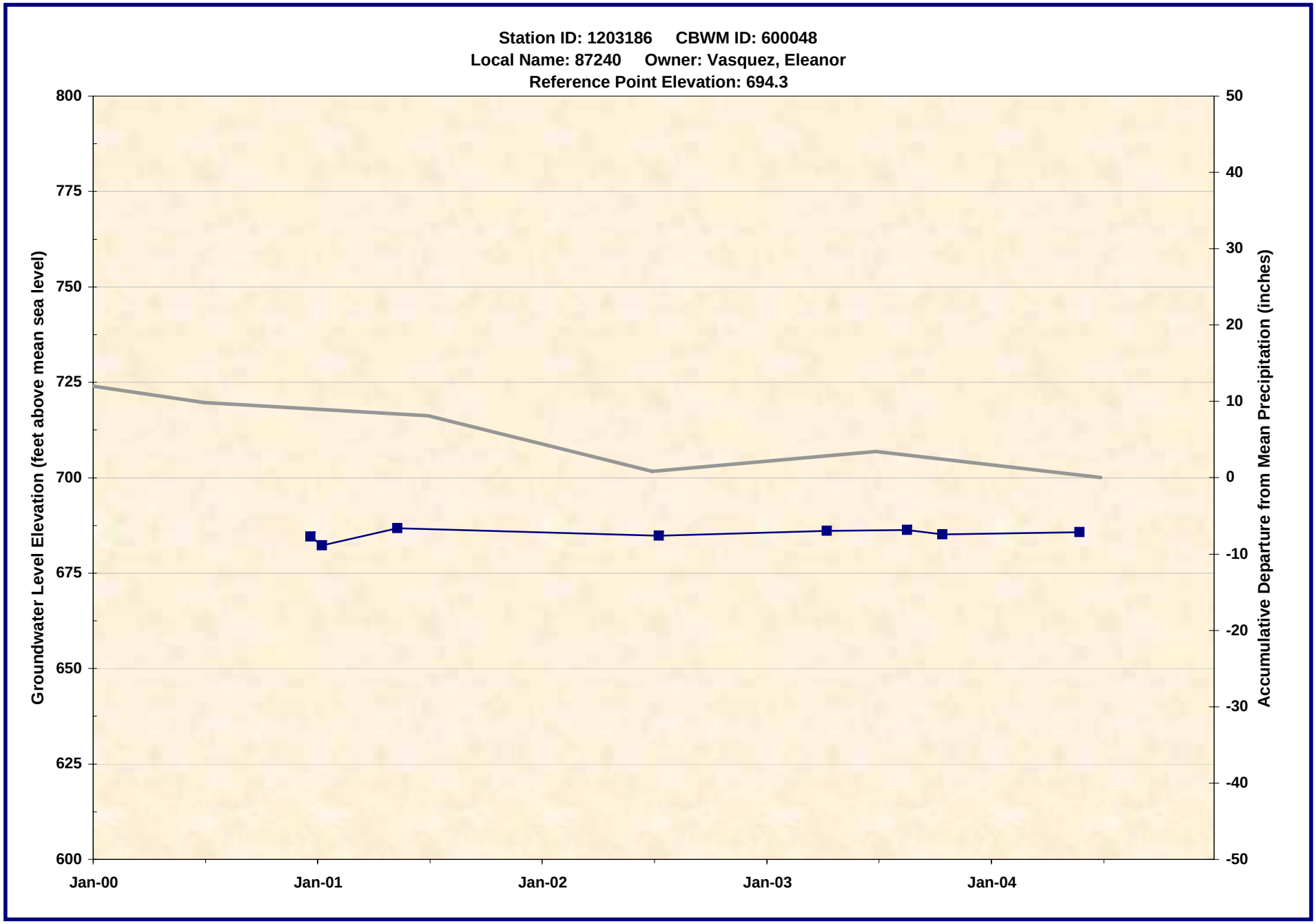

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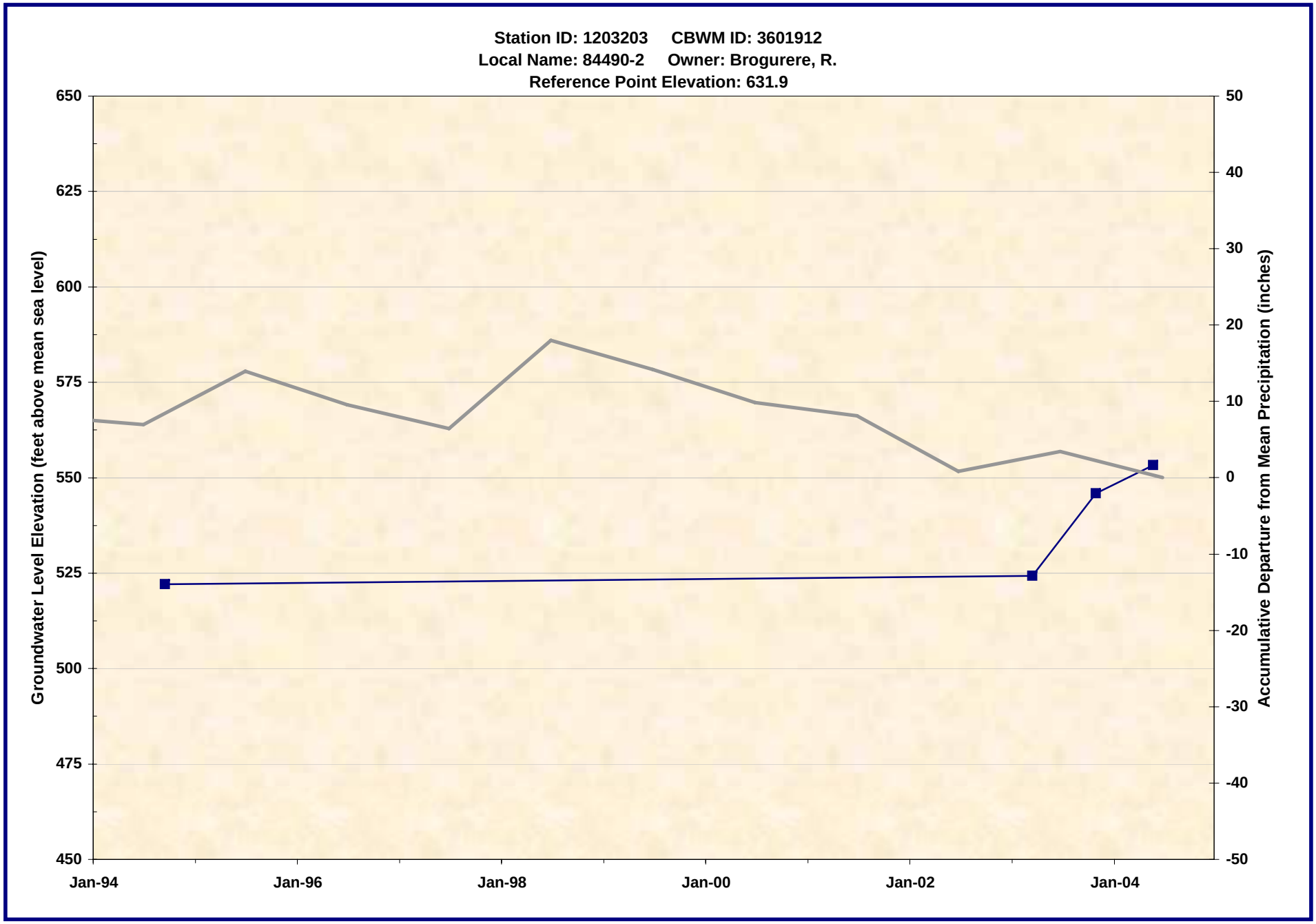

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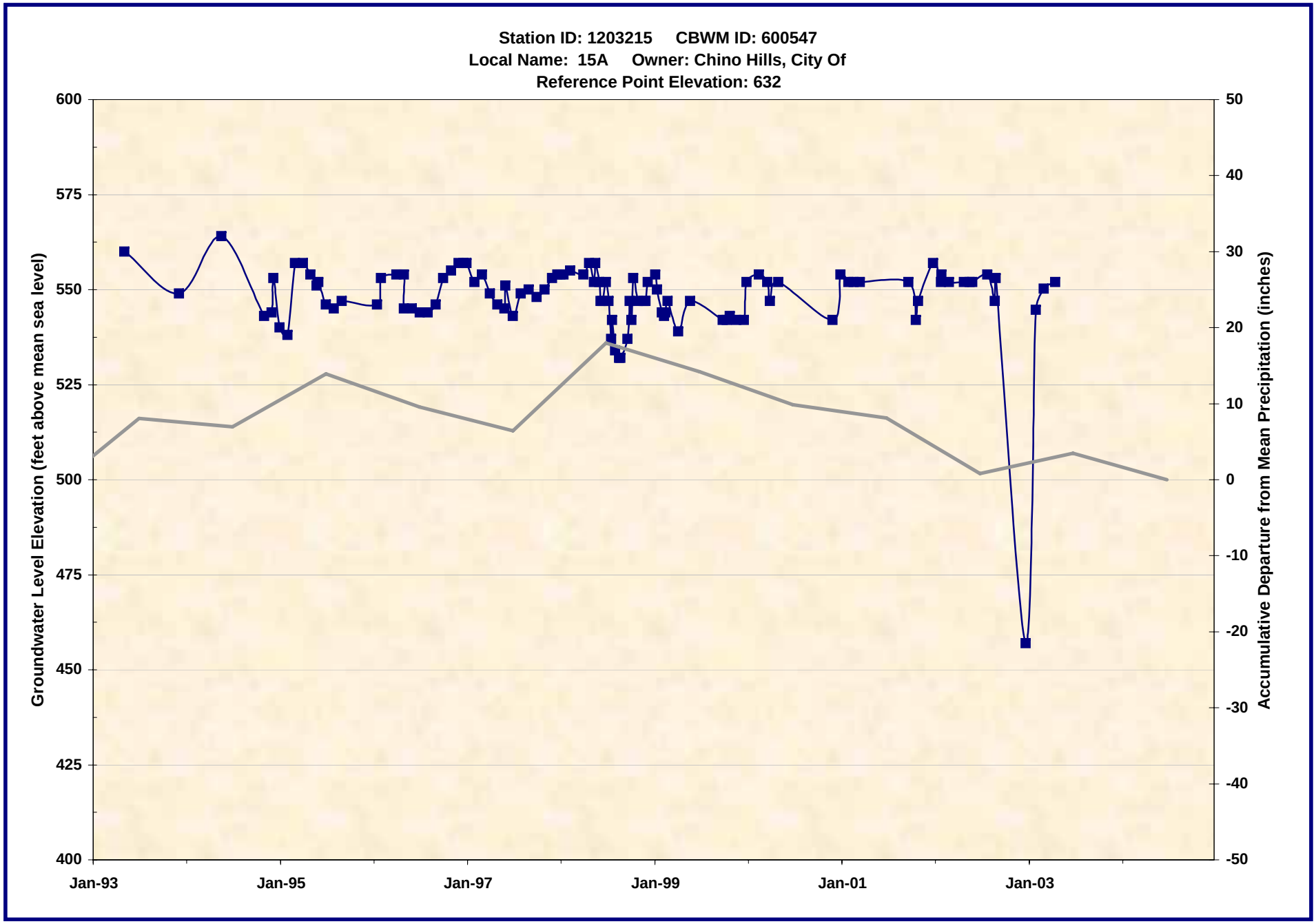

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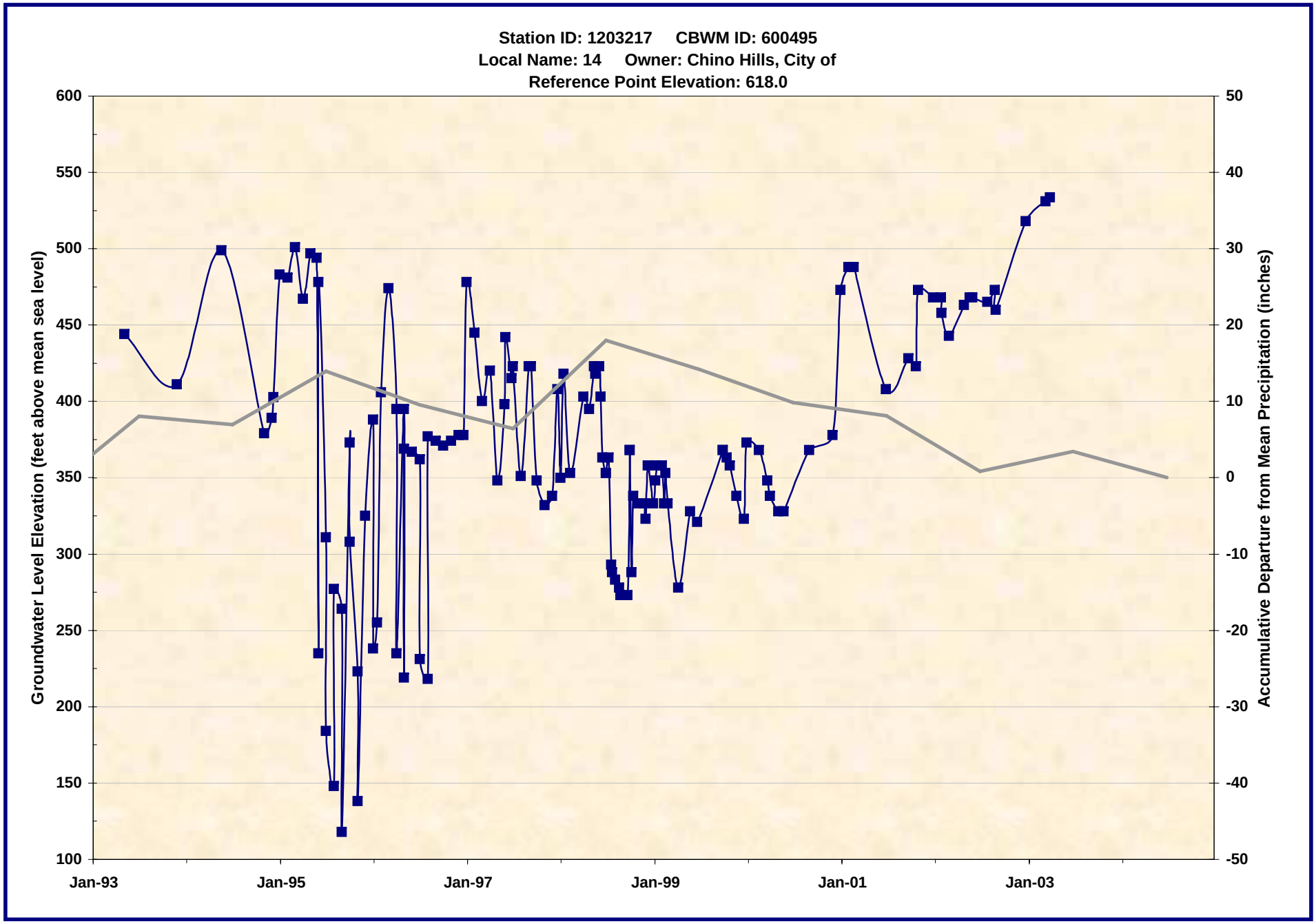

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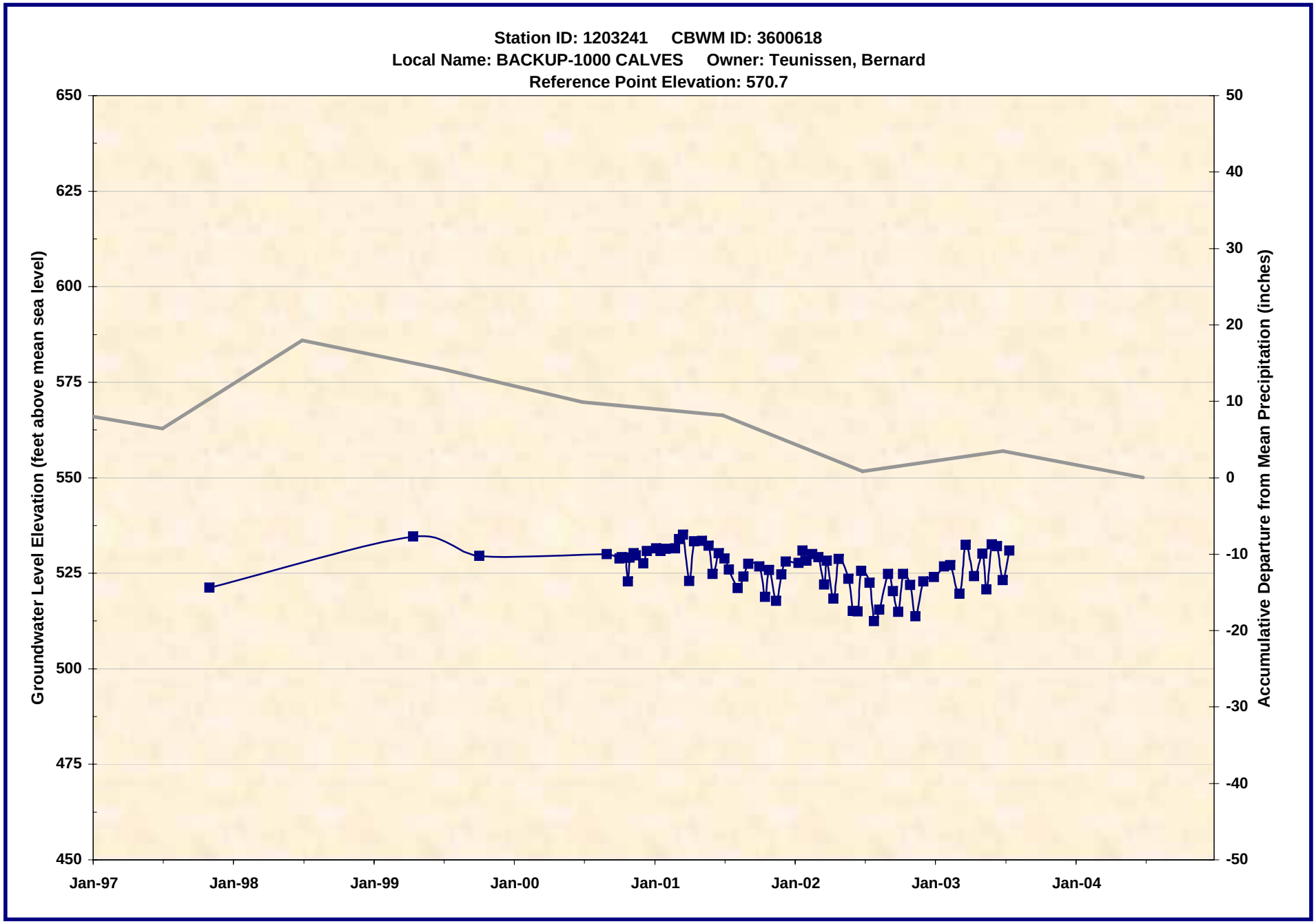

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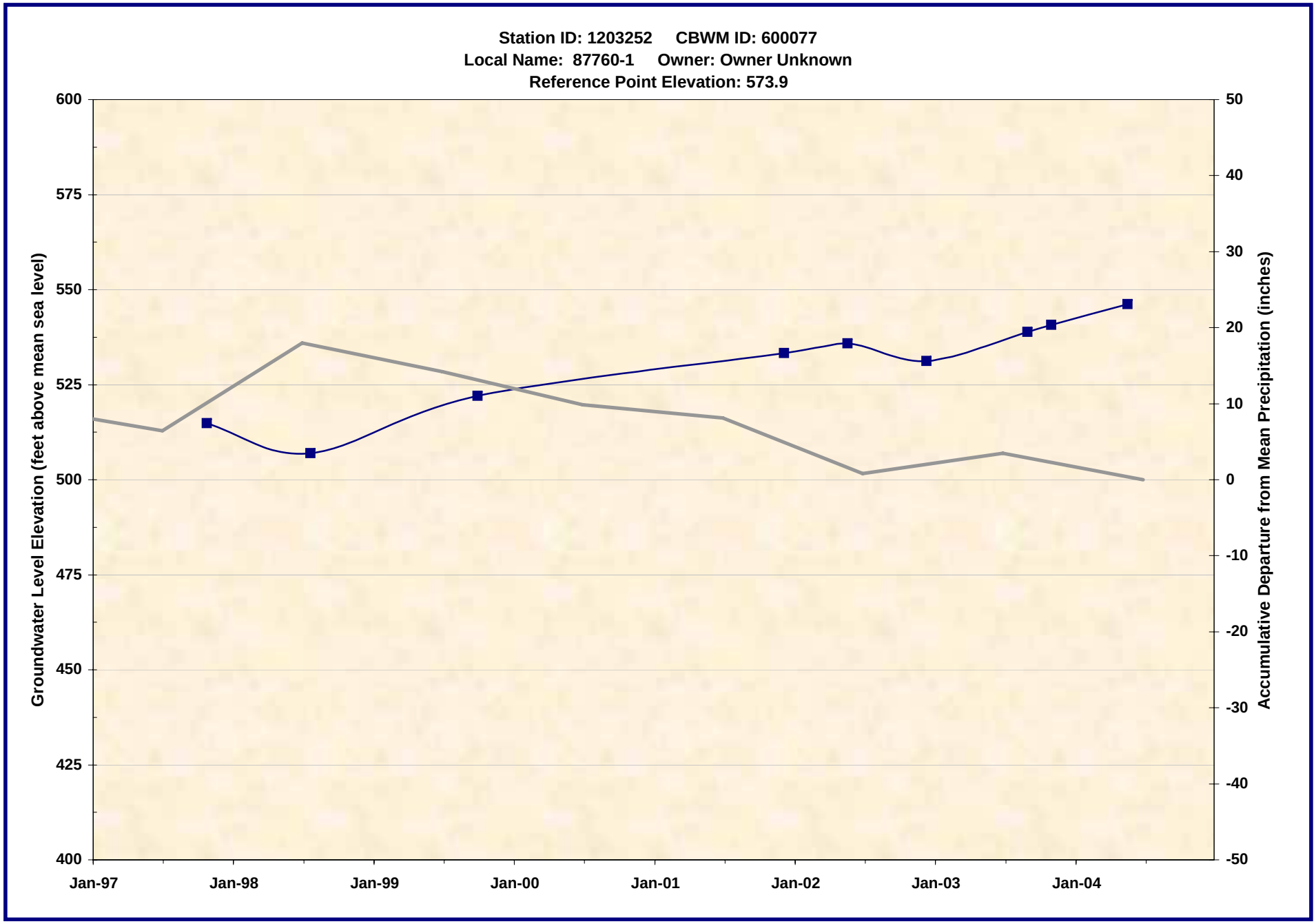

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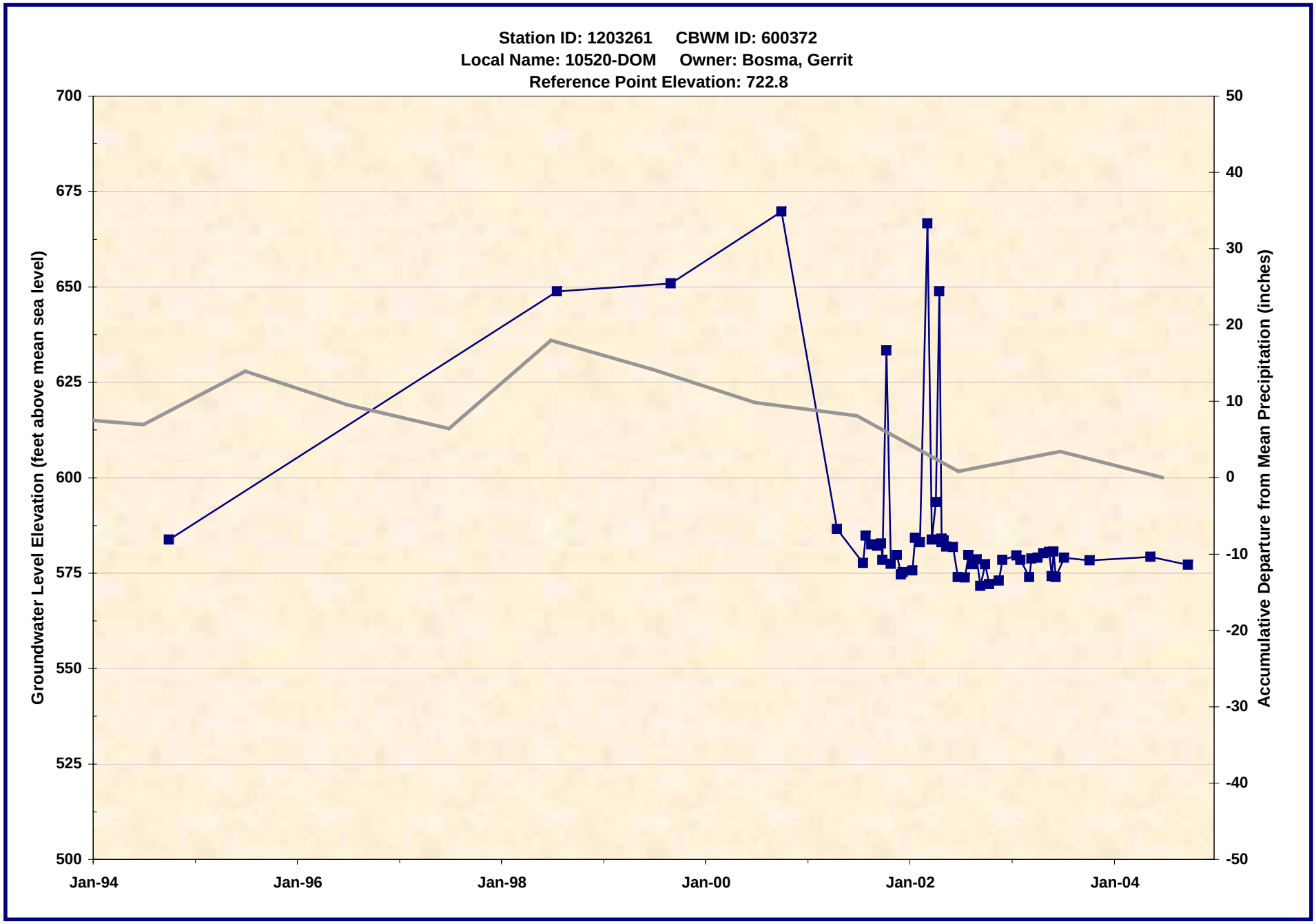

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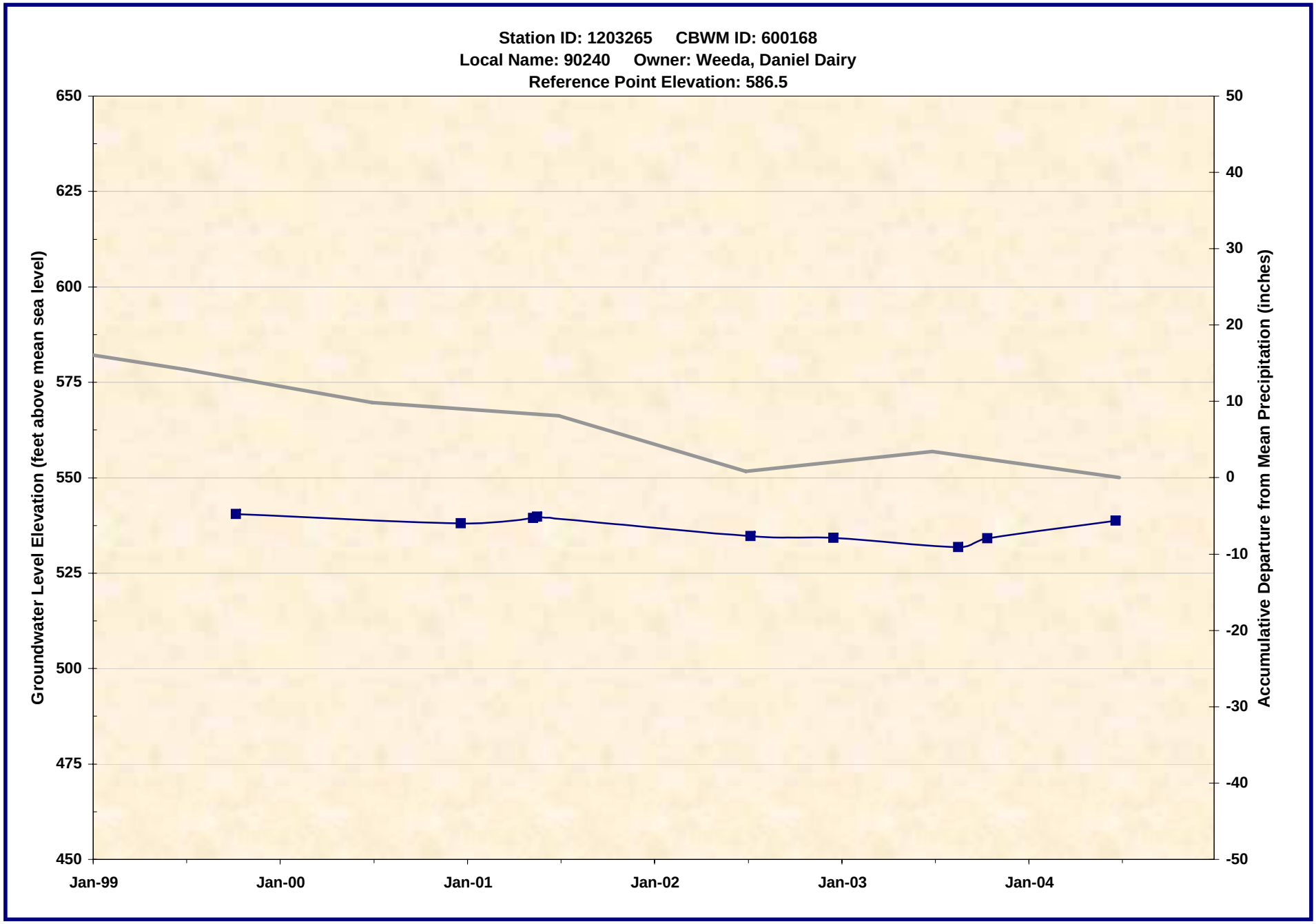

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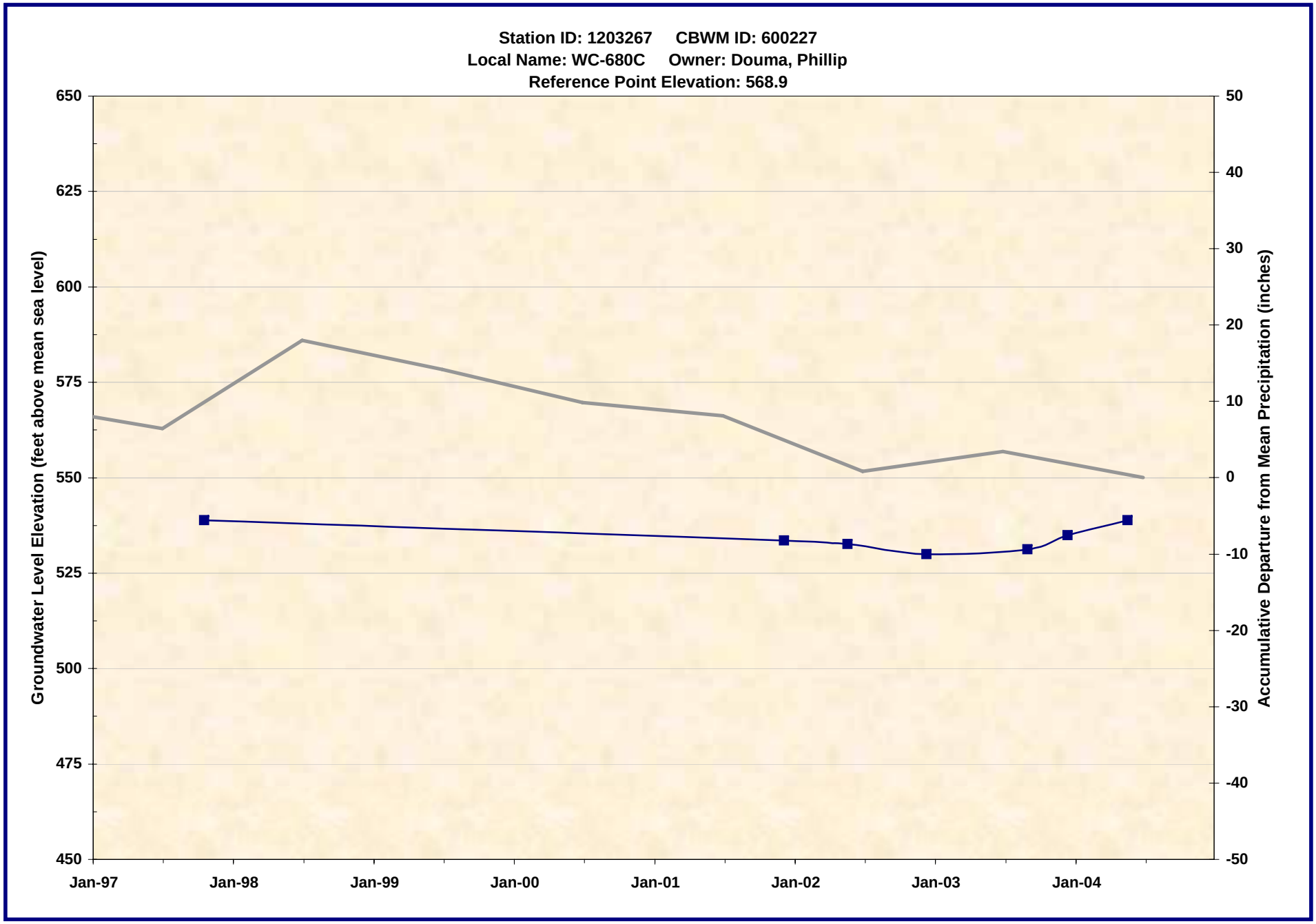

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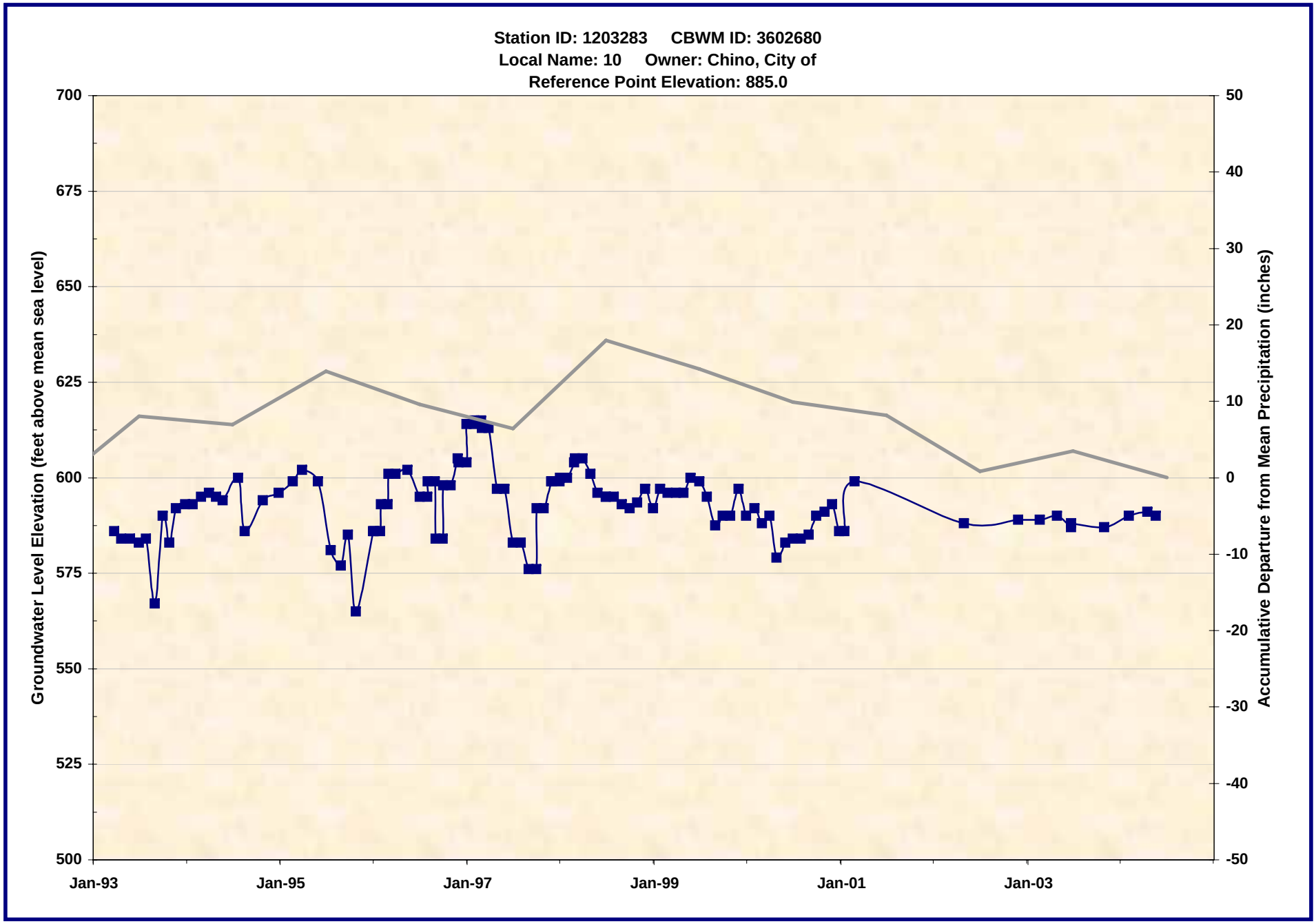

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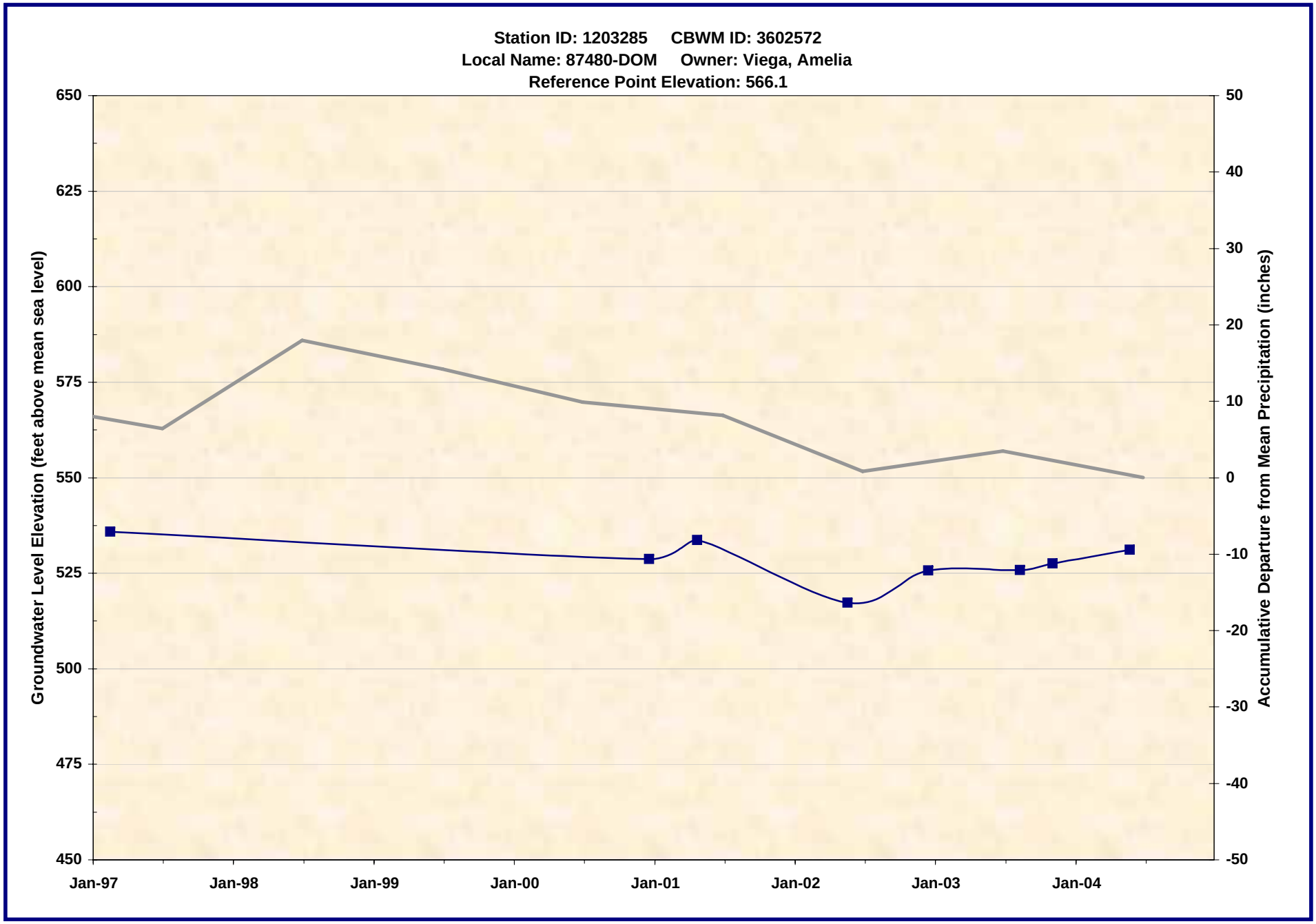

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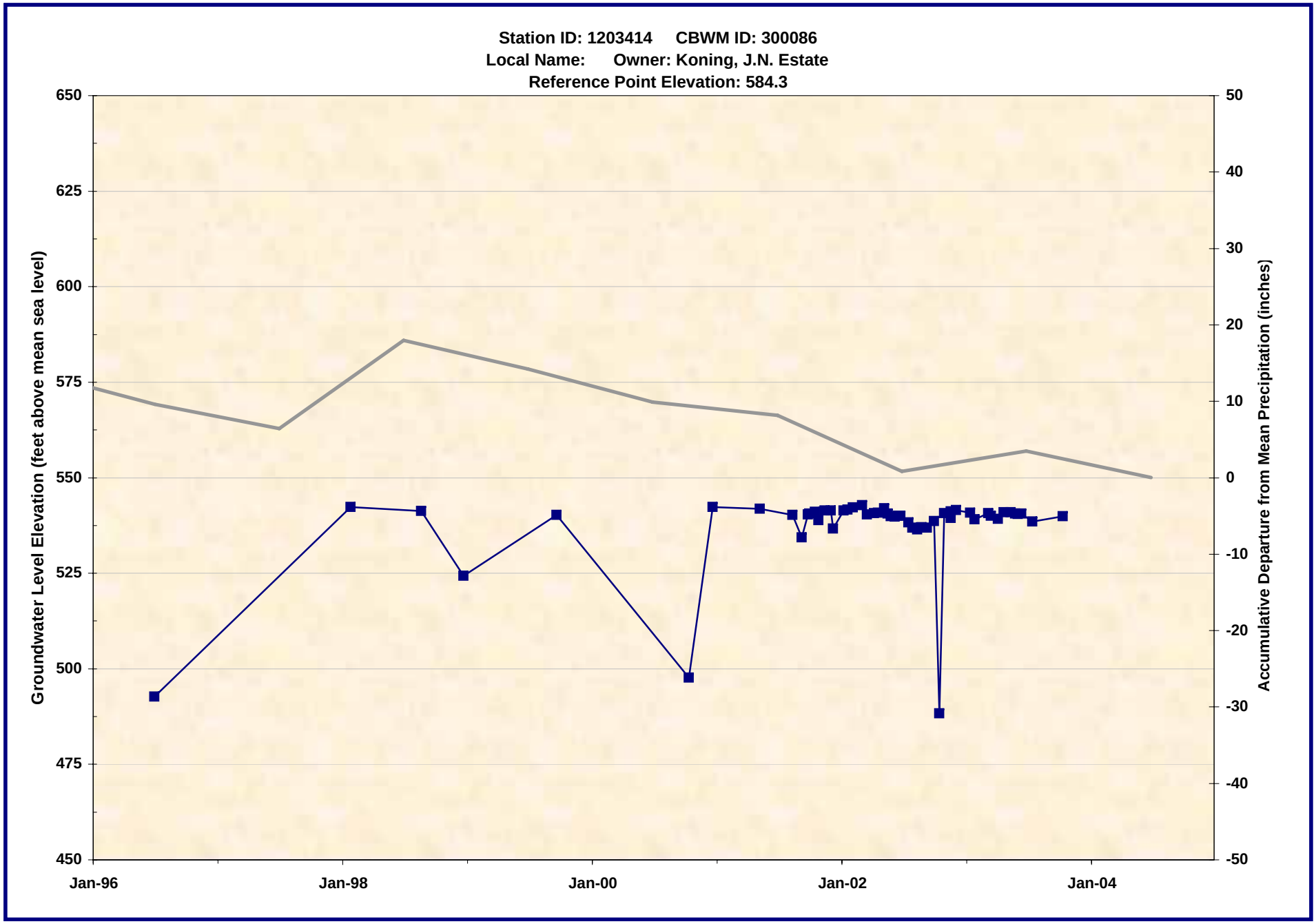

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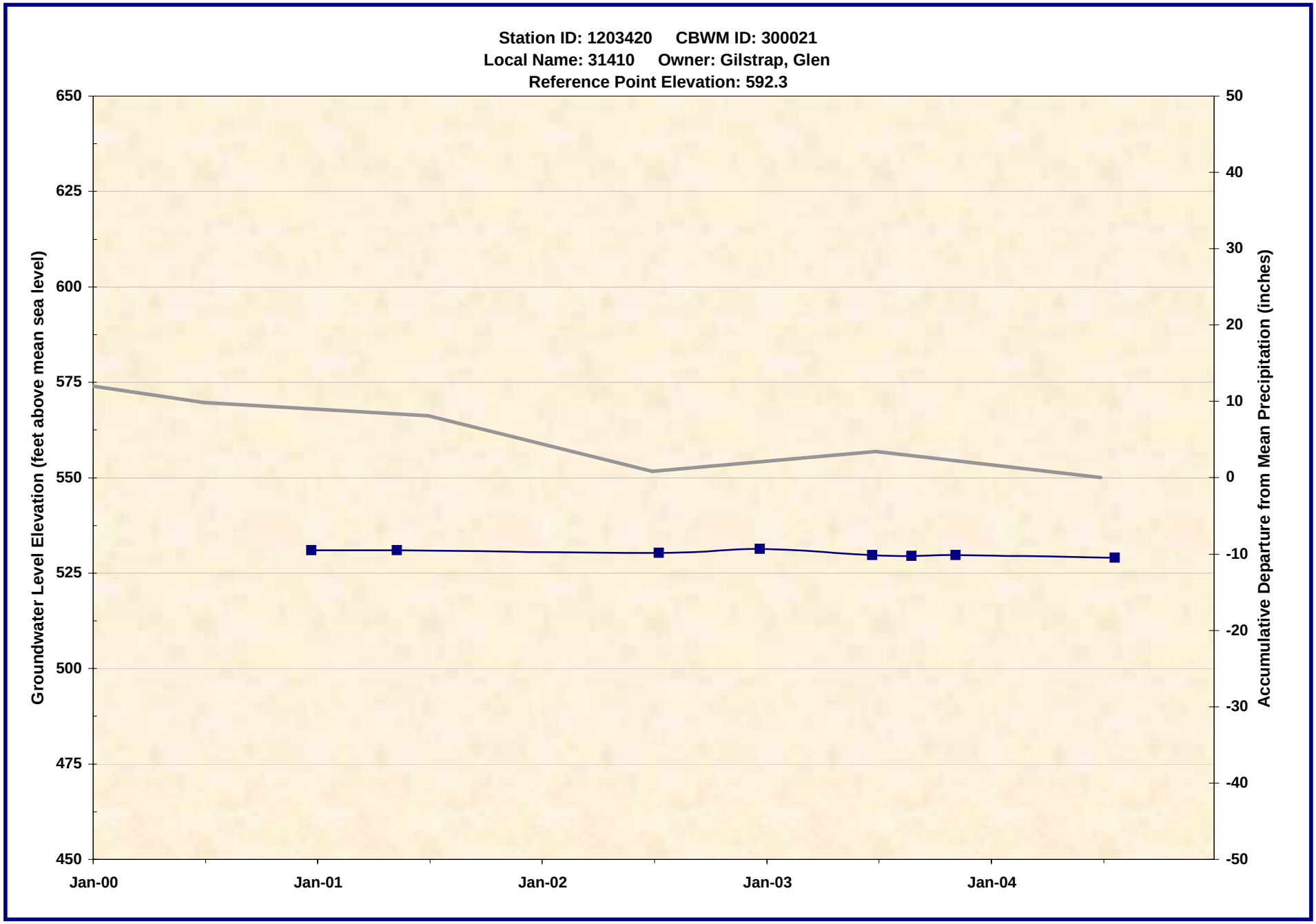

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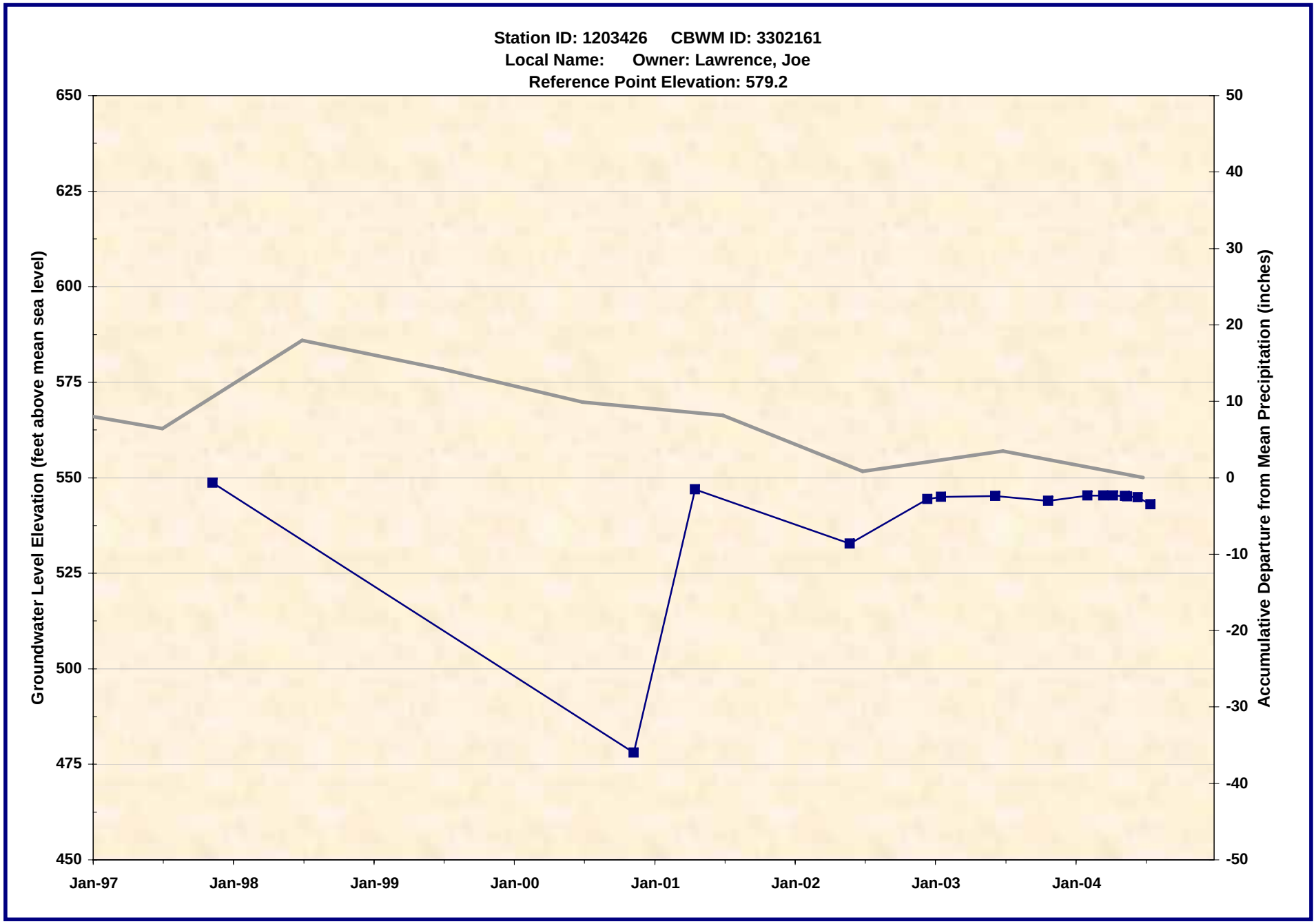

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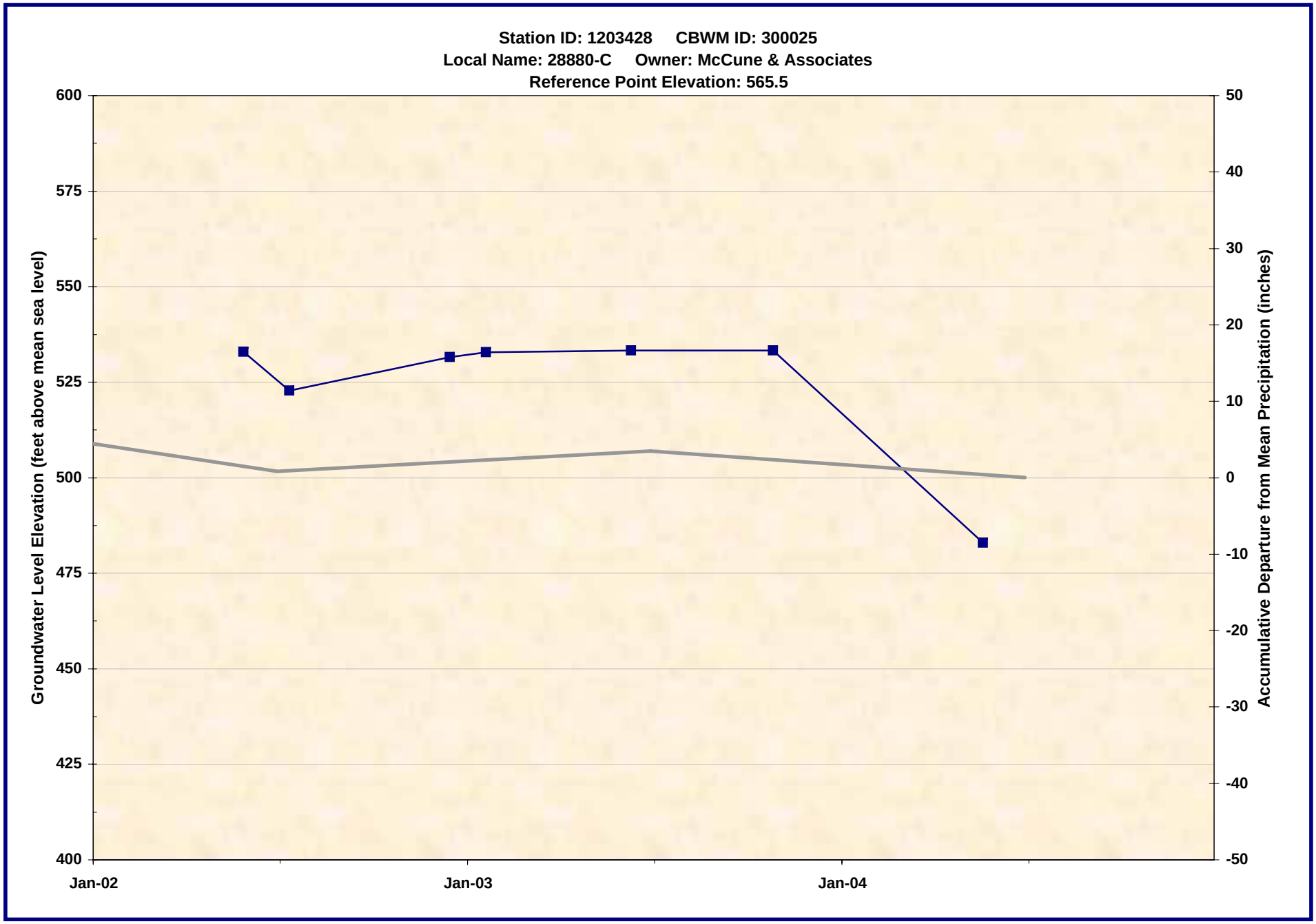

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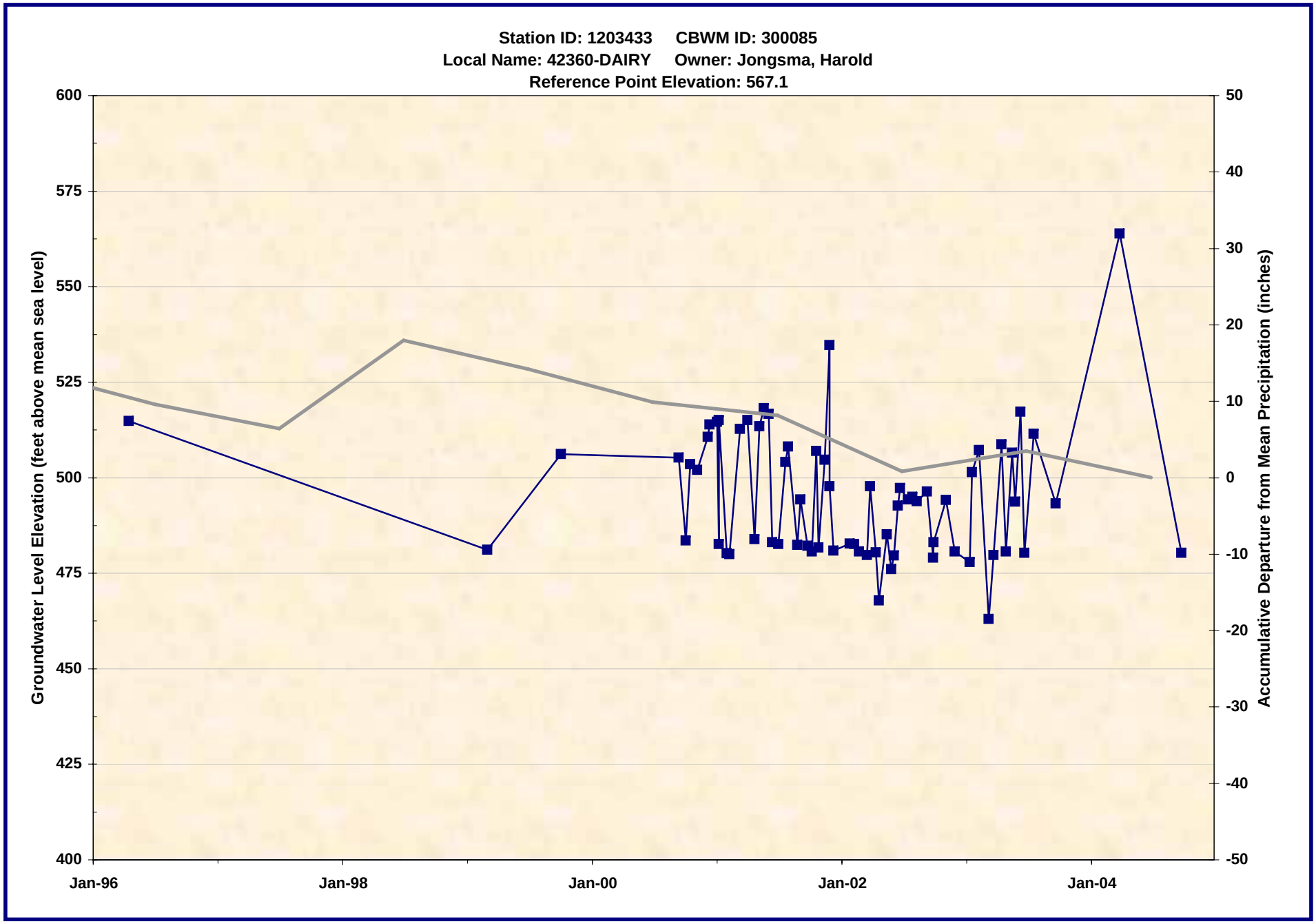

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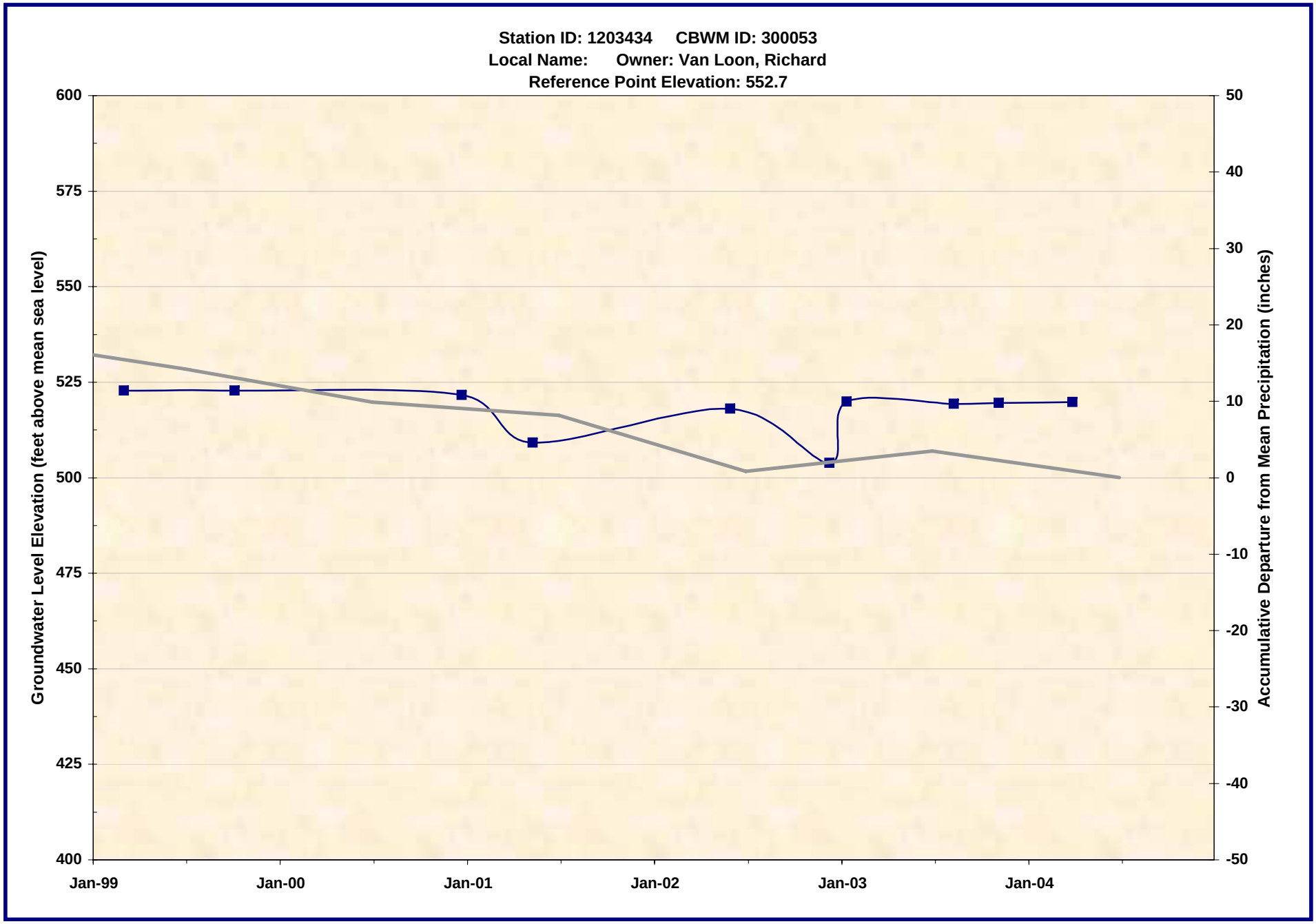

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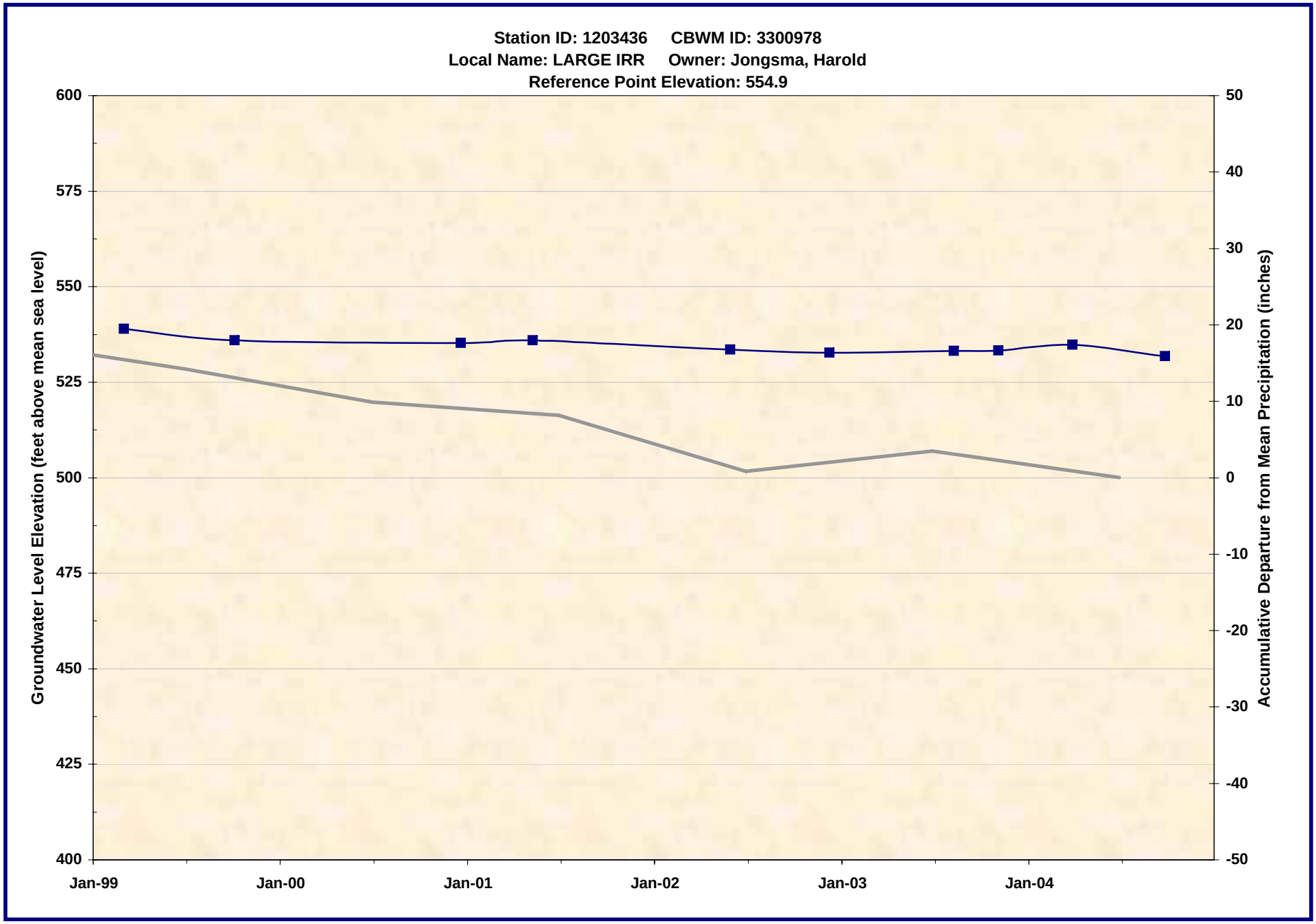

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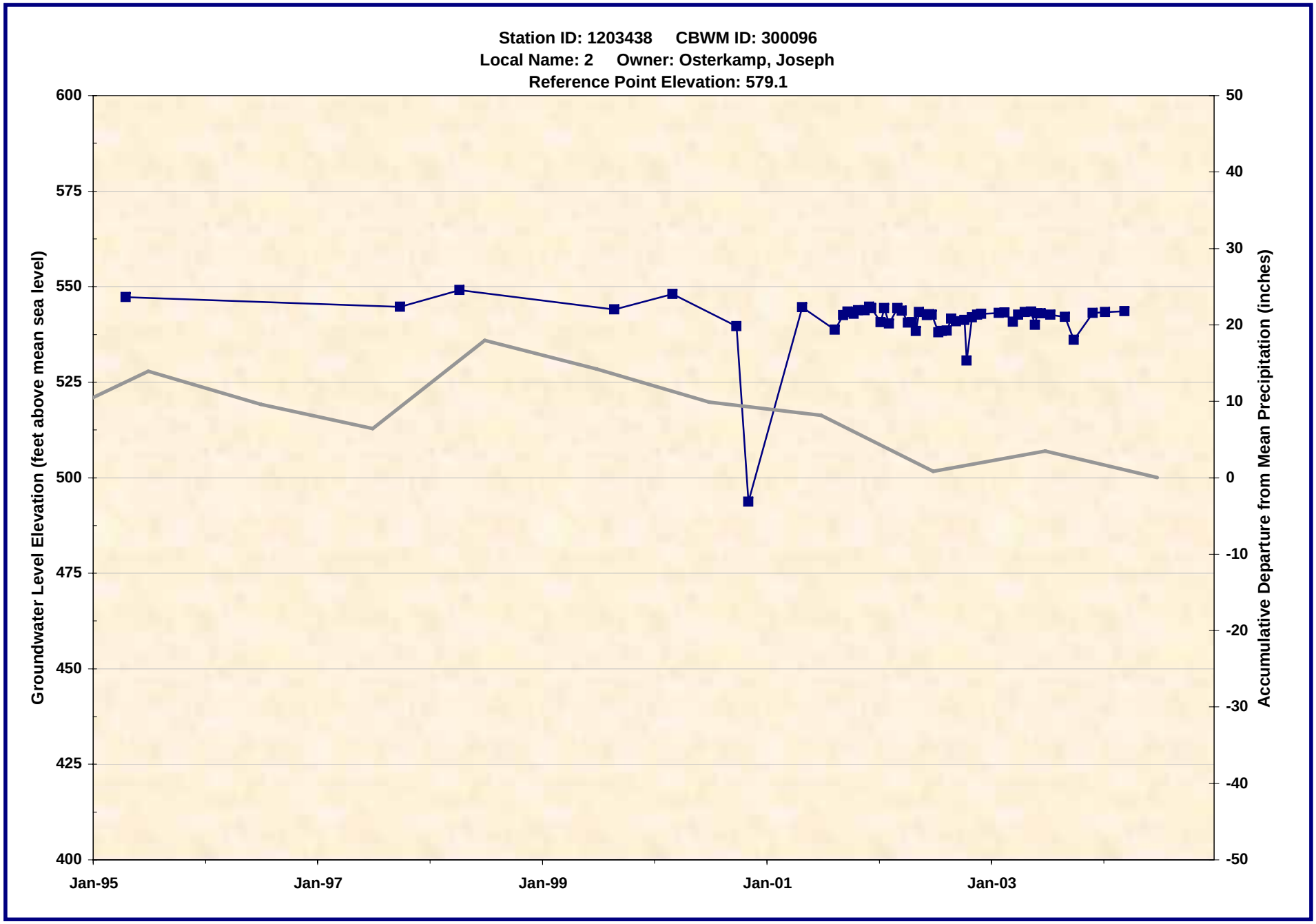

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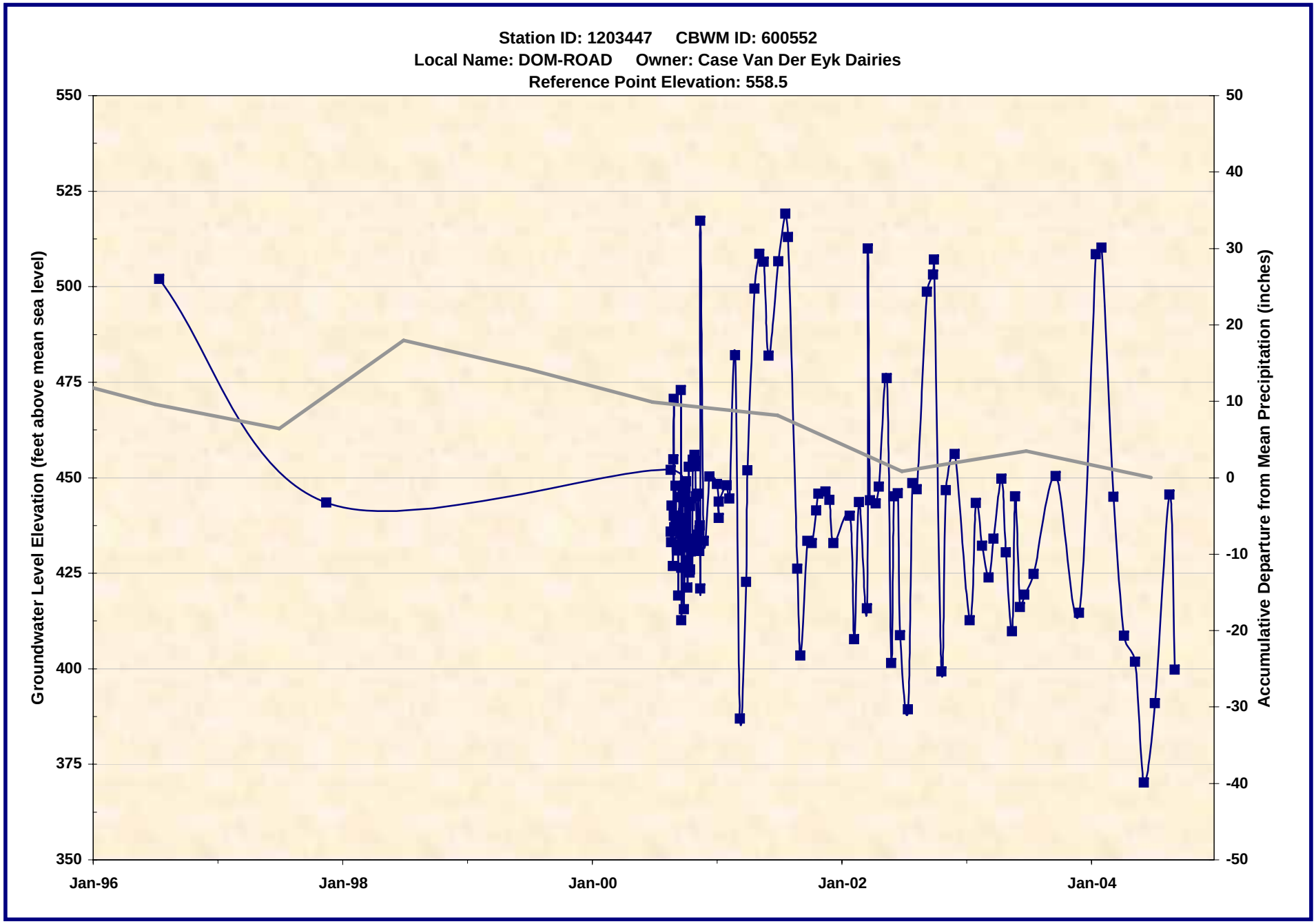

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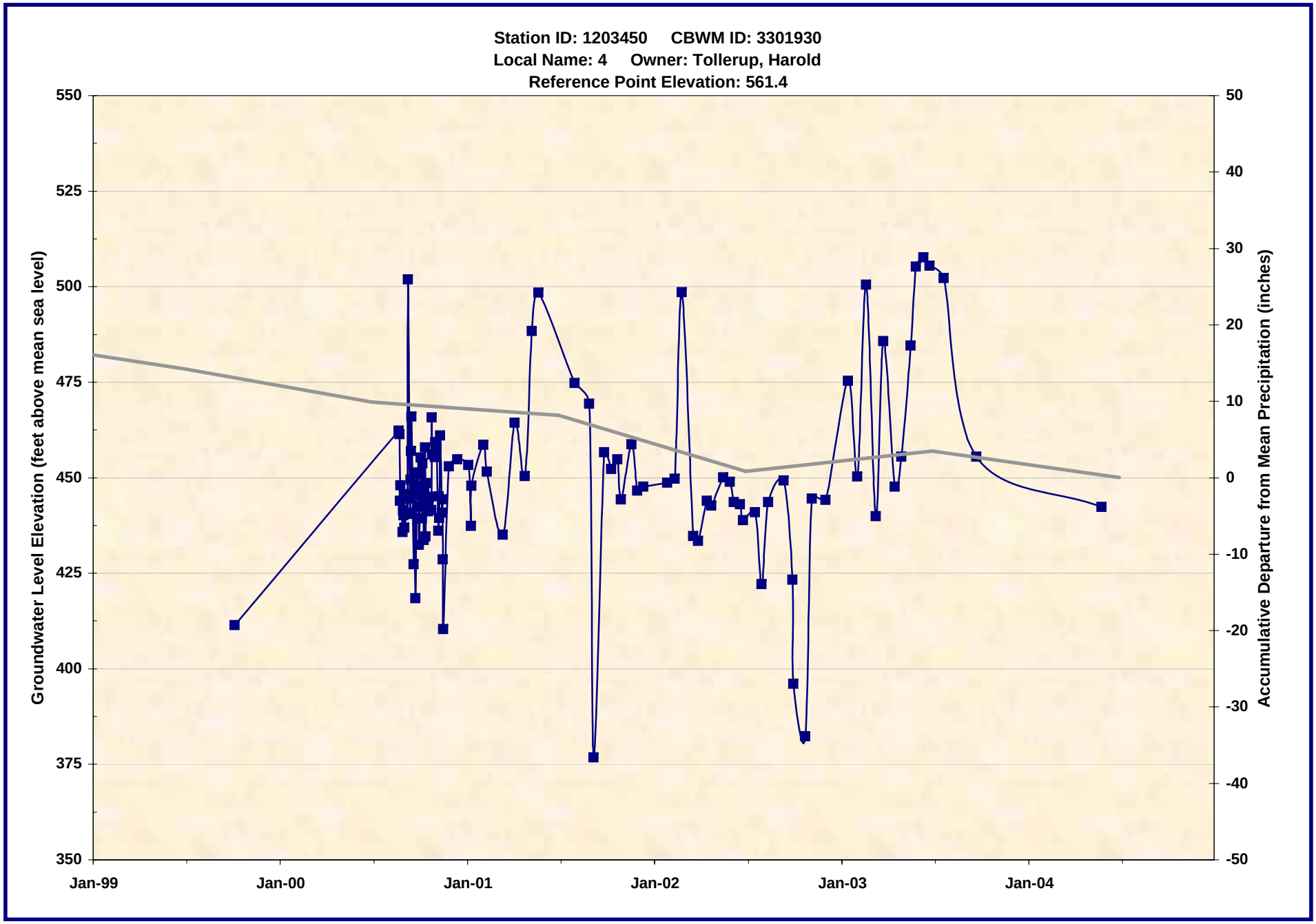

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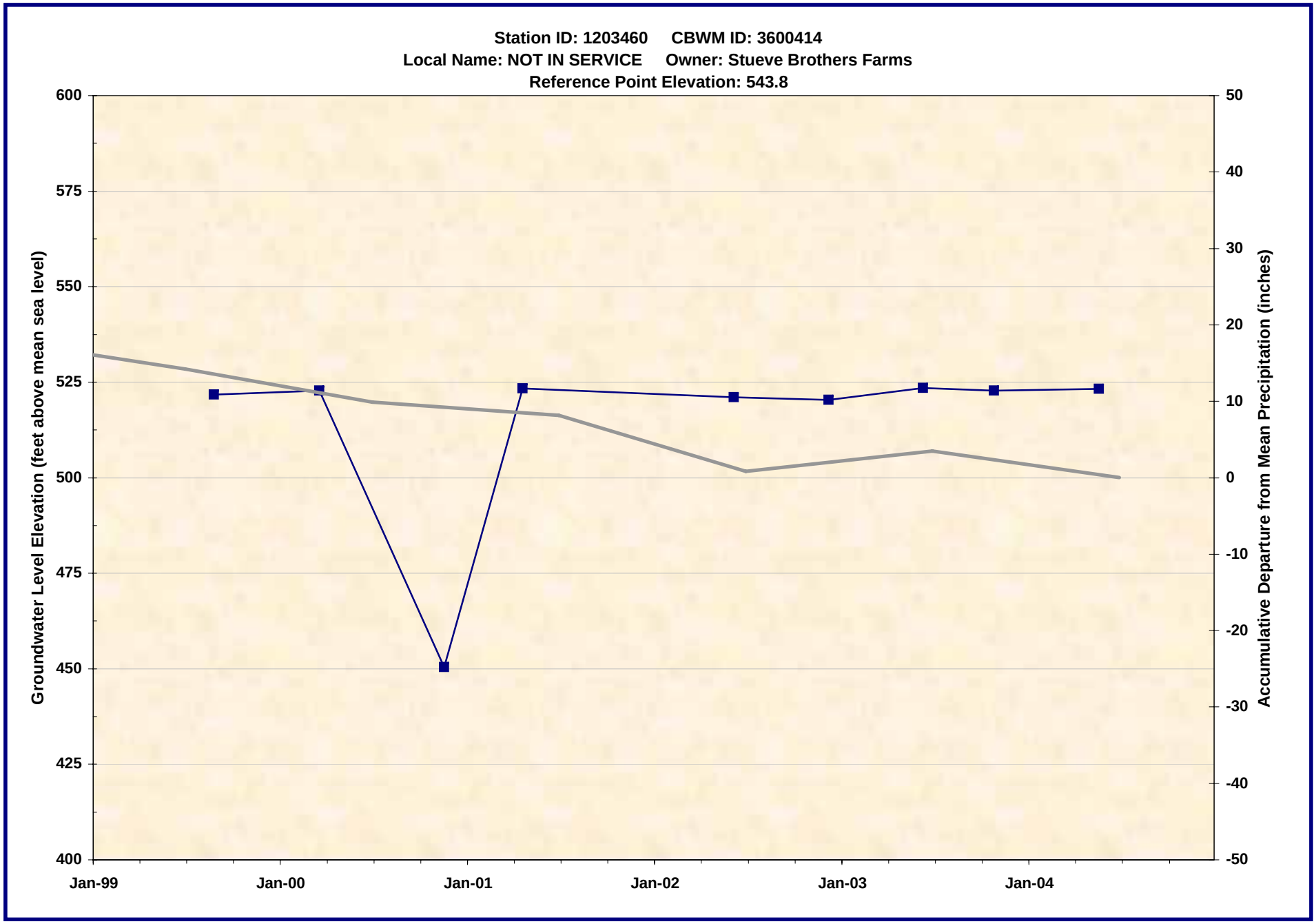

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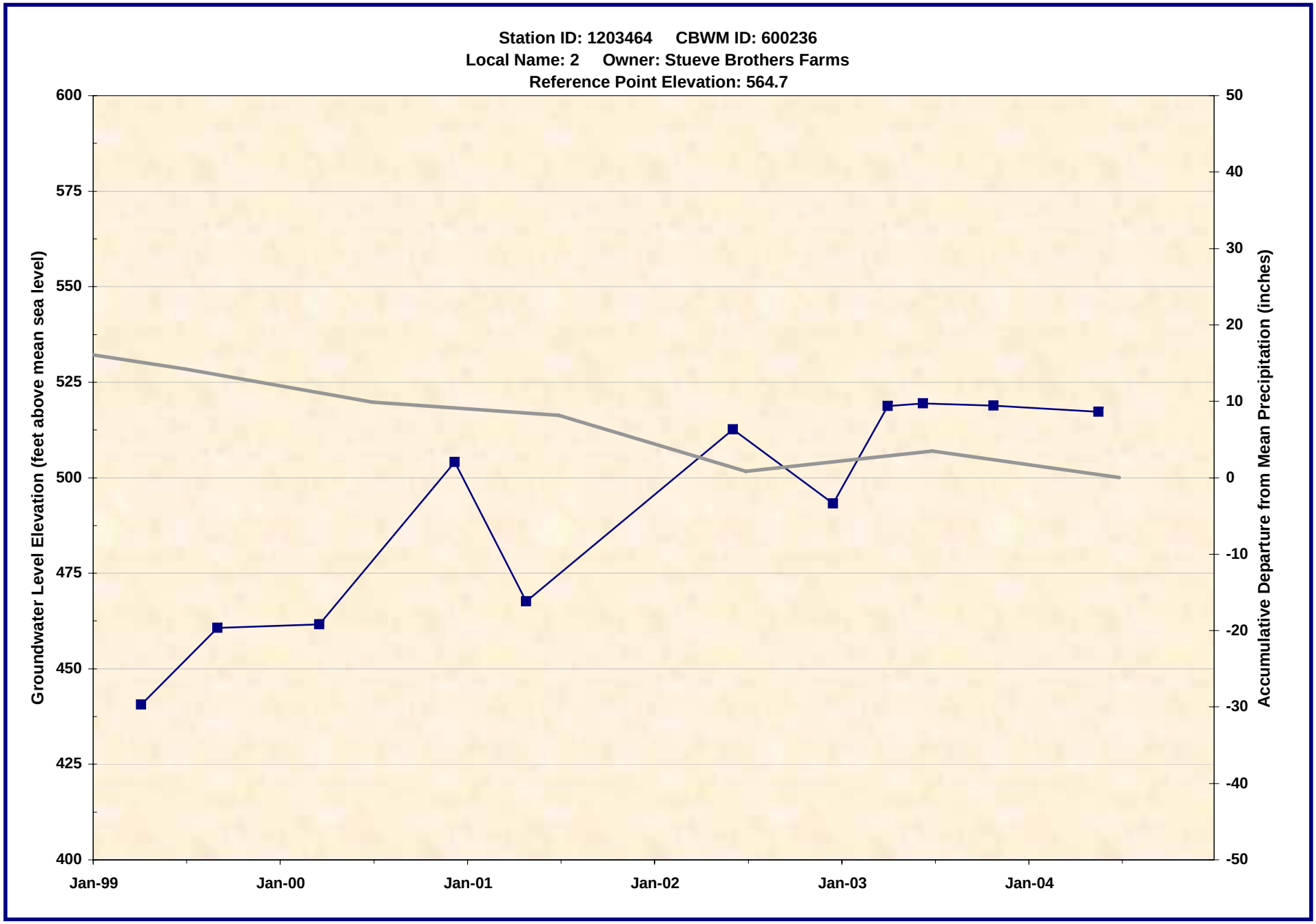

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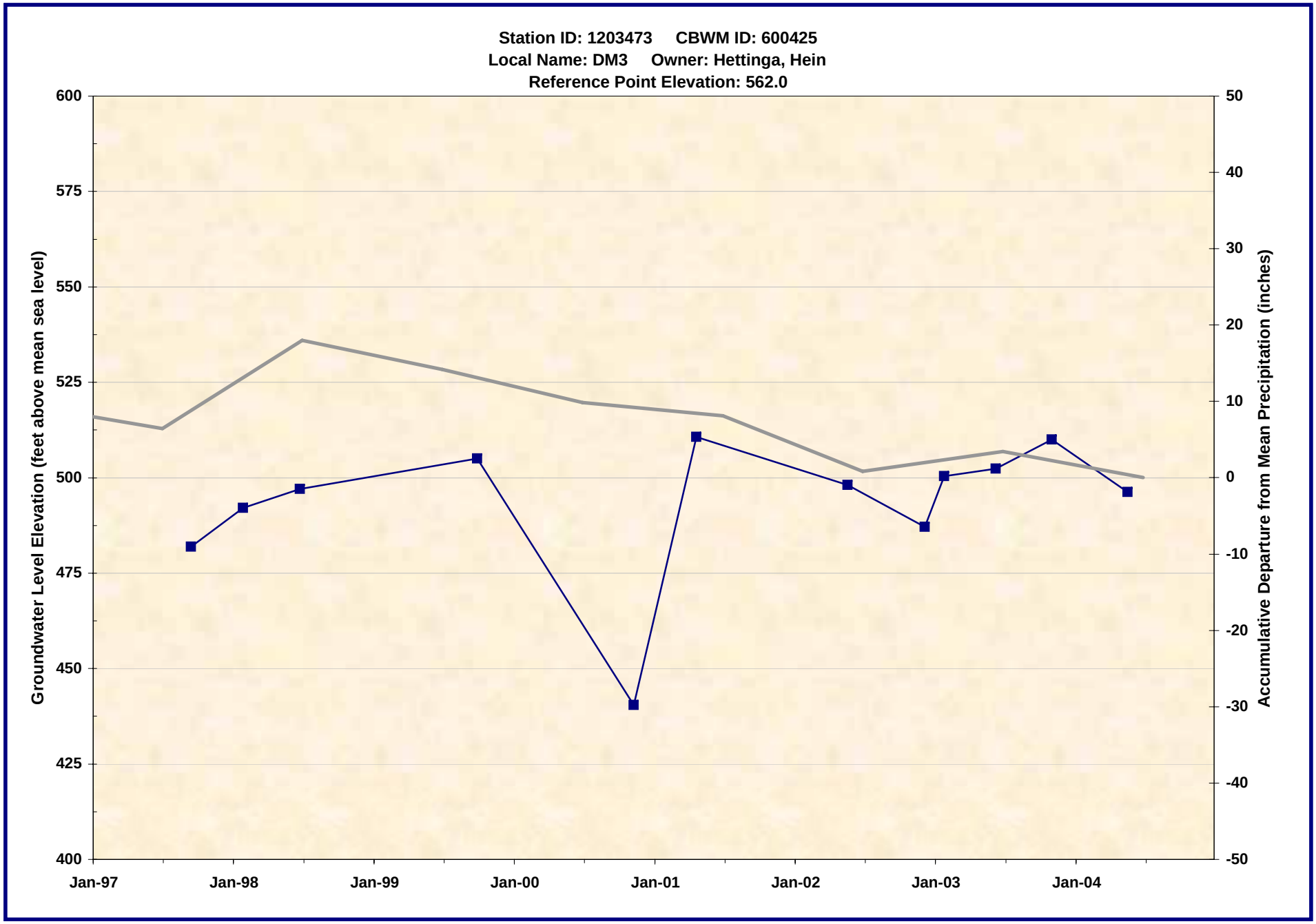

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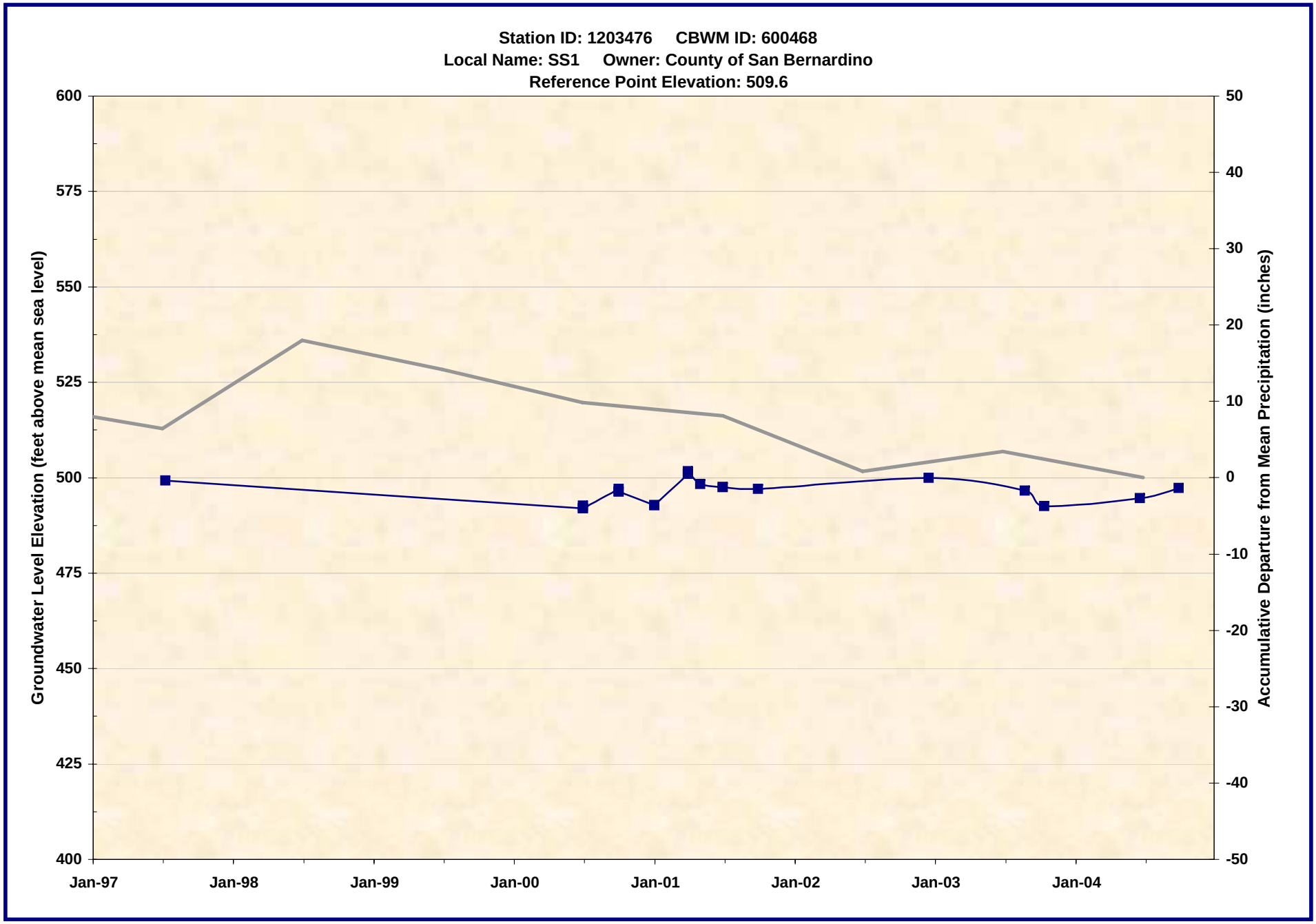

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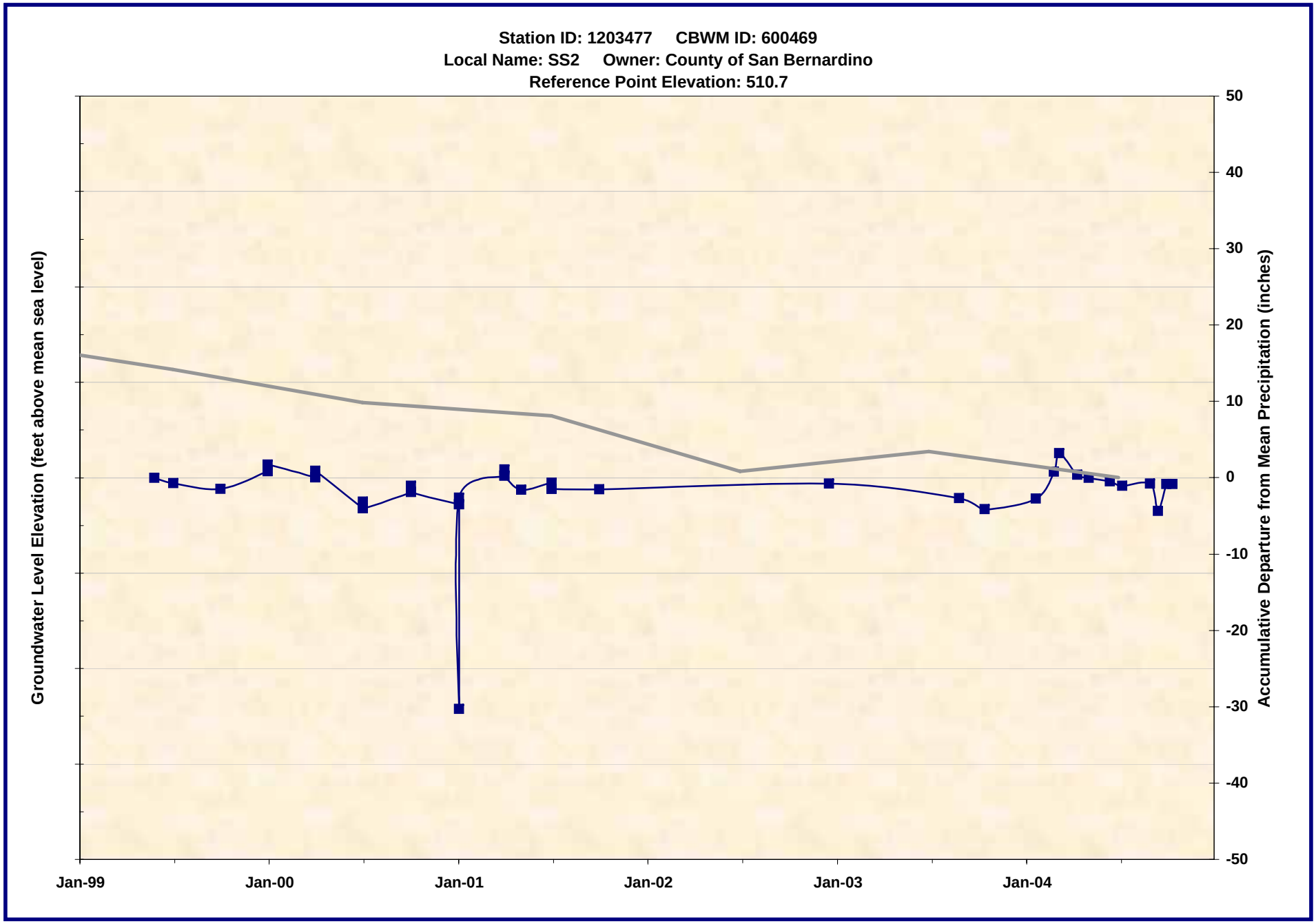

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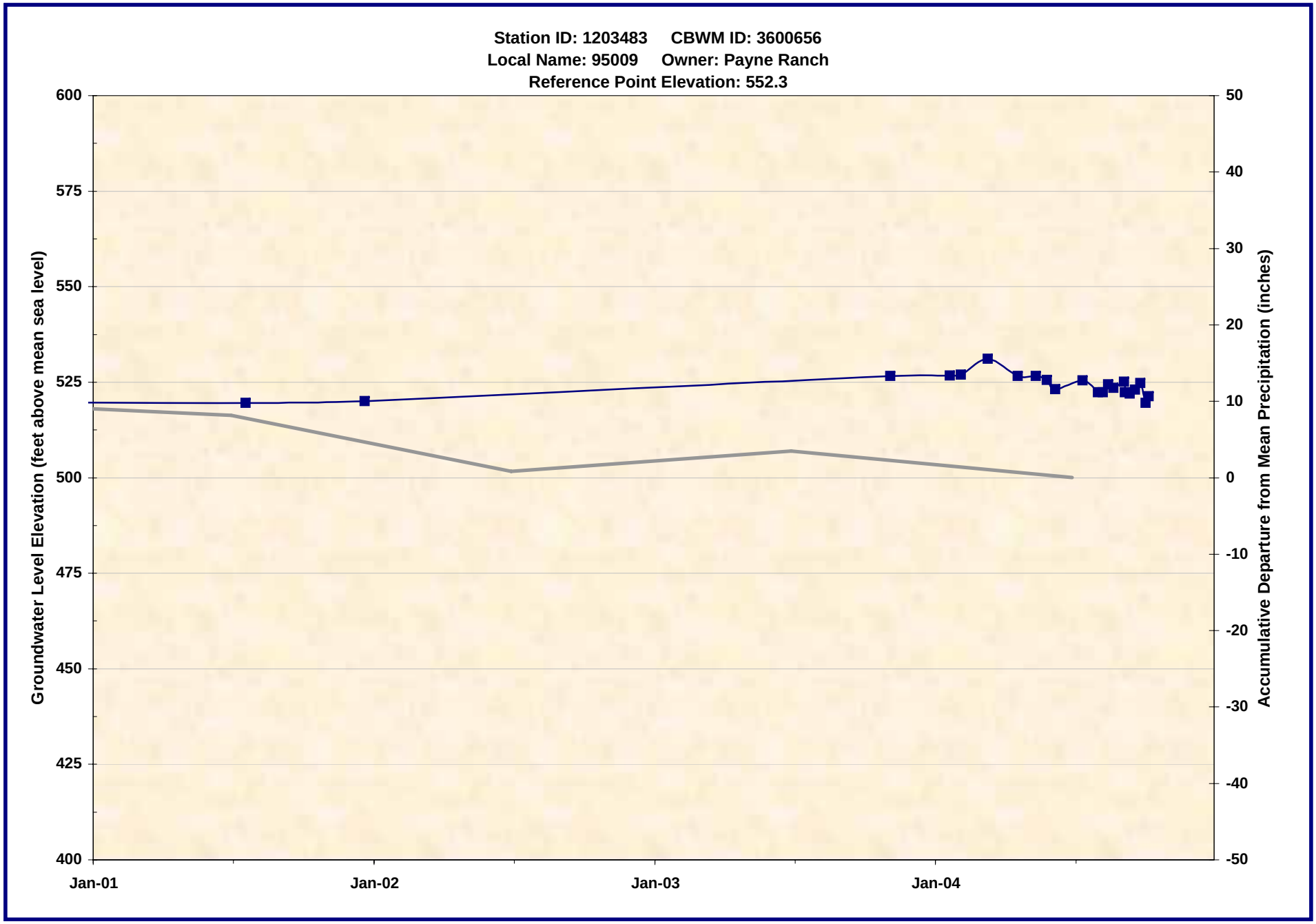

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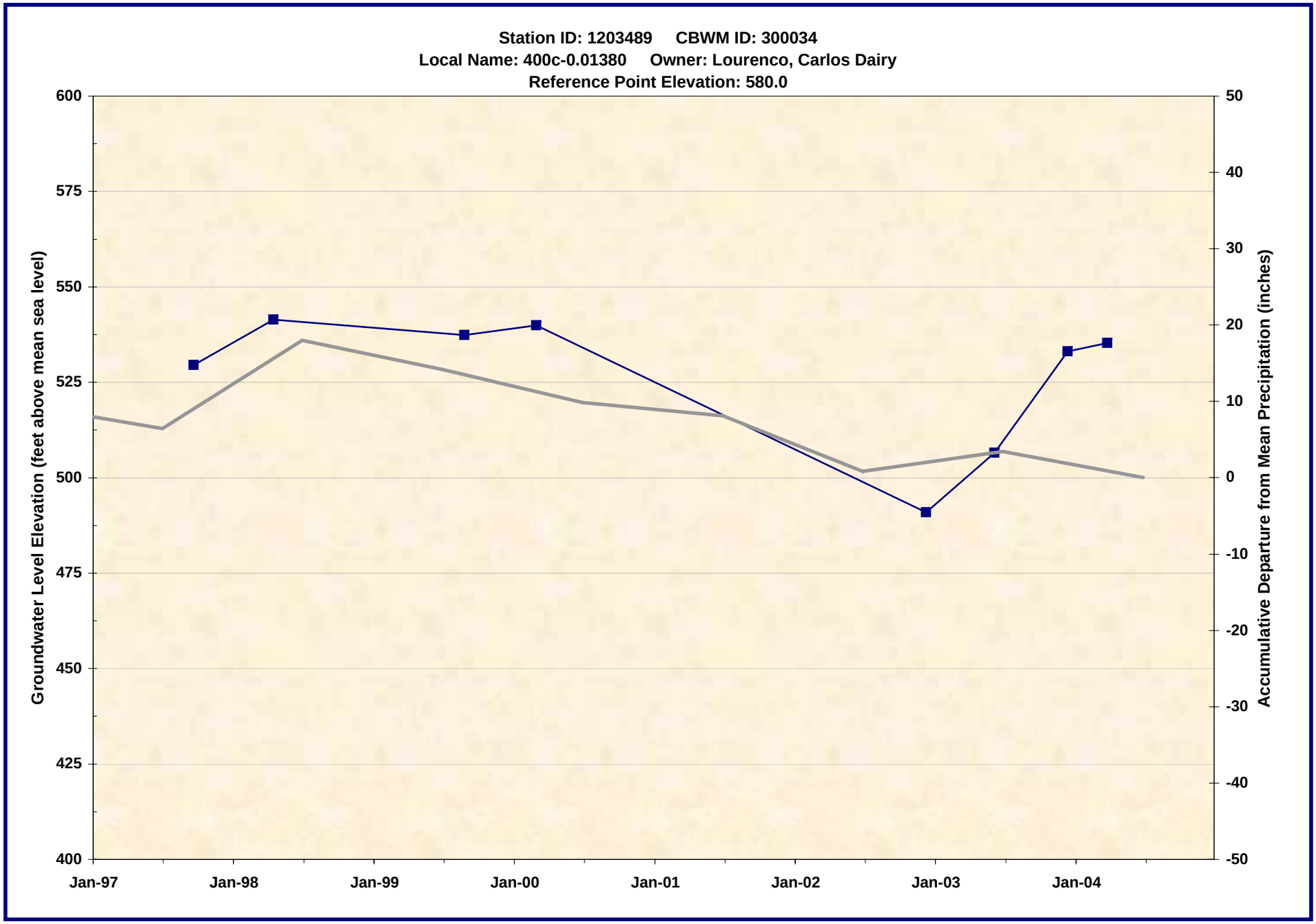

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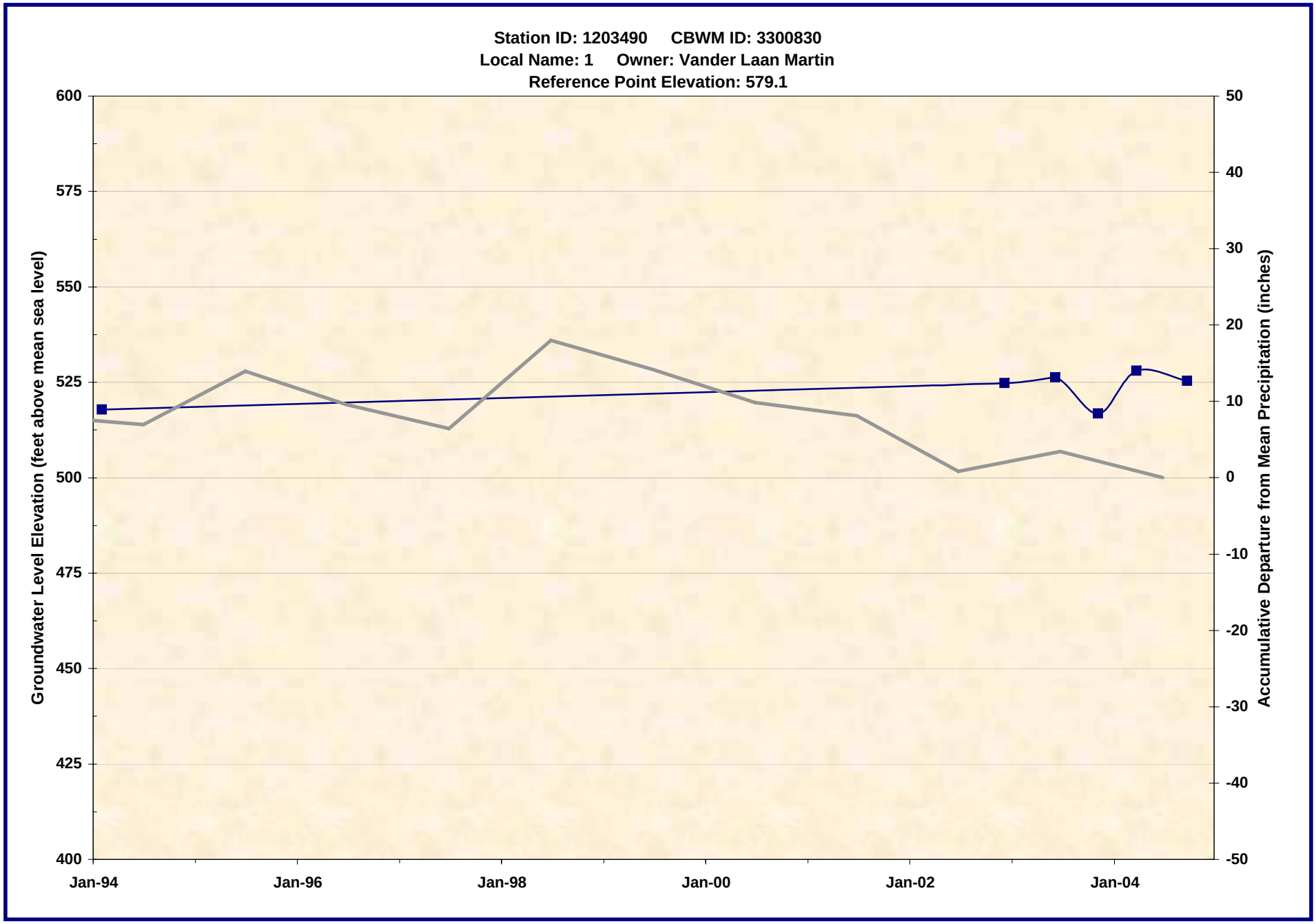

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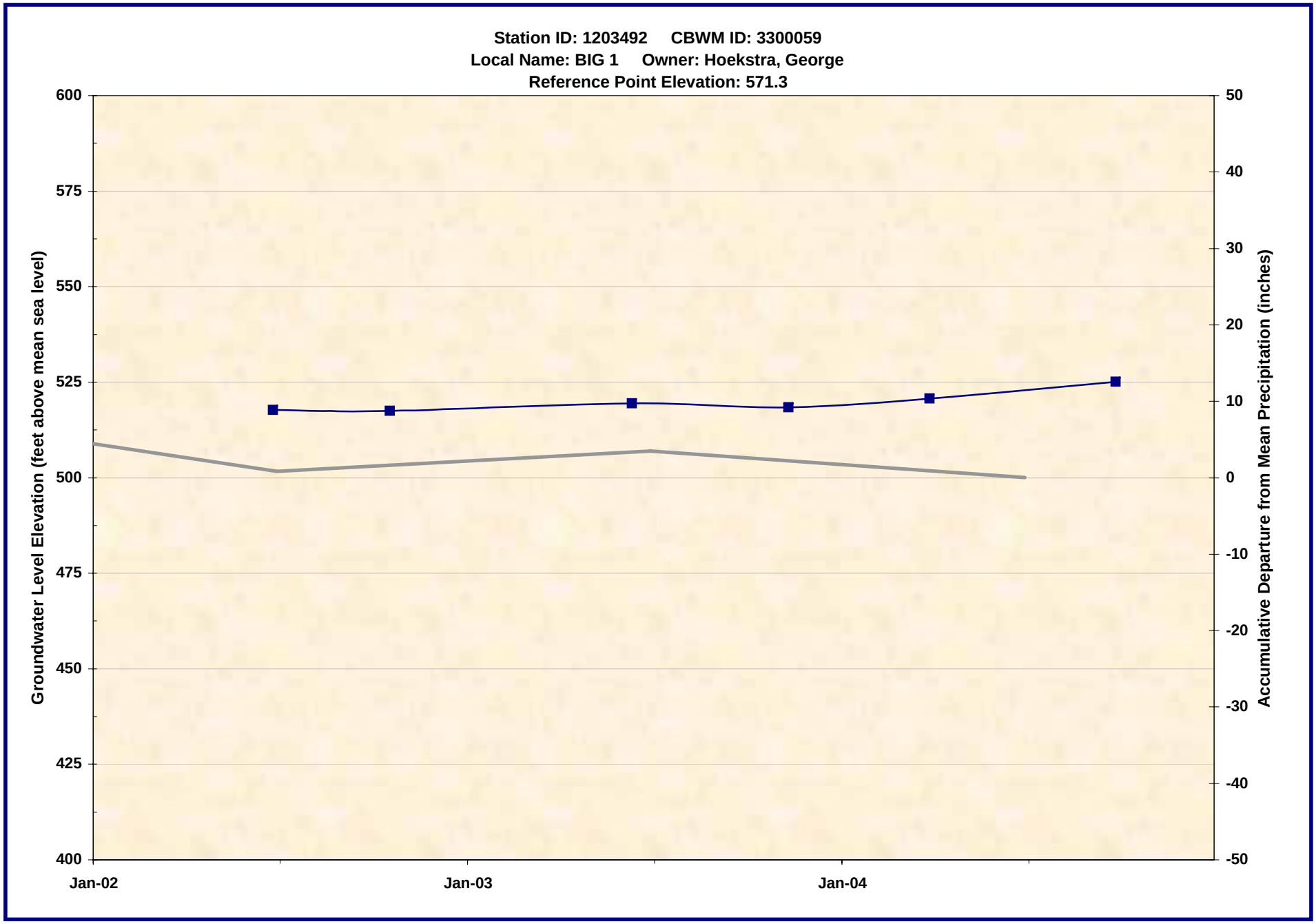

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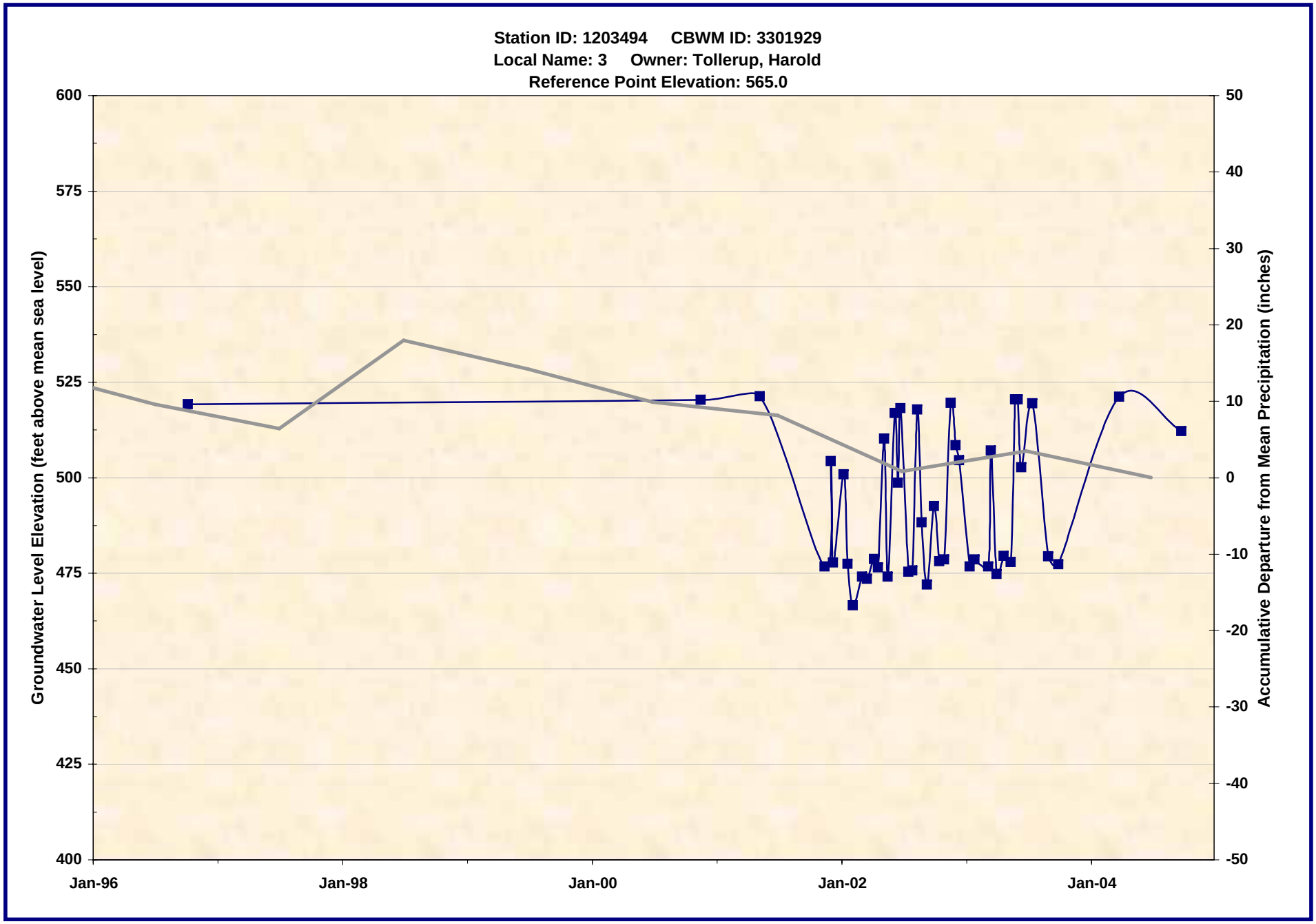

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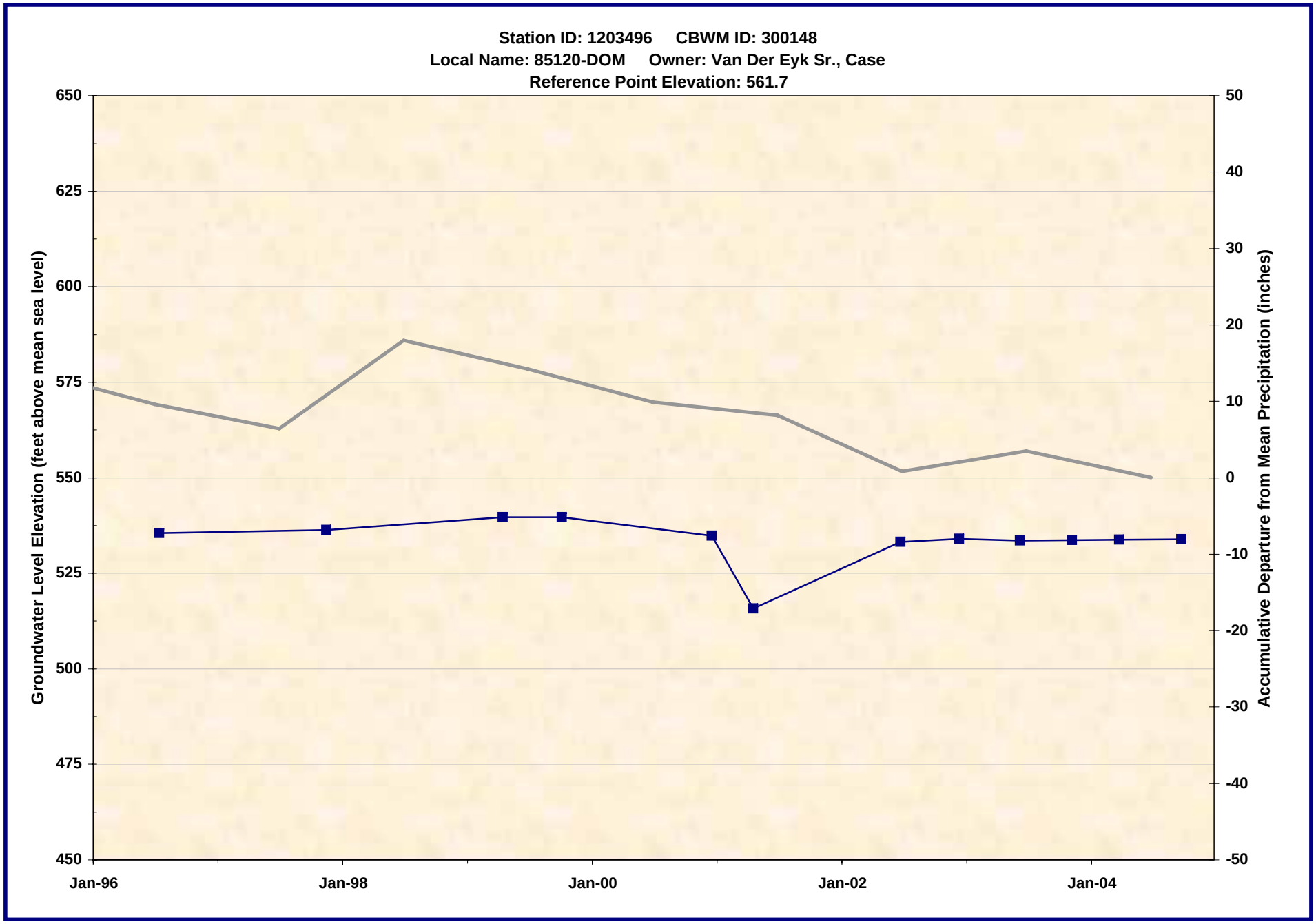

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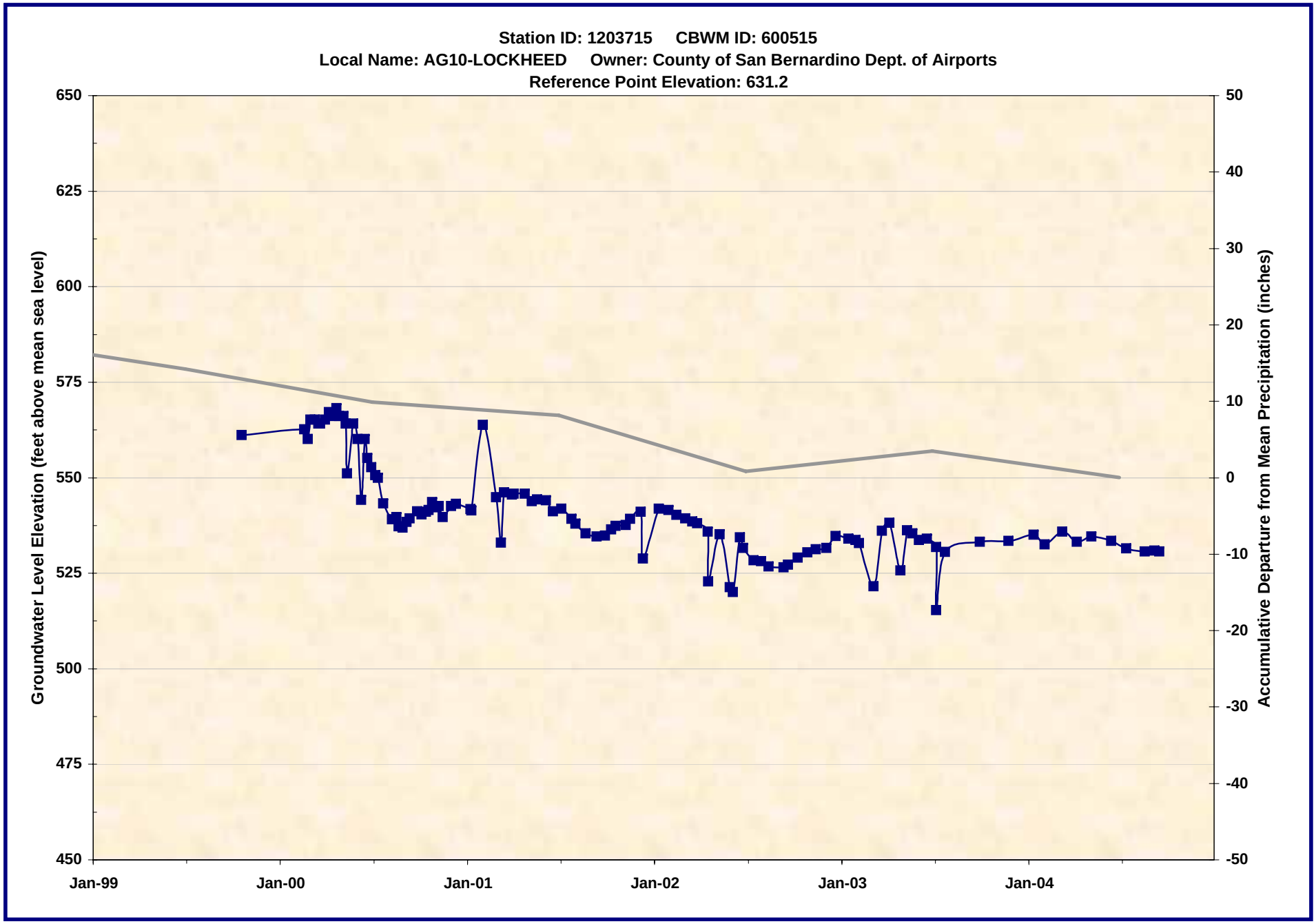

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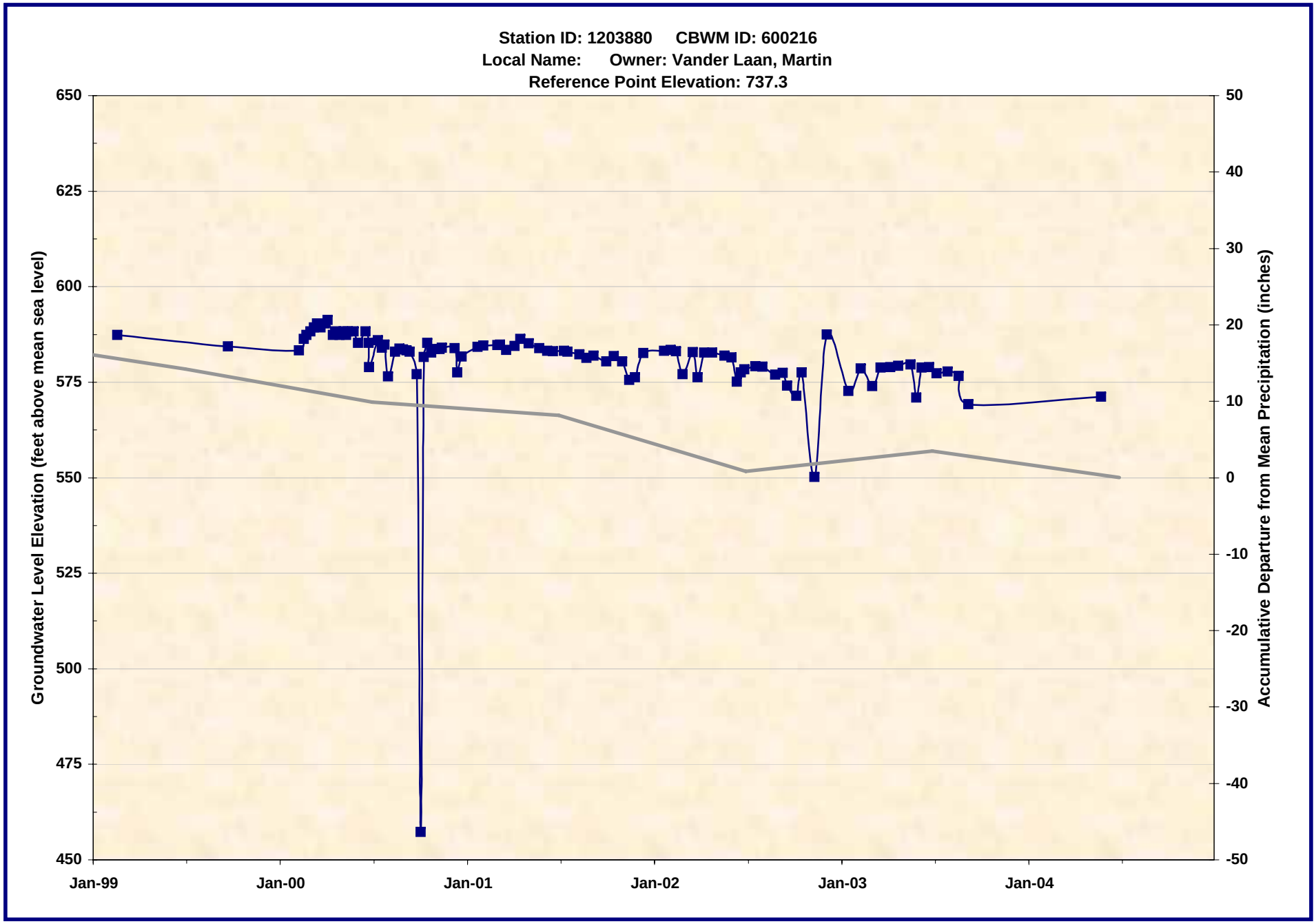

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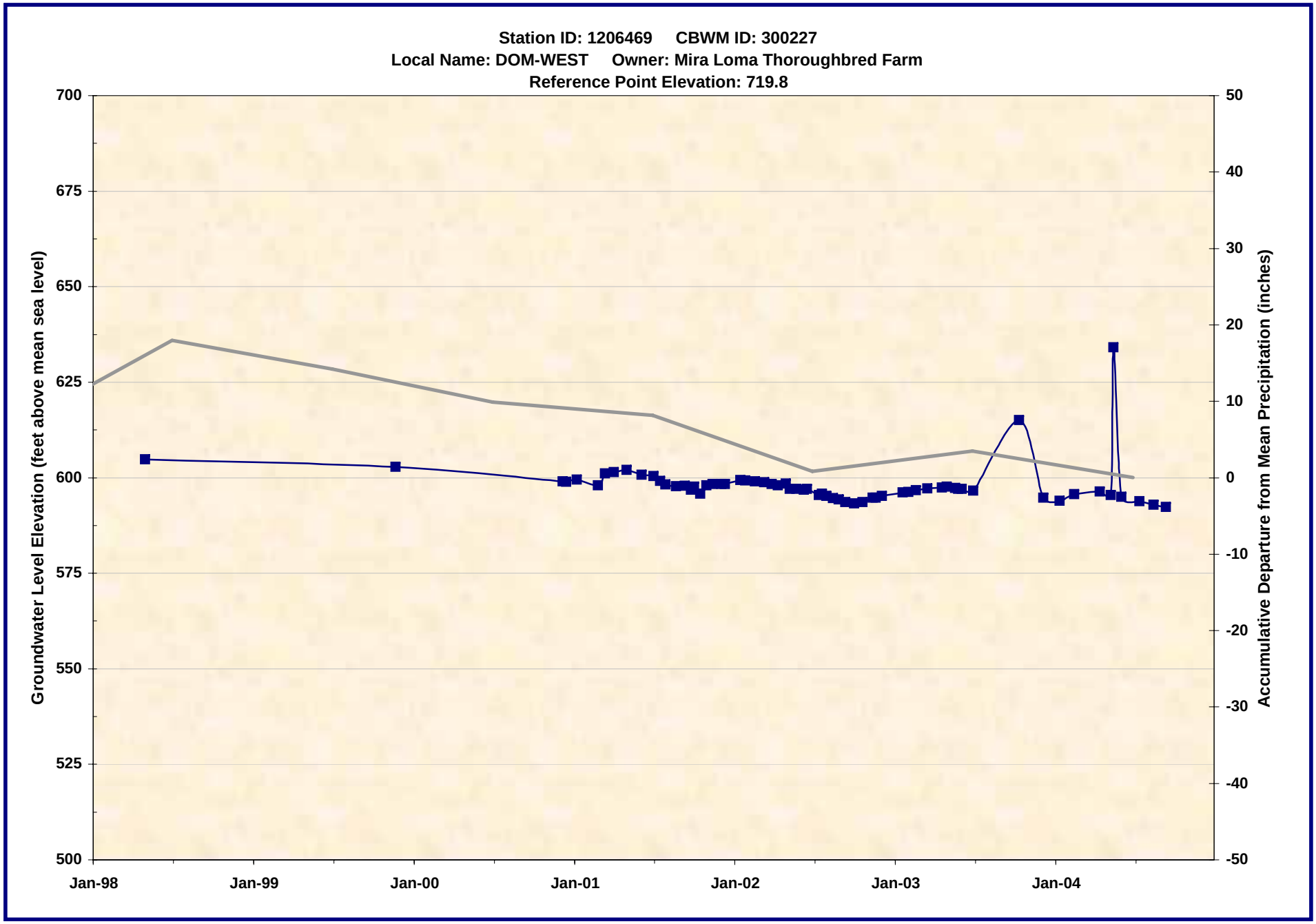

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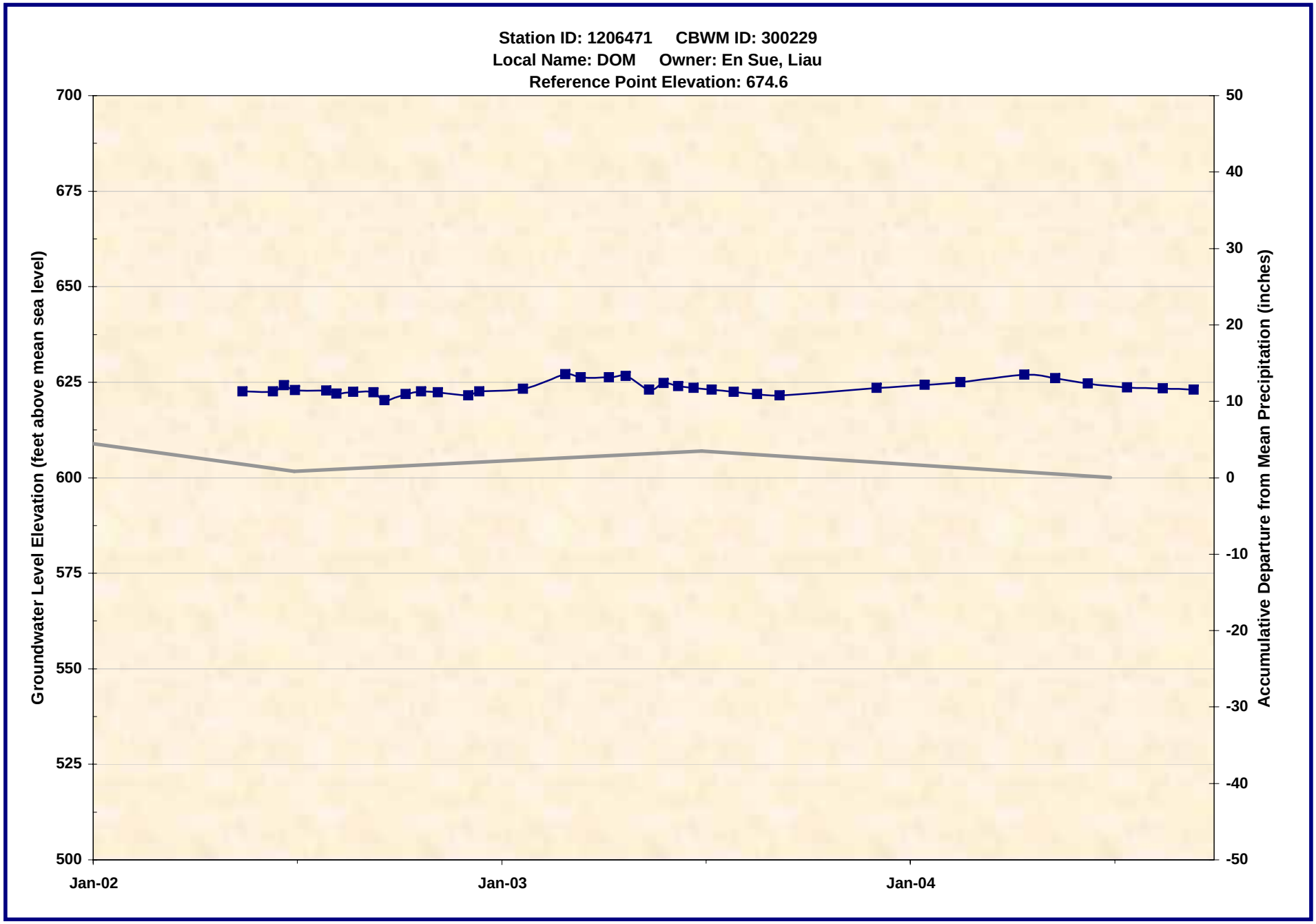

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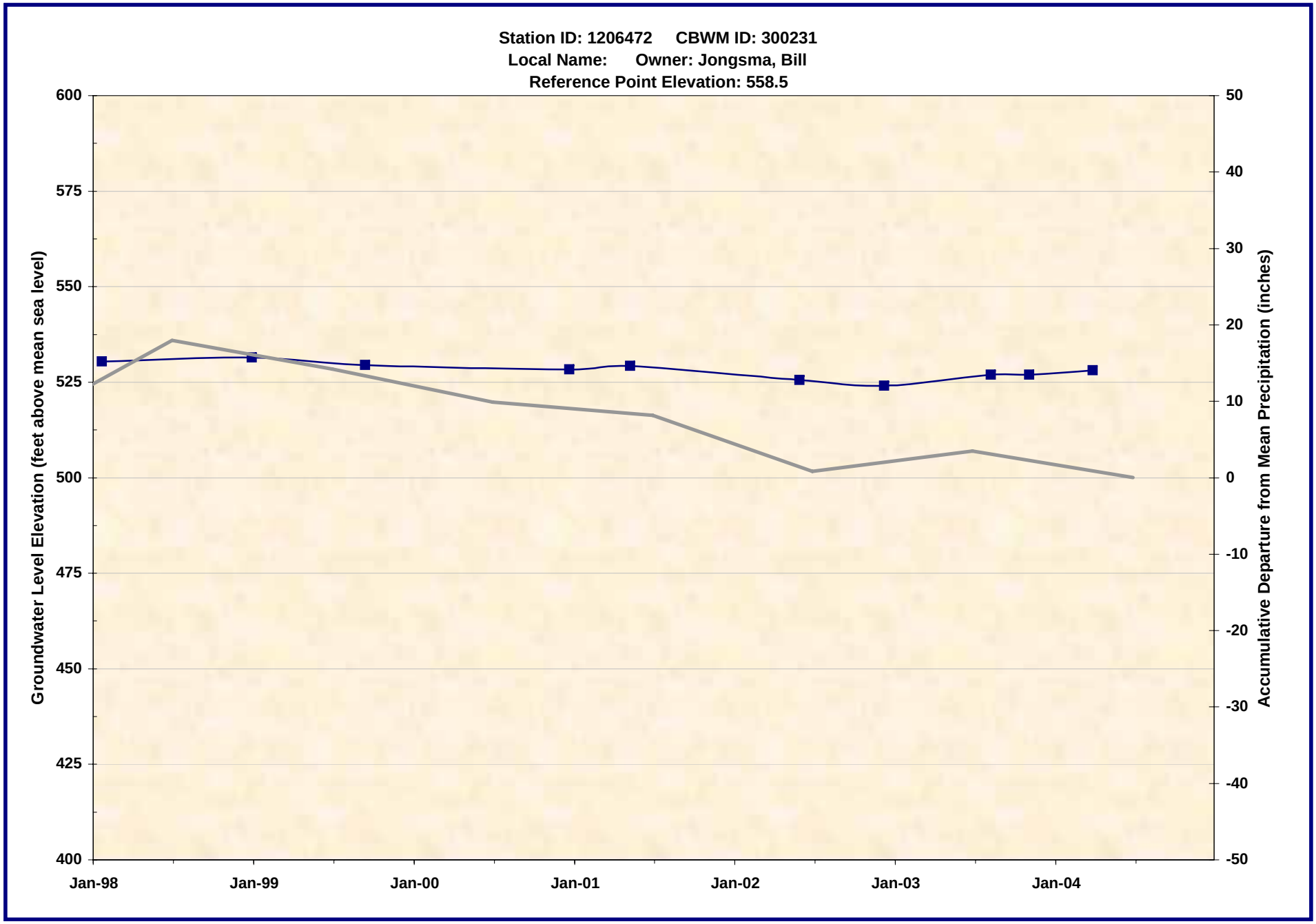

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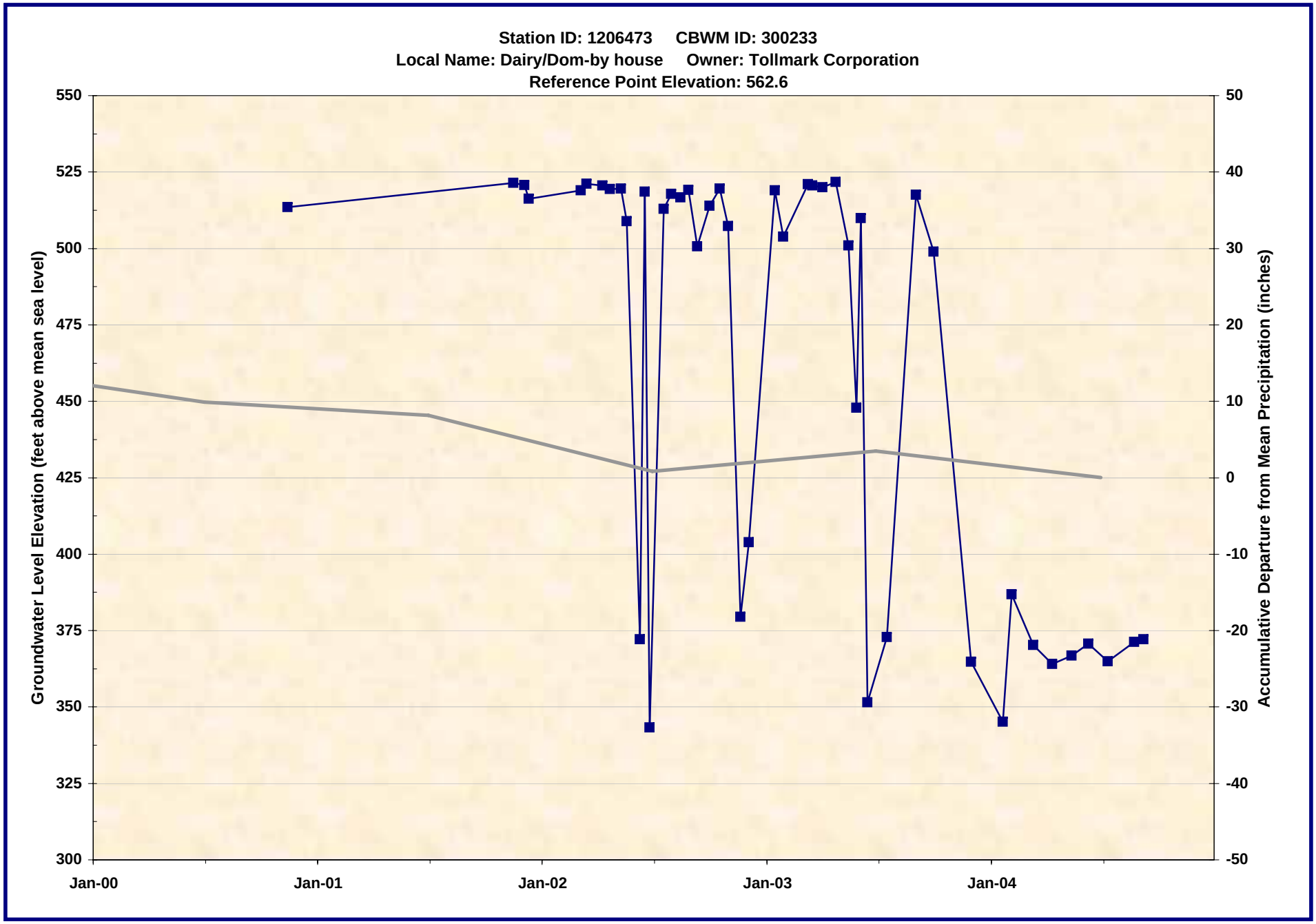

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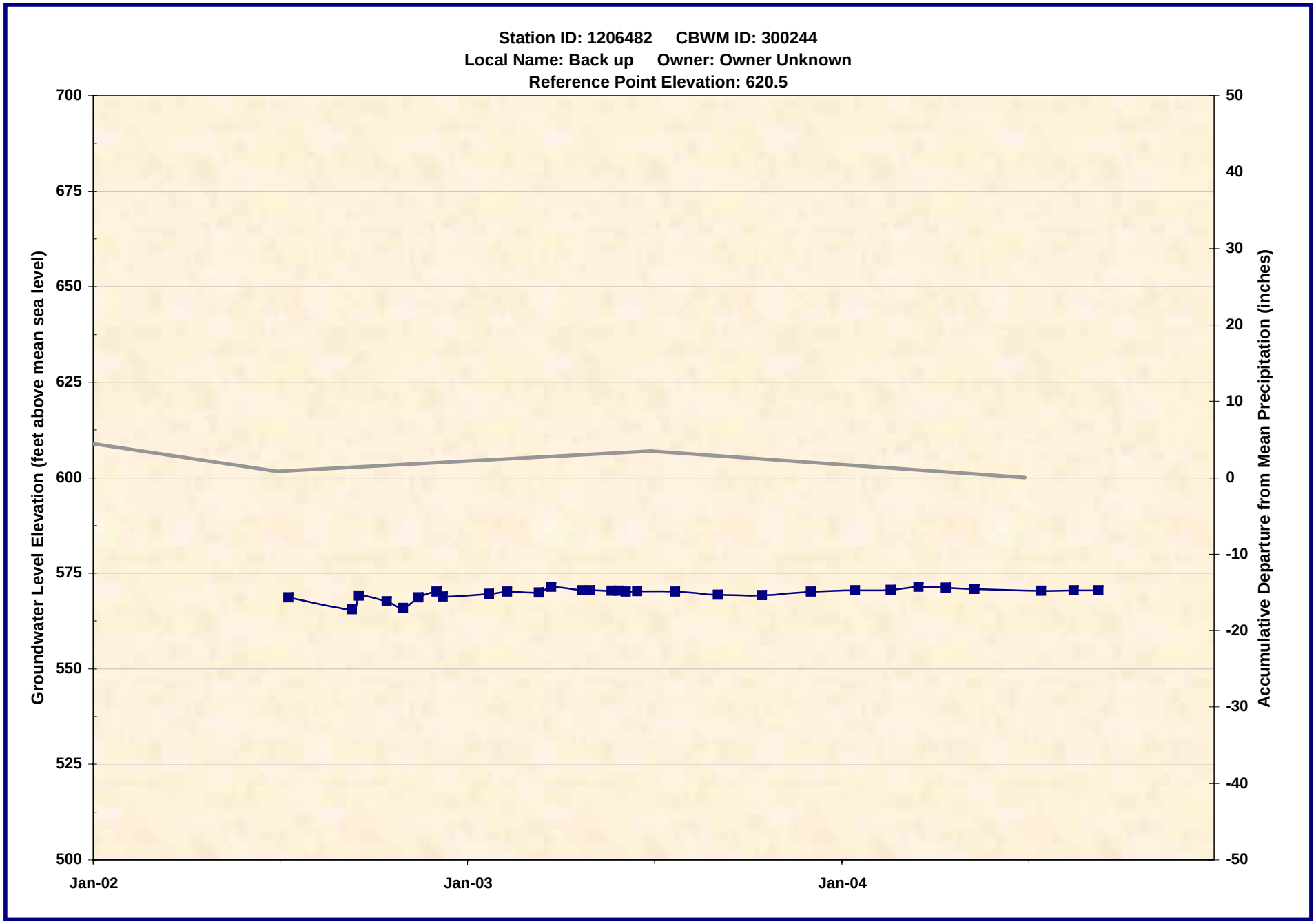

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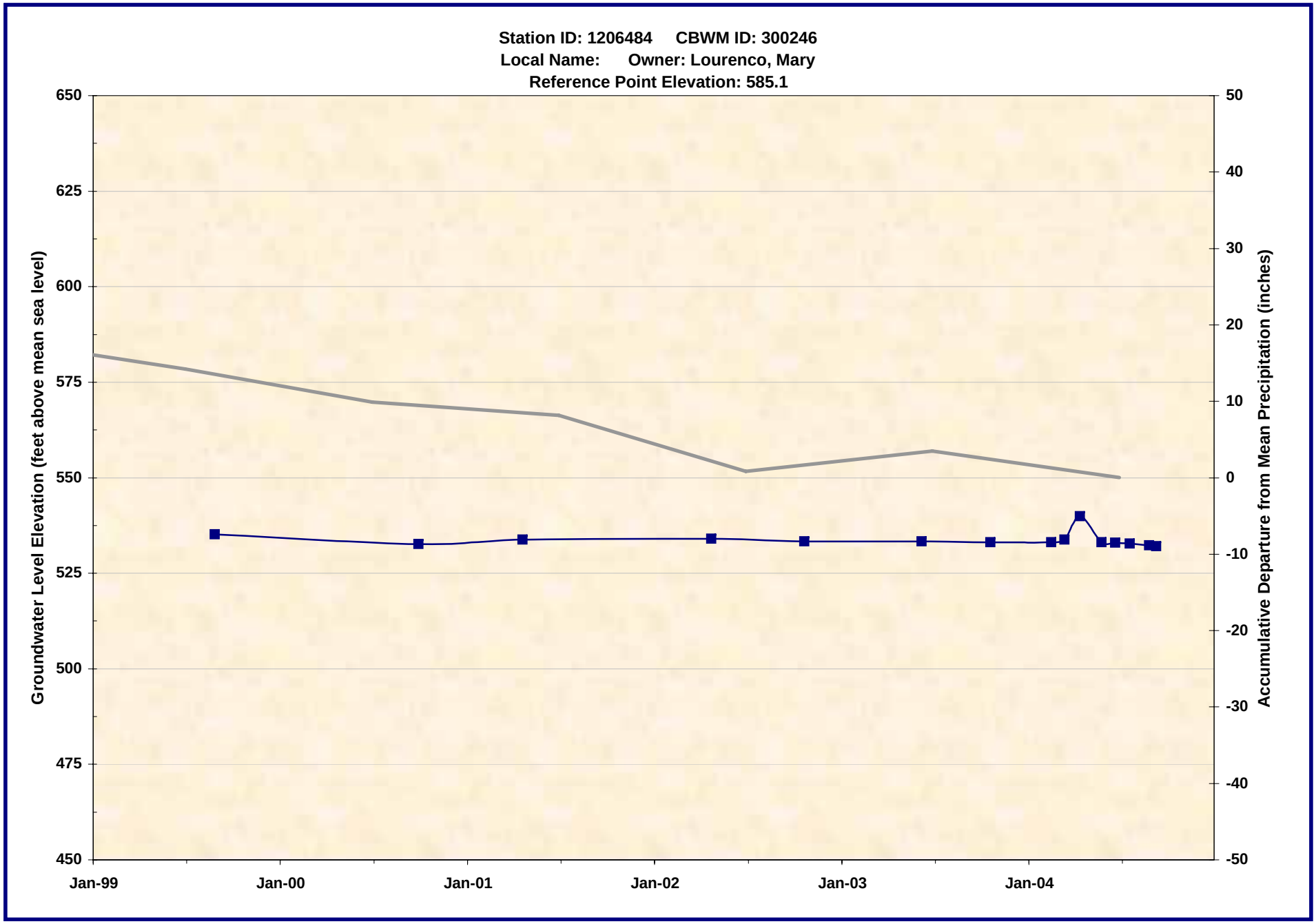

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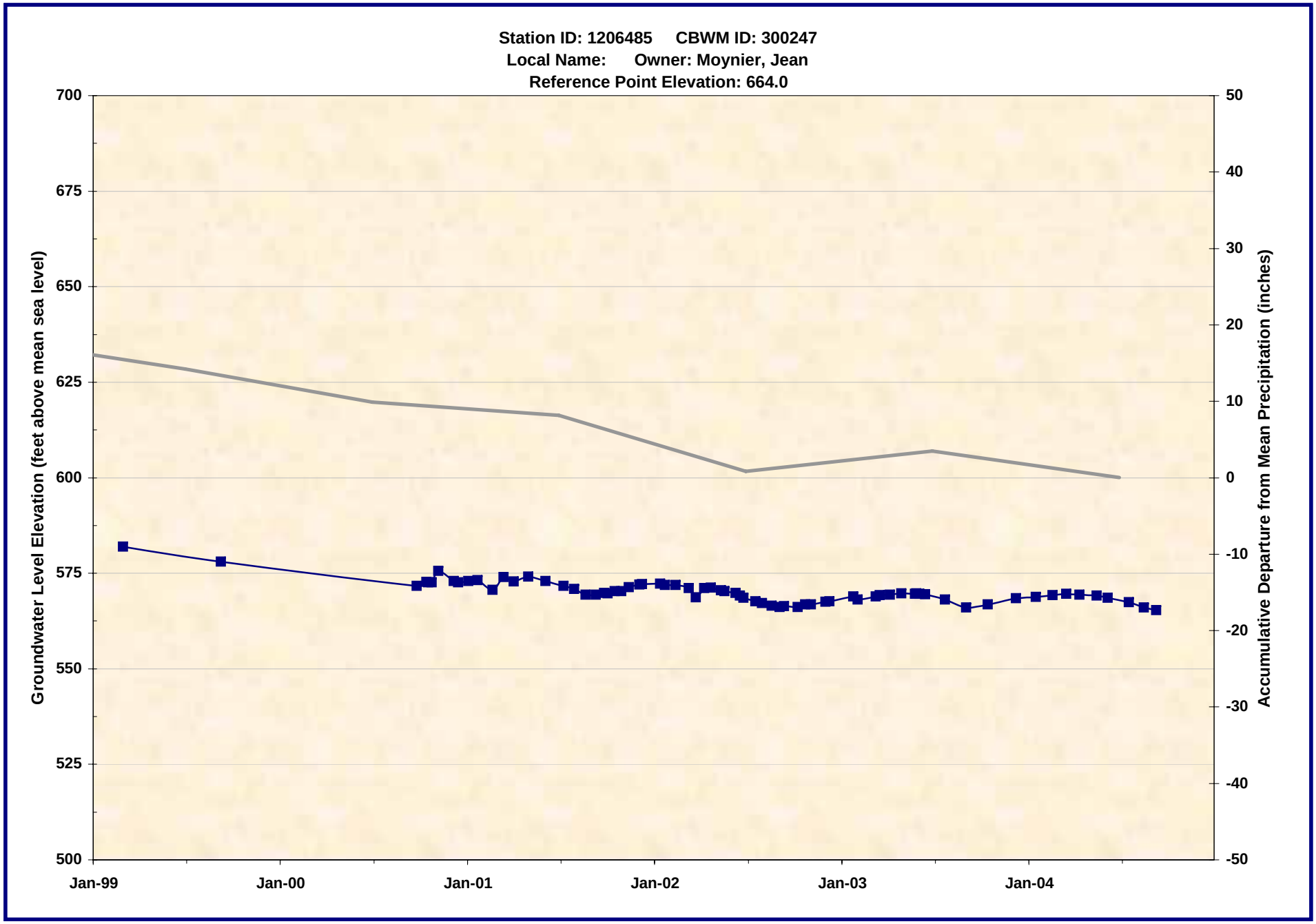

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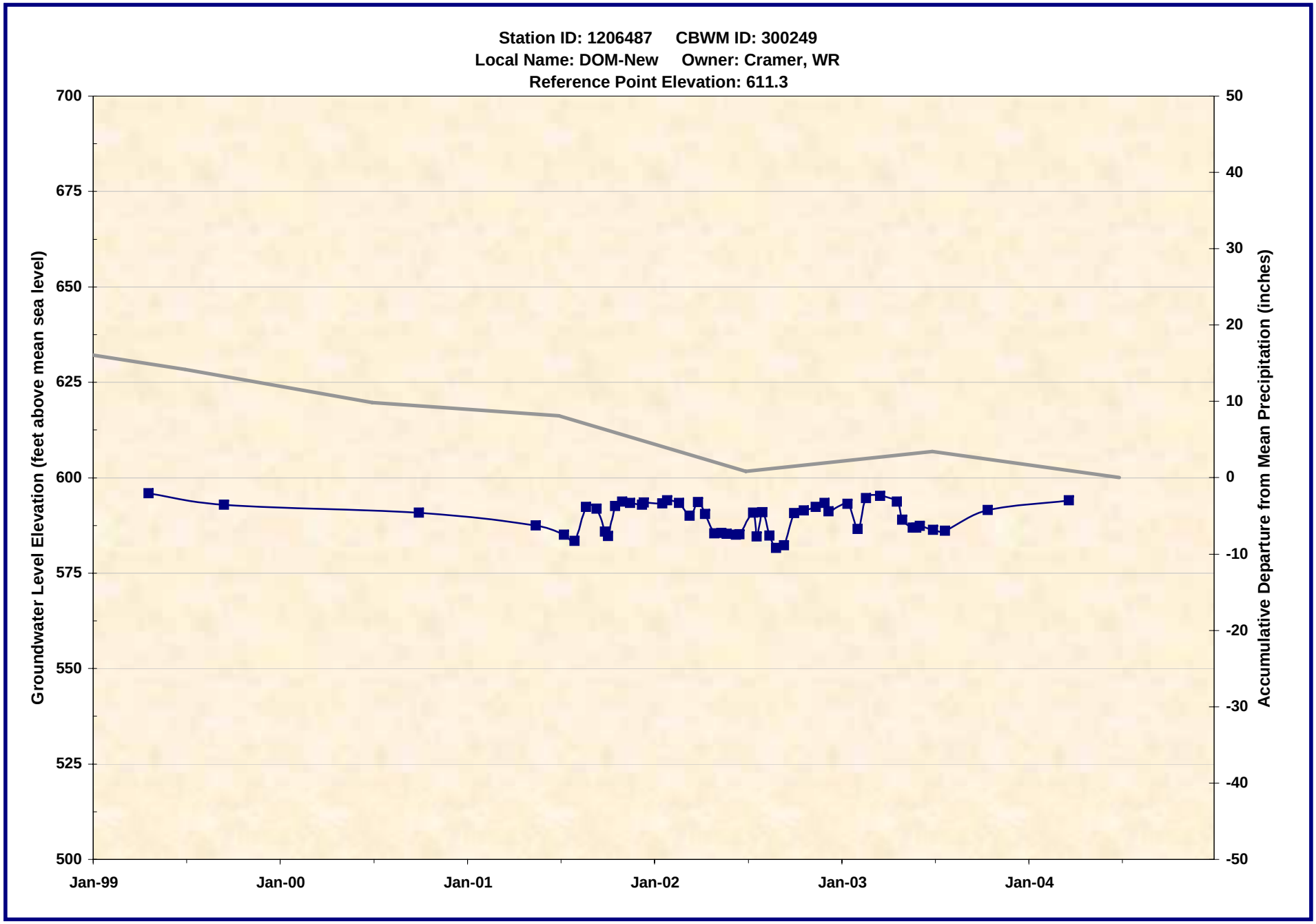

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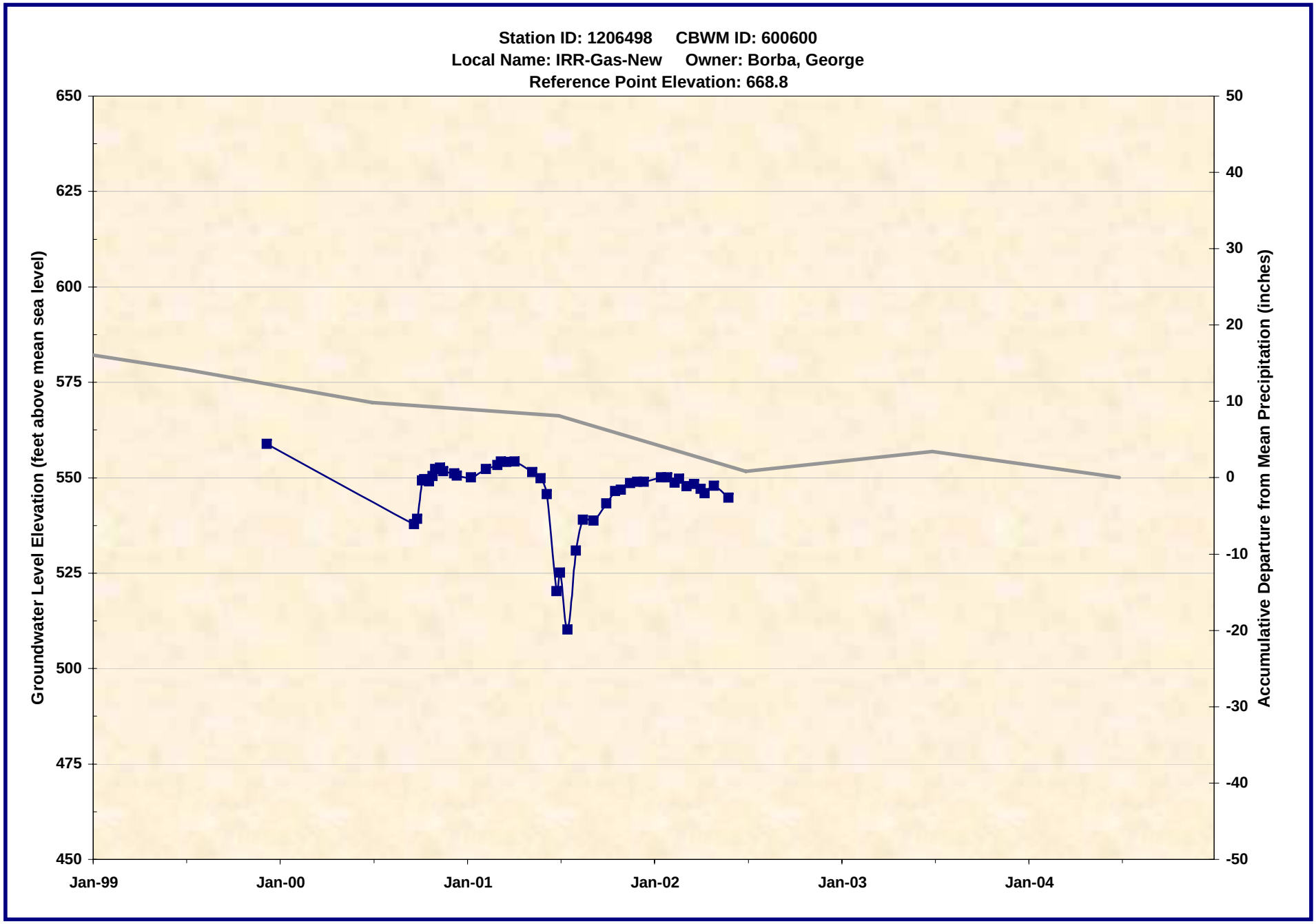

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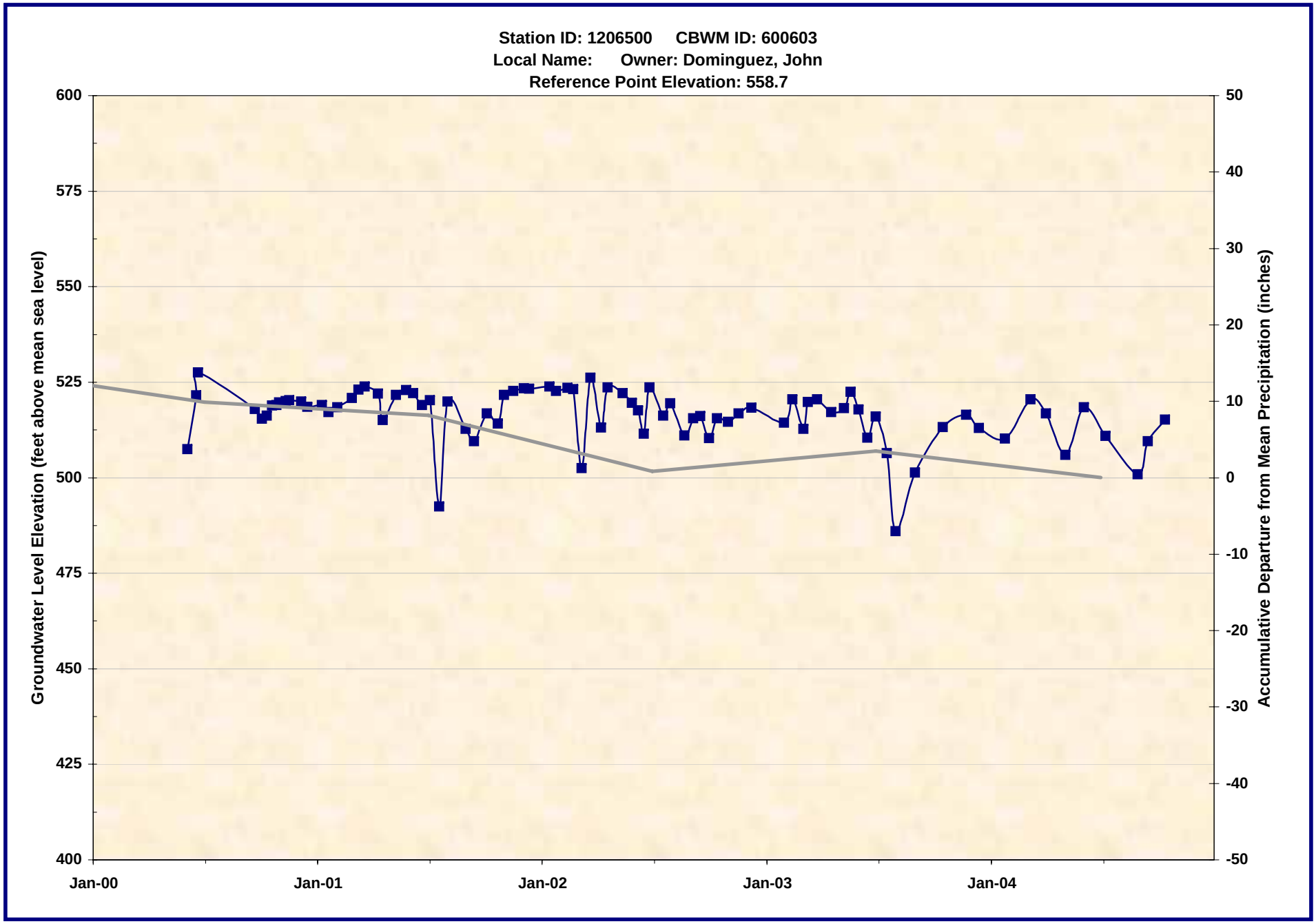

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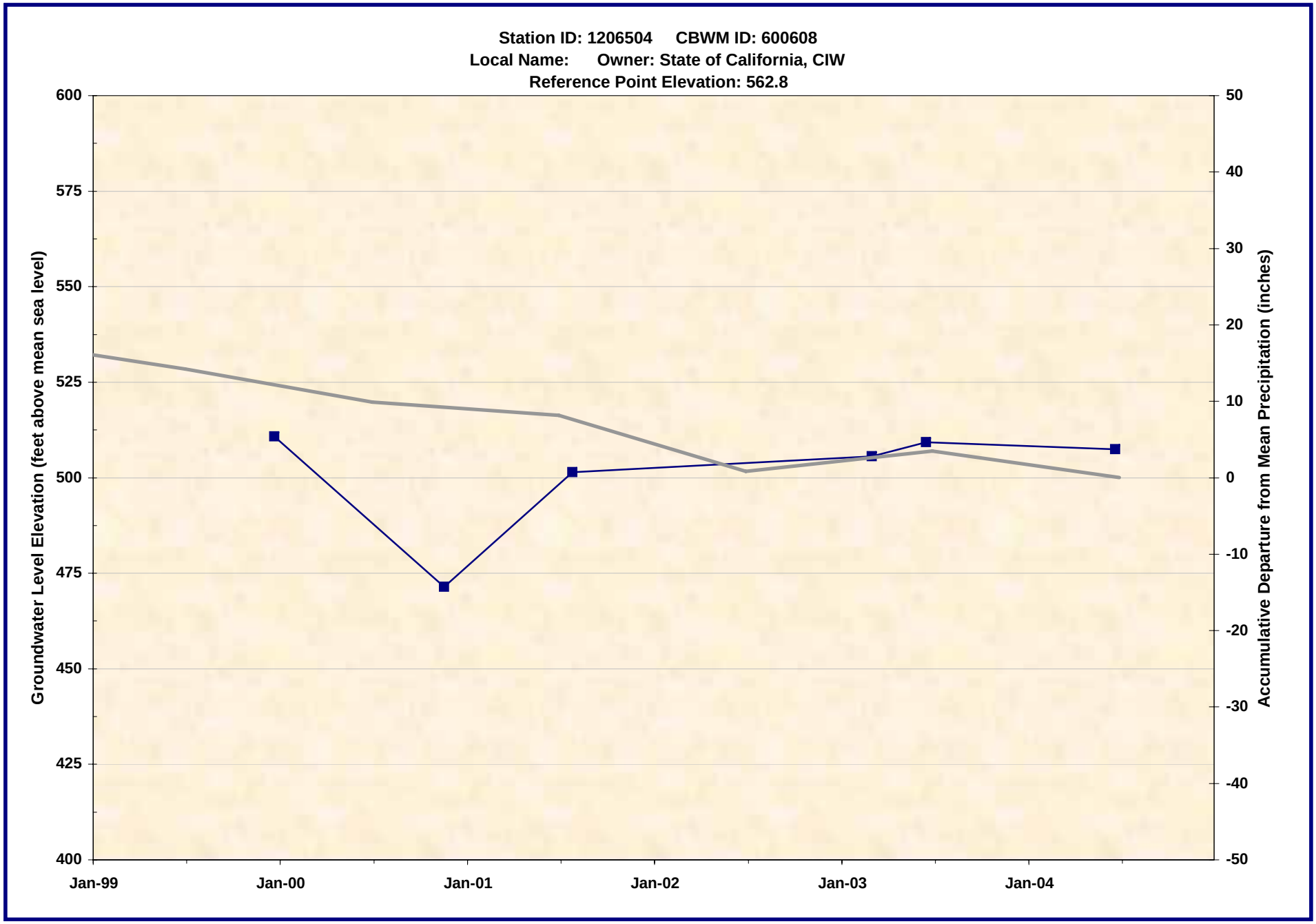

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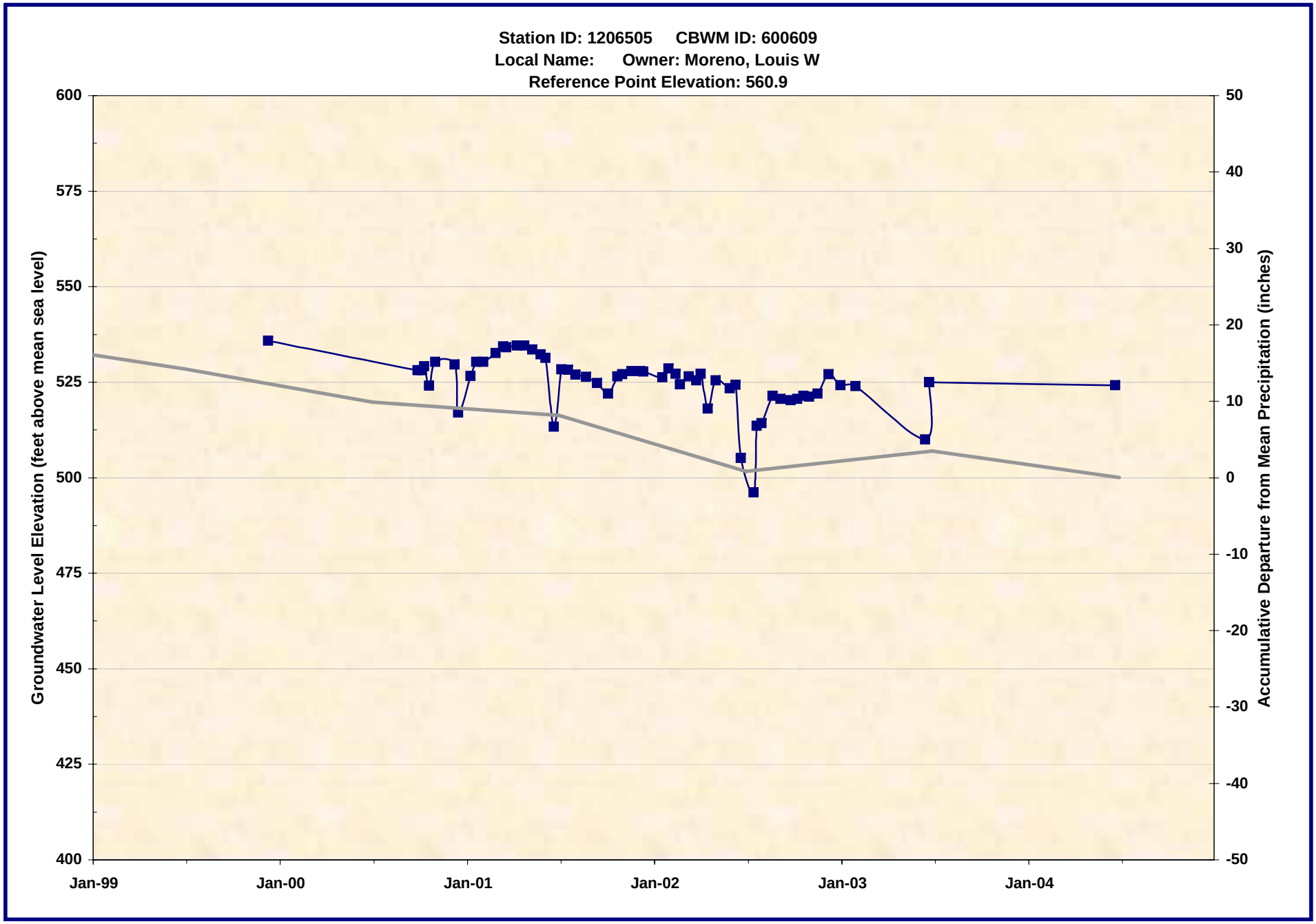

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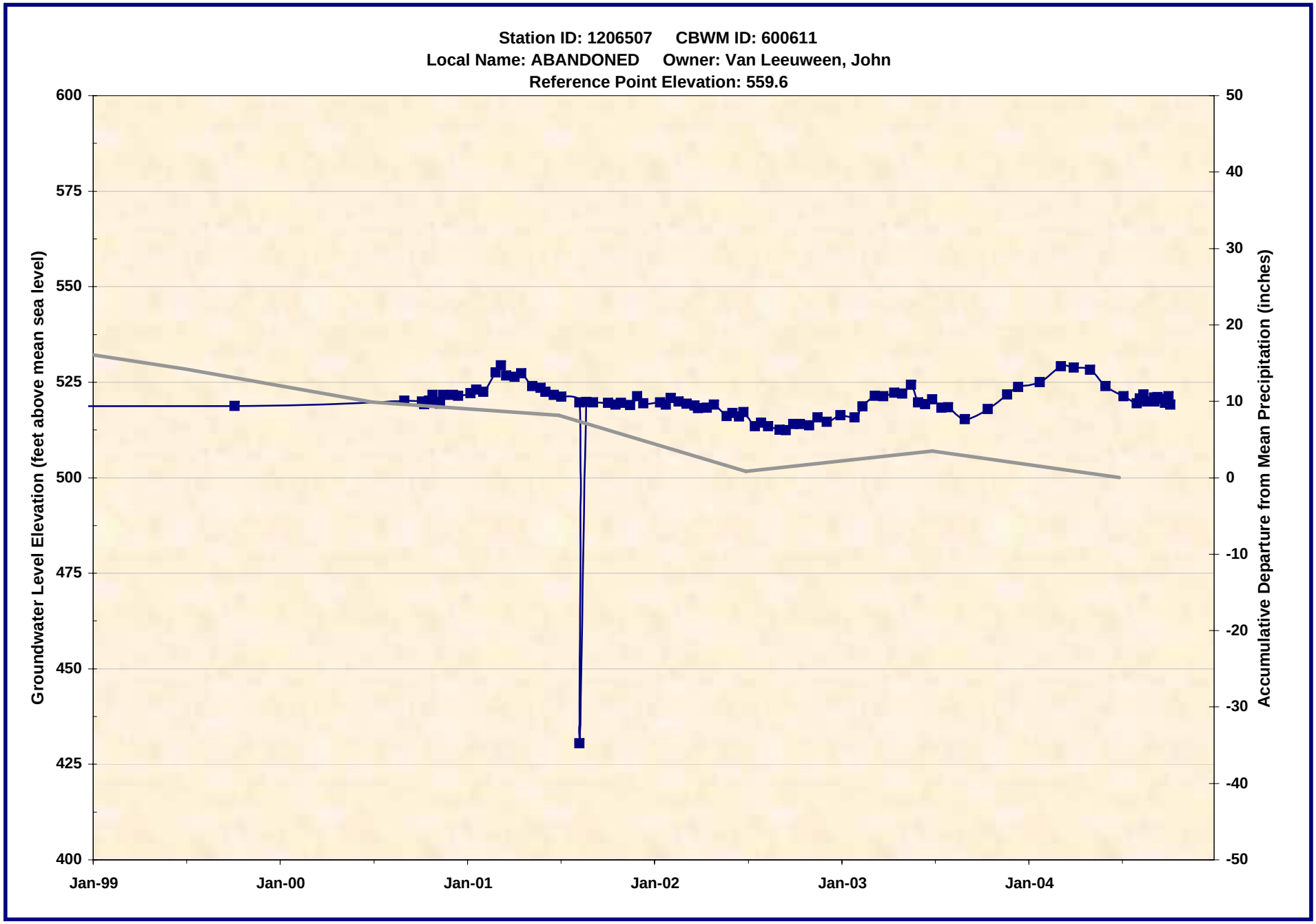

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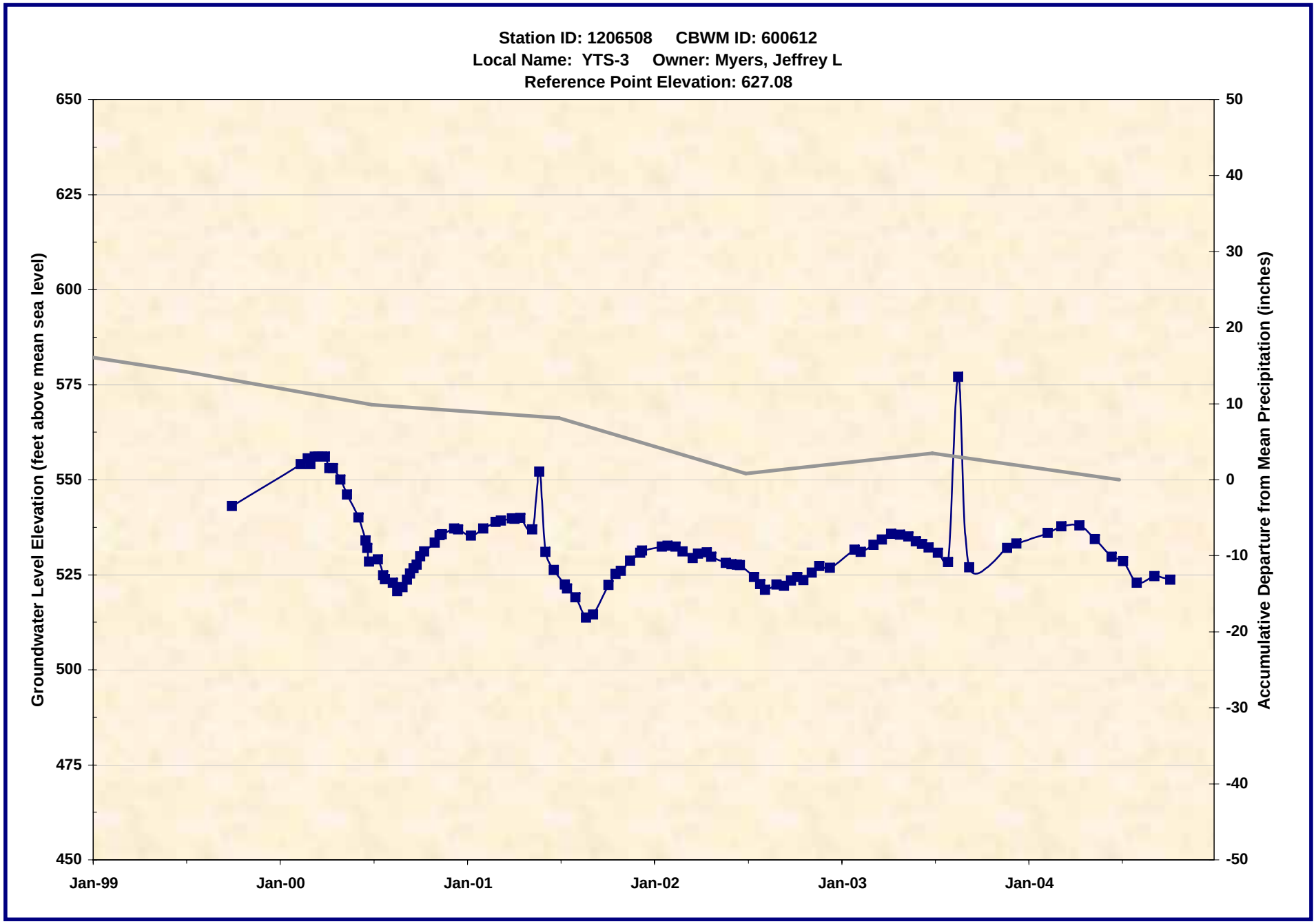

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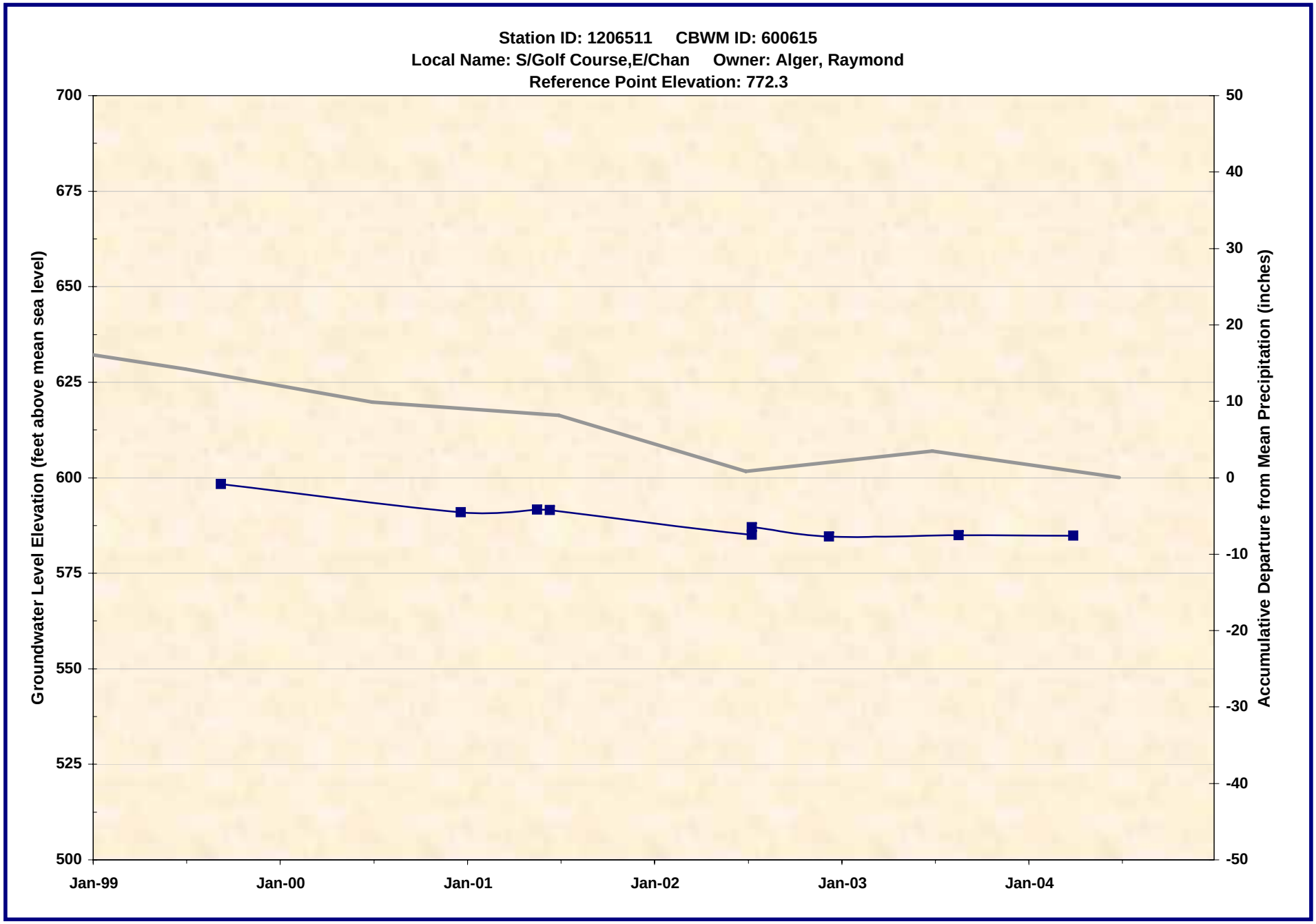

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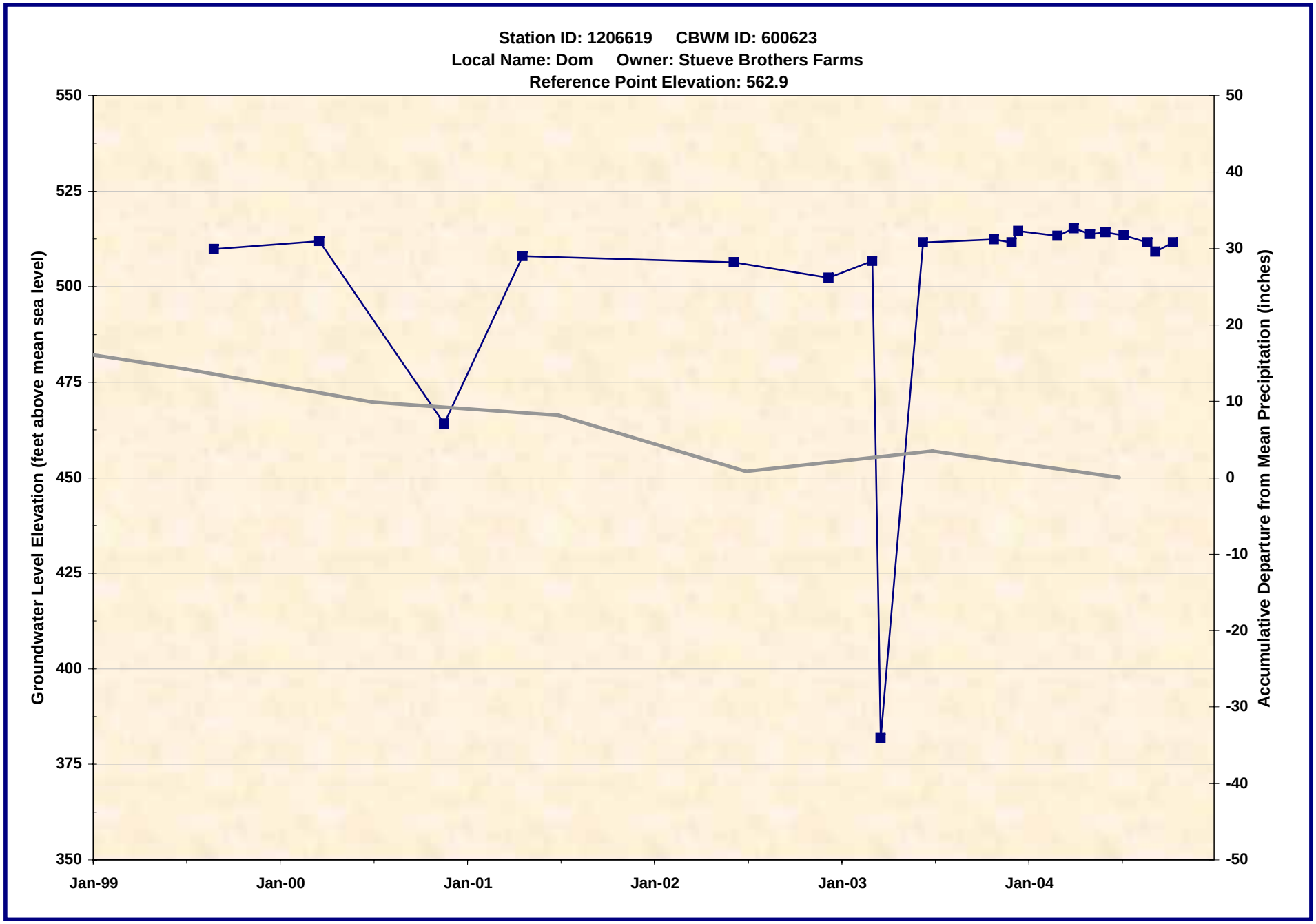

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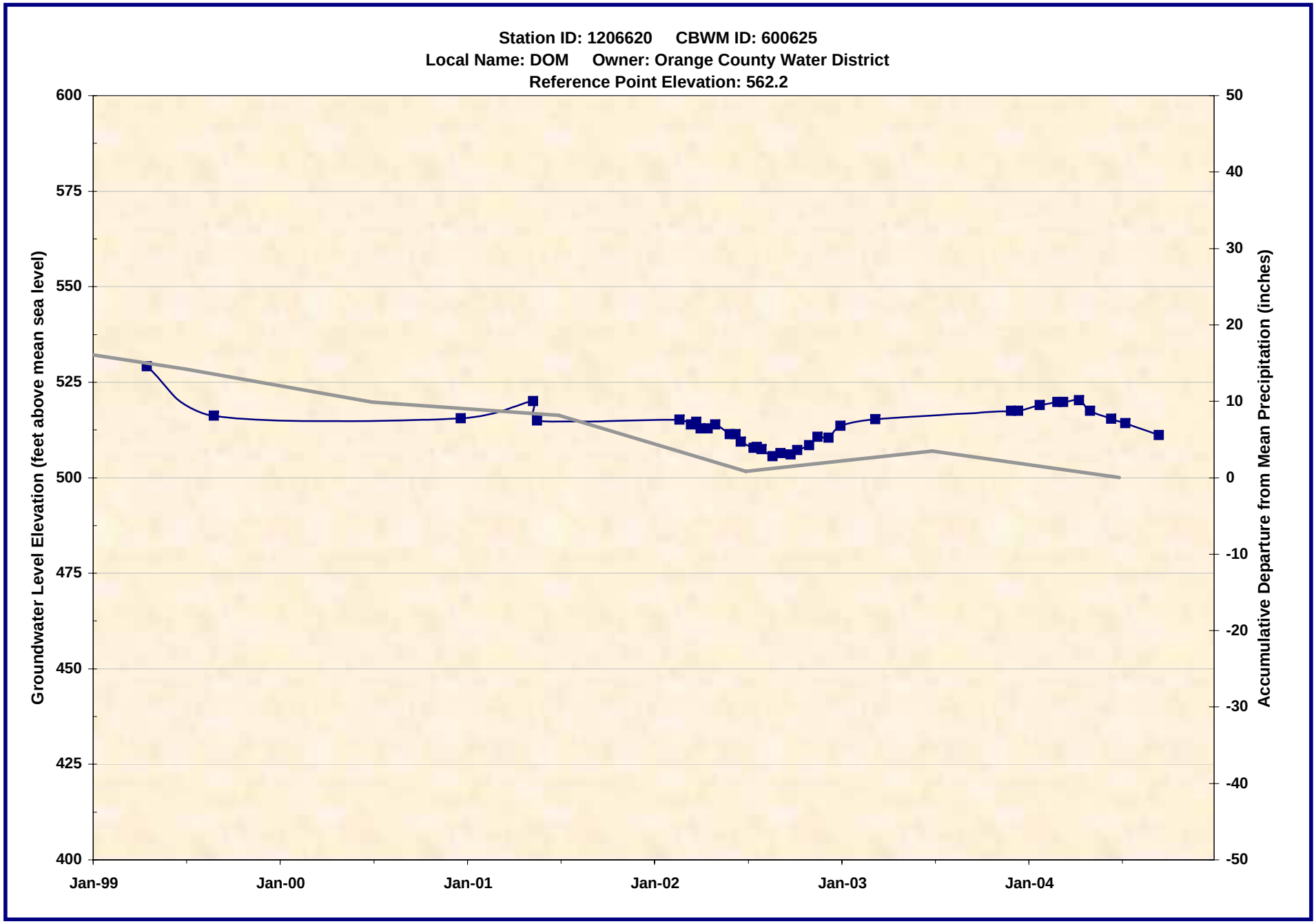

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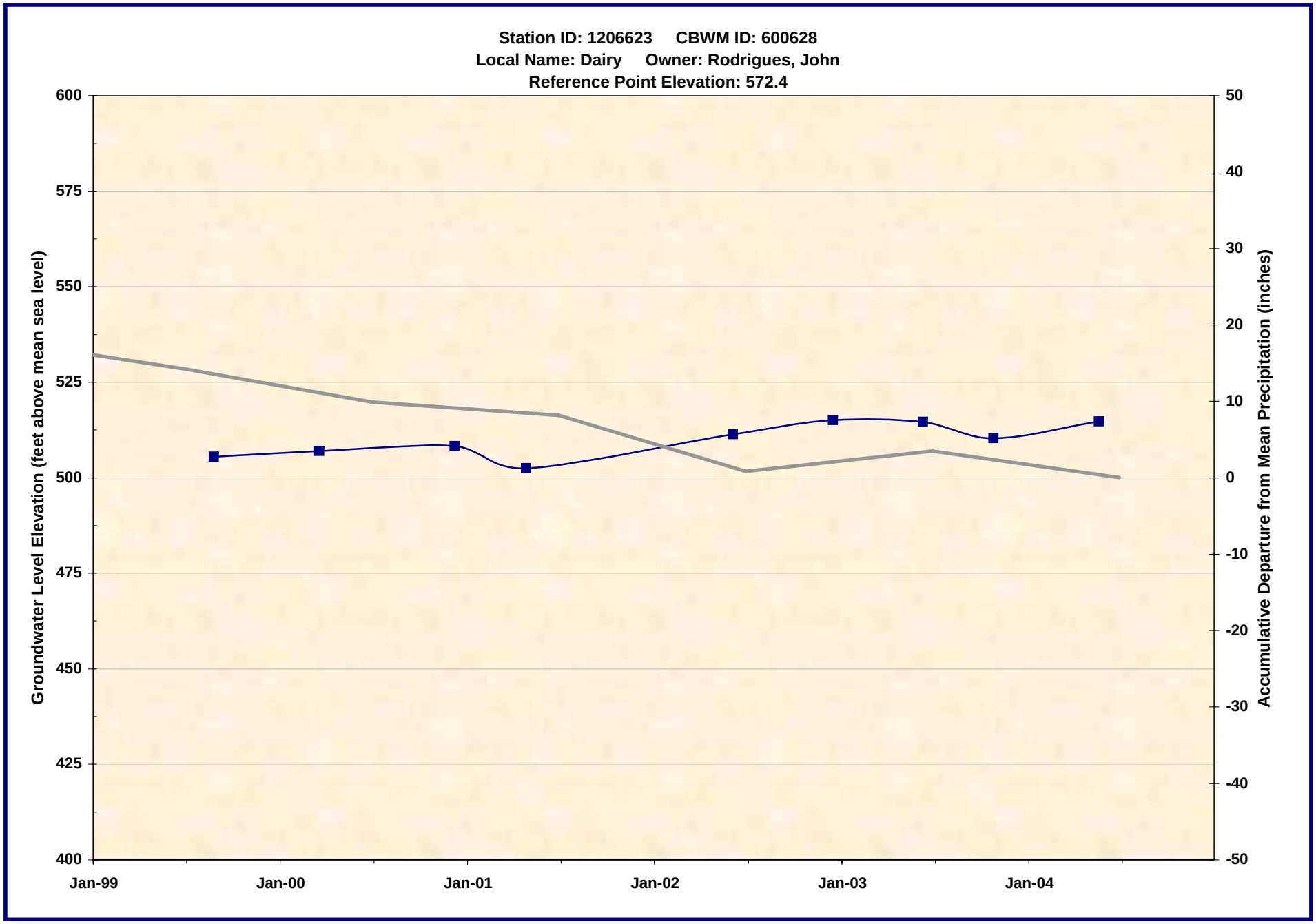

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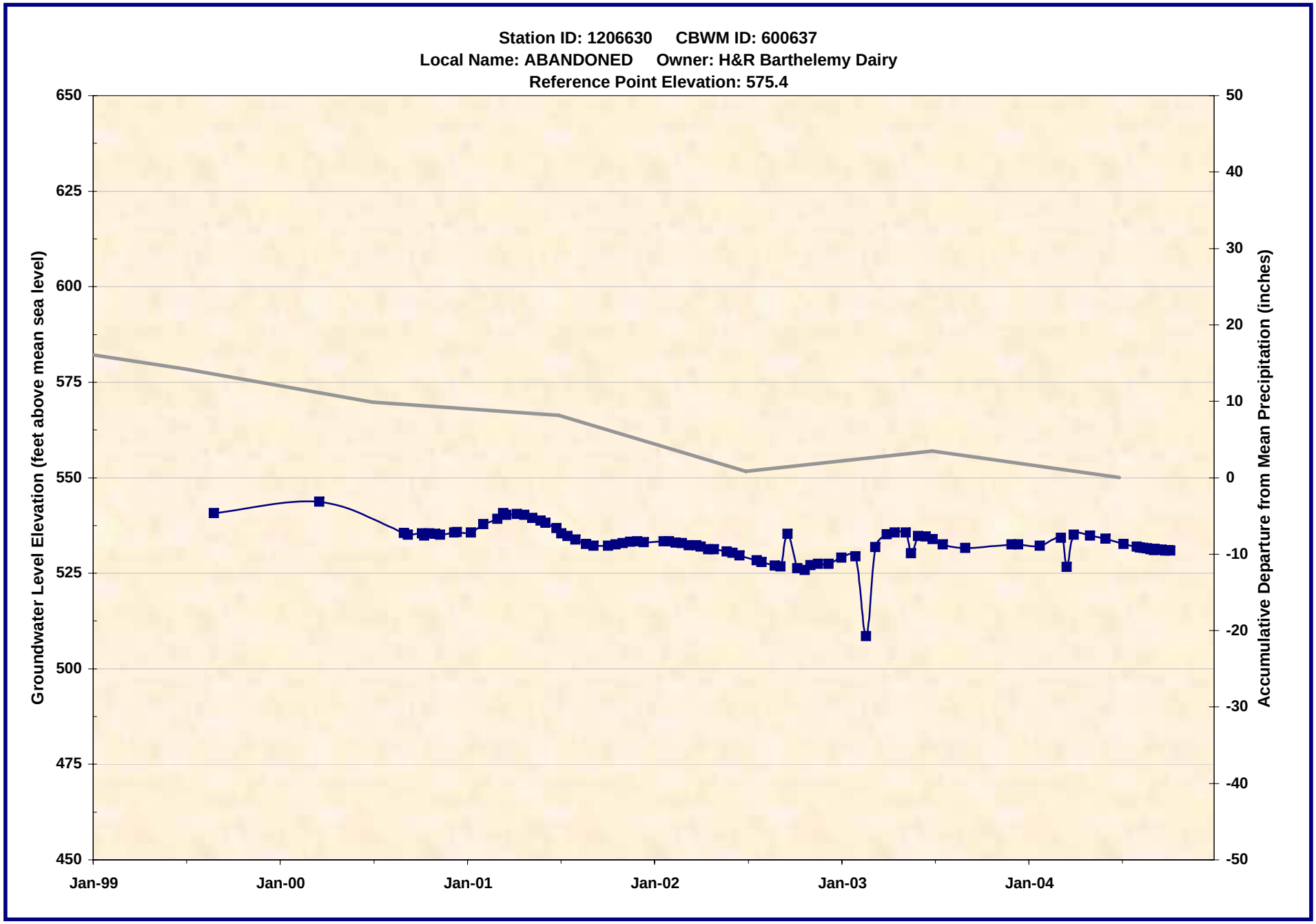

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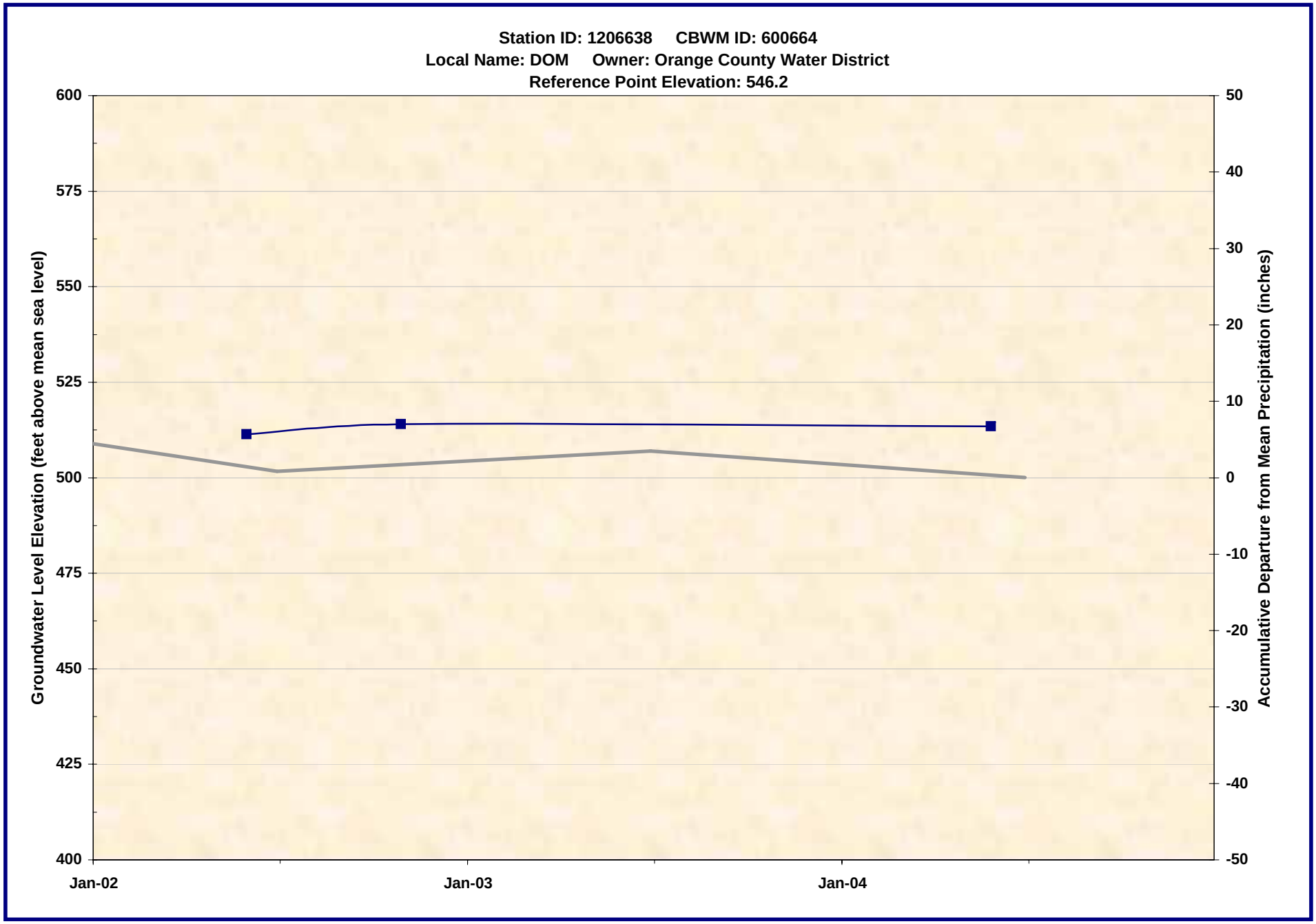

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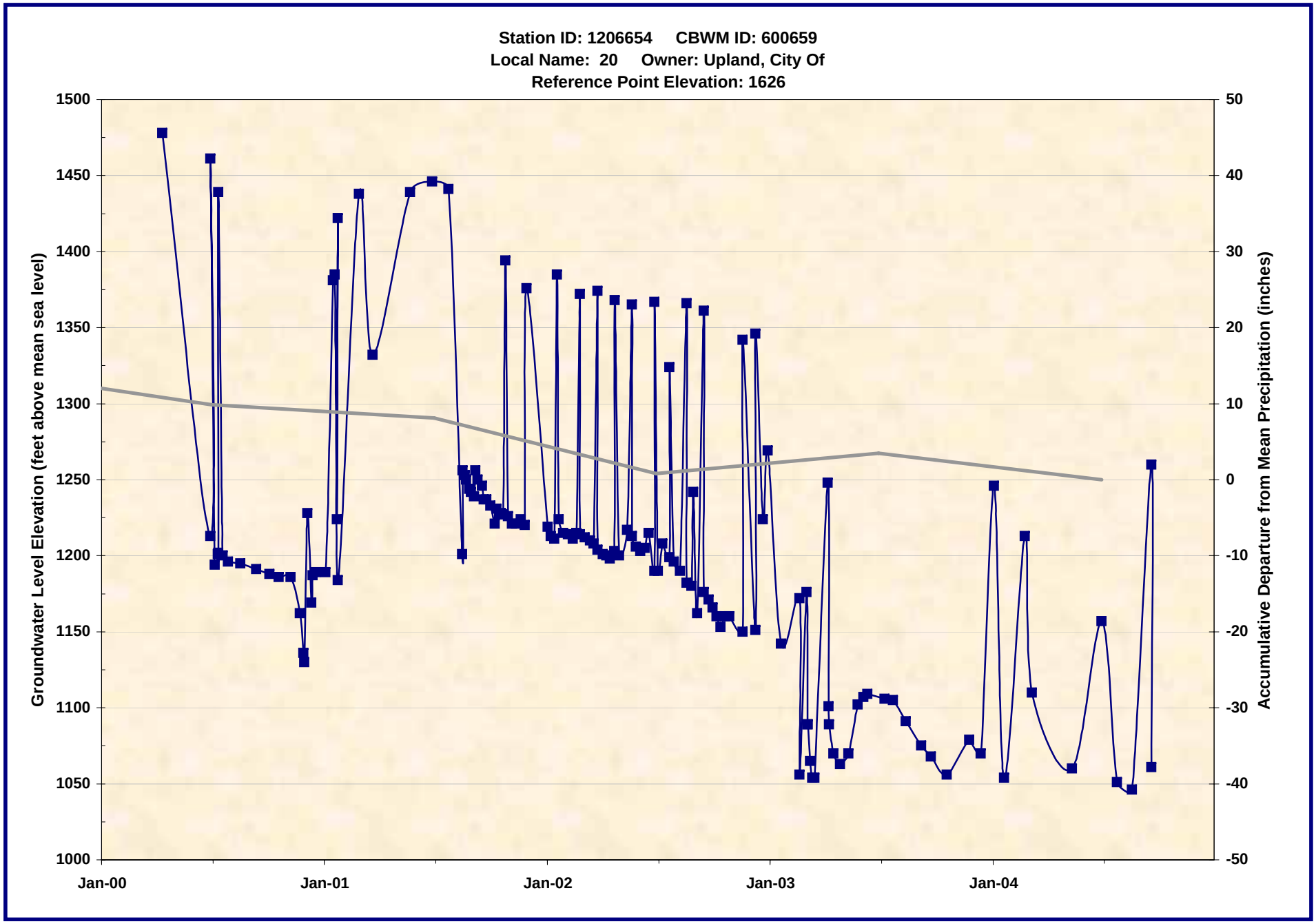

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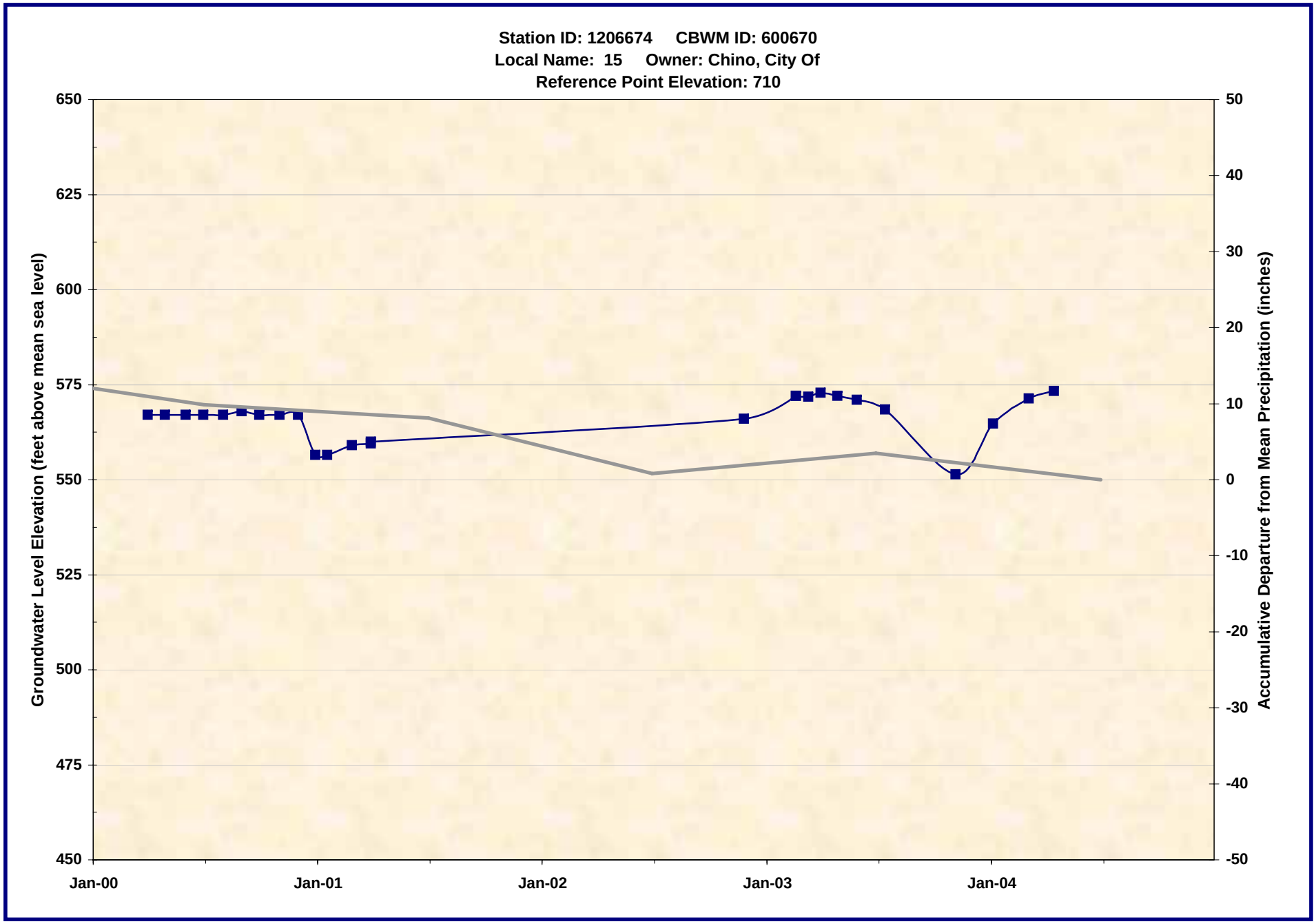

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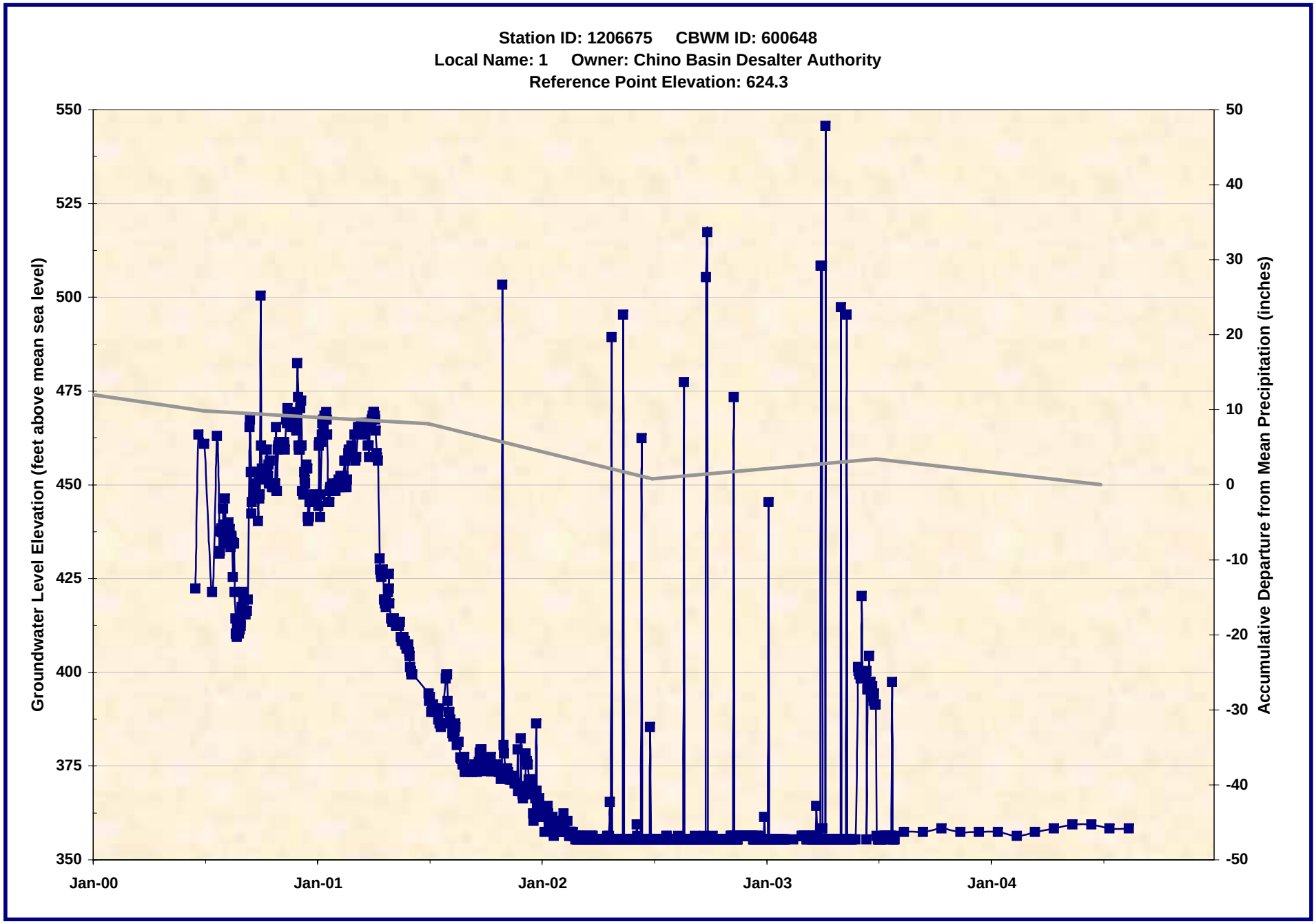

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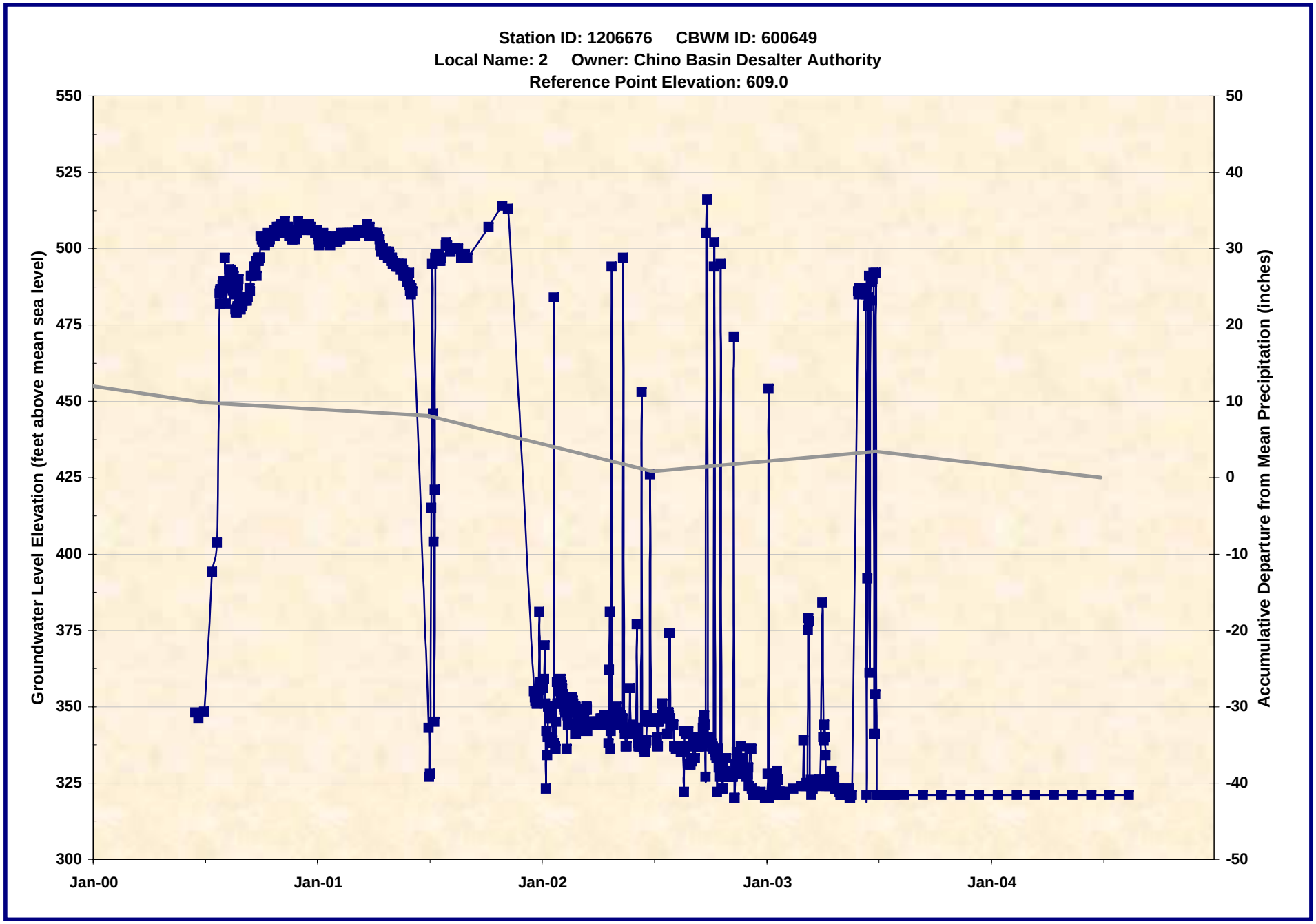

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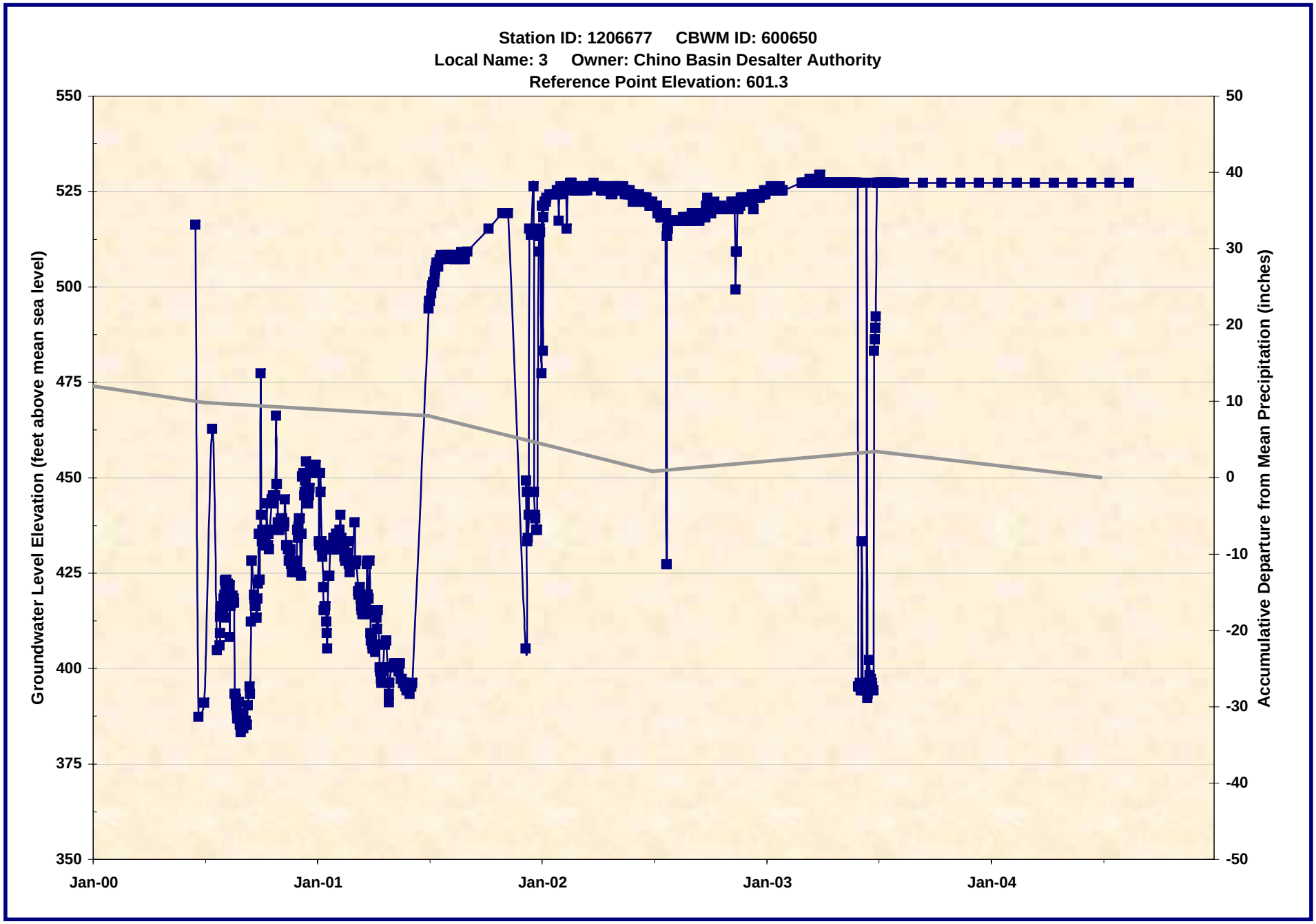

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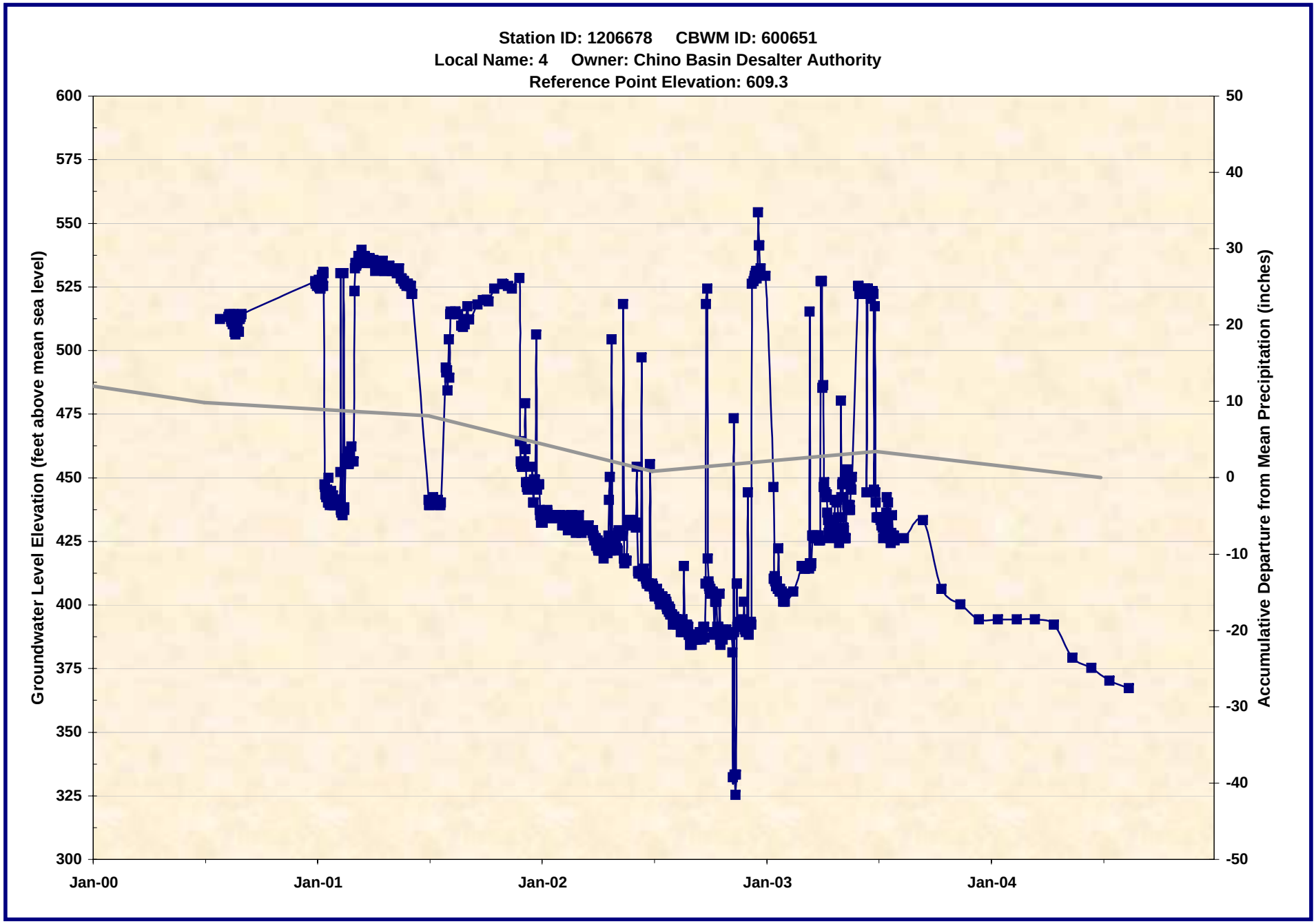

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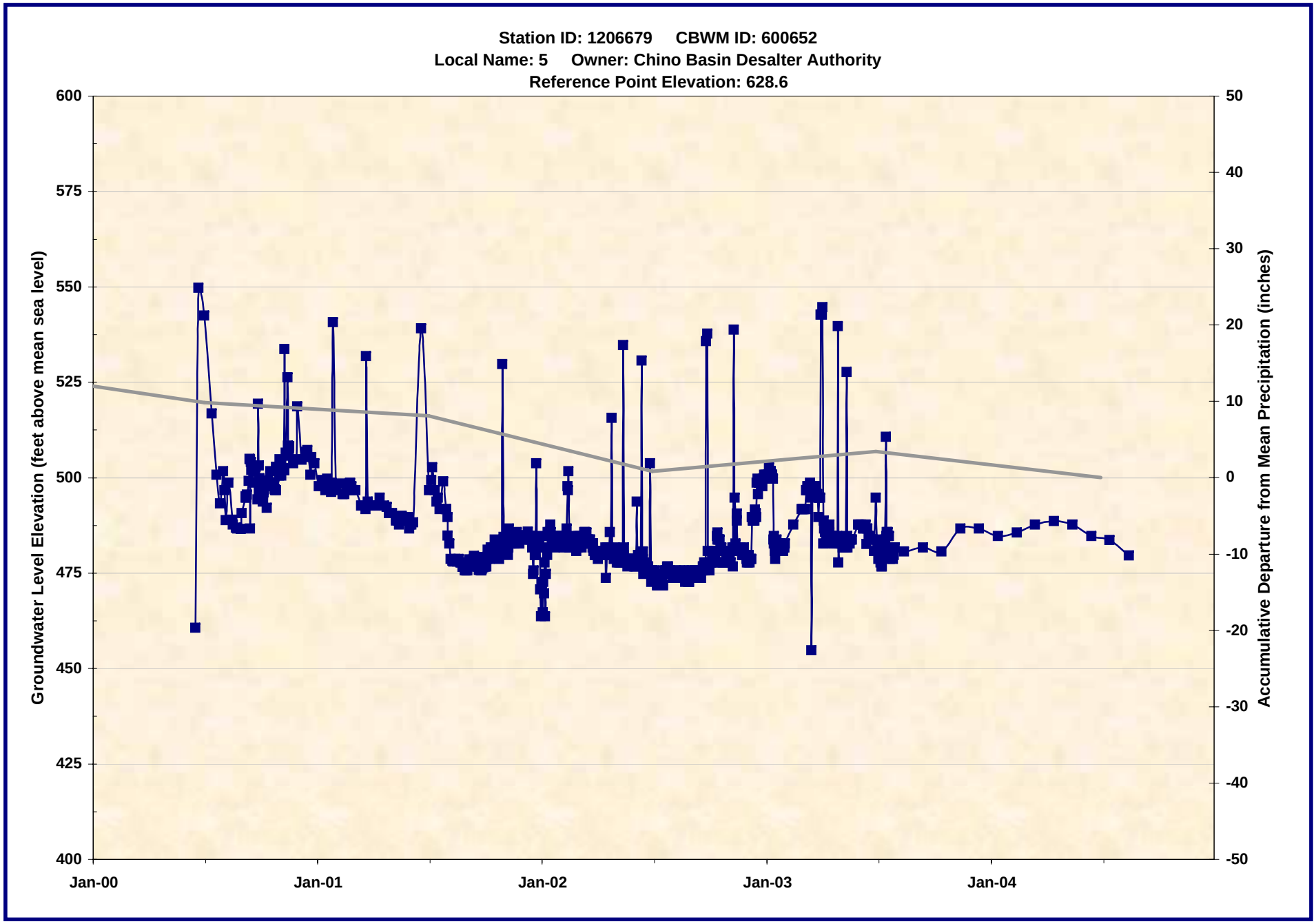

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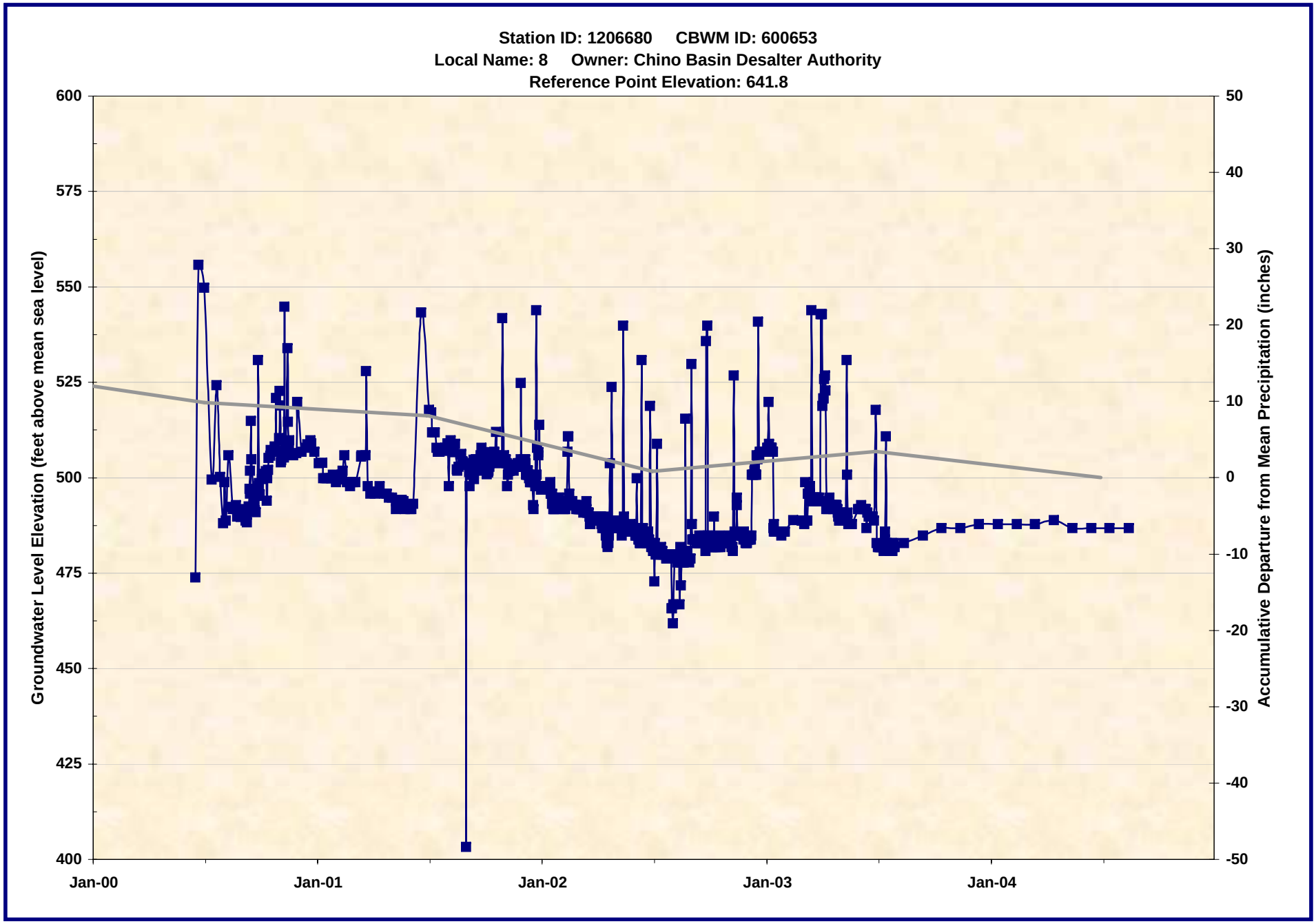

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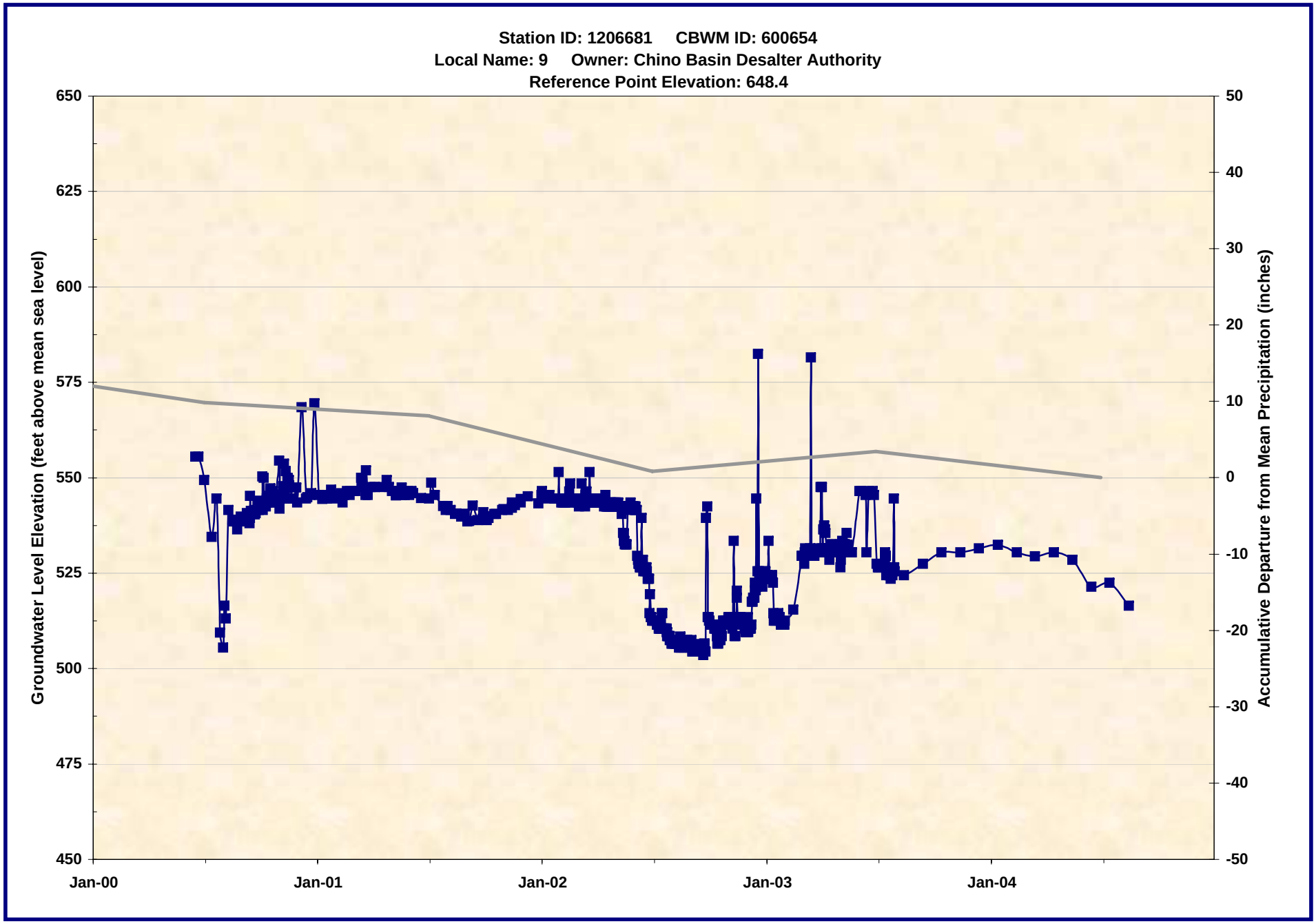

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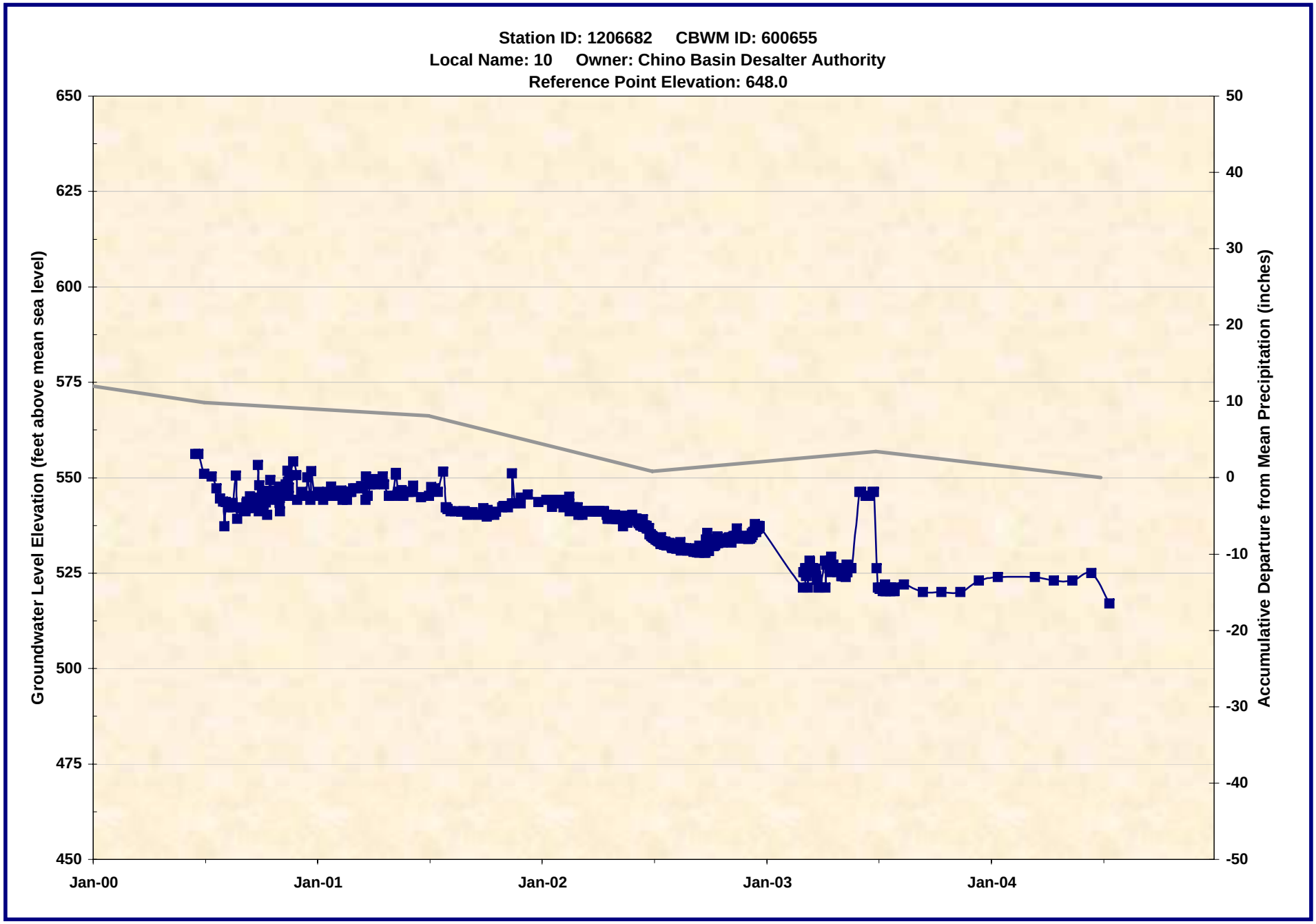

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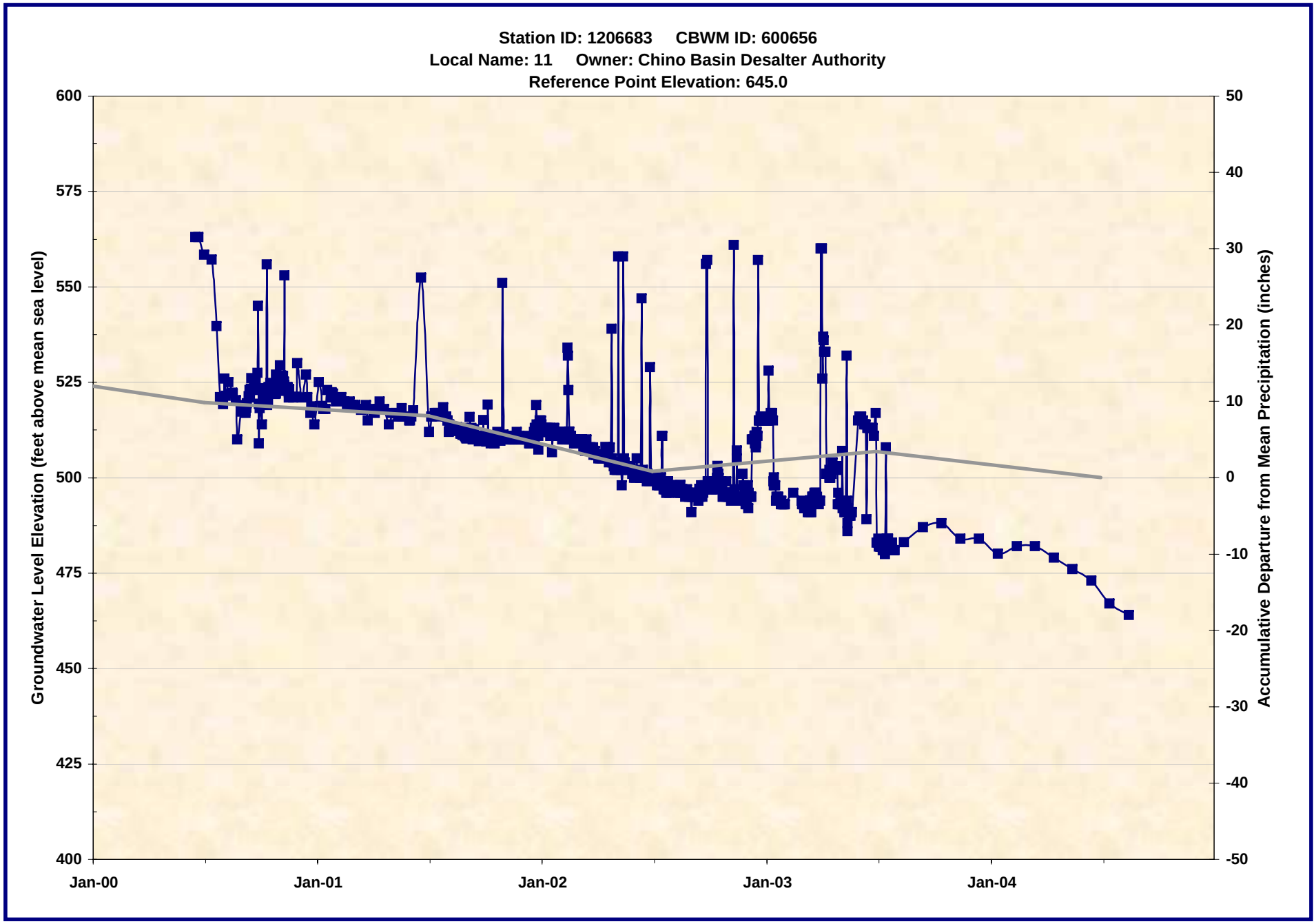

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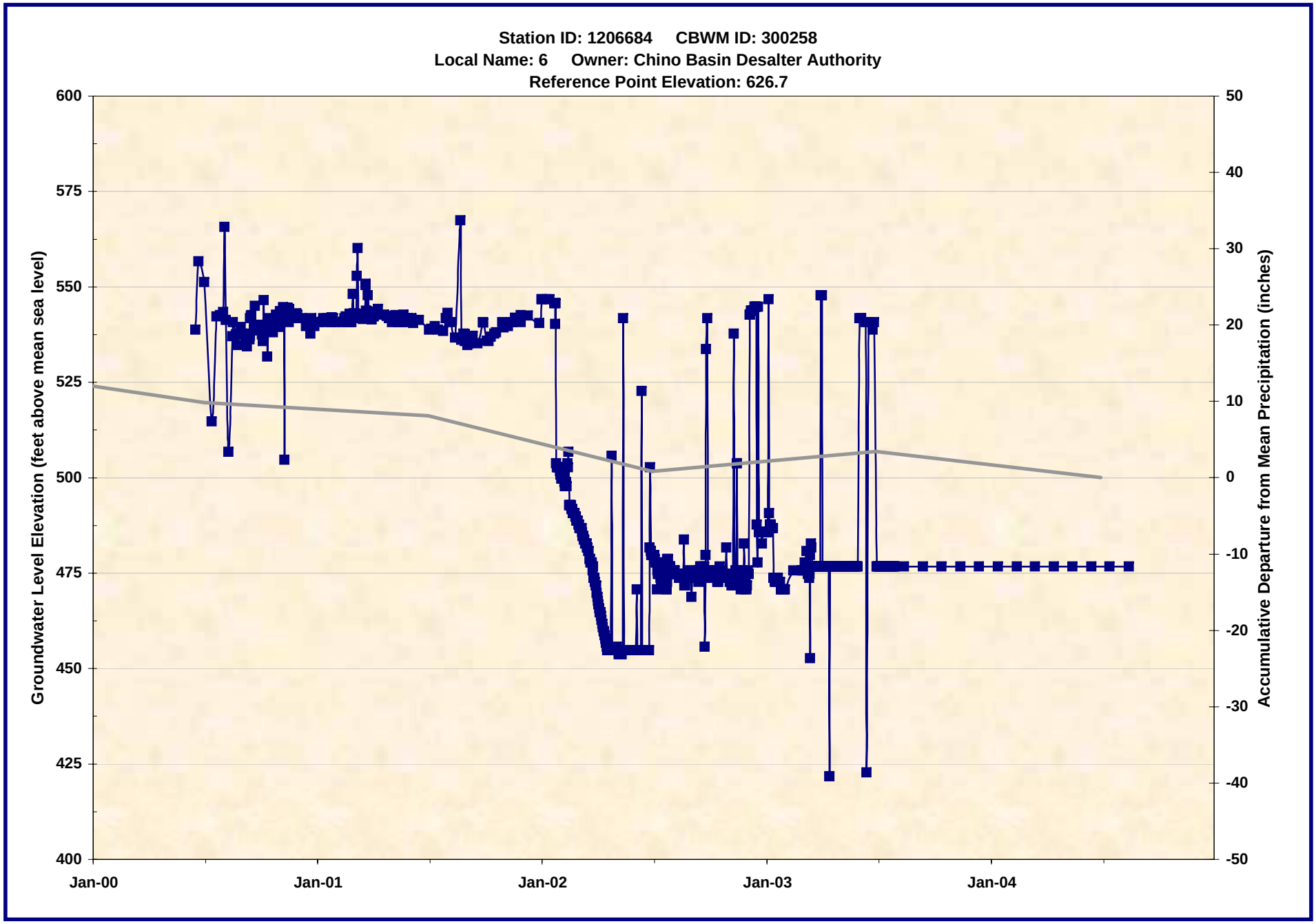

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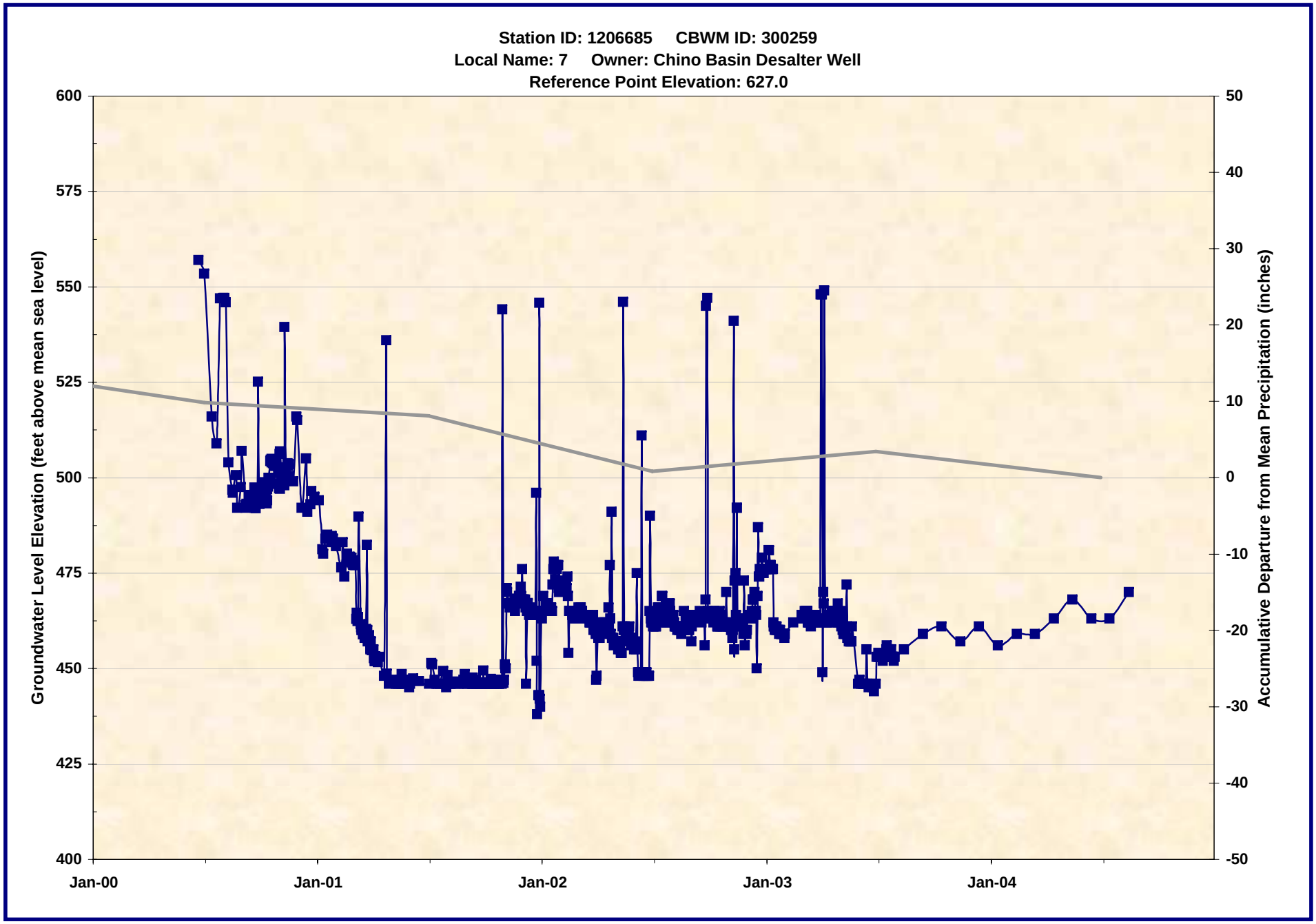

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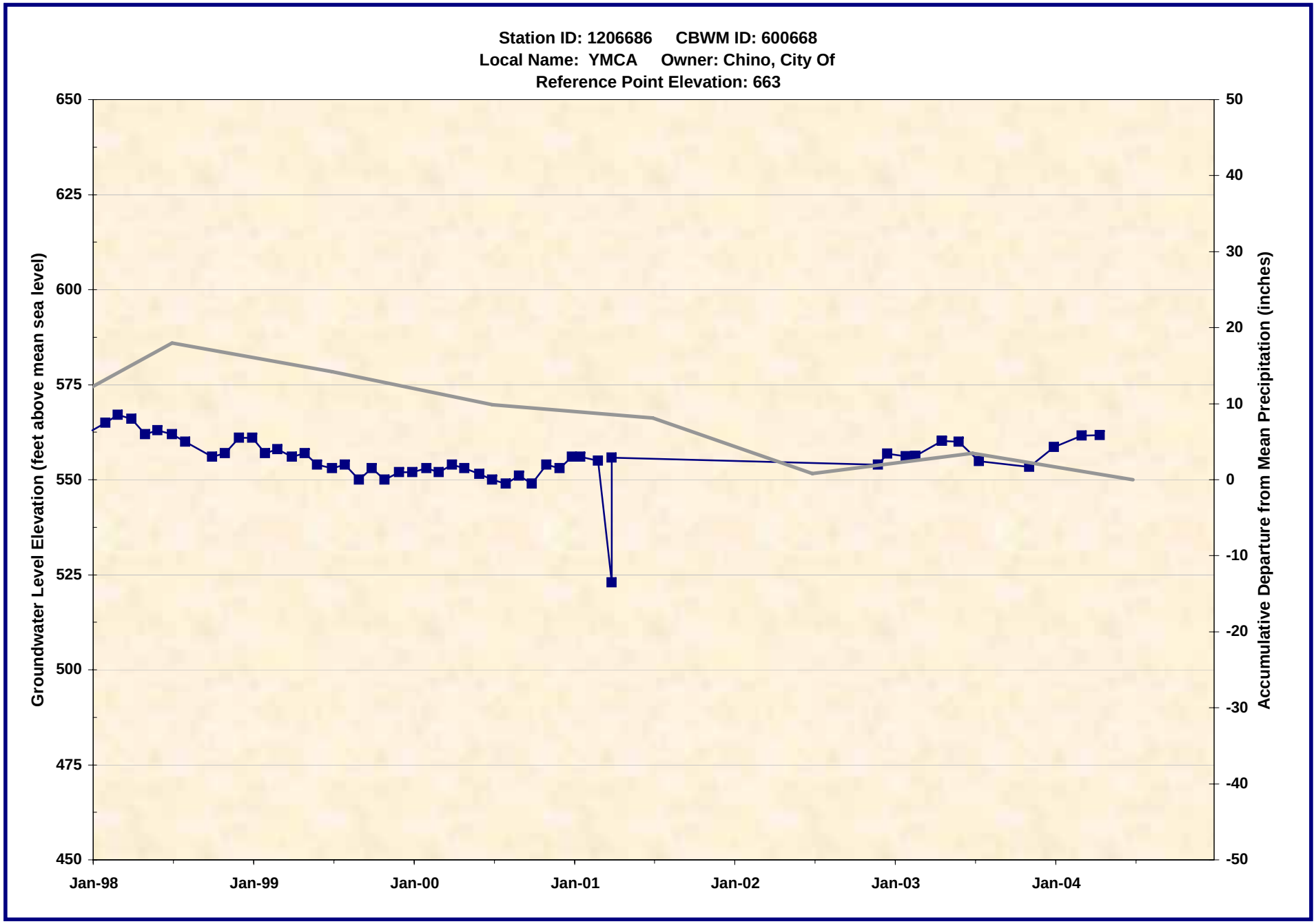

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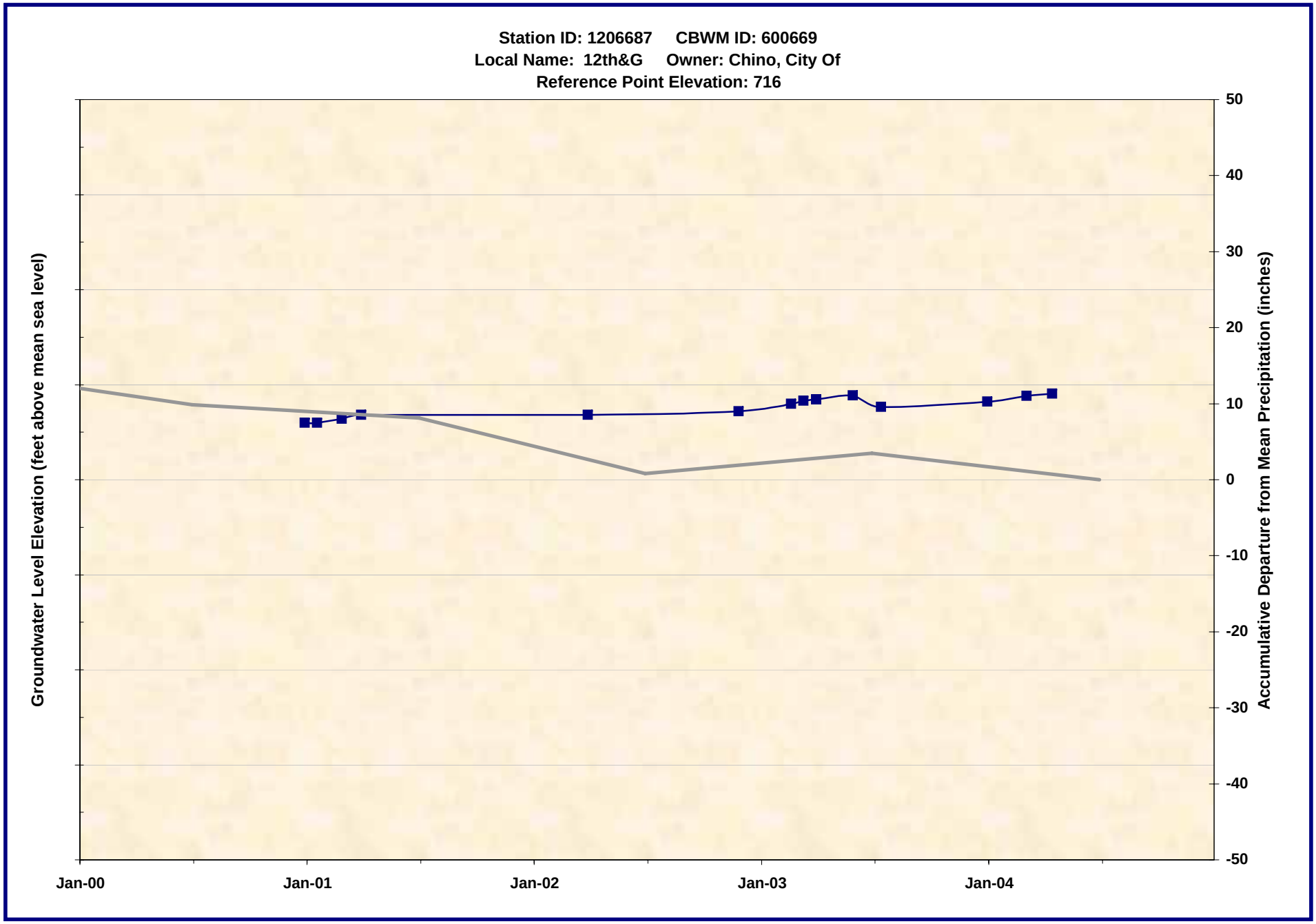

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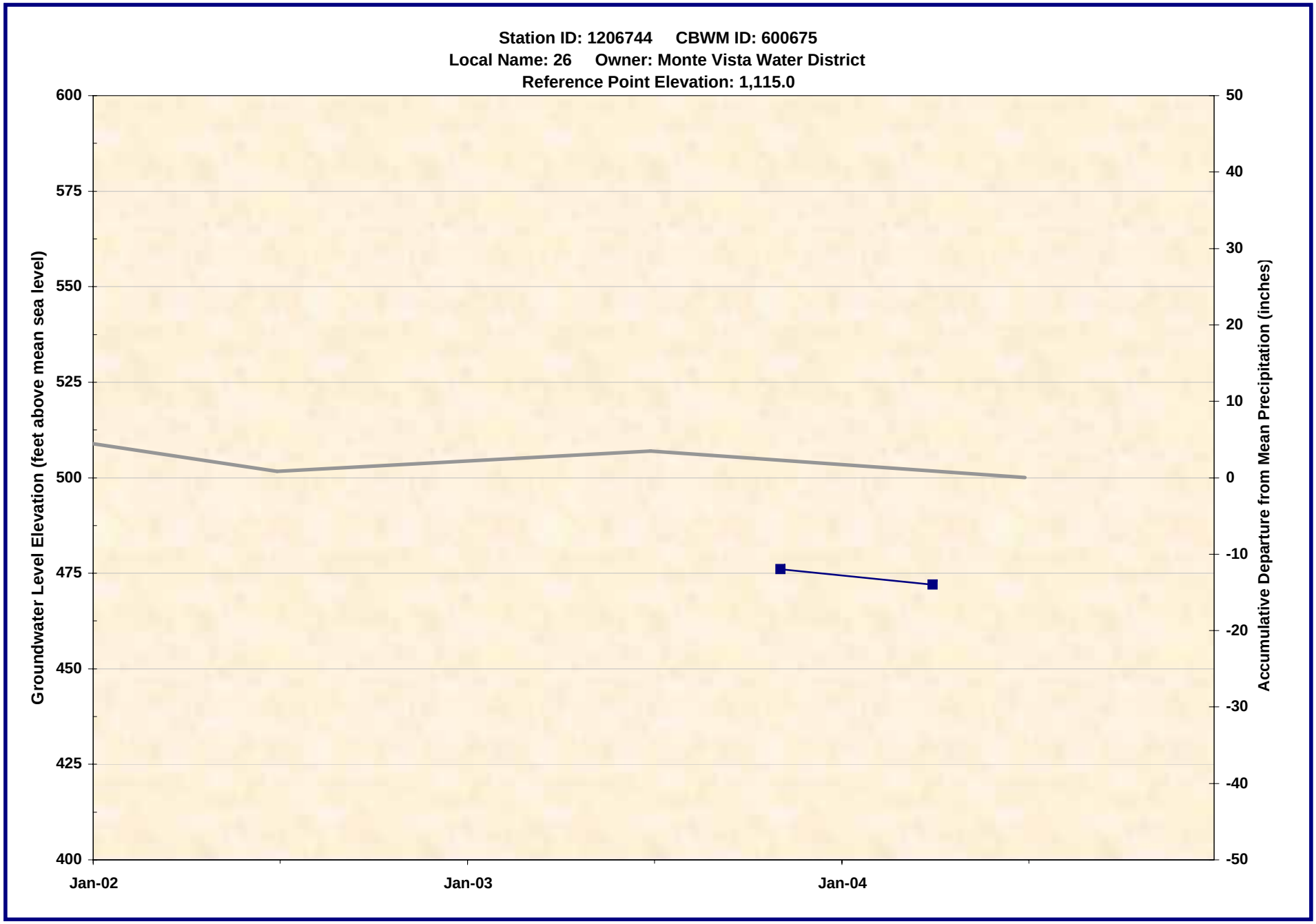

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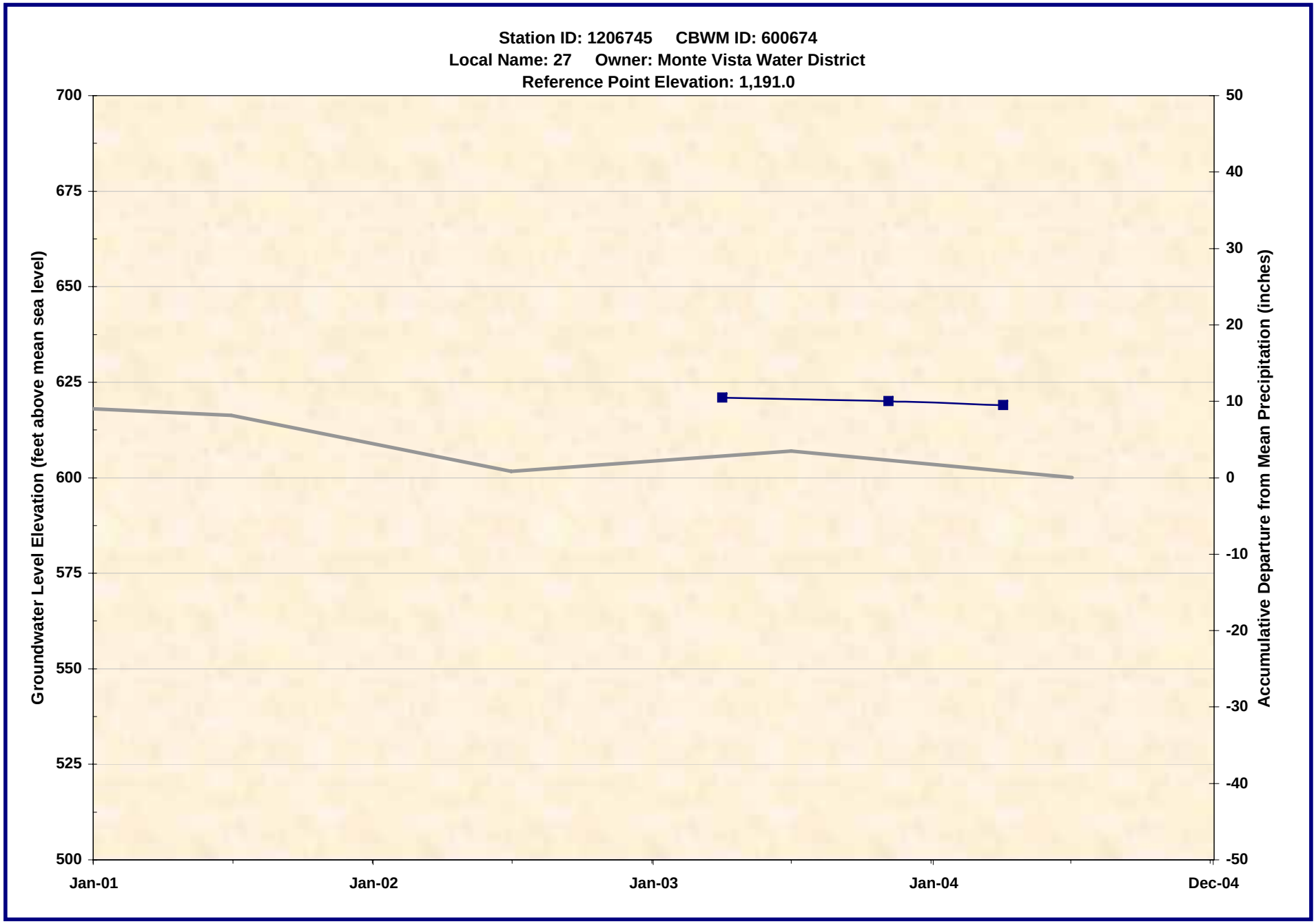

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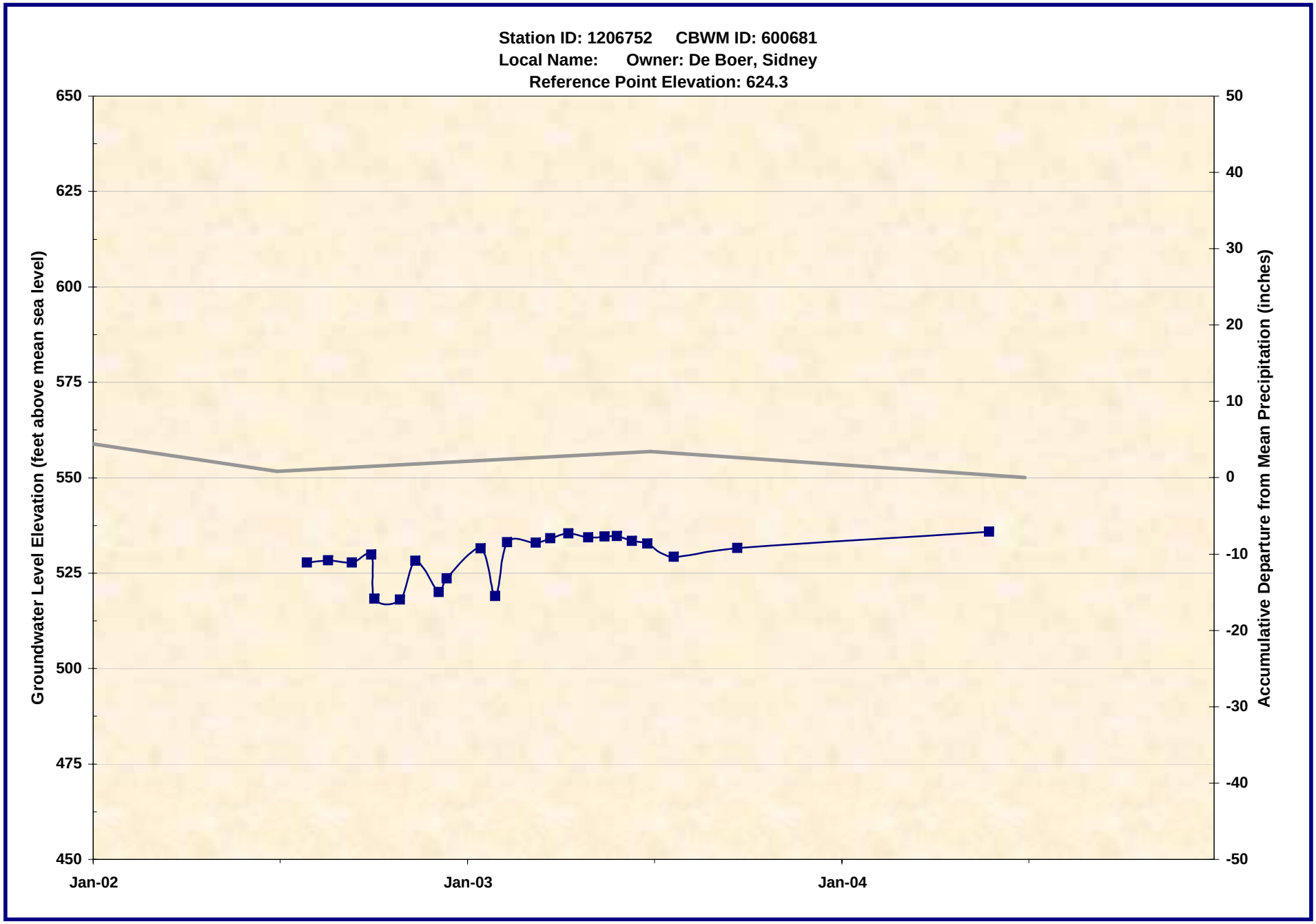

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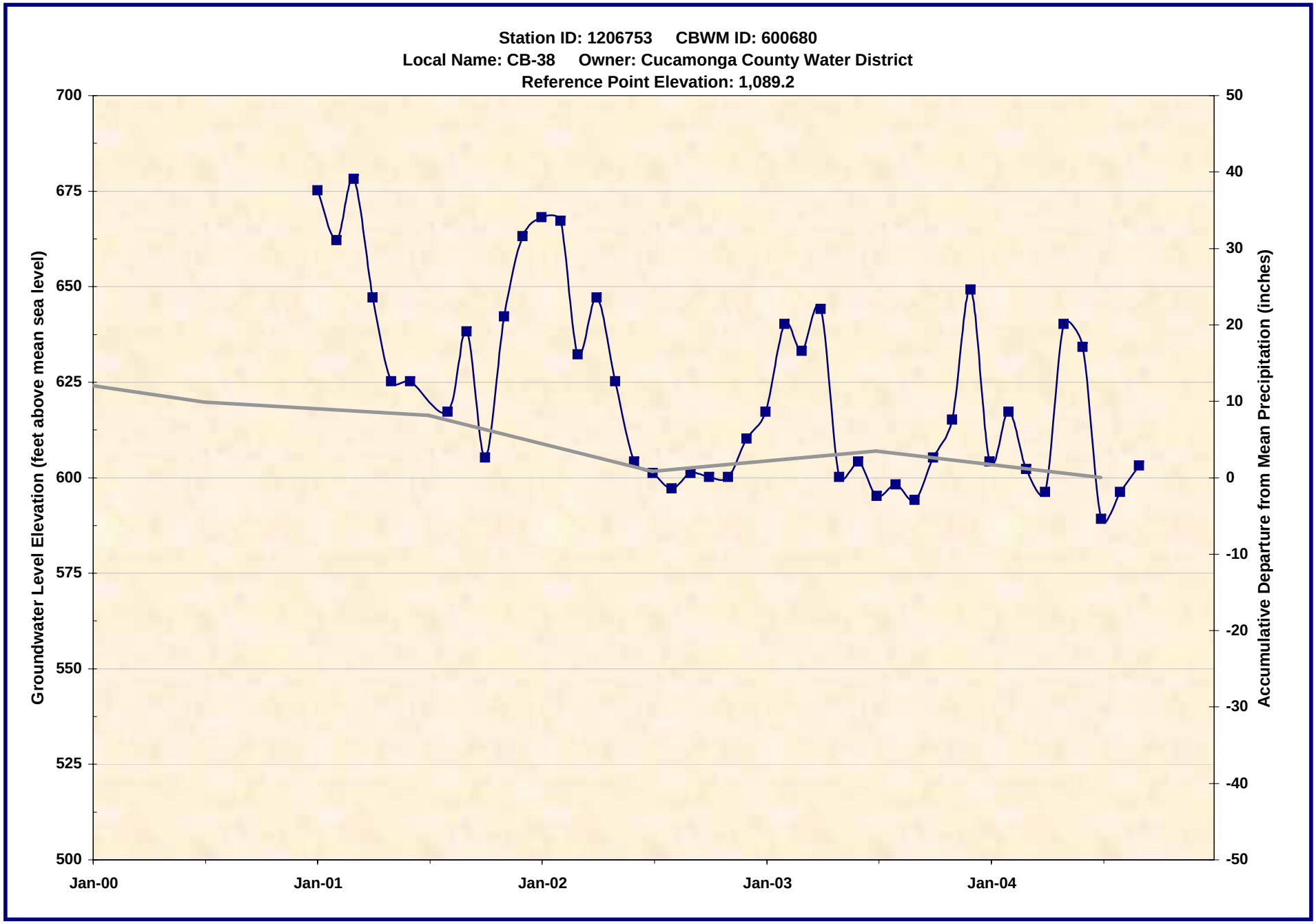

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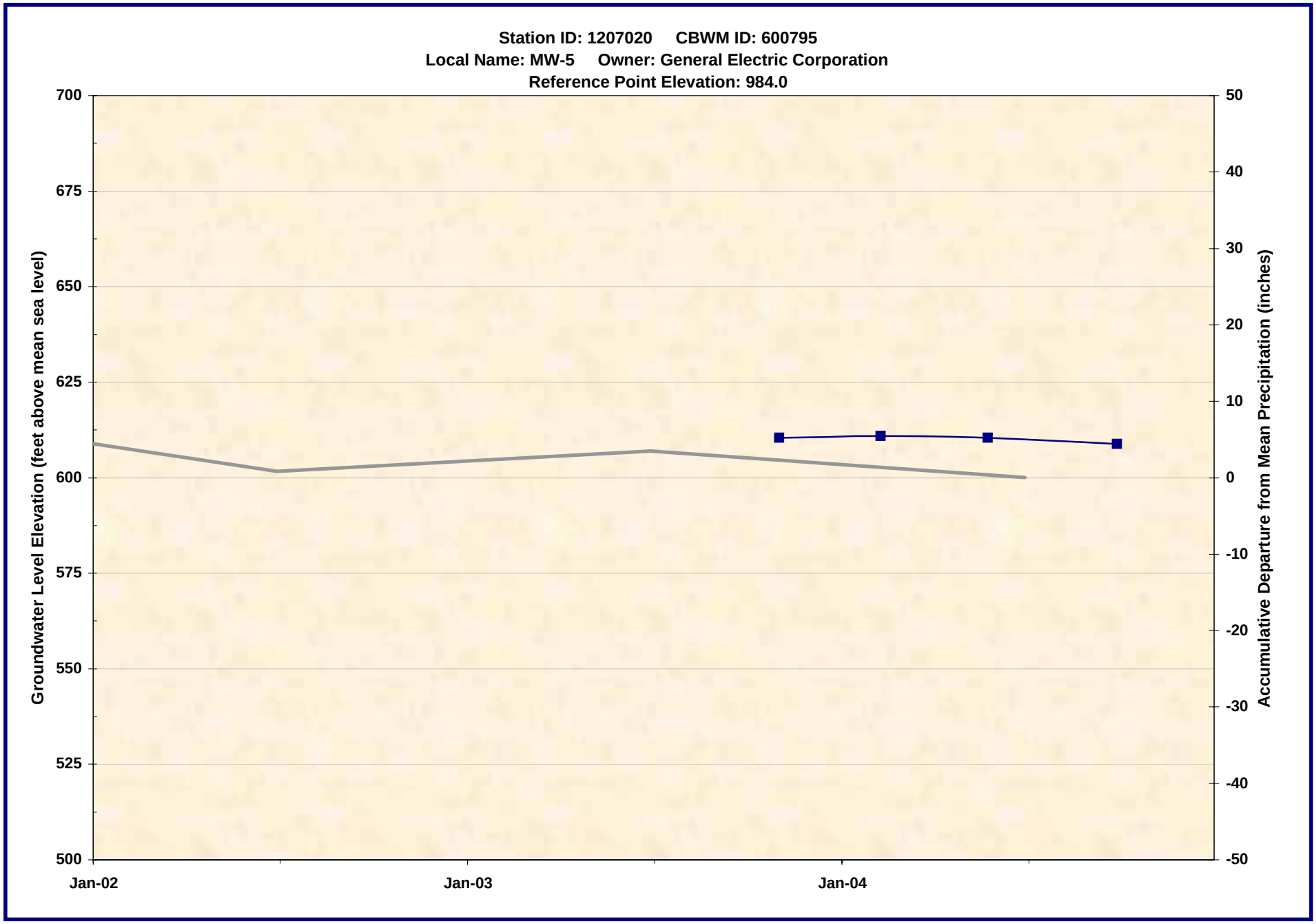

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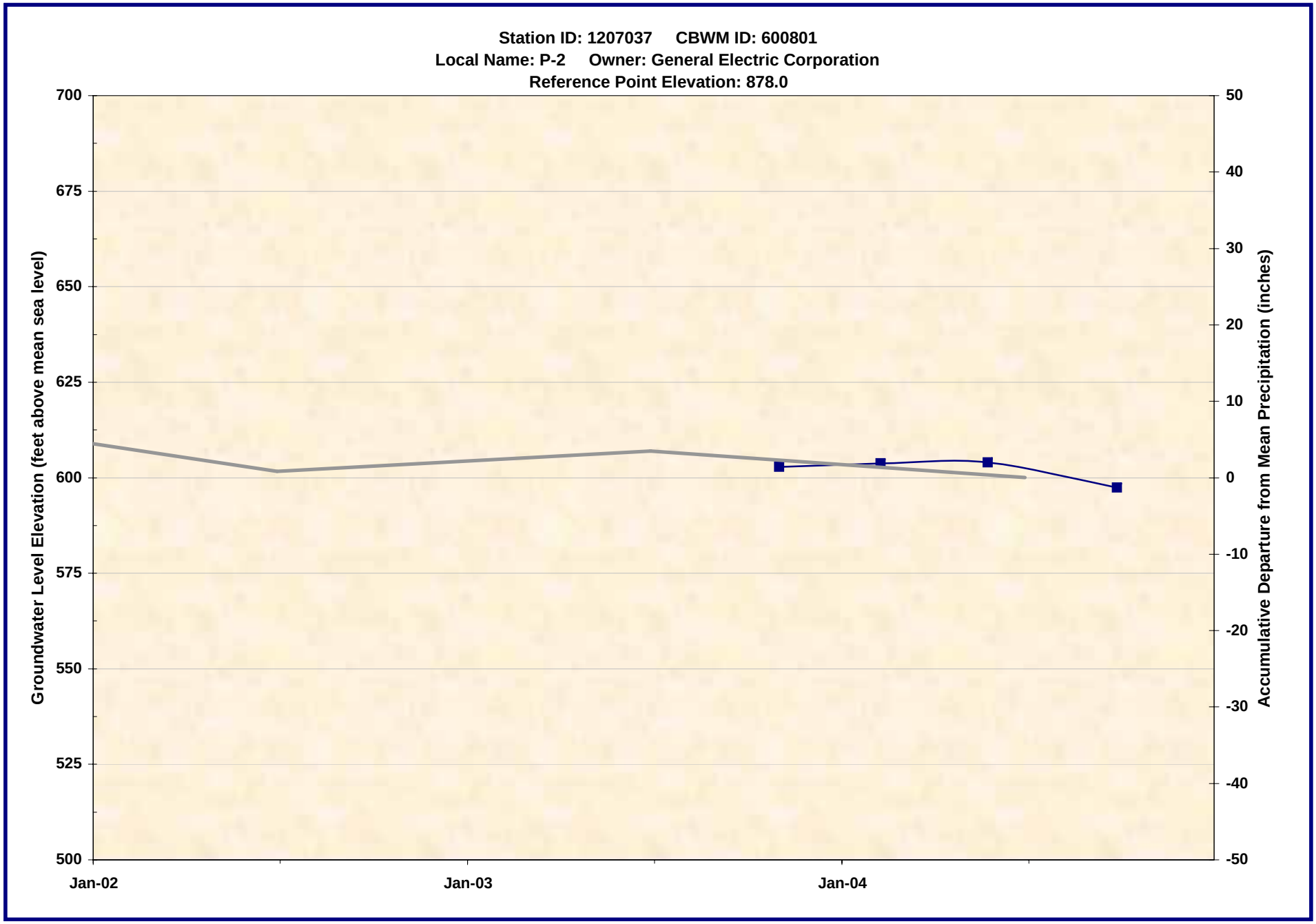

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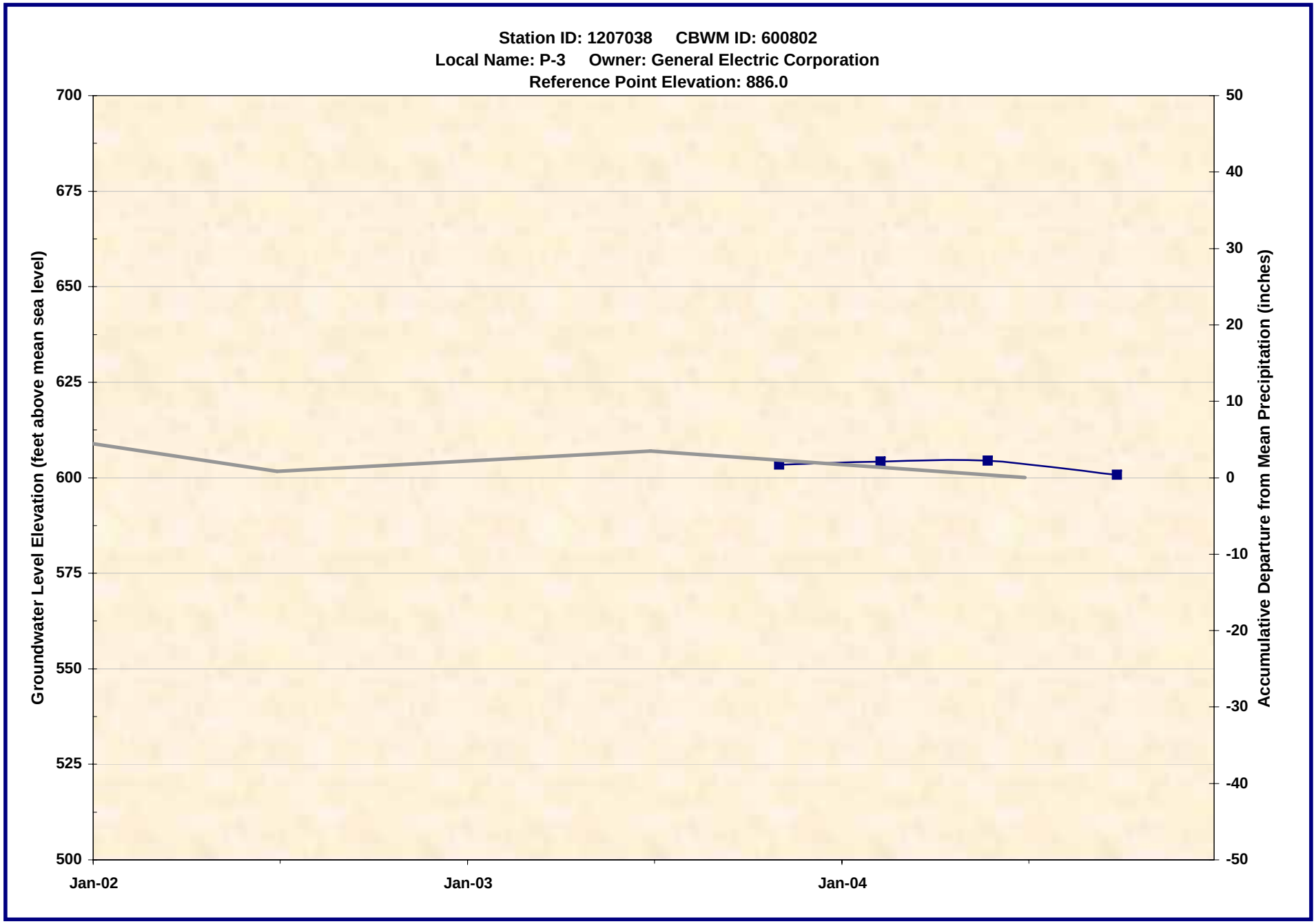

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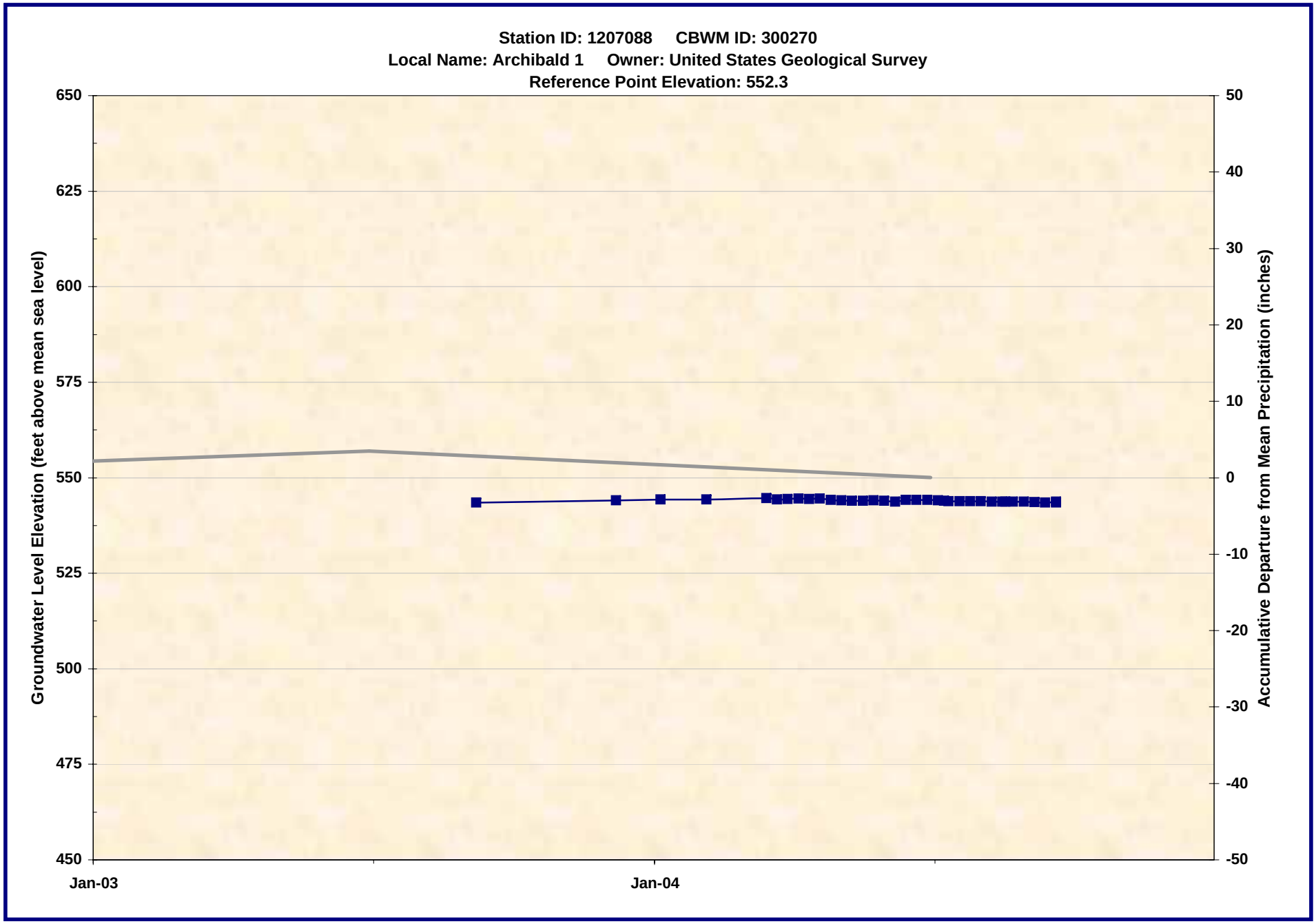

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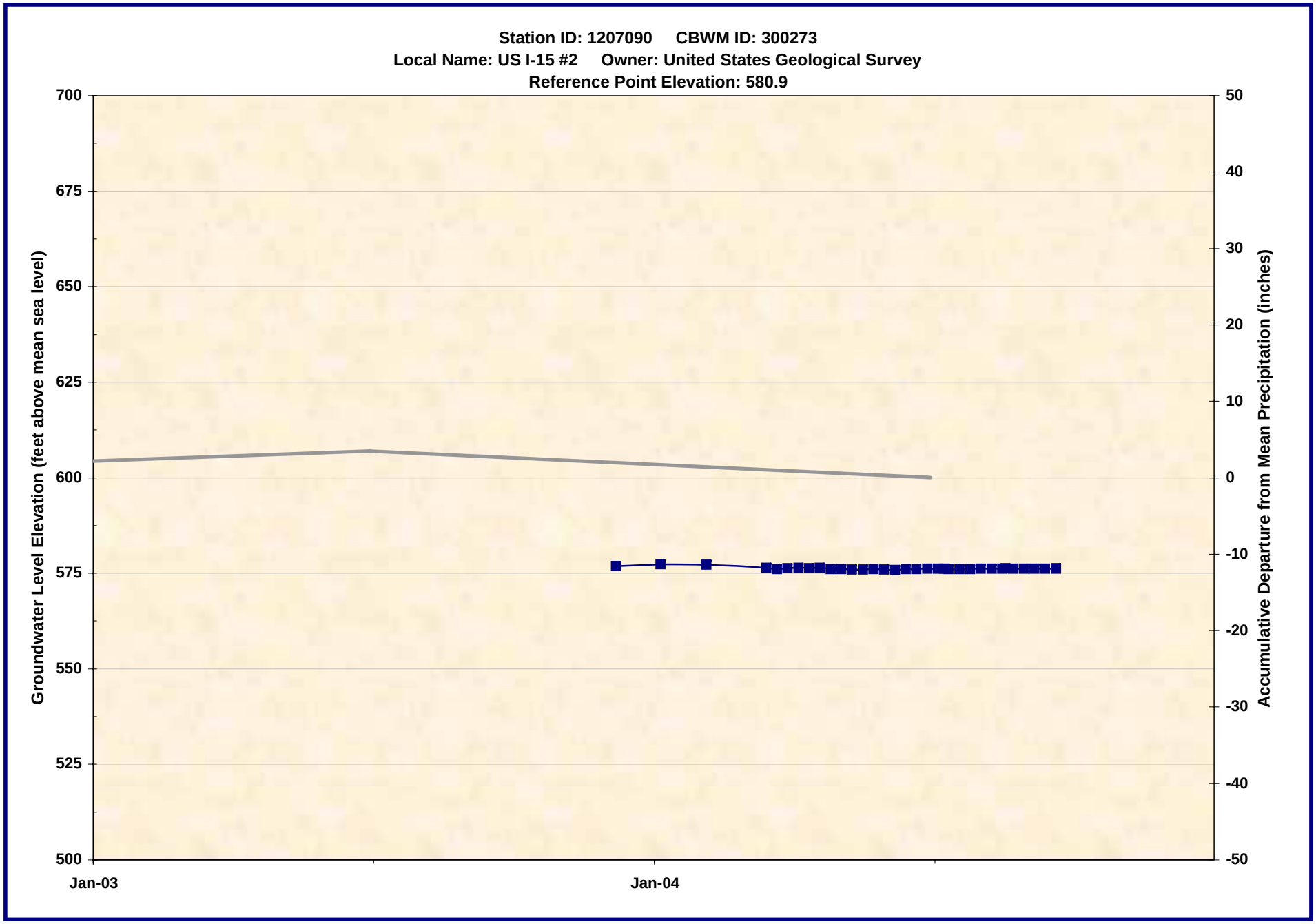

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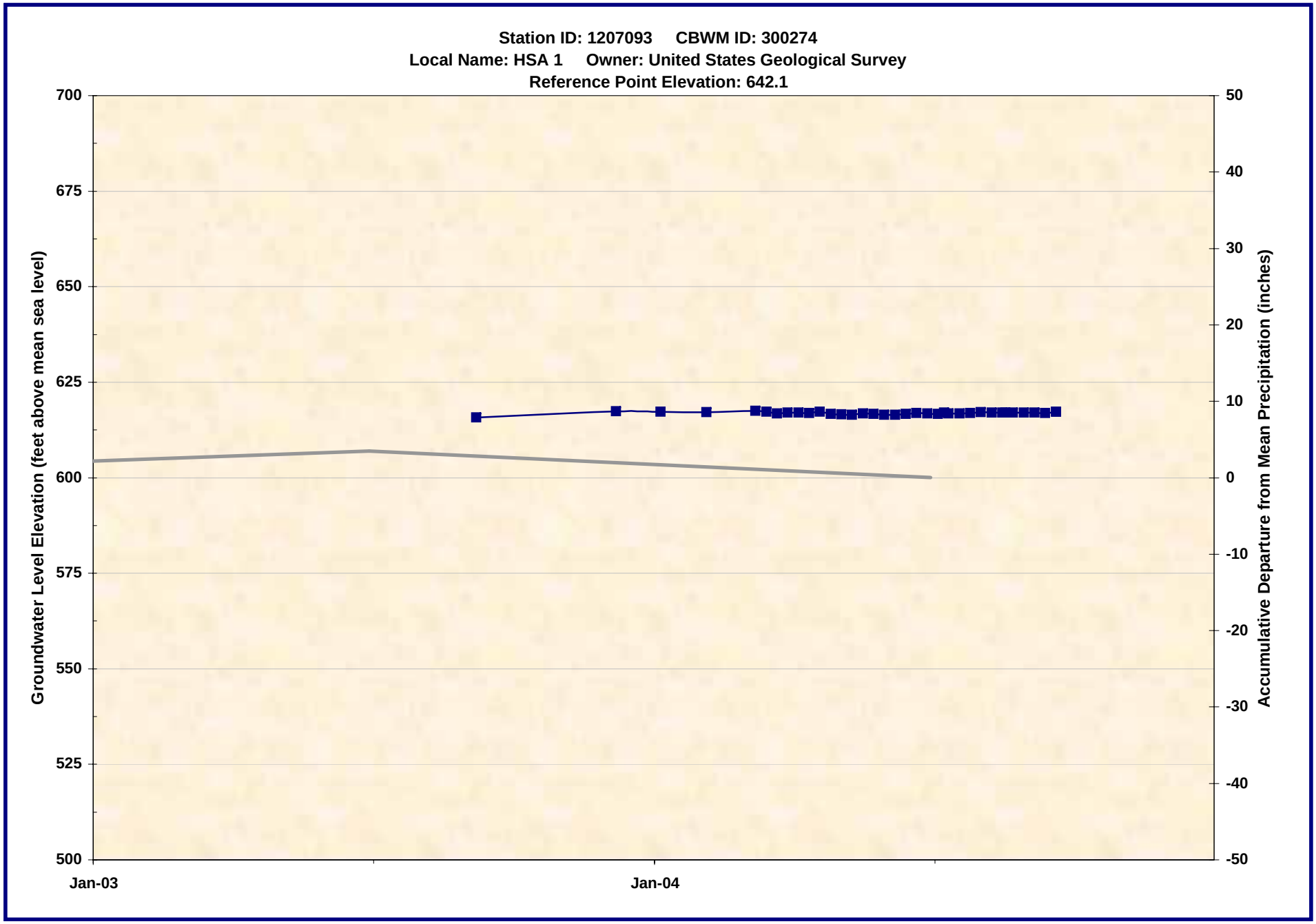

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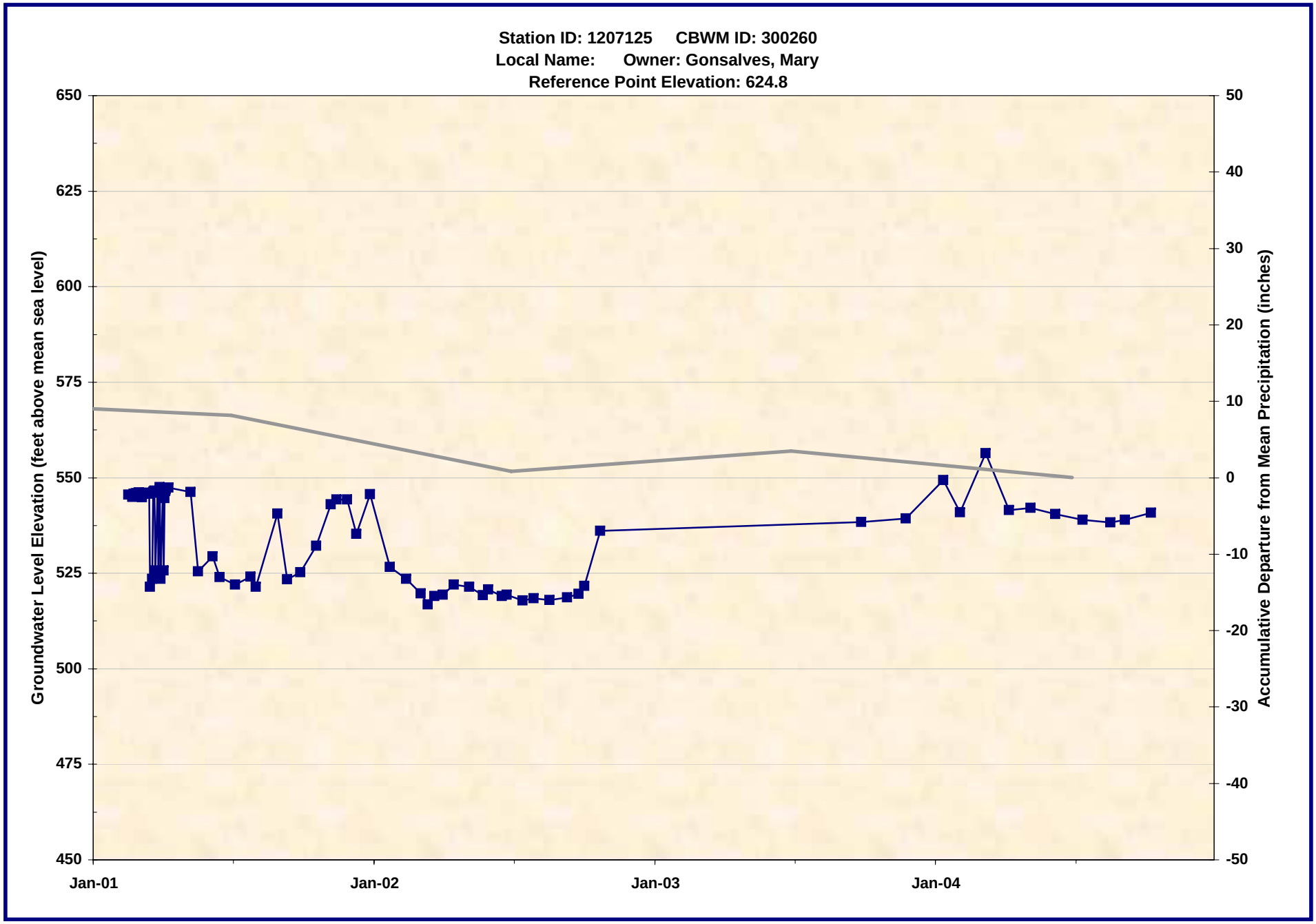

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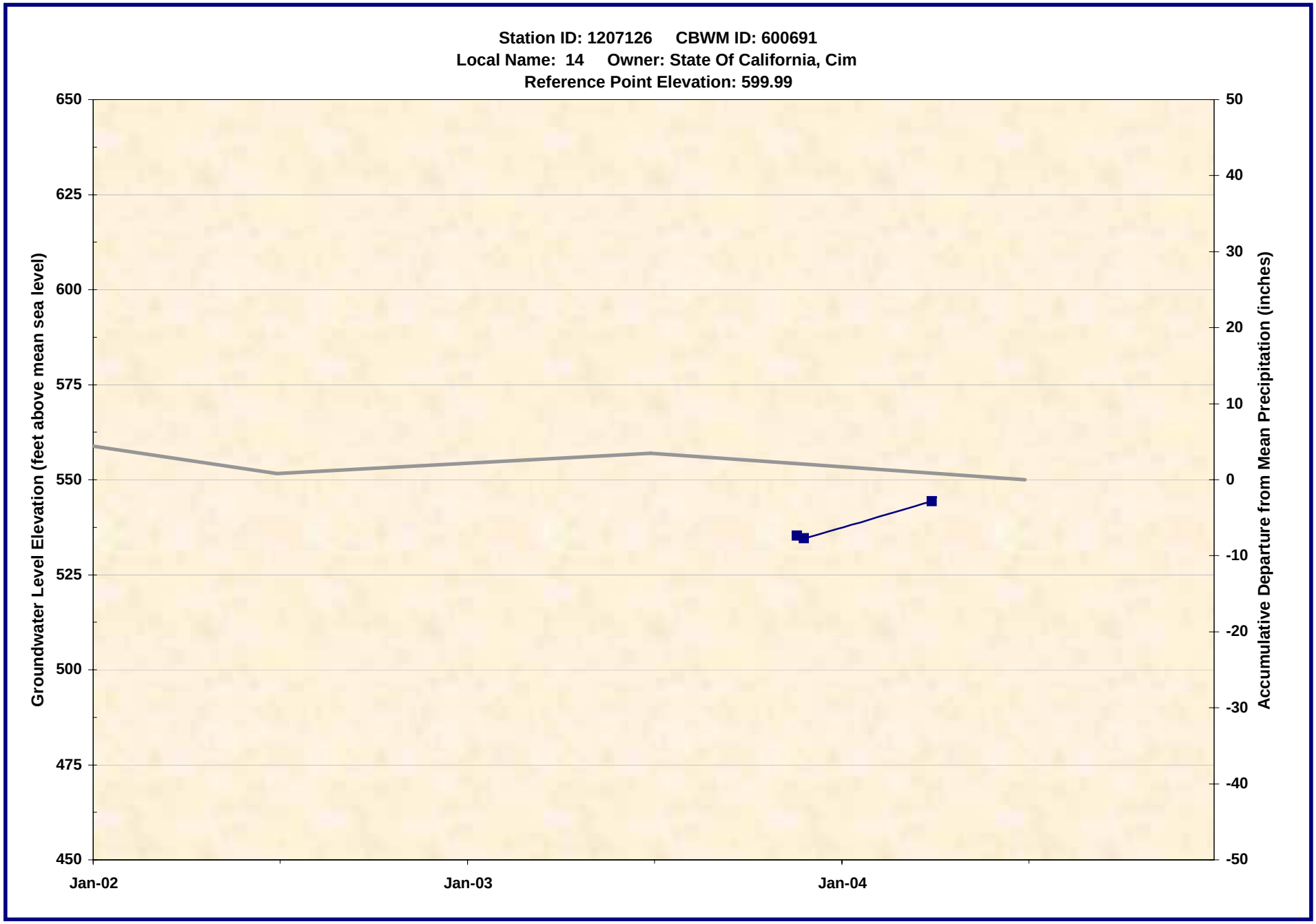

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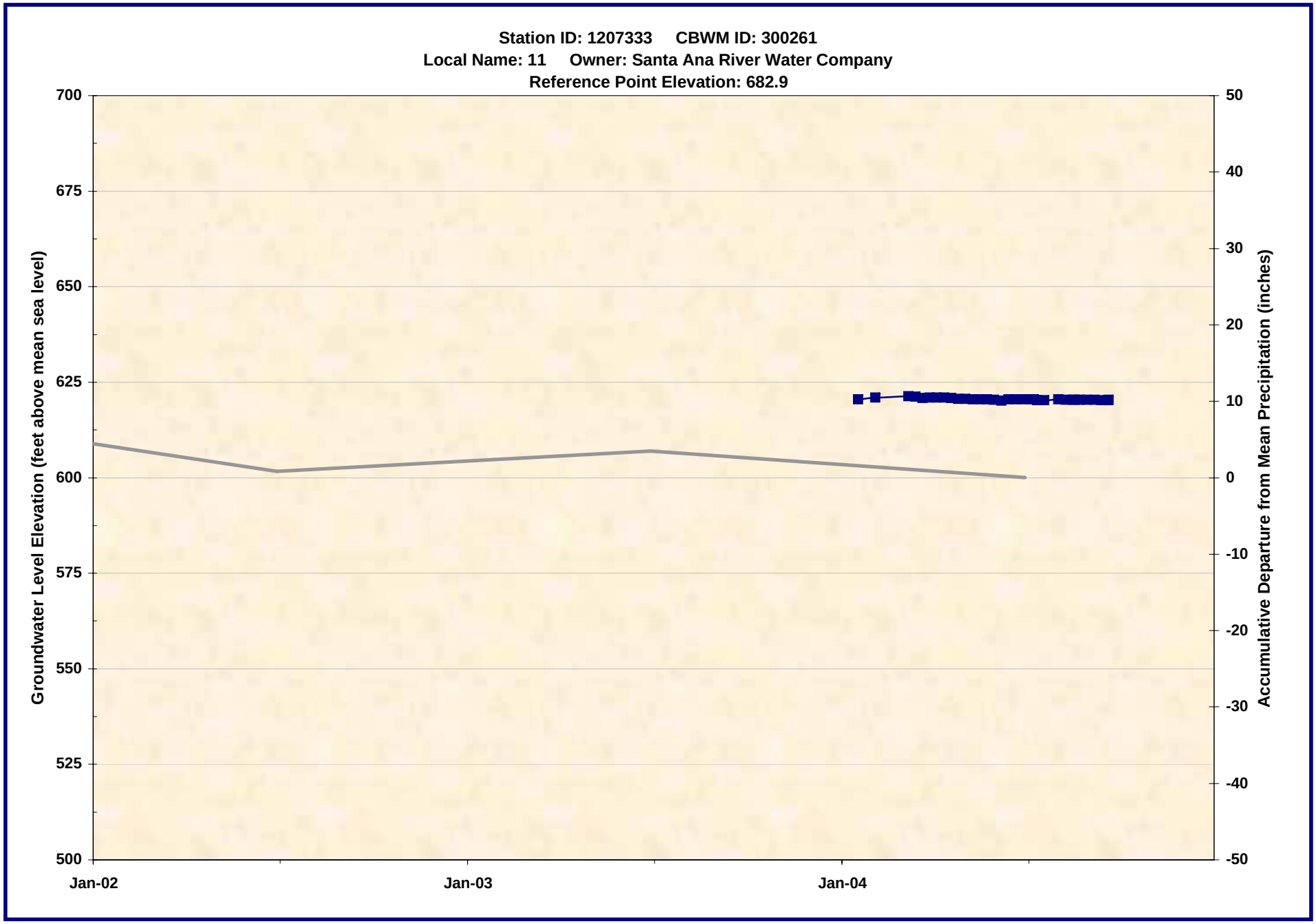

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APPENDIX C

CHEMICALS EXCEEDING FEDERAL OR STATE MAXIMUM CONTAMINANT LEVELS OR NOTIFICATION LEVELS

Appendix C
Chemicals Exceeding Federal or State Maximum Contaminant Levels or Notification Levels

Chemical	Period	Units	Status	Primary EPA MCL	Secondary EPA MCL	Primary CA MCL	Secondary CA MCL	CA NL	Average	Median	Upper Quartile	# of Wells Sampled	# of Wells w/ Detects	# of Wells w/ Exceedances
1,1,1,2-TETRACHLOROETHANE	pre-1980	UG/L												
1,1,1,2-TETRACHLOROETHANE	1980 through 1998	UG/L							0	0	0	148		
1,1,1,2-TETRACHLOROETHANE	1999 to Present	UG/L							0	0	0	740		
1,1,1-TRICHLOROETHANE	pre-1980	UG/L	3	200		200								
1,1,1-TRICHLOROETHANE	1980 through 1998	UG/L	3	200		200			0.017452	0	0	159	4	
1,1,1-TRICHLOROETHANE	1999 to Present	UG/L	3	200		200			0.009955	0	0	866	6	
1,1,2,2-TETRACHLOROETHANE	pre-1980	UG/L				1								
1,1,2,2-TETRACHLOROETHANE	1980 through 1998	UG/L				1			0.011887	0	0	159	3	
1,1,2,2-TETRACHLOROETHANE	1999 to Present	UG/L				1			0	0	0	844		
1,1,2-TRICHLORO-1,2,2-TRIFLUOROETHAN	pre-1980	UG/L				1200								
1,1,2-TRICHLORO-1,2,2-TRIFLUOROETHAN	1980 through 1998	UG/L				1200			0.007317	0	0	150	1	
1,1,2-TRICHLORO-1,2,2-TRIFLUOROETHAN	1999 to Present	UG/L				1200			0.590502	0	0	737	10	
1,1,2-TRICHLOROETHANE	pre-1980	UG/L	3	5		5								
1,1,2-TRICHLOROETHANE	1980 through 1998	UG/L	3	5		5			0.004141	0	0	158	2	
1,1,2-TRICHLOROETHANE	1999 to Present	UG/L	3	5		5			0.010406	0	0	867	12	
1,1-DICHLOROETHANE	pre-1980	UG/L				5								
1,1-DICHLOROETHANE	1980 through 1998	UG/L				5			0.197273	0	0	179	19	3
1,1-DICHLOROETHANE	1999 to Present	UG/L				5			0.07211	0	0	880	24	5
1,1-DICHLOROETHYLENE	pre-1980	UG/L	3	7		6								
1,1-DICHLOROETHYLENE	1980 through 1998	UG/L	3	7		6			0.022895	0	0	162	11	
1,1-DICHLOROETHYLENE	1999 to Present	UG/L	3	7		6			0.453332	0	0	877	43	12

Status
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2 Final MCLs/MCLGs have been promulgated, but are not yet effective.
3 Current MCLs/MCLGs are promulgated and in effect.

Primary EPA MCL Primary EPA MCLs are federally enforceable limits for chemicals in drinking water and are set as close as feasible to the corresponding EPA MCLG.

Secondary EPA MCL Secondary EPA MCLs apply to chemicals in drinking water that adversely affect its odor, taste, or appearance. Secondary EPA MCLs are not based on direct health effects associated with the chemical. Secondary MCLs are considered desirable goals and are not federally enforceable.

Primary CA MCL Primary CA MCLs are analogous to Primary EPA MCLs and are enforceable at the state level.

Secondary CA MCL Secondary CA MCLs are analogous to Secondary EPA MCLs and are applicable at the state level.

CA NL California Notification Levels are noregulatory, health-based advisory levels. CA NL are established by the California Department of Health Services as precautionary measures for contaminants that may be considered candidates for establishment of MCLs.

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Chemical	Period	Units	Status	Primary EPA MCL	Secondary EPA MCL	Primary CA MCL	Secondary CA MCL	CA NL	Average	Median	Upper Quartile	# of Wells Sampled	# of Wells w/ Detects	# of Wells w/ Exceedances
1,1-DICHLOROPROPENE	pre-1980	UG/L												
1,1-DICHLOROPROPENE	1980 through 1998	UG/L							0	0	0	149		
1,1-DICHLOROPROPENE	1999 to Present	UG/L							0	0	0	744		
1,2,3-TRICHLOROBENZENE	pre-1980	UG/L												
1,2,3-TRICHLOROBENZENE	1980 through 1998	UG/L							1.525544	0	0	151	2	
1,2,3-TRICHLOROBENZENE	1999 to Present	UG/L							0.003769	0	0	743	3	
1,2,3-TRICHLOROPROPANE	pre-1980	UG/L						0.005						
1,2,3-TRICHLOROPROPANE	1980 through 1998	UG/L						0.005	0	0	0	149		
1,2,3-TRICHLOROPROPANE	1999 to Present	UG/L						0.005	0.121142	0	0	738	61	56
1,2,4-TRICHLOROBENZENE	pre-1980	UG/L	3	70		5								
1,2,4-TRICHLOROBENZENE	1980 through 1998	UG/L	3	70		5			0.301023	0	0	151	1	1
1,2,4-TRICHLOROBENZENE	1999 to Present	UG/L	3	70		5			0.003837	0	0	834	3	
1,2,4-TRIMETHYLBENZENE	pre-1980	UG/L						330						
1,2,4-TRIMETHYLBENZENE	1980 through 1998	UG/L						330	0.000886	0	0	151	1	
1,2,4-TRIMETHYLBENZENE	1999 to Present	UG/L						330	0.000201	0	0	831	1	
1,2-DICHLOROBENZENE	pre-1980	UG/L	1	100										
1,2-DICHLOROBENZENE	1980 through 1998	UG/L	1	100					0.114927	0	0	234	20	
1,2-DICHLOROBENZENE	1999 to Present	UG/L	1	100					0.019257	0	0	849	9	
1,2-DICHLOROBENZENE	pre-1980	UG/L	3	600		600		600						
1,2-DICHLOROBENZENE	1980 through 1998	UG/L	3	600		600		600	0.114927	0	0	234	20	
1,2-DICHLOROBENZENE	1999 to Present	UG/L	3	600		600		600	0.019257	0	0	849	9	

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Primary EPA MCL Primary EPA MCLs are federally enforceable limits for chemicals in drinking water and are set as close as feasible to the corresponding EPA MCLG.

Secondary EPA MCL Secondary EPA MCLs apply to chemicals in drinking water that adversely affect its odor, taste, or appearance. Secondary EPA MCLs are not based on direct health effects associated with the chemical. Secondary MCLs are considered desirable goals and are not federally enforceable.

Primary CA MCL Primary CA MCLs are analogous to Primary EPA MCLs and are enforceable at the state level.

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Chemical	Period	Units	Status	Primary EPA MCL	Secondary EPA MCL	Primary CA MCL	Secondary CA MCL	CA NL	Average	Median	Upper Quartile	# of Wells Sampled	# of Wells w/ Detects	# of Wells w/ Exceedances
1,2-DICHLOROETHANE	pre-1980	UG/L	3	5		0.5								
1,2-DICHLOROETHANE	1980 through 1998	UG/L	3	5		0.5			0.00922	0	0	161	5	
1,2-DICHLOROETHANE	1999 to Present	UG/L	3	5		0.5			0.075467	0	0	869	20	9
1,2-DICHLOROPROPANE	pre-1980	UG/L	3	5		5								
1,2-DICHLOROPROPANE	1980 through 1998	UG/L	3	5		5			0.460864	0	0	161	6	2
1,2-DICHLOROPROPANE	1999 to Present	UG/L	3	5		5			0.012814	0	0	870	11	
1,3,5-TRIMETHYLBENZENE	pre-1980	UG/L						330						
1,3,5-TRIMETHYLBENZENE	1980 through 1998	UG/L						330	0	0	0	149		
1,3,5-TRIMETHYLBENZENE	1999 to Present	UG/L						330	0	0	0	741		
1,3-DICHLOROBENZENE	pre-1980	UG/L						130						
1,3-DICHLOROBENZENE	1980 through 1998	UG/L						130	0.002529	0	0	219	2	
1,3-DICHLOROBENZENE	1999 to Present	UG/L						130	0.000880	0	0	848	4	
1,3-DICHLOROPROPENE (TOTAL)	pre-1980	UG/L				0.5								
1,3-DICHLOROPROPENE (TOTAL)	1980 through 1998	UG/L				0.5			0	0	0	149		
1,3-DICHLOROPROPENE (TOTAL)	1999 to Present	UG/L				0.5			0	0	0	744		
1,4-DICHLOROBENZENE	pre-1980	UG/L	1	5										
1,4-DICHLOROBENZENE	1980 through 1998	UG/L	1	5					0.020583	0	0	225	13	
1,4-DICHLOROBENZENE	1999 to Present	UG/L	1	5					0.010495	0	0	855	15	
1,4-DICHLOROBENZENE	pre-1980	UG/L	3	75		5		130						
1,4-DICHLOROBENZENE	1980 through 1998	UG/L	3	75		5		130	0.020583	0	0	225	13	
1,4-DICHLOROBENZENE	1999 to Present	UG/L	3	75		5		130	0.010495	0	0	855	15	

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1,4-DIOXANE	pre-1980	UG/L						3						
1,4-DIOXANE	1980 through 1998	UG/L						3						
1,4-DIOXANE	1999 to Present	UG/L						3	0.142509	0	0	62	6	1
1-PHENYLPROPANE (N-PROPYLBENZENE)	pre-1980	UG/L						260						
1-PHENYLPROPANE (N-PROPYLBENZENE)	1980 through 1998	UG/L						260	0	0	0	148		
1-PHENYLPROPANE (N-PROPYLBENZENE)	1999 to Present	UG/L						260	0	0	0	737		
2,2-DICHLOROPROPANE	pre-1980	UG/L												
2,2-DICHLOROPROPANE	1980 through 1998	UG/L							0.000775	0	0	150	1	
2,2-DICHLOROPROPANE	1999 to Present	UG/L							0.000128	0	0	745	1	
2,3,7,8-TCDD (DIOXIN)	pre-1980	UG/L	3	0.00003		0								
2,3,7,8-TCDD (DIOXIN)	1980 through 1998	UG/L	3	0.00003		0			0	0	0	55		
2,3,7,8-TCDD (DIOXIN)	1999 to Present	UG/L	3	0.00003		0			0	0	0	104		
2,4,5-TP (SILVEX)	pre-1980	UG/L	3	50		50								
2,4,5-TP (SILVEX)	1980 through 1998	UG/L	3	50		50			0	0	0	138		
2,4,5-TP (SILVEX)	1999 to Present	UG/L	3	50		50			0	0	0	108		
2,4-D	pre-1980	UG/L	3	70		70								
2,4-D	1980 through 1998	UG/L	3	70		70			37.82506	0	0	141	1	1
2,4-D	1999 to Present	UG/L	3	70		70			3.476563	0	0	128	1	1
2,4-DIMETHYLPHENOL	pre-1980	UG/L						100						
2,4-DIMETHYLPHENOL	1980 through 1998	UG/L						100	0	0	0	21		
2,4-DIMETHYLPHENOL	1999 to Present	UG/L						100	0	0	0	8		

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Chemical	Period	Units	Status	Primary EPA MCL	Secondary EPA MCL	Primary CA MCL	Secondary CA MCL	CA NL	Average	Median	Upper Quartile	# of Wells Sampled	# of Wells w/ Detects	# of Wells w/ Exceedances
2,4-DINITROTOLUENE	pre-1980	UG/L												
2,4-DINITROTOLUENE	1980 through 1998	UG/L							0	0	0	24		
2,4-DINITROTOLUENE	1999 to Present	UG/L							0	0	0	10		
2-CHLOROTOLUENE	pre-1980	UG/L						140						
2-CHLOROTOLUENE	pre-1980	UG/L												
2-CHLOROTOLUENE	1980 through 1998	UG/L						140	0	0	0	149		
2-CHLOROTOLUENE	1980 through 1998	UG/L							0	0	0	149		
2-CHLOROTOLUENE	1999 to Present	UG/L							0	0	0	741		
2-CHLOROTOLUENE	1999 to Present	UG/L						140	0	0	0	741		
4,4-DDD	pre-1980	UG/L												
4,4-DDD	1980 through 1998	UG/L							0	0	0	37		
4,4-DDD	1999 to Present	UG/L							0	0	0	8		
4,4-DDE	pre-1980	UG/L												
4,4-DDE	1980 through 1998	UG/L							0	0	0	37		
4,4-DDE	1999 to Present	UG/L							0	0	0	10		
4,4-DDT	pre-1980	UG/L												
4,4-DDT	1980 through 1998	UG/L							0	0	0	38		
4,4-DDT	1999 to Present	UG/L							0	0	0	9		
4-CHLOROTOLUENE	pre-1980	UG/L												
4-CHLOROTOLUENE	pre-1980	UG/L						140						
4-CHLOROTOLUENE	1980 through 1998	UG/L							0	0	0	149		
4-CHLOROTOLUENE	1980 through 1998	UG/L						140	0	0	0	149		
4-CHLOROTOLUENE	1999 to Present	UG/L							0	0	0	741		
4-CHLOROTOLUENE	1999 to Present	UG/L						140	0	0	0	741		

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ACENAPHTHENE	pre-1980	UG/L												
ACENAPHTHENE	1980 through 1998	UG/L							0	0	0	35		
ACENAPHTHENE	1999 to Present	UG/L							0	0	0	8		
ACENAPHTHYLENE	pre-1980	UG/L												
ACENAPHTHYLENE	1980 through 1998	UG/L							0	0	0	36		
ACENAPHTHYLENE	1999 to Present	UG/L							0	0	0	10		
ALACHLOR	pre-1980	UG/L	3	2		2								
ALACHLOR	1980 through 1998	UG/L	3	2		2			0	0	0	105		
ALACHLOR	1999 to Present	UG/L	3	2		2			0	0	0	108		
ALDICARB	pre-1980	UG/L	2	3				7						
ALDICARB	1980 through 1998	UG/L	2	3				7	0	0	0	90		
ALDICARB	1999 to Present	UG/L	2	3				7	0	0	0	107		
ALDICARB SULFONE	pre-1980	UG/L	2	3										
ALDICARB SULFONE	1980 through 1998	UG/L	2	3					0	0	0	69		
ALDICARB SULFONE	1999 to Present	UG/L	2	3					0	0	0	107		
ALDICARB SULFOXIDE	pre-1980	UG/L	2	4										
ALDICARB SULFOXIDE	1980 through 1998	UG/L	2	4					0	0	0	69		
ALDICARB SULFOXIDE	1999 to Present	UG/L	2	4					0	0	0	107		
ALDRIN	pre-1980	UG/L	3					0.002						
ALDRIN	1980 through 1998	UG/L	3					0.002	0	0	0	67		
ALDRIN	1999 to Present	UG/L	3					0.002	0	0	0	114		

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ALPHA, MIN DETECTABLE ACTIVITY	pre-1980	pCi/l												
ALPHA, MIN DETECTABLE ACTIVITY	1980 through 1998	pCi/l												
ALPHA, MIN DETECTABLE ACTIVITY	1999 to Present	pCi/l							1.899708	1.5	2.27	598	598	
ALPHA-BHC	pre-1980	UG/L						0.015						
ALPHA-BHC	1980 through 1998	UG/L						0.015	0	0	0	36		
ALPHA-BHC	1999 to Present	UG/L						0.015	0	0	0	8		
ALUMINUM	pre-1980	UG/L	3		50	1000	200							
ALUMINUM	1980 through 1998	UG/L	3		50	1000	200		457.3549	0.02	32.01	196	118	40
ALUMINUM	1999 to Present	UG/L	3		50	1000	200		205.9519	0	0	807	109	60
ALUMINUM, DISSOLVED	pre-1980	UG/L	3	50		1000	200							
ALUMINUM, DISSOLVED	1980 through 1998	UG/L	3	50		1000	200		0	0	0	8		
ALUMINUM, DISSOLVED	1999 to Present	UG/L	3	50		1000	200							
AMMONIA (NH3-N)	pre-1980	MG/L												
AMMONIA (NH3-N)	1980 through 1998	MG/L							10.41185	0.08	3.59	17	17	
AMMONIA (NH3-N)	1999 to Present	MG/L							0.014555	0	0	640	62	
ANION	pre-1980	MEQ/L												
ANION	1980 through 1998	MEQ/L							10.64679	6.17	13.46	34	34	
ANION	1999 to Present	MEQ/L							13.78131	12.8	18.8	641	641	
ANTHRACENE	pre-1980	UG/L												
ANTHRACENE	1980 through 1998	UG/L							0	0	0	36		
ANTHRACENE	1999 to Present	UG/L							0	0	0	10		

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ANTIMONY	pre-1980	UG/L	3	6		6								
ANTIMONY	1980 through 1998	UG/L	3	6		6			0.956799	0	0	154	19	12
ANTIMONY	1999 to Present	UG/L	3	6		6			0.012364	0	0	825	18	
ARSENIC	pre-1980	UG/L	1	10										
ARSENIC	1980 through 1998	UG/L	1	10					3.155751	0	0.93	220	98	15
ARSENIC	1999 to Present	UG/L	1	10					1.456267	1.1	1.6	847	525	12
ARSENIC	pre-1980	UG/L	2	50		50								
ARSENIC	1980 through 1998	UG/L	2	50		50			3.155751	0	0.93	220	98	5
ARSENIC	1999 to Present	UG/L	2	50		50			1.456267	1.1	1.6	847	525	3
ASBESTOS	pre-1980	MFL	3	7		7								
ASBESTOS	1980 through 1998	MFL	3	7		7			0	0	0	3		
ASBESTOS	1999 to Present	MFL	3	7		7			0	0	0	43		
ATRAZINE	pre-1980	UG/L	3	3		1								
ATRAZINE	1980 through 1998	UG/L	3	3		1			0	0	0	141		
ATRAZINE	1999 to Present	UG/L	3	3		1			0	0	0	127		
BARIUM	pre-1980	UG/L	3	2000		1000								
BARIUM	1980 through 1998	UG/L	3	2000		1000			68.59917	0	58	220	98	2
BARIUM	1999 to Present	UG/L	3	2000		1000			124.5393	105	185	854	700	
BENTAZON	pre-1980	UG/L				18								
BENTAZON	1980 through 1998	UG/L				18			0	0	0	97		
BENTAZON	1999 to Present	UG/L				18			0	0	0	108		

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BENZENE	pre-1980	UG/L	3	5		1								
BENZENE	1980 through 1998	UG/L	3	5		1			0.083843	0	0	177	19	5
BENZENE	1999 to Present	UG/L	3	5		1			0.012988	0	0	884	21	4
BENZO (A) PYRENE	pre-1980	UG/L	3	0.2		0.2								
BENZO (A) PYRENE	1980 through 1998	UG/L	3	0.2		0.2			0	0	0	95		
BENZO (A) PYRENE	1999 to Present	UG/L	3	0.2		0.2			0	0	0	114		
BENZYL BUTYL PHTHALATE	pre-1980	UG/L	3	6		4								
BENZYL BUTYL PHTHALATE	1980 through 1998	UG/L	3	6		4			0	0	0	54		
BENZYL BUTYL PHTHALATE	1999 to Present	UG/L	3	6		4			0.288462	0	0	13	2	
BERYLLIUM	pre-1980	UG/L	3	4		4								
BERYLLIUM	1980 through 1998	UG/L	3	4		4			0.143339	0	0	178	22	
BERYLLIUM	1999 to Present	UG/L	3	4		4			0.005576	0	0	825	14	
BETA, MIN DETECTABLE ACTIVITY	pre-1980	pCi/l												
BETA, MIN DETECTABLE ACTIVITY	1980 through 1998	pCi/l												
BETA, MIN DETECTABLE ACTIVITY	1999 to Present	pCi/l							2.475969	2.04	3.14	597	597	
BETA-BHC	pre-1980	UG/L						0.025						
BETA-BHC	1980 through 1998	UG/L						0.025	0	0	0	37		
BETA-BHC	1999 to Present	UG/L						0.025	0	0	0	8		
BICARBONATE ALKALINITY	pre-1980	MG/L							228.531	201.5	268.8	415	415	
BICARBONATE ALKALINITY	1980 through 1998	MG/L							222.795	191.4	241.87	326	326	
BICARBONATE ALKALINITY	1999 to Present	MG/L							325.3723	284.5	420.75	782	782	

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BORON, TOTAL, ICAP	pre-1980	MG/L						1	0.011609	0	0	51	36	
BORON, TOTAL, ICAP	1980 through 1998	MG/L						1	20.09782	0.13	0.19	69	58	4
BORON, TOTAL, ICAP	1999 to Present	MG/L						1	1.107394	0	0.08	630	258	2
BROMACIL	pre-1980	UG/L												
BROMACIL	1980 through 1998	UG/L							0	0	0	101		
BROMACIL	1999 to Present	UG/L							0	0	0	107		
BROMOBENZENE	pre-1980	UG/L												
BROMOBENZENE	1980 through 1998	UG/L							0	0	0	149		
BROMOBENZENE	1999 to Present	UG/L							6.75E-05	0	0	741	1	
BROMOCHLOROMETHANE	pre-1980	UG/L												
BROMOCHLOROMETHANE	1980 through 1998	UG/L							0	0	0	148		
BROMOCHLOROMETHANE	1999 to Present	UG/L							0	0	0	740		
BROMODICHLOROMETHANE (THM)	pre-1980	UG/L	2	80										
BROMODICHLOROMETHANE (THM)	1980 through 1998	UG/L	2	80					0.096225	0	0	161	21	
BROMODICHLOROMETHANE (THM)	1999 to Present	UG/L	2	80					0.005194	0	0	849	13	
BROMODICHLOROMETHANE (THM)	pre-1980	UG/L	3	80										
BROMODICHLOROMETHANE (THM)	1980 through 1998	UG/L	3	80					0.096225	0	0	161	21	
BROMODICHLOROMETHANE (THM)	1999 to Present	UG/L	3	80					0.005194	0	0	849	13	
BROMOFORM (THM)	pre-1980	UG/L	2	80										
BROMOFORM (THM)	1980 through 1998	UG/L	2	80					0.084445	0	0	157	14	
BROMOFORM (THM)	1999 to Present	UG/L	2	80					0.020742	0	0	844	17	
BROMOFORM (THM)	pre-1980	UG/L	3	80										
BROMOFORM (THM)	1980 through 1998	UG/L	3	80					0.084445	0	0	157	14	
BROMOFORM (THM)	1999 to Present	UG/L	3	80					0.020742	0	0	844	17	

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BROMOMETHANE	pre-1980	UG/L												
BROMOMETHANE	1980 through 1998	UG/L							0.020307	0	0	157	3	
BROMOMETHANE	1999 to Present	UG/L							0.001261	0	0	847	3	
BUTACHLOR	pre-1980	UG/L												
BUTACHLOR	1980 through 1998	UG/L							0	0	0	72		
BUTACHLOR	1999 to Present	UG/L							0	0	0	107		
CADMIUM	pre-1980	UG/L	3	5		5			4.96627	2.86	2.86	3	3	1
CADMIUM	1980 through 1998	UG/L	3	5		5			32.73332	0	0	231	43	2
CADMIUM	1999 to Present	UG/L	3	5		5			0.003388	0	0	847	16	
CALCIUM	pre-1980	MG/L							73.38572	59.27	86.37	462	462	
CALCIUM	1980 through 1998	MG/L							112.3985	70.88	118.57	409	408	
CALCIUM	1999 to Present	MG/L							146.3722	130	208.25	814	814	
CAPTAN	pre-1980	UG/L						1.5						
CAPTAN	1980 through 1998	UG/L						1.5	0	0	0	11		
CAPTAN	1999 to Present	UG/L						1.5						
CARBARYL	pre-1980	UG/L						700						
CARBARYL	1980 through 1998	UG/L						700	0	0	0	102		
CARBARYL	1999 to Present	UG/L						700	0	0	0	126		
CARBOFURAN	pre-1980	UG/L	3	40		18								
CARBOFURAN	1980 through 1998	UG/L	3	40		18			0	0	0	136		
CARBOFURAN	1999 to Present	UG/L	3	40		18			0	0	0	108		

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CARBON DISULFIDE	pre-1980	UG/L						160						
CARBON DISULFIDE	1980 through 1998	UG/L						160	1.9	1.9		2	2	
CARBON DISULFIDE	1999 to Present	UG/L						160	0.052928	0	0	106	17	
CARBON TETRACHLORIDE	pre-1980	UG/L	3	5		0.5								
CARBON TETRACHLORIDE	1980 through 1998	UG/L	3	5		0.5			0.075	0	0	156	1	1
CARBON TETRACHLORIDE	1999 to Present	UG/L	3	5		0.5			0.000592	0	0	844	1	
CARBONATE ALKALINITY	pre-1980	MG/L							7.118089	6.75	10	110	83	
CARBONATE ALKALINITY	1980 through 1998	MG/L							2.514433	0	0.8	289	133	
CARBONATE ALKALINITY	1999 to Present	MG/L							0.765586	0.69	0.98	773	623	
CARBOPHENOTHION	pre-1980	UG/L						7						
CARBOPHENOTHION	1980 through 1998	UG/L						7	0	0	0	4		
CARBOPHENOTHION	1999 to Present	UG/L						7						
CATIONS	pre-1980	MEQ/L												
CATIONS	1980 through 1998	MEQ/L							11.17561	6.75	14.7	34	34	
CATIONS	1999 to Present	MEQ/L							13.92886	12.9	18.97	641	641	
CHLORDANE	pre-1980	UG/L	3	2		0.1								
CHLORDANE	1980 through 1998	UG/L	3	2		0.1			0	0	0	133		
CHLORDANE	1999 to Present	UG/L	3	2		0.1			0	0	0	130		
CHLORIDE	pre-1980	MG/L	3		250		250		37.46223	21	46	467	467	4
CHLORIDE	1980 through 1998	MG/L	3		250		250		75.14624	30.09	85.87	404	404	12
CHLORIDE	1999 to Present	MG/L	3		250		250		99.68753	76	147	817	817	51

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CHLOROETHANE	pre-1980	UG/L												
CHLOROETHANE	1980 through 1998	UG/L							0.012665	0	0	157	3	
CHLOROETHANE	1999 to Present	UG/L							0.002194	0	0	845	3	
CHLOROFORM (THM)	pre-1980	UG/L	2	80										
CHLOROFORM (THM)	1980 through 1998	UG/L	2	80					1.333327	0	0.08	316	100	1
CHLOROFORM (THM)	1999 to Present	UG/L	2	80					0.441571	0	0	897	116	
CHLOROFORM (THM)	pre-1980	UG/L	3	80										
CHLOROFORM (THM)	1980 through 1998	UG/L	3	80					1.333327	0	0.08	316	100	1
CHLOROFORM (THM)	1999 to Present	UG/L	3	80					0.441571	0	0	897	116	
CHLOROMETHANE	pre-1980	UG/L												
CHLOROMETHANE	1980 through 1998	UG/L							0.013131	0	0	161	5	
CHLOROMETHANE	1999 to Present	UG/L							0.007123	0	0	847	4	
CHLOROPICRIN	pre-1980	UG/L						56						
CHLOROPICRIN	1980 through 1998	UG/L						56	0	0	0	34		
CHLOROPICRIN	1999 to Present	UG/L						56						
CHLOROPROPHAM	pre-1980	UG/L						1200						
CHLOROPROPHAM	1980 through 1998	UG/L						1200	0	0	0	28		
CHLOROPROPHAM	1999 to Present	UG/L						1200						
CHLORTHAL	pre-1980	UG/L						3500						
CHLORTHAL	1980 through 1998	UG/L						3500	0	0	0	11		
CHLORTHAL	1999 to Present	UG/L						3500						

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Appendix C
Chemicals Exceeding Federal or State Maximum Contaminant Levels or Notification Levels

Chemical	Period	Units	Status	Primary EPA MCL	Secondary EPA MCL	Primary CA MCL	Secondary CA MCL	CA NL	Average	Median	Upper Quartile	# of Wells Sampled	# of Wells w/ Detects	# of Wells w/ Exceedances
CHROMIUM (TOTAL)	pre-1980	UG/L	3	100		50								
CHROMIUM (TOTAL)	1980 through 1998	UG/L	3	100		50			15.43260	0	3.96	190	66	11
CHROMIUM (TOTAL)	1999 to Present	UG/L	3	100		50			11.07795	7.3	15.5	778	618	4
CHRYSENE	pre-1980	UG/L												
CHRYSENE	1980 through 1998	UG/L							0	0	0	37		
CHRYSENE	1999 to Present	UG/L							0	0	0	10		
CIS-1,2-DICHLOROETHYLENE	pre-1980	UG/L	3	70		6								
CIS-1,2-DICHLOROETHYLENE	1980 through 1998	UG/L	3	70		6			0.208366	0	0	162	13	2
CIS-1,2-DICHLOROETHYLENE	1999 to Present	UG/L	3	70		6			0.728700	0	0	773	44	10
CIS-1,3-DICHLOROPROPENE	pre-1980	UG/L				0.5								
CIS-1,3-DICHLOROPROPENE	1980 through 1998	UG/L				0.5			0	0	0	77		
CIS-1,3-DICHLOROPROPENE	1999 to Present	UG/L				0.5			0	0	0	736		
COLOR	pre-1980	UNITS			15		15		0			1		
COLOR	1980 through 1998	UNITS			15		15		0.854475	0	0.38	138	39	1
COLOR	1999 to Present	UNITS			15		15		2.339094	0.38	3	747	377	13
COPPER, TOTAL, ICAP	pre-1980	MG/L	3	1.3	1	1.3	1							
COPPER, TOTAL, ICAP	1980 through 1998	MG/L	3	1.3	1	1.3	1		0.044530	0	0.01	230	88	2
COPPER, TOTAL, ICAP	1999 to Present	MG/L	3	1.3	1	1.3	1		0.026864	0	0	858	117	1
CR-DISS (HEXAVALENT)	pre-1980	UG/L	3	100		50			18.94608	10	10	3	3	
CR-DISS (HEXAVALENT)	1980 through 1998	UG/L	3	100		50			26.24970	4.21	12	71	47	4
CR-DISS (HEXAVALENT)	1999 to Present	UG/L	3	100		50			8.094852	3.9	7	467	412	4

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CYANIDE	pre-1980	MG/L	3	0.2		0.15								
CYANIDE	1980 through 1998	MG/L	3	0.2		0.15			0.000107	0	0	125	1	
CYANIDE	1999 to Present	MG/L	3	0.2		0.15			0.000400	0	0	165	14	
DALAPON	pre-1980	UG/L	3	200		200								
DALAPON	1980 through 1998	UG/L	3	200		200			0	0	0	89		
DALAPON	1999 to Present	UG/L	3	200		200			7.385321	0	0	109	1	1
DI(2-ETHYLHEXYL)ADIPATE	pre-1980	UG/L	3	400		400								
DI(2-ETHYLHEXYL)ADIPATE	1980 through 1998	UG/L	3	400		400			0	0	0	86		
DI(2-ETHYLHEXYL)ADIPATE	1999 to Present	UG/L	3	400		400			0	0	0	106		
DI(2-ETHYLHEXYL)PHTHALATE	pre-1980	UG/L	3	6		4								
DI(2-ETHYLHEXYL)PHTHALATE	1980 through 1998	UG/L	3	6		4			2.255667	0	0	121	16	11
DI(2-ETHYLHEXYL)PHTHALATE	1999 to Present	UG/L	3	6		4			0.403693	0	0	128	9	3
DIAZINON	pre-1980	UG/L						6						
DIAZINON	1980 through 1998	UG/L						6	0	0	0	129		
DIAZINON	1999 to Present	UG/L						6	0	0	0	115		
DIBROMOCHLOROMETHANE (THM)	pre-1980	UG/L	2	80										
DIBROMOCHLOROMETHANE (THM)	1980 through 1998	UG/L	2	80					0.061446	0	0	156	18	
DIBROMOCHLOROMETHANE (THM)	1999 to Present	UG/L	2	80					0.011019	0	0	738	11	
DIBROMOCHLOROMETHANE (THM)	pre-1980	UG/L	3	80										
DIBROMOCHLOROMETHANE (THM)	1980 through 1998	UG/L	3	80					0.061446	0	0	156	18	
DIBROMOCHLOROMETHANE (THM)	1999 to Present	UG/L	3	80					0.011019	0	0	738	11	

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DIBROMOCHLOROPROPANE (DBCP)	pre-1980	UG/L		0.2		0.2								
DIBROMOCHLOROPROPANE (DBCP)	1980 through 1998	UG/L		0.2		0.2			0.027957	0	0	146	21	6
DIBROMOCHLOROPROPANE (DBCP)	1999 to Present	UG/L		0.2		0.2			0.004156	0	0	729	25	6
DIBROMOMETHANE	pre-1980	UG/L												
DIBROMOMETHANE	1980 through 1998	UG/L							0	0	0	149		
DIBROMOMETHANE	1999 to Present	UG/L							0	0	0	833		
DICHLORODIFLUOROMETHANE	pre-1980	UG/L						1000						
DICHLORODIFLUOROMETHANE	1980 through 1998	UG/L						1000	1.447302	0	0	186	29	
DICHLORODIFLUOROMETHANE	1999 to Present	UG/L						1000	0.138387	0	0	862	21	
DICHLOROMETHANE	pre-1980	UG/L	3	5		5								
DICHLOROMETHANE	1980 through 1998	UG/L	3	5		5			1.35595	0	0	195	33	8
DICHLOROMETHANE	1999 to Present	UG/L	3	5		5			0.041971	0	0	863	24	1
DIELDRIN	pre-1980	UG/L						0.002						
DIELDRIN	1980 through 1998	UG/L						0.002	0	0	0	67		
DIELDRIN	1999 to Present	UG/L						0.002	0	0	0	114		
DIETHYL PHTHALATE	pre-1980	UG/L	3	6		4								
DIETHYL PHTHALATE	1980 through 1998	UG/L	3	6		4			0.059375	0	0	56	1	
DIETHYL PHTHALATE	1999 to Present	UG/L	3	6		4			0	0	0	12		
DI-ISOPROPYL ETHER	pre-1980	UG/L												
DI-ISOPROPYL ETHER	1980 through 1998	UG/L												
DI-ISOPROPYL ETHER	1999 to Present	UG/L							0	0	0	601		

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DIMETHOATE	pre-1980	UG/L						100						
DIMETHOATE	1980 through 1998	UG/L						100	0	0	0	87		
DIMETHOATE	1999 to Present	UG/L						100	0	0	0	107		
DIMETHYL PHTHALATE	pre-1980	UG/L												
DIMETHYL PHTHALATE	1980 through 1998	UG/L							0.111591	0	0	57	3	
DIMETHYL PHTHALATE	1999 to Present	UG/L							0.706667	0	0	15	4	
DI-N-BUTYLPHTHALATE	pre-1980	UG/L	3	6		4								
DI-N-BUTYLPHTHALATE	1980 through 1998	UG/L	3	6		4			1.434994	0	0	63	4	3
DI-N-BUTYLPHTHALATE	1999 to Present	UG/L	3	6		4			0.257143	0	0.6	14	3	
DINOSEB	pre-1980	UG/L	3	7		7								
DINOSEB	1980 through 1998	UG/L	3	7		7			0	0	0	94		
DINOSEB	1999 to Present	UG/L	3	7		7			0	0	0	108		
DIPHENAMIDE	pre-1980	UG/L						200						
DIPHENAMIDE	1980 through 1998	UG/L						200	0	0	0	20		
DIPHENAMIDE	1999 to Present	UG/L						200						
DIQUAT	pre-1980	UG/L	3	20		20								
DIQUAT	1980 through 1998	UG/L	3	20		20			0	0	0	42		
DIQUAT	1999 to Present	UG/L	3	20		20			0	0	0	92		
ENDOTHALL	pre-1980	UG/L	3	100		100								
ENDOTHALL	1980 through 1998	UG/L	3	100		100			0	0	0	44		
ENDOTHALL	1999 to Present	UG/L	3	100		100			0	0	0	74		

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ENDRIN	pre-1980	UG/L	3	2		2								
ENDRIN	1980 through 1998	UG/L	3	2		2			0	0	0	140		
ENDRIN	1999 to Present	UG/L	3	2		2			0	0	0	115		
EPTC	pre-1980	UG/L												
EPTC	1980 through 1998	UG/L							0	0	0	28		
EPTC	1999 to Present	UG/L							0	0		2		
ETHION	pre-1980	UG/L						4						
ETHION	1980 through 1998	UG/L						4	0	0	0	32		
ETHION	1999 to Present	UG/L						4						
ETHYLBENZENE	pre-1980	UG/L	1	30										
ETHYLBENZENE	1980 through 1998	UG/L	1	30					0.019948	0	0	165	9	
ETHYLBENZENE	1999 to Present	UG/L	1	30					0.001881	0	0	846	4	
ETHYLBENZENE	pre-1980	UG/L	3	700		300								
ETHYLBENZENE	1980 through 1998	UG/L	3	700		300			0.019948	0	0	165	9	
ETHYLBENZENE	1999 to Present	UG/L	3	700		300			0.001881	0	0	846	4	
ETHYLENE DIBROMIDE (EDB)	pre-1980	UG/L	3	0.05		0.05								
ETHYLENE DIBROMIDE (EDB)	1980 through 1998	UG/L	3	0.05		0.05			0.000104	0	0	144	1	
ETHYLENE DIBROMIDE (EDB)	1999 to Present	UG/L	3	0.05		0.05			0.000753	0	0	730	26	2
FLUORANTHENE	pre-1980	UG/L												
FLUORANTHENE	1980 through 1998	UG/L							0	0	0	36		
FLUORANTHENE	1999 to Present	UG/L							0	0	0	8		

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FLUORENE	pre-1980	UG/L												
FLUORENE	1980 through 1998	UG/L							0	0	0	37		
FLUORENE	1999 to Present	UG/L							125	0	250	8	2	
FLUORIDE (TEMPERATURE DEPENDENT)	pre-1980	MG/L	1	2					0.449039	0.28	0.35	425	425	2
FLUORIDE (TEMPERATURE DEPENDENT)	1980 through 1998	MG/L	1	2					37.77992	0.22	0.35	377	366	34
FLUORIDE (TEMPERATURE DEPENDENT)	1999 to Present	MG/L	1	2					8.813841	0.15	0.2	806	798	17
FLUORIDE (TEMPERATURE DEPENDENT)	pre-1980	MG/L	3	4	2	2			0.449039	0.28	0.35	425	425	2
FLUORIDE (TEMPERATURE DEPENDENT)	1980 through 1998	MG/L	3	4	2	2			37.77992	0.22	0.35	377	366	34
FLUORIDE (TEMPERATURE DEPENDENT)	1999 to Present	MG/L	3	4	2	2			8.813841	0.15	0.2	806	798	17
FOAMING AGENTS (MBAS)	pre-1980	MG/L			0.5		0.5							
FOAMING AGENTS (MBAS)	1980 through 1998	MG/L			0.5		0.5		0.007218	0	0	153	38	
FOAMING AGENTS (MBAS)	1999 to Present	MG/L			0.5		0.5		0.055654	0.05	0.09	752	474	
GLYPHOSATE	pre-1980	UG/L	3	700		700								
GLYPHOSATE	1980 through 1998	UG/L	3	700		700			0	0	0	108		
GLYPHOSATE	1999 to Present	UG/L	3	700		700			0	0	0	94		
GROSS ALPHA	pre-1980	PC/L	3	15		15								
GROSS ALPHA	1980 through 1998	PC/L	3	15		15			1.991540	1.45	2.18	143	142	
GROSS ALPHA	1999 to Present	PC/L	3	15		15			9.250553	6.8	13.71	726	678	153
GROSS ALPHA COUNTING ERROR	pre-1980	PC/L												
GROSS ALPHA COUNTING ERROR	1980 through 1998	PC/L							1.397051	1.34	1.5	143	143	
GROSS ALPHA COUNTING ERROR	1999 to Present	PC/L							2.675231	2.1	3.71	726	692	

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GROSS BETA	pre-1980	PC/L	3			50								
GROSS BETA	1980 through 1998	PC/L	3			50			2.203772	2.1	3.2	38	37	
GROSS BETA	1999 to Present	PC/L	3			50			4.387968	3.65	5.8	603	479	
GROSS BETA COUNTING ERROR	pre-1980	PC/L												
GROSS BETA COUNTING ERROR	1980 through 1998	PC/L							1.581316	1.45	1.8	38	38	
GROSS BETA COUNTING ERROR	1999 to Present	PC/L							2.451006	1.9	3.5	603	487	
HEPTACHLOR	pre-1980	UG/L	3	0.4		0.01								
HEPTACHLOR	1980 through 1998	UG/L	3	0.4		0.01			0	0	0	110		
HEPTACHLOR	1999 to Present	UG/L	3	0.4		0.01			0	0	0	115		
HEPTACHLOR EPOXIDE	pre-1980	UG/L	3	0.2		0.01								
HEPTACHLOR EPOXIDE	1980 through 1998	UG/L	3	0.2		0.01			0	0	0	110		
HEPTACHLOR EPOXIDE	1999 to Present	UG/L	3	0.2		0.01			0	0	0	115		
HEXACHLOROBENZENE	pre-1980	UG/L	3	1		1								
HEXACHLOROBENZENE	1980 through 1998	UG/L	3	1		1			0	0	0	97		
HEXACHLOROBENZENE	1999 to Present	UG/L	3	1		1			0	0	0	115		
HEXACHLOROBUTADIENE	pre-1980	UG/L												
HEXACHLOROBUTADIENE	1980 through 1998	UG/L							0	0	0	149		
HEXACHLOROBUTADIENE	1999 to Present	UG/L							0	0	0	745		

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HEXACHLOROCYCLOPENTADIENE	pre-1980	UG/L	1	8										
HEXACHLOROCYCLOPENTADIENE	1980 through 1998	UG/L	1	8					0	0	0	97		
HEXACHLOROCYCLOPENTADIENE	1999 to Present	UG/L	1	8					0	0	0	115		
HEXACHLOROCYCLOPENTADIENE	pre-1980	UG/L	3	50		50								
HEXACHLOROCYCLOPENTADIENE	1980 through 1998	UG/L	3	50		50			0	0	0	97		
HEXACHLOROCYCLOPENTADIENE	1999 to Present	UG/L	3	50		50			0	0	0	115		
HYDROXIDE ALKALINITY	pre-1980	MG/L							0	0	0	13		
HYDROXIDE ALKALINITY	1980 through 1998	MG/L							0.005394	0	0	249	13	
HYDROXIDE ALKALINITY	1999 to Present	MG/L							0.006847	0	0.01	761	615	
IRON, TOTAL, ICAP	pre-1980	MG/L	3		0.3		0.3		0.025112	0	0	41	29	2
IRON, TOTAL, ICAP	1980 through 1998	MG/L	3		0.3		0.3		8.741472	0.03	0.17	246	161	42
IRON, TOTAL, ICAP	1999 to Present	MG/L	3		0.3		0.3		0.606957	0	0	859	207	78
ISOPHORONE	pre-1980	UG/L												
ISOPHORONE	1980 through 1998	UG/L							0.073333	0	0	25	1	
ISOPHORONE	1999 to Present	UG/L							0.188889	0	0	9	1	
ISOPROPYLBENZENE	pre-1980	UG/L						770						
ISOPROPYLBENZENE	1980 through 1998	UG/L						770	0.000993	0	0	151	1	
ISOPROPYLBENZENE	1999 to Present	UG/L						770	0.008593	0	0	832	2	
LANGELIER INDEX @ SOURCE TEMP.	pre-1980													
LANGELIER INDEX @ SOURCE TEMP.	1980 through 1998								0.474808	0.23	0.4	91	79	
LANGELIER INDEX @ SOURCE TEMP.	1999 to Present								0.738461	0.75	0.98	653	636	

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Appendix C
Chemicals Exceeding Federal or State Maximum Contaminant Levels or Notification Levels

Chemical	Period	Units	Status	Primary EPA MCL	Secondary EPA MCL	Primary CA MCL	Secondary CA MCL	CA NL	Average	Median	Upper Quartile	# of Wells Sampled	# of Wells w/ Detects	# of Wells w/ Exceedances
LEAD	pre-1980	UG/L	3	15		15			54.65057	48.36	89.19	4	4	4
LEAD	1980 through 1998	UG/L	3	15		15			2.286313	0	0.7	219	67	10
LEAD	1999 to Present	UG/L	3	15		15			0.412776	0	0.1	847	220	3
LINDANE	pre-1980	UG/L	3	0.2		0.2								
LINDANE	1980 through 1998	UG/L	3	0.2		0.2			0	0	0	140		
LINDANE	1999 to Present	UG/L	3	0.2		0.2			0	0	0	111		
M,P-XYLENE	pre-1980	UG/L	1	20										
M,P-XYLENE	1980 through 1998	UG/L	1	20					0.291622	0	0	148	2	1
M,P-XYLENE	1999 to Present	UG/L	1	20					0.002307	0	0	737	3	
M,P-XYLENE	pre-1980	UG/L	3	10000		1750								
M,P-XYLENE	1980 through 1998	UG/L	3	10000		1750			0.291622	0	0	148	2	
M,P-XYLENE	1999 to Present	UG/L	3	10000		1750			0.002307	0	0	737	3	
MAGNESIUM	pre-1980	MG/L							15.95049	11.93	19.38	462	462	
MAGNESIUM	1980 through 1998	MG/L							24.84883	13	25.35	407	406	
MAGNESIUM	1999 to Present	MG/L							31.03454	25	46.5	814	808	
MANGANESE, TOTAL, ICAP	pre-1980	MG/L	3		0.05		0.05	0.5	0.022618	0.02	0.02	5	4	
MANGANESE, TOTAL, ICAP	1980 through 1998	MG/L	3		0.05		0.05	0.5	18.99442	0	0.01	241	103	30
MANGANESE, TOTAL, ICAP	1999 to Present	MG/L	3		0.05		0.05	0.5	5.665583	0	0	793	107	45
MERCURY	pre-1980	UG/L	3	2		2								
MERCURY	1980 through 1998	UG/L	3	2		2			1.445855	0	0	223	35	5
MERCURY	1999 to Present	UG/L	3	2		2			0.010823	0	0	847	26	

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METHOXYCHLOR	pre-1980	UG/L	3	40		30								
METHOXYCHLOR	1980 through 1998	UG/L	3	40		30			0	0	0	137		
METHOXYCHLOR	1999 to Present	UG/L	3	40		30			0	0	0	107		
METHYL ETHYL KETONE	pre-1980	UG/L												
METHYL ETHYL KETONE	1980 through 1998	UG/L							0	0	0	129		
METHYL ETHYL KETONE	1999 to Present	UG/L							0	0	0	772		
METHYL ISOBUTYL KETONE	pre-1980	UG/L						40						
METHYL ISOBUTYL KETONE	pre-1980	UG/L						120						
METHYL ISOBUTYL KETONE	1980 through 1998	UG/L						40	0	0	0	132		
METHYL ISOBUTYL KETONE	1980 through 1998	UG/L						120	0	0	0	132		
METHYL ISOBUTYL KETONE	1999 to Present	UG/L						40	0.000650	0	0	769	1	
METHYL ISOBUTYL KETONE	1999 to Present	UG/L						120	0.000650	0	0	769	1	
METHYL PARATHION	pre-1980	UG/L						2						
METHYL PARATHION	1980 through 1998	UG/L						2	0	0	0	4		
METHYL PARATHION	1999 to Present	UG/L						2						
METHYL-TERT-BUTYL-ETHER (MTBE)	pre-1980	UG/L				13	5	35						
METHYL-TERT-BUTYL-ETHER (MTBE)	1980 through 1998	UG/L				13	5	35	0.003271	0	0	107	1	
METHYL-TERT-BUTYL-ETHER (MTBE)	1999 to Present	UG/L				13	5	35	16.88089	0	0	838	7	4
METOLACHLOR	pre-1980	UG/L												
METOLACHLOR	1980 through 1998	UG/L							0	0	0	72		
METOLACHLOR	1999 to Present	UG/L							0	0	0	107		

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Appendix C
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METRIBUZIN	pre-1980	UG/L												
METRIBUZIN	1980 through 1998	UG/L							0	0	0	72		
METRIBUZIN	1999 to Present	UG/L							0	0	0	107		
MOLINATE	pre-1980	UG/L				200								
MOLINATE	1980 through 1998	UG/L				200			0	0	0	113		
MOLINATE	1999 to Present	UG/L				200			0	0	0	110		
MONOCHLOROBENZENE	pre-1980	UG/L	3	100		70								
MONOCHLOROBENZENE	1980 through 1998	UG/L	3	100		70			0.061990	0	0	260	32	
MONOCHLOROBENZENE	1999 to Present	UG/L	3	100		70			0.007312	0	0	847	9	
NAPHTHALENE	pre-1980	UG/L						170						
NAPHTHALENE	pre-1980	UG/L												
NAPHTHALENE	1980 through 1998	UG/L							0.003094	0	0	153	3	
NAPHTHALENE	1980 through 1998	UG/L						170	0.003094	0	0	153	3	
NAPHTHALENE	1999 to Present	UG/L							0.012096	0	0	837	2	
NAPHTHALENE	1999 to Present	UG/L						170	0.012096	0	0	837	2	
N-BUTYLBENZENE	pre-1980	UG/L						260						
N-BUTYLBENZENE	1980 through 1998	UG/L						260	0	0	0	149		
N-BUTYLBENZENE	1999 to Present	UG/L						260	0	0	0	741		
NICKEL	pre-1980	UG/L				100								
NICKEL	1980 through 1998	UG/L				100			11.47149	0	0	148	25	6
NICKEL	1999 to Present	UG/L				100			6.295397	0	7.8	756	370	3

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NITRATE NITROGEN (NO3-N)	pre-1980	MG/L	3	10		10			6.499747	4.37	7.65	487	487	82
NITRATE NITROGEN (NO3-N)	1980 through 1998	MG/L	3	10		10			15.34033	8.47	18.12	458	455	202
NITRATE NITROGEN (NO3-N)	1999 to Present	MG/L	3	10		10			29.35333	17.6	45.82	928	924	604
NITROBENZENE	pre-1980	UG/L												
NITROBENZENE	1980 through 1998	UG/L							0	0	0	24		
NITROBENZENE	1999 to Present	UG/L							0	0	0	376		
N-NITROSODIMETHYLAMINE	pre-1980	UG/L						0.01						
N-NITROSODIMETHYLAMINE	1980 through 1998	UG/L						0.01	0	0	0	23		
N-NITROSODIMETHYLAMINE	1999 to Present	UG/L						0.01	0.000553	0	0	24	2	1
NO2-N	pre-1980	MG/L	3	1		1								
NO2-N	1980 through 1998	MG/L	3	1		1			0.157687	0.13	0.33	130	84	
NO2-N	1999 to Present	MG/L	3	1		1			0.009278	0	0	760	28	1
ODOR THRESHOLD @ 60 C	pre-1980	TON			3		3		1			1	1	
ODOR THRESHOLD @ 60 C	1980 through 1998	TON			3		3		0.657116	1	1	137	90	
ODOR THRESHOLD @ 60 C	1999 to Present	TON			3		3		1.213855	1	1.33	747	697	14
OXAMYL	pre-1980	UG/L	3	200		50								
OXAMYL	1980 through 1998	UG/L	3	200		50			0	0	0	124		
OXAMYL	1999 to Present	UG/L	3	200		50			0	0	0	108		

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O-XYLENE	pre-1980	UG/L	1	20										
O-XYLENE	1980 through 1998	UG/L	1	20					0.138802	0	0	159	11	
O-XYLENE	1999 to Present	UG/L	1	20					0.003425	0	0	848	6	
O-XYLENE	pre-1980	UG/L	3	10000		1750								
O-XYLENE	1980 through 1998	UG/L	3	10000		1750			0.138802	0	0	159	11	
O-XYLENE	1999 to Present	UG/L	3	10000		1750			0.003425	0	0	848	6	
PCB-1016	pre-1980	UG/L	3	0.5		0.5								
PCB-1016	1980 through 1998	UG/L	3	0.5		0.5			0	0	0	37		
PCB-1016	1999 to Present	UG/L	3	0.5		0.5			0	0	0	8		
PCB-1221	pre-1980	UG/L	3	0.5		0.5								
PCB-1221	1980 through 1998	UG/L	3	0.5		0.5			0	0	0	37		
PCB-1221	1999 to Present	UG/L	3	0.5		0.5			0	0	0	8		
PCB-1232	pre-1980	UG/L	3	0.5		0.5								
PCB-1232	1980 through 1998	UG/L	3	0.5		0.5			0	0	0	37		
PCB-1232	1999 to Present	UG/L	3	0.5		0.5			0	0	0	8		
PCB-1242	pre-1980	UG/L	3	0.5		0.5								
PCB-1242	1980 through 1998	UG/L	3	0.5		0.5			0	0	0	37		
PCB-1242	1999 to Present	UG/L	3	0.5		0.5			0	0	0	8		
PCB-1248	pre-1980	UG/L	3	0.5		0.5								
PCB-1248	1980 through 1998	UG/L	3	0.5		0.5			0	0	0	37		
PCB-1248	1999 to Present	UG/L	3	0.5		0.5			0	0	0	8		

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PCB-1254	pre-1980	UG/L	3	0.5		0.5								
PCB-1254	1980 through 1998	UG/L	3	0.5		0.5			0	0	0	37		
PCB-1254	1999 to Present	UG/L	3	0.5		0.5			0	0	0	8		
PCB-1260	pre-1980	UG/L	3	0.5		0.5								
PCB-1260	1980 through 1998	UG/L	3	0.5		0.5			0	0	0	37		
PCB-1260	1999 to Present	UG/L	3	0.5		0.5			0	0	0	8		
PENTACHLOROPHENOL	pre-1980	UG/L	3	1		1		30						
PENTACHLOROPHENOL	1980 through 1998	UG/L	3	1		1		30	0	0	0	98		
PENTACHLOROPHENOL	1999 to Present	UG/L	3	1		1		30	0	0	0	116		
PERCHLORATE	pre-1980	UG/L						6						
PERCHLORATE	1980 through 1998	UG/L						6	3.737592	0	7.84	80	31	24
PERCHLORATE	1999 to Present	UG/L						6	4.009904	0	0	818	150	90
PH (LABORATORY)	pre-1980				<6.5 OR >8.5				7.782358	7.72	7.86	462	462	5
PH (LABORATORY)	1980 through 1998				<6.5 OR >8.5				7.960640	7.53	7.8	457	457	11
PH (LABORATORY)	1999 to Present				<6.5 OR >8.5				7.549157	7.59	7.75	803	803	6
PH OF CACO3 SATURATION(25C)	pre-1980	Units												
PH OF CACO3 SATURATION(25C)	1980 through 1998	Units												
PH OF CACO3 SATURATION(25C)	1999 to Present	Units							6.791516	6.75	7.11	606	606	
PHENANTHRENE	pre-1980	UG/L												
PHENANTHRENE	1980 through 1998	UG/L							0	0	0	37		
PHENANTHRENE	1999 to Present	UG/L							0	0	0	10		

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PICLORAM	pre-1980	UG/L	3	500		500								
PICLORAM	1980 through 1998	UG/L	3	500		500			0	0	0	93		
PICLORAM	1999 to Present	UG/L	3	500		500			0	0	0	108		
P-ISOPROPYLTOLUENE	pre-1980	UG/L												
P-ISOPROPYLTOLUENE	1980 through 1998	UG/L							0	0	0	148		
P-ISOPROPYLTOLUENE	1999 to Present	UG/L							0	0	0	741		
POLYCHLORINATED BIPHENYLS (TOTAL	pre-1980	UG/L	3	0.5										
POLYCHLORINATED BIPHENYLS (TOTAL	1980 through 1998	UG/L	3	0.5					0	0	0	93		
POLYCHLORINATED BIPHENYLS (TOTAL	1999 to Present	UG/L	3	0.5					0	0	0	107		
POTASSIUM	pre-1980	MG/L							2.587737	2	2.5	430	430	
POTASSIUM	1980 through 1998	MG/L							2.870994	2.25	3.2	387	385	
POTASSIUM	1999 to Present	MG/L							3.033548	2.85	3.6	813	809	
PROMETRYN	pre-1980	UG/L												
PROMETRYN	1980 through 1998	UG/L							0	0	0	94		
PROMETRYN	1999 to Present	UG/L							0	0	0	105		
PROPACHLOR	pre-1980	UG/L												
PROPACHLOR	1980 through 1998	UG/L							0	0	0	45		
PROPACHLOR	1999 to Present	UG/L							0	0	0	106		
PROPOXUR	pre-1980	UG/L						30						
PROPOXUR	1980 through 1998	UG/L						30	0			1		
PROPOXUR	1999 to Present	UG/L						30						

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PYRENE	pre-1980	UG/L												
PYRENE	1980 through 1998	UG/L							0	0	0	37		
PYRENE	1999 to Present	UG/L							0	0	0	10		
RA 226 + RA 228	pre-1980	PCI/L	1	20										
RA 226 + RA 228	1980 through 1998	PCI/L	1	20					0.290000	0.14	0.14	3	3	
RA 226 + RA 228	1999 to Present	PCI/L	1	20					0.400000	0.4		2	1	
RA 226 + RA 228	pre-1980	PCI/L	3	5		5								
RA 226 + RA 228	1980 through 1998	PCI/L	3	5		5			0.290000	0.14	0.14	3	3	
RA 226 + RA 228	1999 to Present	PCI/L	3	5		5			0.400000	0.4		2	1	
RADIUM 226	pre-1980	PCI/L	1	20										
RADIUM 226	1980 through 1998	PCI/L	1	20					0.113333	0	0.1	15	6	
RADIUM 226	1999 to Present	PCI/L	1	20					0.096175	0.1	0.17	21	14	
RADIUM 226	pre-1980	PCI/L	3	5		5								
RADIUM 226	1980 through 1998	PCI/L	3	5		5			0.113333	0	0.1	15	6	
RADIUM 226	1999 to Present	PCI/L	3	5		5			0.096175	0.1	0.17	21	14	
RADIUM 228	pre-1980	PCI/L	1	20										
RADIUM 228	1980 through 1998	PCI/L	1	20										
RADIUM 228	1999 to Present	PCI/L	1	20					0.012024	0	0	41	6	
RADIUM 228	pre-1980	PCI/L	3	5		5								
RADIUM 228	1980 through 1998	PCI/L	3	5		5								
RADIUM 228	1999 to Present	PCI/L	3	5		5			0.012024	0	0	41	6	
SEC-BUTYLBENZENE	pre-1980	UG/L						260						
SEC-BUTYLBENZENE	1980 through 1998	UG/L						260	0	0	0	149		
SEC-BUTYLBENZENE	1999 to Present	UG/L						260	0	0	0	741		

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SELENIUM	pre-1980	UG/L	3	50		50								
SELENIUM	1980 through 1998	UG/L	3	50		50			1.252371	0	0	203	45	
SELENIUM	1999 to Present	UG/L	3	50		50			0.261286	0	0	843	49	
SILICA	pre-1980	MG/L												
SILICA	1980 through 1998	MG/L							28.51889	29.25	31.08	30	30	
SILICA	1999 to Present	MG/L							32.50656	33	36	412	411	
SILVER	pre-1980	UG/L	3		100		100							
SILVER	1980 through 1998	UG/L	3		100		100		0.957233	0	0	213	25	
SILVER	1999 to Present	UG/L	3		100		100		0.004451	0	0	847	18	
SIMAZINE	pre-1980	UG/L	3	4		4								
SIMAZINE	1980 through 1998	UG/L	3	4		4			0	0	0	141		
SIMAZINE	1999 to Present	UG/L	3	4		4			0	0	0	127		
SODIUM	pre-1980	MG/L							34.08204	24	38	467	467	
SODIUM	1980 through 1998	MG/L							53.70179	27.8	60	408	408	
SODIUM	1999 to Present	MG/L							52.87754	38.63	66.75	814	814	
SPECIFIC CONDUCTANCE	pre-1980	MICROMHO							600.6057	468.42	734.23	463	463	
SPECIFIC CONDUCTANCE	1980 through 1998	MICROMHO							819.7116	522.63	860	367	367	
SPECIFIC CONDUCTANCE	1999 to Present	MICROMHO							1140.895	999.79	1641.25	806	806	
STRONTIUM-90	pre-1980	PCI/L				8								
STRONTIUM-90	1980 through 1998	PCI/L				8			0	0	0	5		
STRONTIUM-90	1999 to Present	PCI/L				8			0	0	0	6		

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STYRENE	pre-1980	UG/L	1	10										
STYRENE	1980 through 1998	UG/L	1	10					0.001693	0	0	150	1	
STYRENE	1999 to Present	UG/L	1	10					0.000282	0	0	834	1	
STYRENE	pre-1980	UG/L	3	100		100								
STYRENE	1980 through 1998	UG/L	3	100		100			0.001693	0	0	150	1	
STYRENE	1999 to Present	UG/L	3	100		100			0.000282	0	0	834	1	
SULFATE	pre-1980	MG/L	3		250		250		47.81138	24.18	49.42	464	464	12
SULFATE	1980 through 1998	MG/L	3		250		250		99.85303	45.5	121.18	477	477	38
SULFATE	1999 to Present	MG/L	3		250		250		95.12848	67.43	119	904	904	69
TERBACIL	pre-1980	UG/L												
TERBACIL	1980 through 1998	UG/L												
TERBACIL	1999 to Present	UG/L							0	0		2		
TERT-AMYL METHYL ETHER	pre-1980	UG/L												
TERT-AMYL METHYL ETHER	1980 through 1998	UG/L							0	0	0	25		
TERT-AMYL METHYL ETHER	1999 to Present	UG/L							0	0	0	741		
TERT-BUTYL ALCOHOL	pre-1980	UG/L						12						
TERT-BUTYL ALCOHOL	1980 through 1998	UG/L						12						
TERT-BUTYL ALCOHOL	1999 to Present	UG/L						12	0.361789	0	0	123	1	1
TERT-BUTYL ETHYL ETHER	pre-1980	UG/L												
TERT-BUTYL ETHYL ETHER	1980 through 1998	UG/L							0	0	0	28		
TERT-BUTYL ETHYL ETHER	1999 to Present	UG/L							0	0	0	737		

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TERT-BUTYLBENZENE	pre-1980	UG/L						260						
TERT-BUTYLBENZENE	1980 through 1998	UG/L						260	0	0	0	149		
TERT-BUTYLBENZENE	1999 to Present	UG/L						260	0	0	0	741		
TETRACHLOROETHYLENE	pre-1980	UG/L	3	5		5								
TETRACHLOROETHYLENE	1980 through 1998	UG/L	3	5		5			4.0829	0	0.25	247	82	23
TETRACHLOROETHYLENE	1999 to Present	UG/L	3	5		5			0.308391	0	0	920	76	21
THALLIUM	pre-1980	UG/L	3	2		2								
THALLIUM	1980 through 1998	UG/L	3	2		2			13.85237	0	0	168	21	18
THALLIUM	1999 to Present	UG/L	3	2		2			0.002048	0	0	825	15	
THIOBENCARB	pre-1980	UG/L				70	1							
THIOBENCARB	1980 through 1998	UG/L				70	1		0.038839	0	0	112	1	1
THIOBENCARB	1999 to Present	UG/L				70	1		0	0	0	127		
TOLUENE	pre-1980	UG/L	1	40										
TOLUENE	1980 through 1998	UG/L	1	40					0.033734	0	0	177	18	
TOLUENE	1999 to Present	UG/L	1	40					0.025543	0	0	852	9	
TOLUENE	pre-1980	UG/L	3	1000		150								
TOLUENE	1980 through 1998	UG/L	3	1000		150			0.033734	0	0	177	18	
TOLUENE	1999 to Present	UG/L	3	1000		150			0.025543	0	0	852	9	
TOTAL ALKALINITY (AS CACO3)	pre-1980	MG/L							193.4412	166.56	225.72	412	412	
TOTAL ALKALINITY (AS CACO3)	1980 through 1998	MG/L							225.1131	156.26	230	305	305	
TOTAL ALKALINITY (AS CACO3)	1999 to Present	MG/L							267.1241	234.5	345.25	762	762	

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Chemical	Period	Units	Status	Primary EPA MCL	Secondary EPA MCL	Primary CA MCL	Secondary CA MCL	CA NL	Average	Median	Upper Quartile	# of Wells Sampled	# of Wells w/ Detects	# of Wells w/ Exceedances
TOTAL DISSOLVED SOLIDS	pre-1980	MG/L			500				426.6064	307.5	555.25	336	336	96
TOTAL DISSOLVED SOLIDS	1980 through 1998	MG/L			500				480.0652	330.54	559.88	424	424	126
TOTAL DISSOLVED SOLIDS	1999 to Present	MG/L			500				753.5648	655	1080	817	817	483
TOTAL HARDNESS (AS CACO3)	pre-1980	MG/L							238.8474	191.27	298.64	463	463	
TOTAL HARDNESS (AS CACO3)	1980 through 1998	MG/L							233.3858	201.26	268.22	308	308	
TOTAL HARDNESS (AS CACO3)	1999 to Present	MG/L							500.3722	436.33	720.5	781	781	
TOTAL RADON 222	pre-1980	PC/L	1	300										
TOTAL RADON 222	1980 through 1998	PC/L	1	300					9			1	1	
TOTAL RADON 222	1999 to Present	PC/L	1	300					220.9118	203	240	181	180	21
TOTAL RADON 222 COUNTING ERROR	pre-1980	PC/L												
TOTAL RADON 222 COUNTING ERROR	1980 through 1998	PC/L							12			1	1	
TOTAL RADON 222 COUNTING ERROR	1999 to Present	PC/L							13.03020	14	16	181	181	
TOTAL TRIHALOMETHANES	pre-1980	UG/L	2	80										
TOTAL TRIHALOMETHANES	1980 through 1998	UG/L	2	80					0.422445	0	0	151	22	
TOTAL TRIHALOMETHANES	1999 to Present	UG/L	2	80					0.516297	0	0	200	25	
TOTAL TRIHALOMETHANES	pre-1980	UG/L	3	80										
TOTAL TRIHALOMETHANES	1980 through 1998	UG/L	3	80					0.422445	0	0	151	22	
TOTAL TRIHALOMETHANES	1999 to Present	UG/L	3	80					0.516297	0	0	200	25	
TOXAPHENE	pre-1980	UG/L	3	3		3								
TOXAPHENE	1980 through 1998	UG/L	3	3		3			0	0	0	140		
TOXAPHENE	1999 to Present	UG/L	3	3		3			0	0	0	115		

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TRANS-1,2-DICHLOROETHYLENE	pre-1980	UG/L	3	100		10								
TRANS-1,2-DICHLOROETHYLENE	1980 through 1998	UG/L	3	100		10			0.028830	0	0	167	7	
TRANS-1,2-DICHLOROETHYLENE	1999 to Present	UG/L	3	100		10			0.031537	0	0	871	26	
TRANS-1,3-DICHLOROPROPENE	pre-1980	UG/L				0.5								
TRANS-1,3-DICHLOROPROPENE	1980 through 1998	UG/L				0.5			0	0	0	77		
TRANS-1,3-DICHLOROPROPENE	1999 to Present	UG/L				0.5			0.000163	0	0	736	1	
TRICHLOROETHYLENE	pre-1980	UG/L	3	5		5								
TRICHLOROETHYLENE	1980 through 1998	UG/L	3	5		5			15.23739	0	0.75	333	156	43
TRICHLOROETHYLENE	1999 to Present	UG/L	3	5		5			11.10743	0	0.35	914	252	99
TRICHLOROFLUOROMETHANE	pre-1980	UG/L				150		150						
TRICHLOROFLUOROMETHANE	1980 through 1998	UG/L				150		150	0.161246	0	0	173	18	
TRICHLOROFLUOROMETHANE	1999 to Present	UG/L				150		150	0.273043	0	0	772	24	1
TRITIUM	pre-1980	PCI/L				20000								
TRITIUM	1980 through 1998	PCI/L				20000			0	0	0	5		
TRITIUM	1999 to Present	PCI/L				20000			51.44444	0	154.33	6	1	
TURBIDITY (LAB)	pre-1980	NTU					5							
TURBIDITY (LAB)	1980 through 1998	NTU					5		1.461513	0.18	0.35	141	138	7
TURBIDITY (LAB)	1999 to Present	NTU					5		3.023921	0.19	0.52	773	659	36
URANIUM	pre-1980	UG/L	1	30		20								
URANIUM	1980 through 1998	UG/L	1	30		20			1.638085	1	2.78	40	27	
URANIUM	1999 to Present	UG/L	1	30		20			6.909844	6.3	10.88	16	15	

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VINYL CHLORIDE	pre-1980	UG/L	3	2		0.5								
VINYL CHLORIDE	1980 through 1998	UG/L	3	2		0.5			0.119904	0	0	167	10	5
VINYL CHLORIDE	1999 to Present	UG/L	3	2		0.5			0.011633	0	0	858	14	2
XYLENES (TOTAL)	pre-1980	UG/L	1	20										
XYLENES (TOTAL)	1980 through 1998	UG/L	1	20					0.410323	0	0	176	15	1
XYLENES (TOTAL)	1999 to Present	UG/L	1	20					0	0	0	299		
XYLENES (TOTAL)	pre-1980	UG/L	3	10000		1750								
XYLENES (TOTAL)	1980 through 1998	UG/L	3	10000		1750			0.410323	0	0	176	15	
XYLENES (TOTAL)	1999 to Present	UG/L	3	10000		1750			0	0	0	299		
ZINC	pre-1980	UG/L	3		5000	5000			146.8707	135.05	196.88	4	4	
ZINC	1980 through 1998	UG/L	3		5000	5000			30.043	0	20	232	105	
ZINC	1999 to Present	UG/L	3		5000	5000			21.61172	6.6	12	858	531	

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PEACE AGREEMENT

CHINO BASIN

JUNE 29, 2000

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PEACE AGREEMENT
CHINO BASIN

THIS AGREEMENT (Agreement) is dated the 29th day of June, 2000 regarding the Chino Groundwater Basin.

RECITALS

WHEREAS, disputes have arisen from time to time among and between water users within the Santa Ana River Watershed resulting in a judgment entered in Orange County Superior Court Case No. 117628, Orange County Water District v. City of Chino in 1969; and

WHEREAS, a complaint was filed on January 2, 1975, seeking an adjudication of water rights, injunctive relief and the imposition of a physical solution for the Chino Groundwater Basin (hereinafter Chino Basin); and

WHEREAS, a Judgment was entered in San Bernardino County Superior Court Case No. 164327 in Chino Basin Municipal Water District v. City of Chino, et al. in 1978, now designated No. RCV 51010 that adjudicated rights to the groundwater and storage capacity within the Chino Basin and established a physical solution; and

WHEREAS, the Parties intend that each Producer should be able to Produce both the quantity and quality of water to meet its water supply needs to the greatest extent possible from the water that underlies the Producer's area of benefit; and

WHEREAS, the Judgment provides the State of California is the largest owner of land overlying the Chino Basin, and provides that all future Production by the State, or its departments or agencies for overlying use on State-owned lands shall be considered as use by the Agricultural Pool; and

WHEREAS, Paragraph 16 of the Judgment authorized the appointment of a Watermaster for a term or terms of five (5) years; and

WHEREAS, Watermaster has the express powers and duties as provided in the Judgment or as "hereafter ordered or authorized by the Court in the exercise of the Court's continuing jurisdiction" subject to the limitations stated elsewhere in the Judgment; and

WHEREAS, Paragraph 41 of the Judgment provides that "Watermaster, with the advice of the Advisory and Pool Committees" has "discretionary powers in order to develop an optimum basin management program (OBMP) for Chino Basin"; and

WHEREAS, on February 19, 1998, in San Bernardino County Superior Court Case Number RCV 51010, the Court appointed a "Nine-member Board as Interim Watermaster for a twenty-six month period commencing March 1, 1998 and ending June 30, 2000" and "directed the Interim Watermaster to develop and submit the OBMP"; and

WHEREAS, a draft Programmatic Environmental Impact Report (PEIR) for the OBMP has been completed and distributed to the Parties as well as the State Clearinghouse and other interested Parties and the Inland Empire Utilities Agency (IEUA) is serving as "Lead Agency" for purposes of preparing and completing the PEIR as previously directed by the Court on November 18, 1999; and

WHEREAS, this Agreement facilitates the implementation of the OBMP which is subject to environmental review under the California Environmental Quality Act (CEQA) as previously directed by the Court; and

WHEREAS, disputes have arisen in regard to a number of matters pertaining to the power and authority of the Court and Watermaster under the Judgment, including but not limited to Watermaster power and author-

ity regarding recharge, owning property, holding water rights, water Transfers, storage, yield management, land use conversions, assessments, benefits, procedures and the adoption and implementation of the OBMP; and

WHEREAS, OCWD has filed a petition with the State Water Resources Control Board requesting a change of the Santa Ana River's "Fully Appropriated" status, and filed an application to appropriate up to five hundred seven thousand (507,000) acre-feet of such newly declared surplus water; and

WHEREAS, the Parties to this Agreement desire to resolve issues by consent under the express terms and conditions stated herein; and

WHEREAS, the Parties wish to preserve and maintain Watermaster's role under the Judgment without compromising the Parties' collective and individual "benefits of the bargain" under this Agreement; and

WHEREAS, the Parties intend that this Agreement shall enable the adoption and implementation of an OBMP consistent herewith, which will benefit the Basin and all Parties hereto;

NOW, THEREFORE, in consideration of the mutual promises specified herein and by conditioning their performance under this Agreement upon conditions precedent set forth in Article III, the Watermaster approval and Court Order of its terms, and for other good and valuable consideration, the Parties agree as follows:

I
DEFINITIONS AND RULES OF CONSTRUCTION

1.1 Definitions. As used in this Agreement, these terms, including any grammatical variations thereof shall have the following meanings:

(a) "Agricultural Pool" shall have the meaning of Overlying (Agricultural) Pool as used in the Judgment and shall include all its members;

(b) "Appropriative Pool" shall have the meaning as used in the Judgment and shall include all its members;

(c) "Basin Water" means groundwater within Chino Basin which is part of the Safe Yield, Operating Safe Yield, or Replenishment Water in the Basin as a result of operations under the physical solution decreed in the Judgment. Basin Water does not include "Stored Water;"

(d) "Best Efforts" means reasonable diligence and reasonable efforts under the totality of the circumstances. Indifference and inaction do not constitute Best Efforts. Futile action(s) are not required.

(e) "CBWCD" means the Chino Basin Water Conservation District;

(f) "CEQA" means the California Environmental Quality Act, Public Resources Code Sections 21000 et seq; 14 California Code of Regulations 15000 et seq.;

(g) "Chino Basin" or "Basin" means the groundwater basin underlying the area shown on Exhibit "B" to the Judgment and within the boundaries described on Exhibit "K" to the Judgment;

(h) "Chino Basin Watershed" means the surface drainage area tributary to and overlying Chino Basin;

(i) "Chino I Desalter" also known as the SAWPA Desalter means the Desalter owned and operated by PC14 with a present capacity of eight (8) million gallons per day (mgd) and in existence on the Effective Date;

(j) "Chino I Desalter Expansion" means the planned expansion of the Chino I Desalter from its present capacity of eight (8) mgd to a capacity of up to fourteen (14) mgd, to be owned and operated by IEUA and WMWD acting through PC14;

(k) "Chino II Desalter" means a new Desalter not in existence on the Effective Date with a design capacity of ten (10) mgd, to be owned, constructed, and operated by IEUA and WMWD acting independently or in their complete discretion, acting through the PC14, constructed and operated consistent with the OBMP and to be located on the eastside of the Chino Basin;

(l) "Court" means the court exercising continuing jurisdiction under the Judgment;

(m) "Date of Execution" means the first day following the approval and execution of the Agreement by the last Party to do so;

(n) "Desalter" and "Desalters" means the Chino I Desalter, Chino I Desalter Expansion, the Chino II Desalter and Future Desalters, consisting of all the capital facilities and processes that remove salt from Basin Water, including extraction wells, transmission facilities for delivery of groundwater to the Desalter, Desalter treatment and delivery facilities for the desalted water including pumping and storage facilities, and treatment and disposal capacity in the SARI System;

(o) "Early Transfer" means the reallocation of Safe Yield not Produced by the Agricultural Pool to the Appropriative Pool on an annual basis rather than according to the five year increment described in Paragraph 10 of Exhibit "H" of the Judgment;

(p) "Effective Date" means October 1, 2000, provided that all conditions precedent have been waived or satisfied;

(q) "Future Desalters" means enlargement of the Chino I Desalter to a capacity greater than the Chino I Expansion or enlargement of the Chino II Desalter and any other new Desalter facilities that may be needed to carry out the purposes of the OBMP over the term of this Agreement;

(r) "General law" means all applicable state and federal law;

(s) "Groundwater" means water beneath the surface of the ground and within the zone of saturation, i.e., below the existing water table;

(t) "IEUA" means the Inland Empire Utilities Agency, referred to in the Judgment as Chino Basin Municipal Water District;

(u) "In-lieu recharge" means taking supplies of Supplemental Water in lieu of pumping groundwater otherwise subject to Production as an allocated share of Operating Safe Yield, as provided in Exhibit "H" Paragraph 11 of the Judgment;

(v) "Judgment" means the Judgment dated January 27, 1978, in San Bernardino County Case No. 164327 (redesignated as San Bernardino County Case No. RCV 51010) as amended by Order Approving Amendments to Judgment Dated December 1, 1995, and Order for Amendments to the Judgment Regard-

ing Changes in Pooling Plans and Appropriative Pool Representation on the Advisory Committee, dated September 18, 1996 and other such amendments;

(w) "Jurupa Community Services District" (JCSD) means the Jurupa Community Services District and the Santa Ana River Water Company individually. Subject to the provisions of this Agreement, the design and delivery obligations for the Chino II Desalter set forth in Section 7.3 regarding Jurupa Community Services District include both the Jurupa Community Services District and the Santa Ana River Water Company. Santa Ana River Water Company may exercise its discretion to receive its portion of the desalted water through an interconnection or at its own expense through an independent pipeline to connect to the Chino II Desalter or in any other method as the Jurupa Community Services District and the Santa Ana River Water Company may jointly agree. Nothing in this definition shall be construed as expanding the initial mgd capacity of the Chino II Desalter as provided in the facilities plan which is attachment "1" to the OBMP Implementation Plan (Exhibit "B" hereto). If it is necessary to meet Santa Ana River Water Company's demands and there is insufficient initial capacity in the Chino II Desalter to satisfy the demands of Santa Ana River Water Company for desalted water in the quantities as provided in the Revised Draft Water Supply Plan Phase I Desalting Project Facilities Report, Jurupa's and Ontario's entitlement to desalted water made available from the initial capacity of the Chino II Desalter shall abate pro-rata to accommodate the demand of Santa Ana River Water Company up to a maximum quantity of 1,300 acre feet per year.

(x) "Local Storage" means water held in a storage account pursuant to a Local Storage agreement between a party to the

Judgment and Watermaster and consisting of: (i) a Producer's unproduced carry-over water or (ii) a party to the Judgment's Supplemental Water, up to a cumulative maximum of fifty thousand (50,000) acre-feet for all parties to the Judgment.

(y) "Material Physical Injury" means material injury that is attributable to the Recharge, Transfer, storage and recovery, management, movement or Production of water, or implementation of the OBMP, including, but not limited to, degradation of water quality, liquefaction, land subsidence, increases in pump lift (lower water levels) and adverse impacts associated with rising groundwater. Material Physical Injury does not include "economic injury" that results from other than physical causes. Once fully mitigated, physical injury shall no longer be considered to be material;

(z) "Metropolitan Water District" means the Metropolitan Water District of Southern California;

(aa) "New Yield" means proven increases in yield in quantities greater than historical amounts from sources of supply including, but not limited to, capture of rising water, capture of available storm flow, operation of the Desalters (including the Chino I Desalter), induced Recharge and other management activities implemented and operational after June 1, 2000;

(bb) "Non-Agricultural Pool" shall have the meaning as used in the Judgment for the Overlying (Non-Agricultural Pool) and shall include all its members;

(cc) "OBMP Assessments" means assessments, other than the assessments levied as provided in Section 5.1(g), levied by Watermaster for the purpose of implementing the Optimum

Basin Management Program (OBMP),, which shall be deemed Administrative Assessments under Paragraph 54 of the Judgment.

(dd) "OCWD" means the Orange County Water District;

(ee) "Operating Safe Yield" means the annual amount of groundwater which Watermaster shall determine, pursuant to criteria specified in Exhibit "I" to the Judgment, can be Produced from Chino Basin by the Appropriative Pool parties free of Replenishment obligation under the Physical Solution. Watermaster shall include any New Yield in determining Operating Safe Yield;

(ff) "Overdraft" means a condition wherein the total annual Production from the Basin exceeds the Safe Yield thereof, as provided in the Judgment;

(gg) "Party or Parties" means a Party to this Agreement;

(hh) "Party or parties to the Judgment" means a party to the Judgment;

(ii) "Produce or Produced" means to pump or extract groundwater from the Chino Basin;

(jj) "Producer" means any person who Produces groundwater from the Chino Basin;

(kk) "Production" means the annual quantity, stated in acre feet, of water Produced from the Chino Basin;

(ll) "PC14" means Project Committee No. 14, members of SAWPA, composed of IEUA, WMWD, and OCWD, pursuant

to Section 18 of the SAWPA Joint Exercise of Powers Agreement which now constitutes the executive Authority through which SAWPA acts with respect to the Chino I Desalter;

(mm) "Public Hearing" means a hearing of Watermaster after notice pursuant to Paragraphs 58 and 59 or other Paragraphs of the Judgment that may be applicable, to all parties to the Judgment and to any other person entitled to notice under the Judgment, this Agreement or general law;

(nn) "Recharge and Recharge Water" means introduction of water into the Basin, directly or indirectly, through injection, percolation, delivering water for use in-lieu of Production or other method. Recharge references the physical act of introducing water into the Basin. Recharge includes Replenishment Water but not all Recharge is Replenishment Water. This definition shall not be construed to limit or abrogate the authority of CBWCD under general law;

(oo) "Replenishment Water" means Supplemental Water used to Recharge the Basin pursuant to the physical solution, either directly by percolating or injecting the water into the Basin or indirectly by delivering the water for use in lieu of Production and use of Safe Yield or Operating Safe Yield;

(pp) "Recycled Wastewater" means water which, as a result of treatment of wastewater, is suitable for a direct beneficial use or a controlled use that would not otherwise occur and is therefore considered a valuable resource, referred to as "reclaimed water" in the Judgment.

(qq) "Safe Yield" means the long-term average annual quantity of groundwater (excluding Replenishment Water or Stored Water but including return flow to the Basin from use of

Replenishment or Stored Water) which can be Produced from the Basin under cultural conditions of a particular year without causing an undesirable result;

(rr) "Salt Credits" means an assignable credit that may be granted by the Regional Water Quality Control Board and computed by Watermaster from activities that result from removal of salt from the Basin, or that result in a decrease in the amount of salt entering the Basin;

(ss) "SAWPA" means the Santa Ana Watershed Project Authority;

(tt) "Sphere of Influence" has the same meaning as set forth in Government Code Section 56076;

(uu) "Storage and Recovery Program" means the use of the available storage capacity of the Basin by any person under the direction and control of Watermaster pursuant to a storage and recovery agreement but excluding "Local Storage", including the right to export water for use outside the Chino Basin and typically of broad and mutual benefit to the parties to the Judgment;

(vv) "Stored Water" means Supplemental Water held in storage, as a result of direct spreading, injection or in-lieu delivery, for subsequent withdrawal and use pursuant to agreement with Watermaster;

(ww) "Supplemental Water" means water imported to Chino Basin from outside the Chino Basin Watershed and recycled water;

(xx) "Transfer" means the assignment, lease, or sale of a right to Produce water to another Producer within the Chino Basin or to another person or entity for use outside the Basin in con-

formance with the Judgment, whether the Transfer is of a temporary or permanent nature;

(yy) "TVMWD" means Three Valleys Municipal Water District (referred to in the Judgment as Pomona Valley Municipal Water District);

(zz) "Watermaster" means Watermaster as the term is used in the Judgment;

(aaa) "Watermaster Resolution 88-3" means the resolution by the Chino Basin Watermaster establishing the procedure for transferring unallocated Safe Yield water from the Agricultural Pool to the Appropriative Pool, adopted on April 6, 1988 and rescinding Resolution 84-2 in its entirety;

(bbb) "WMWD" means Western Municipal Water District;

1.2 Rules of Construction.

(a) Unless the context clearly requires otherwise:

(i) The plural and singular forms include the other;

(ii) "Shall," "will," "must," and "agrees" are each mandatory;

(iii) "may" is permissive;

(iv) "or" is not exclusive;

(v) "includes" and "including" are not limiting; and

(vi) "between" includes the ends of the identified range.

(b) Headings at the beginning of Articles, paragraphs and sub-paragraphs of this Agreement are solely for the convenience of the Parties, are not a part of this Agreement and shall not be used in construing it.

(c) The masculine gender shall include the feminine and neuter genders and vice versa.

(d) The word "person" shall include individual, partnership, corporation, limited liability company, business trust, joint stock company, trust, unincorporated association, joint venture, governmental authority, water district and other entity of whatever nature.

(e) Reference to any agreement (including this Agreement), document, or instrument means such agreement, document, instrument as amended or modified and in effect from time to time in accordance with the terms thereof and, if applicable, the terms hereof.

(f) Except as specifically provided herein, reference to any law, statute, ordinance, regulation or the like means such law as amended, modified, codified or reenacted, in whole or in part and in effect from time to time, including any rules and regulations promulgated thereunder.

II
COMPLIANCE WITH CEQA

2.1 Commitments Shall be Consistent With CEQA Compliance. In executing this Agreement, the Parties agree that no commitment will be made to carry out any "project" under the OBMP and within the meaning of CEQA unless and until the environmental review and assessments required by CEQA for that defined "project" have been

completed. Any future implementing actions in furtherance of Program Elements 2 through 9 that meet the definition of "project" under CEQA, shall be subject to further environmental documentation in the form of an exemption, a negative declaration, mitigated negative declaration, environmental impact report, supplemental EIR or subsequent EIR. Any challenge claiming a breach of this article shall be brought within the same period of time applicable to claims under Public Resources Code section 21000, et seq.

2.2 Reservation of Discretion. Execution of this Agreement is not intended to commit any Party to undertake a project without compliance with CEQA or to commit the Parties to a course of action, which would result in the present approval of a future project.

2.3 No Prejudice by Comment or Failure to Comment. Nothing in the PEIR, or a Party's failure to object or comment thereon, shall limit any Party's right to allege that "Material Physical Injury" will result or has resulted from the implementation of the OBMP, the storage, recovery, management, movement or Production of water as provided in Article V herein.

2.4 Acknowledgment that IEUA is the Lead Agency. IEUA has been properly designated as the "Lead Agency" for the purposes of preparing the PEIR as ordered by court on November 18, 1999.

III
CONDITIONS PRECEDENT

3.1 Performance Under Articles V, VI, and VII is Subject to Satisfaction of Conditions Precedent. Each Party's obligations under this Agreement are subject to the satisfaction of the following conditions on or before the dates specified below, unless satisfaction of a specified condition or conditions is waived in writing by all other Parties:

(a) The Parties' covenants and commitments set forth in Article V are expressly conditioned upon Watermaster's contemporaneous approval of this Agreement and the OBMP Implementation Plan by June 29, 2000 and upon an Order of the Court directing Watermaster to proceed in accordance with this, Agreement and only this Agreement, on or before July 13, 2000. Watermaster's approval of this Agreement and the OBMP Implementation Plan shall be in the form of a resolution substantially similar to Exhibit "A" attached hereto and it shall contain a commitment to adopt the requisite policies and procedures to implement the provisions set forth in Article V on or before December 31, 2000, unless an earlier date for performance is otherwise expressly provided herein.

(b) Appropriation by the California Legislature of at least $121,000,000 from the proceeds made available by the passage of Proposition 13 for the benefit of the SAWPA by October 1, 2000.

IV
MUTUAL COVENANTS

4.1 Joint Defense. The Parties shall proceed with reasonable diligence and use Best Efforts to jointly defend any lawsuit or administrative proceeding challenging the legality, validity, or enforceability of any term of this Agreement. However, nothing herein shall require the State of California to incur legal or administrative costs in support of such an effort.

4.2 No Opposition to the OBMP. No Party to this Agreement shall oppose Watermaster's adoption and implementation of the OBMP as provided in Exhibit B attached hereto in a manner consistent with this Agreement, or the execution of Memoranda of Agreement that incorporate the provisions which are substantially similar to those

contained in Exhibit "C" attached hereto. Nothing herein shall be construed as limiting any Party's right of participation in all the functions of Watermaster as are provided in the Judgment or to preclude a party to the Judgment from seeking judicial review of Watermaster determinations pursuant to the Judgment or as otherwise provided in this Agreement.

4.3 Indemnification of the Agricultural Pool. The Parties shall indemnify and defend the State of California and the members of the Agricultural Pool against any lawsuit or administrative proceedings, without limitation, arising from Watermaster's adoption, approval, management, or implementation of a Storage and Recovery Program.

4.4 Consent to Specified Changes to the Judgment. Each Party consents to the following modifications to the Judgment.

(a) The Judgment shall be amended so that the last sentence of Paragraph 8 of the Judgment reads:

> All overlying rights are appurtenant to the land and cannot be assigned or conveyed separate or apart therefrom for the term of the Peace Agreement except that the members of the Overlying (Non-Agricultural) Pool shall have the right to Transfer or lease their quantified Production rights within the Overlying (Non-Agricultural) Pool or to Watermaster in conformance with the procedures described in the Peace Agreement between the Parties therein, dated June 29, 2000.

(b) Paragraph 6 of Exhibit "G" to the Judgment regarding the Overlying Non-Agricultural Pool shall be amended to read:

> Assignment. Rights herein decreed are appurtenant to that land and are only assignable with the land for over-

lying use thereon; provided, however, (a) that any appropriator who may, directly or indirectly, undertake to provide water service to such overlying lands may, by an appropriate agency agreement on a form approved by Watermaster, exercise said overlying right to the extent, but only to the extent necessary to provide water service to said overlying lands, and (b) the members of the pool shall have the right to Transfer or lease their quantified Production rights within the pool or to Watermaster in conformance with the procedures described in the Peace Agreement between the Parties therein, dated June 29, 2000 for the term of the Peace Agreement.

(c) The 1995 Amendment to the Judgment shall be amended as follows: Section 10(b)(3)(i) shall now read:

"For the term of the Peace Agreement, in any year in which sufficient unallocated Safe Yield from the Overlying (Agricultural) Pool is available for such conversion claims, Watermaster shall allocate to each appropriator with a conversion claim, 2.0 acre-feet of unallocated Safe Yield water for each converted acre for which conversion has been approved and recorded by the Watermaster."

Appendix 1 to the Judgment shall be construed to be consistent with this amendment. All other parts of the 1995 Amendment shall remain the same.

4.5 Construction of "Operating Yield" Under the Judgment. Exhibit I to the Judgment shall be construed to authorize Watermaster to include New Yield as a component of Operating Safe Yield.

4.6 Best Efforts to Obtain Funding for OBMP. Each Party shall use Best Efforts to obtain and support funding that is consistent with the

OBMP and this Agreement. The Parties shall coordinate their individual efforts and report their progress to Watermaster no less than each quarter beginning on the Effective Date.

4.7 CBWCD. Watermaster shall provide for, arrange or approve the necessary revenue to fund Recharge activities listed in the OBMP and CBWCD shall not assume any legal duty or responsibility to conduct Recharge other than as is expressly set forth herein, as it may agree or as may be provided under general law or the Judgment.

V
WATERMASTER PERFORMANCE

5.1 Recharge and Replenishment. After the Effective Date and until the termination of this Agreement, the Parties expressly consent to Watermaster's performance of the following actions, programs or procedures regarding Recharge and Replenishment:

(a) All Recharge of the Chino Basin with Supplemental Water shall be subject to Watermaster approval.

(b) Watermaster will ensure that any person may make application to Watermaster to Recharge the Chino Basin with Supplemental Water, including the exercise of the right to offer to sell in-lieu Recharge water to Watermaster as provided in the Judgment and the Agreement in a manner that is consistent with the OBMP and the law. Watermaster shall not approve an application by any party to the Judgment if it is inconsistent with the terms of the Agreement, or will cause any Material Physical Injury to any party to the Judgment or the Basin. Any potential or threatened Material Physical Injury to any Party or the Basin caused by the Recharge of Supplemental Water shall be fully and reasonably mitigated as a condition of approval. In the event the Material Physical Injury cannot be fully and

reasonably mitigated, the request for Recharge of Supplemental Water must be denied.

(c) Watermaster shall administer, direct and conduct the Recharge of all water n a manner that is consistent with this Agreement, the OBMP and causes no Material Physical Injury to any party to the Judgment or the Chino Basin. Nothing herein shall be construed as committing a Party to provide Supplemental Water upon terms and conditions that are not deemed acceptable to that Party.

(d) Notwithstanding Section 5.1(c), CBWCD shall reserve its complete discretion to Recharge the Basin with water other than Supplemental Water as may be authorized by general law so long as the Recharge is in accordance with the limitations in the Judgment, if any and is in accordance with the provisions of Section 5.1(d)(i)-(v).

(i) Upon request by Watermaster CBWCD shall exercise Best Efforts to consult, coordinate and cooperate with Watermaster when recharging water into the Basin;

(ii) CBWCD shall provide Watermaster with reasonable notice in advance of any material change in its historic Recharge operations;

(iii) CBWCD shall not be required to provide funding for Recharge projects merely by virtue of its execution of this Agreement;

(iv) CBWCD shall Recharge the Basin in a manner that does not cause Material Physical Injury to any party to the Judgment or the Basin. Upon Watermaster's receipt of a written allegation that an existing or proposed

CBWCD Recharge activity has or will cause Material Physical Injury to any party to the Judgment or the Basin, Watermaster shall hold a Public Hearing within a reasonable time. Watermaster shall provide notice and opportunity to be heard to interested parties to the Judgment including CBWCD. After hearing, Watermaster may approve, deny or condition the CBWCD's Recharge. Watermaster's decision shall be based upon the record and it shall be subject to the court's review;

(v) CBWCD's Recharge of the Basin coupled with an intent to store and recover water shall require a storage and recovery agreement.

(e) Watermaster shall exercise its Best Efforts to:

(i) protect and enhance the Safe Yield of the Chino Basin through Replenishment and Recharge;

(ii) ensure there is sufficient Recharge capacity for Recharge Water to meet the goals of the OBMP and the future water supply needs within the Chino Basin;

(iii) direct Recharge relative to Production in each area and sub-area of the Basin to achieve long term balance and to promote the goal of equal access to groundwater within all areas and sub-areas of the Chino Basin;

(iv) evaluate the potential or threat for any Material Physical Injury to any party to the Judgment or the Chino Basin, including, but not limited to, any Material Physical Injury that may result from any Transfer of water in storage or water rights which is proposed in place of

physical Recharge of water to Chino Basin in accordance with the provisions of Section 5.3;

(v) establish and periodically update criteria for the use of water from different sources for Replenishment purposes;

(vi) ensure a proper accounting of all sources of Recharge to the Chino Basin;

(vii) Recharge the Chino Basin with water in any area where groundwater levels have declined to such an extent that there is an imminent threat of Material Physical Injury to any party to the Judgment or the Basin;

(viii) maintain long-term hydrologic balance between total Recharge and discharge within all areas and sub-areas;

(ix) coordinate, facilitate and arrange for the construction of the works and facilities necessary to implement the quantities of Recharge identified in the OBMP Implementation Plan.

(f) Watermaster shall undertake Recharge, using water of the lowest cost and the highest quality, giving preference as far as possible to the augmentation and the Recharge of native storm water.

(g) In furtherance of its obligations under this Section, for a period of five years, commencing with Fiscal Year 2000-2001, and within each such Fiscal Year Watermaster shall arrange for the physical Recharge of Supplemental Water in the amount of an annual average of 6,500 acre-feet per year in one or more of

the areas commonly known as the Montclair, Brooks and Upland spreading facilities.

(i) If for any reason at the end of the five year period, a cumulative total of 32,500 acre-feet of physical Recharge has not been accomplished under this subdivision, then Recharge shall continue at the above referenced locations at the average annual rate of 6,500 acre-feet until the full 32,500 acre-feet of physical Recharge has been accomplished;

(ii) The Recharged Supplemental Water shall increase the Operating Safe Yield under the Judgment. The cost and allocation of this Supplemental Water under this Section 5.1g shall be apportioned pro rata among the members of the Appropriative Pool under the Judgment according to the Producer's share of the initial Safe Yield;

(iii) The need to continue physical Recharge under this paragraph shall be evaluated by Watermaster after the conclusion of Fiscal Year 2004-2005. In evaluating further physical Recharge pursuant to this paragraph, Watermaster shall take into account the provisions of this Article, the Judgment and the OBMP among all other relevant factors. Except as to Watermaster's determination of Material Physical Injury, the rights of each party to the Judgment to purchase or lease water to meet its over-Production obligation shall be unaffected by this provision;

(h) Watermaster shall not own Recharge projects, including but not limited to spreading grounds, injection wells, or diversion works. It shall never own real property. However, Watermaster may own water rights in trust for the benefit of the

parties to the Judgment. Moreover, Watermaster shall arrange, facilitate and provide for Recharge by entering into contracts with appropriate persons, which may provide facilities and operations for physical Recharge of water as required by the Judgment and this Agreement, or pursuant to the OBMP. Any such contracts shall include appropriate terms and conditions, including terms for the location and payment of costs necessary for the operation and maintenance of facilities, if any.

(i) CBWCD's rights and obligations to obtain Replenishment Water are unaffected by the execution of this Agreement. Its obligation, rights and duties regarding Recharge may be set by arms length negotiation through separate agreement or as they otherwise exist under general law and the Judgment.

(j) Watermaster shall provide an annual accounting of the amount of Recharge and the location of the specific types of Recharge.

5.2 Storage and Recovery. After the Effective Date and until the termination of this Agreement, the Parties expressly consent to Watermaster's performance of the following actions, programs or procedures regarding the storage and recovery of water:

(a) In General.

(i) All storage capacity shall be subject to regulation and control by Watermaster;

(ii) No person shall store water in and recover water from the Chino Basin without an agreement with Watermaster;

(iii) Watermaster will ensure that any person, including but not limited to the State of California and the Department

of Water Resources may make application to Watermaster to store and recover water from the Chino Basin as provided herein in a manner that is consistent with the OBMP and the law. Watermaster shall not approve an application to store and recover water if it is inconsistent with the terms of this Agreement or will cause any Material Physical Injury to any party to the Judgment or the Basin. Any potential or threatened Material Physical Injury to any Party or the Basin caused by the storage and recovery of water shall be reasonably and fully mitigated as a condition of approval. In the event the Material Physical Injury cannot be mitigated, the request for storage and recovery must be denied.

(iv) This Agreement shall not be construed to limit the State or its department or agencies from using available storage capacity in the Basin in accordance with the provisions of this Section under a storage and recovery agreement with Watermaster.

(b) Local Storage.

(i) For a period of five years from the Effective Date, Watermaster shall ensure that: (a) the quantity of water actually held in Local Storage under a storage agreement with Watermaster is confirmed and protected and (b) each party to the Judgment shall have the right to store its un-Produced carry-over water. Thereafter, a party to the Judgment may continue to Produce the actual quantity of carry-over water and Supplemental Water held in its storage account, subject only to the loss provisions set forth in this Section 5.2. This means a party to the Judgment may increase the total volume of carry-over water it holds in Local Storage up to five years after the

Effective Date and as Watermaster may approve pursuant to a Local Storage agreement for Supplemental Water.

(ii) For a period of five years from the Effective Date, any party to the Judgment may make application to Watermaster for a Local Storage agreement, whereby it may store Supplemental Water in the Chino Basin.

(iii) Watermaster shall provide reasonable advance written notice to all interested parties of the proposed Local Storage agreement, prior to approving the agreement. The notice shall include the persons engaged in the Local Storage, the location of the Recharge and Production facilities and the potential for any Material Physical Injury, if any.

(iv) Watermaster shall approve the Local Storage agreement so long as: (1) the total quantity of Supplemental Water authorized to be held in Local Storage under all then existing Local Storage agreements for all parties to the Judgment does not exceed the cumulative total of 50,000 acre-feet; (2) the party to the Judgment making the request provides their own Recharge facilities for the purpose of placing the Supplemental Water into Local Storage; (3) the agreement will not result in any Material Physical Injury to any party to the Judgment or the Basin. Watermaster may approve a proposed agreement with conditions that mitigate any threatened or potential Material Physical Injury.

(v) There shall be a rebuttable presumption that the Local Storage agreement for Supplemental Water does not

result in Material Physical Injury to a party to the Judgment or the Basin.

(vi) In the event any party to the Judgment, or Watermaster, objects to a proposed Local Storage agreement for Supplemental Water and submits evidence that there may be a Material Physical Injury to any party to the Judgment or the Basin, Watermaster shall hold a Public Hearing and allow the objecting party to the Judgment a reasonable opportunity to be heard.

(vii) In the event more than one party to the Judgment submits a request for an agreement to store Supplemental Water pursuant to a Local Storage agreement, Watermaster shall give priority to the first party to file a bona fide written request which shall include the name of the party to the Judgment, the source, quantity and quality of the Supplemental Water, an identification of the party to the Judgment's access to or ownership of the Recharge facilities, the duration of the Local Storage and any other information Watermaster shall reasonably request. Watermaster shall not grant any person the right to store more than the then existing amount of available Local Storage. The amount of Local Storage available for the storage of Supplemental Water shall be determined by subtracting the previously approved and allocated quantity of storage capacity for Supplemental Water from the cumulative maximum of 50,000 acre-feet.

(viii) Watermaster shall base any decision to approve or disapprove any proposed agreement upon the record.

(ix) Any party to the Judgment may seek judicial review of Watermaster's decision.

(x) Five years after the Effective Date, Watermaster shall have discretion to place reasonable limits on the further accrual of carry-over and Supplemental Water in Local Storage. However, Watermaster shall not limit the accrual of carry-over Local Storage for Fontana Union Mutual Water Company and Cucamonga County Water District when accruing carry-over storage pursuant to *Lease of Corporate Shares Coupled with Irrevocable Proxy, dated July 1, 1993 between Cucamonga County Water District and Fontana Water Resources Inc. and the Settlement Agreement Among Fontana Union Water Company, Kaiser Steel Reserves Inc., San Gabriel Valley Water Company and Cucamonga County Water Districts dated February 7, 1992*, to a quantity less than 25,000 acre-feet for the term of this Agreement.

(xi) Watermaster shall evaluate the need for limits on water held in Local Storage to determine whether the accrual of additional Local Storage by the parties to the Judgment should be conditioned, curtailed or prohibited if it is necessary to provide priority for the use of storage capacity for those Storage and Recovery Programs that provide broad mutual benefits to the parties to the Judgment as provided in this paragraph and Section 5.2(c) below;

(xii) Watermaster shall set the annual rate of loss from Local Storage for parties to the Judgment at zero until 2005. Thereafter the rate of loss from Local Storage for parties to the Judgment will be 2% until recalculated based upon the best available scientific information. Losses

shall be deducted annually from each party to the Judgment's storage account;

(xiii) Watermaster shall allow water held in storage to be transferred pursuant to the provisions of Section 5.3 below. Storage capacity is not transferable by any party to the Judgment or any Party hereto.

(c) Storage and Recovery Program.

(i) Watermaster will ensure that no person shall store water in and recover water from the Basin, other than pursuant to a Local Storage agreement, without a storage and recovery agreement with Watermaster;

(ii) Watermaster shall prepare a list of basic information that a proposed applicant for a Storage and Recovery Program must submit to Watermaster prior to the execution of a storage and recovery agreement;

(iii) As a precondition of any project, program or contract regarding the use of Basin storage capacity pursuant to a Storage and Recovery Program, Watermaster shall first request proposals from qualified persons.

(iv) Watermaster shall be guided by the following criteria in evaluating any request to store and recover water from the Basin by a party to the Judgment or any person under a Storage and Recovery Program.

(a) The initial target for the cumulative quantity of water held in storage is 500,000 acre-feet in addition to the existing storage accounts;

(b) Watermaster shall prioritize its efforts to regulate and condition the storage and recovery of water developed in a Storage and Recovery Program for the mutual benefit of the parties to the Judgment and give first priority to Storage and Recovery Programs that provide broad mutual benefits;

(v) For the term of this Agreement, members of the Appropriative Pool and the Non-Agricultural Pool shall be exclusively entitled to the compensation paid for a Storage and Recovery Program irrespective of whether it be in the form of money, revenues, credits, proceeds, programs, facilities, or other contributions (collectively "compensation") as directed by the Non-Agricultural and the Appropriative Pools;

(vi) The compensation received from the use of available storage capacity under a Storage and Recovery Program, may be used to off-set the Watermaster's cost of operation, to reduce assessments on the parties to the Judgment within the Appropriative and Non-Agricultural Pools, and to defray the costs of capital projects as may be requested by the members of the Non-Agricultural Pools and the Appropriative Pool;

(xiii) Any potential or threatened Material Physical Injury to any party to the Judgment or the Basin caused by storage and recovery of water, whether Local Storage and recovery or pursuant to a Storage and Recovery Program, shall be reasonably and fully mitigated as a condition of approval;

(ix) Watermaster reserves discretion to negotiate appropriate terms and conditions or to refuse to enter into a Storage

and Recovery or to deny any request. However, with respect to persons not parties to the Judgment, Watermaster reserves complete discretion. Watermaster shall base any decision to approve or disapprove any proposed Storage and Recovery Program upon the record. However, it may not approve a proposed Storage and Recovery Program unless it has first imposed conditions to reasonably and fully mitigate any threatened or potential Material Physical Injury;

(x) Any party to the Judgment may seek review of the Watermaster's decision regarding a Storage and Recovery Program.

(d) The specific terms and conditions for the use of the facilities of CBWCD in connection with Local Storage or Storage and Recovery Programs shall be covered under separate agreements reached by arms length bargaining between Watermaster and CBWCD. Watermaster and any other Party shall not be entitled to the income received by CBWCD for use of its facilities in connection with Local Storage or Storage and Recovery Programs without the consent of CBWCD. Nothing in this Agreement shall be construed as preventing CBWCD from entering into an agreement with others for use of its facilities in a manner consistent with Section 5.1(d) i-v of this Agreement.

(e) Nothing herein shall be construed as prohibiting the export of Supplemental Water stored under a Storage and Recovery Program and pursuant to a storage and recovery agreement.

(f) Watermaster shall exercise Best Efforts to undertake the following measures:

(i) Complete the Short-term conjunctive use project, authorized by Watermaster and conducted by IEUA, TVMWD and MWD;

(ii) Evaluate and develop a seasonal peaking program for in-Basin use and dry year yield to reduce the Basin's demand on the Metropolitan Water District for imported water;

(iii) Evaluate and develop a dry year export program;

(iv) Evaluate and develop a seasonal peaking export program;

5.3 Transfers. After the Effective Date and until the termination of this Agreement, the Parties expressly consent to Watermaster's performance of the following actions, programs or procedures regarding the Transfer of water:

(a) Watermaster will ensure that any party to the Judgment may Transfer water in a manner that is consistent with this Agreement, the OBMP and the law. Watermaster shall not approve a Transfer if it is inconsistent with the terms of the Agreement, or will cause any Material Physical Injury to any party to the Judgment or the Basin. Any potential or threatened Material Physical Injury to any party to the Judgment or the Basin caused by the Transfer of water shall be fully and reasonably mitigated as a condition of approval. In the event the Material Physical Injury cannot be fully and reasonably mitigated, the request for Transfer must be denied.

(b) A party to the Judgment may make application to Watermaster to Transfer water as provided in the Judgment.

(i) Watermaster shall provide reasonable advance written notice to all the parties to the Judgment of a proposed Transfer, prior to approving the Transfer. The notice shall include the persons engaged in the Transfer, the location of the Production and Watermaster's analysis of the potential for Material Physical Injury, if any;

(ii) Watermaster shall approve the Transfer of water as provided in the Judgment so long as the individual Transfer does not result in any Material Physical Injury to any party to the Judgment or the Basin. Watermaster may approve a proposed Transfer with conditions that fully and reasonably mitigate any threatened or potential Material Physical Injury;

(iii) There shall be a rebuttable presumption that the Transfer and the Production by the transferee does not result in Material Physical Injury to a party to the Judgment or the Basin;

(iv) In the event any party to the Judgment, or Watermaster, objects to a proposed Transfer and submits evidence that there may be Material Physical Injury to any party to the Judgment or the Basin, Watermaster shall hold a Public Hearing and allow the objecting party to the Judgment a reasonable opportunity to be heard;

(v) Watermaster shall base any decision to approve or disapprove any proposed Transfer upon the record after considering potential impacts associated with the individual Transfer alone and without regard to impacts attributable to any other Transfers;

(vi) Any party to the Judgment may seek judicial review of the Watermaster's decision.

(c) Watermaster shall allow Producers to lease water rights to make up for the lessee's over-Production.

(d) Except as provided in Section 5.2, Producers shall not be required to file a storage and recovery or recapture plan except when Producing water transferred from a storage account.

(e) Watermaster shall approve the Transfer or lease of the quantified Production rights of Non-Agricultural Producers within the Non-Agricultural Pool subject to the provisions of paragraph (b) above. The right to Transfer within the pool includes the right to lease water to other members of the Non-Agricultural Overlying Pool. In addition, the parties to the Judgment with rights within the Non-Agricultural Pool shall have the additional right to Transfer their rights to Watermaster for the purposes of Replenishment for a Desalter or for a Storage and Recovery Program.

(f) Consistent with the provisions of 88-3, Watermaster shall approve the Transfer of unallocated Safe Yield under-Produced by the Agricultural Pool in Fiscal Year 1998-99, for Transfer to the Appropriative Pool in Fiscal Year 1999-2000, 35,262.452 acre-feet consistent with Watermaster Resolution 88-3. This Transfer shall be in addition to the Early Transfer of the 32,800 acre-feet per year from the Agricultural Pool to the Appropriative Pool referenced below in 5.3(g).

(g) Watermaster shall approve an "Early Transfer" of water to the Appropriative Pool in an amount not less than 32,800 acre-feet per year that is the expected approximate quantity of water not Produced by the Agricultural Pool. The quantity of water sub-

ject to Early Transfer under this paragraph shall be the greater of (i) 32,800 acre-feet or (ii) 32,800 acre-feet plus the actual quantity of water not Produced by the Agricultural Pool for that Fiscal Year that is remaining after all the land use conversions are satisfied pursuant to 5.3(i) below.

(i) The Early Transfer water shall be annually allocated among the members of the Appropriative Pool in accordance with their pro-rata share of the initial Safe Yield.

(ii) The Transfer shall not limit the Production right of the Agricultural Pool under the Judgment to Produce up to 82,800 acre-feet of water in any year or 414,000 acre-feet in any five years as provided in the Judgment.

(iii) The combined Production of all parties to the Judgment shall not cause a Replenishment assessment on the members of the Agricultural Pool. The Agricultural Pool shall be responsible for any Replenishment obligation created by the Agricultural Pool Producing more than 414,000 acre-feet in any five-year period.

(iv) The parties to the Judgment and Watermaster shall Produce water in accordance with the Operating Safe Yield and shall procure sufficient quantities of Replenishment Water to satisfy over-Production requirements, whatever they may be, and avoid Material Physical Injury to any party to the Judgment or the Basin;

(v) Nothing herein shall be construed as modifying the procedures or voting rights within or by the members of the Agricultural Pool.

(h) The amount of water rights converted for agricultural land to urban use is presently 2.6 acre-feet per acre, with 1.3 acre-feet per acre being allocated collectively to all members of the Appropriative Pool with an initial share of Safe Yield and 1.3 acre-feet per acre being allocated to that appropriator providing service for that urban use. The rate of 2.6 acre-feet per acre shall be changed to a total of 2.0 acre-feet per acre, all of which shall be allocated upon the conversion of the land to that party to the Judgment which is an a member of the Appropriative Pool, on the Effective Date of this Agreement, and whose Sphere of Influence or authorized service area contains the land (purveyor). Upon such conversion of water rights, the purveyor will pledge that amount of water needed for such urban land use, when such urban land use is established, up to 2 acre-feet of water per acre of land per year will be made available for service for such converted land by purveyor under its then-existing standard laws, regulations, rules and policies, or for service arranged by such purveyor, subject only to prohibition of such service by a federal, state agency or court with jurisdiction to enforce such prohibition. The owner of such converted land shall have the right to enforce such pledge by specific performance or writ of mandate under the terms of this Agreement. No monetary damages shall be awarded.

(*i*) The members of the Agricultural Pool, including the State of California, shall have the right to engage in a voluntary agreement with an appropriator which has a service area contiguous to or inclusive of the agricultural land, to provide the required water to the overlying land on behalf of the member of the Agricultural Pool unless otherwise prohibited by general law. The appropriator providing service shall be entitled to a credit to off-set Production to the extent it is serving the overlying land up to the amount of the historical maximum annual quantity of water previously used on the property.

5.4 Assessments, Credits, and Reimbursements. After the Effective Date and until the termination of this Agreement, the Parties expressly consent to Watermaster's performance of the following actions, programs or procedures regarding Assessments.

(a) During the term of this Agreement, all assessments and expenses of the Agricultural Pool including those of the Agricultural Pool Committee shall be paid by the Appropriative Pool. This includes but is not limited to OBMP Assessments, assessments pursuant to Paragraphs 20, 21, 22, 30, 42, 51, 53, 54 both General Administrative Expenses and Special Project Expenses, 55, and Exhibit F (Overlying Agricultural Pool Pooling Plan) of the Judgment except however in the event the total Agricultural Pool Production exceeds 414,000 acre-feet in any five consecutive year period as defined in the Judgment, the Agricultural Pool shall be responsible for its Replenishment obligation pursuant to Paragraph 45 of the Judgment.

(b) The City of Pomona (Pomona) shall be allowed a credit of up to $2 (two) million against OBMP Assessments for its installation and operation and maintenance of its existing anion exchange project, which is hereby determined to further the purposes of the OBMP. Pomona's construction and operation of its anion exchange project was not legally compelled and Pomona had no legal duty to construct the project. For the 30 (thirty) year initial Term of this Agreement, Pomona's OBMP Assessment shall be credited $66,667 per year, not to exceed Pomona's total BMP Assessment attributable to the project's Production for that year. Extension of the Term of this Agreement shall not extend the period of credit.

(c) Kaiser Ventures (Kaiser) in recognition of its contribution of 25,000 acre-feet to offset Replenishment obligations for the

Desalters shall be allowed a credit of up to $900,000 (nine hundred thousand dollars) against OBMP Assessments for the Desalters and related facilities. For the 30 (thirty) year initial Term of this Agreement, Kaiser's OBMP Assessment shall be credited up to $30,000 (thirty thousand dollars) per year, not to exceed Kaiser's OBMP Assessment attributable to Desalters and related facilities. Extension of the Term of this Agreement shall not extend the period of credit. In the event Kaiser Transfers its water rights appurtenant to its overlying land which it owns on the date of execution, the purchaser (Kaiser's successor in interest) shall be entitled one-half (½) of the annual credit.

(d) Watermaster shall adopt reasonable procedures to evaluate requests for OBMP credits against future OBMP Assessments or for reimbursement. Any Producer or party to the Judgment, including but not limited to the State of California, may make application to Watermaster for reimbursement or credit against future OBMP Assessments for any capital or operations and maintenance expenses incurred in the implementation of any project or program, including the cost of relocating groundwater Production facilities, that carries out the purposes of the OBMP including but not limited to those facilities relating to the prevention of subsidence in the Basin, in advance of construction or that is prospectively dedicated to service of the stated goals of the OBMP. Watermaster shall exercise reasonable discretion in making its determination, considering the importance of the project or program to the successful completion of the OBMP, the available alternative funding sources, and the professional engineering and design standards as may be applicable under the circumstances. However, Watermaster shall not approve such a request for reimbursement or credit against future BMP Assessments under this section where the

Producer or party to the Judgment was otherwise legally compelled to make the improvement.

(e) Any Producer that Watermaster compels to move a groundwater Production facility that is in existence on the Date of Execution shall have the right to receive a credit against future Watermaster assessments or reimbursement up to the reasonable cost of the replacement groundwater Production facility.

(f) The procurement of Replenishment Water and the levy of assessments shall be consistent with the provisions of Section 5.4(a) above.

5.5 Salt Credits. After the Effective Date and until the termination of this Agreement, the Parties expressly consent to Watermaster's performance of the following actions, programs or procedures regarding Salt Credits. Watermaster shall assign to the members of the Appropriative Pool, salt credits under the OBMP other than those that were previously allocated for the existing Chino I Desalter, or are attributable to a project or program undertaken by the State of California for the benefit of its overlying land and that carry out the purposes of the OBMP.

5.6 Metering. After the Effective Date and until the termination of this Agreement, the Parties expressly consent to Watermaster's performance of the following actions, programs or procedures regarding metering:

(a) With respect to the obligation to install meters, which is set forth in the Judgment Paragraph 21, any Assessment levied by Watermaster on the members of the Agricultural Pool, regarding metering shall be paid by the Appropriative Pool. Members of the Agricultural Pool, shall have no obligation to install meters hereafter. The obligation to install meters on wells

owned or operated by members of the Agricultural Pool, shall become that of the Watermaster.

(b) Agricultural Pool meters shall be installed within thirty-six months of the Date of Execution. Watermaster shall be responsible for providing the meter, as well as the cost of any installation, maintenance, inspection, testing and repairing. The members of the Agricultural Pool, shall provide reasonable access during business hours to a location reasonably appropriate for installation, inspection, and repairing of a meter.

(c) The State of California reserves its right to continue to install, operate, maintain, inspect, test and repair its own meters on wells owned or operated by the State, unless it consents to installation by Watermaster in which case Watermaster assumes the cost.

VI
COVENANTS BY THE MEMBERS OF THE AGRICULTURAL POOL

6.1 Best Efforts to Support Storage and Recovery. The members and representatives of the Agricultural Pool shall exercise Best Efforts to support the development of any Storage and Recovery Project, once it has been approved by Watermaster, so long as there is no Material Physical Injury to a member of the Agricultural Pool or the Basin.

6.2 Covenant of Good Faith and Fair Dealing. The members and representatives of the Agricultural Pool, including the State of California in its capacity as a member and owner of overlying land within the Agricultural Pool, shall be bound by the covenant of good faith and fair dealing, and not oppose or undermine the efforts of Watermaster to secure the development of a Storage and Recovery Program, so

long as there is no potential or threatened Material Physical Injury to a member of the Agricultural Pool or the Basin.

6.3 Waiver of Compensation. For the term of this Agreement, the members and representatives of the Agricultural Pool shall waive any claims or rights they might raise or possess, and shall not be entitled, to any compensation from a Storage and Recovery Program irrespective of whether it be in the form of money, revenues, credits, proceeds, programs, facilities, or other contributions (compensation). Further, the members of the Appropriative Pool and the Non-Agricultural Overlying Pool shall have the exclusive rights to any such compensation. This Section shall not apply to the charges adopted by CBWCD for storage and recovery purposes. This paragraph shall not be construed as a limitation on the ability of the State of California to make application to the Watermaster for a Storage and Recovery Program pursuant to Section 5.2.

VII
DESALTERS

7.1 Need for Desalters. The OBMP requires construction and operation of Desalters. The Desalters shall be owned, operated and maintained by IEUA and WMWD acting independently or in their complete discretion, acting through PC14 consistent with the terms of this Agreement.

7.2 Ownership and Operation.

(a) Chino I Desalter.

(i) The existing "Chino I Desalter," also known as the "SAWPA Desalter," consisting of extraction wells, transmission facilities for delivery of groundwater to the Chino I Desalter, Desalter treatment and delivery facil-

ities for product water, including pumping and storage facilities, and treatment and disposal capacity in the SARI System, is owned and operated by SAWPA, which has created "The Project Committee No. 14 (PC14)" comprised of SAWPA members, IEUA, WMWD, and OCWD, pursuant to "Project Agreement No. 14" dated April 2, 1991, to exercise all the powers and responsibilities of Section 18 of the SAWPA Joint Exercise of Powers Agreement, which now constitutes the executive authority through which SAWPA acts with respect to the Chino I Desalter and to fund repayment for any loans for construction and operation and maintenance of such Desalter and a "Financing Agreement" dated April 1, 2000.

(ii) The Chino I Desalter is operated pursuant to (a) "take or pay" agreements with the purchasers of water made available from such Desalter; (b) an agreement with the Metropolitan Water District (MWD) subsidizing that Desalter to reduce the cost of the water made available by that Desalter compared to the alternative cost of uninterruptible treated imported water available from MWD; and (c) an agreement with the Watermaster, all Pools of Producers from the Chino Basin, Kaiser Ventures, Inc., formerly known as Kaiser Resources, Inc. (Kaiser) and the California Regional Water Quality Control Board, Santa Ana Region (RWQB), regarding provision of certain water with which to satisfy the Replenishment obligation for operating the Desalter.

(b) Chino II Desalter and Chino I Expansion.

IEUA and WMWD acting independently or in their complete discretion through PC14 must own and operate the Chino II

Desalter and the Chino I Expansion in the same manner as the Chino I Desalter, except as otherwise provided in this Agreement.

(c) Future Desalters.

IEUA and WMWD acting independently or in their complete discretion through PC14 must own and operate Future Desalters, if and only if, they can secure funding from state, federal or sources other than the Parties to pay the capital costs required to construct Future Desalters.

7.3 Design and Construction of Chino II Desalter, Chino I Expansion and Future Desalters.

(a) IEUA and WMWD acting independently or in their complete discretion, acting through PC14 shall design and construct the Chino II Desalter on the eastside of the Chino Basin and expand the capacity of the Chino I Desalter already in existence on the Date of Execution, from 8 mgd up to 14 million gallons per day.

(b) The Chino II Desalter shall have an initial capacity of 10 mgd and shall be designed to deliver water to Jurupa Community Services District, the City of Ontario, and if requested, others subject to the limitations of available funding. The existing capacity of the Chino I Desalter shall be expanded by a minimum of 2 mgd and up to 6 mgd, depending on the rate of development and availability of funding and shall be designed to deliver water to the Cities of Chino, Chino Hills and the State of California as provided in this Section.

(c) There is no minimum initial capacity established for Future Desalters as the size and timing of Future Desalters are dependent upon variables not presently subject to reliable estimates.

(i) It is contemplated by the Parties that Future Desalters, and a further expansion of the Chino I Desalter to a capacity greater than the Chino I Expansion or the Chino II Desalter to a capacity greater than 10 mgd may occur;

(ii) IEUA and WMWD shall design and construct Future Desalters, whether acting independently, or in their complete discretion, through PC14, provided that their obligation shall be conditioned upon their ability to secure funding from the state or federal sources other than the Parties to pay the capital costs of construction. Absent such funding, the IEUA and WMWD, acting independently or, in their complete discretion, acting through PC14, shall have no obligation to construct Future Desalters;

(d) The specific location of wells to supply the Chino II Desalter and Future Desalters shall be determined with Watermaster approval and shall be in a location, which is consistent with and shall carry out the purpose of the OBMP. The design and construction of the Chino II Desalter, Chino I Expansion, and Future Desalters shall be in accordance with the OBMP and subject to Watermaster approval. Watermaster approval shall not be unreasonably withheld and shall insure that the operation of the Desalters will implement the OBMP and not result in Material Physical Injury to any party to the Judgment or the Basin.

(e) Wells operated in connection with the Desalters shall be designed and constructed to Produce water with high total

dissolved solids (TDS) and be located in areas consistent with the purposes of the OBMP.

7.4 Funding.

(a) The capital costs of the Chino I Desalter are not affected by this Agreement.

(b) The capital costs of designing and constructing the Chino II Desalter and the Chino I Desalter Expansion shall be partially derived from Proposition 13 funds. The Parties shall exercise their Best Efforts to secure said funds from the appropriate state agencies. However, all unmet capital, operation and maintenance costs relative to the Chino II Desalter shall be paid from the following sources and in the following order of priority:

(i) The net amount of funding received by SAWPA from its existing preliminary gross allocation of $87,000,000 from the $235,000,000 Proposition 13 bond funding provided for the Santa Ana River Watershed sub-account, which currently includes $20,000,000-30,000,000 earmarked for the Chino II Desalter and $5,000,000 for the Chino I Desalter Expansion;

(ii) All other eligible Proposition 13 bond funding;

(iii) All other available federal, state or SAWPA funding;

(iv) MWD subsidies or other funding without committing the storage space of the Chino Basin under any storage and recovery or conjunctive use agreement, such as that secured pursuant to Agreement Number 7658, between MWD, SAWPA, IEUA, WMWD and OCWD dated

December 7, 1995, and entitled "Chino Basin Desalinization Program, Phase I, Joint Participation Agreement for Recovery and Utilization of Contaminated Groundwater;"

(v) Revenue derived from the sale of water made available from the Desalters; and

(vi) Any additional revenue arranged by IEUA and WMWD acting independently or in their complete discretion, acting through PC14, pursuant to an agreement substantially similar to or an amendment of the SAWPA PC14 Agreement entered into on or about April 2, 1991.

(c) IEUA's and WMWD's obligation to construct Future Desalters whether acting independently, or in their complete discretion, through PC14, shall be conditioned upon their ability to secure state or federal funding to pay for the capital costs related to such construction. Absent such state and/or federal funding, the IEUA and WMWD, acting independently or, in their complete discretion, acting through PC14, shall have no obligation to construct Future Desalters.

(i) If, after the earlier of ten years, or the conversion of 20,000 acres of agricultural land, Watermaster, in its discretion, determines that Future Desalters are necessary to implement the OBMP, IEUA or WMWD, acting independently or in their complete discretion acting through PC14, shall have a period up to thirty-six (36) months to secure sufficient funding from State or Federal sources to pay for all the capital costs required to construct "Future Desalters;"

(ii) If IEUA and WMWD acting independently or, in their complete discretion, acting through PC14 cannot secure the necessary funding, the Parties, other than the Agricultural Pool, will exercise their Best Efforts to negotiate new terms and conditions so as to accomplish the implementation of this portion of the OBMP;

(iii) If, however, the Parties, other than the Agricultural Pool, are unable to negotiate new terms to this Agreement within twenty-four (24) months from the initiation of negotiations, the Parties may appoint a mutually agreed upon mediator. Failing an agreement, the Parties reserve all legal rights and remedies, provided that the Agricultural Pool shall not be liable for the costs of the Future Desalters. The remainder of this Agreement shall remain in full force and effect.

7.5 Replenishment Water. Replenishment for the Desalters shall be provided from the following sources in the following order of priority.

(a) Watermaster Desalter Replenishment account composed of 25,000 acre-feet of water abandoned by Kaiser pursuant to the "Salt Offset Agreement" dated October 21, 1993, between Kaiser and the RWQB, and other water previously dedicated by the Appropriative Pool.

(b) New Yield of the Basin, unless the water Produced and treated by the Desalters is dedicated by a purchaser of the desalted water to offset the price of desalted water to the extent of the dedication;

(c) Safe Yield of the Basin, unless the water Produced and treated by the Desalters is dedicated by a purchaser of the desalted

water to offset the price of desalted water to the extent of the dedication;

(d) Additional Replenishment Water purchased by Watermaster, the costs of which shall be levied as an Assessment by Watermaster.

7.6 Sale of Water.

(a) The terms and conditions for the purchase and sale of water from the Chino I Desalter shall be as provided by separate agreement.

(b) The terms and conditions for the purchase and sale of desalted water from the Chino II Desalter and Chino I Expansion are as follows.

(i) Members of the Appropriative Pool and the State of California shall have the first priority right to purchase desalted water developed by Chino II and Chino I Expansion on an equal basis, pursuant to a water supply contract, which is not a "take or pay" contract but contains a minimum annual quantity of water available to be purchased and is consistent with the provisions of this Agreement.

(ii) OCWD shall have the second priority right to purchase desalted water from the Chino II Desalter and the Chino I Expansion provided that IEUA and WMWD have elected to act through PC14.

(iii) If the members of the Appropriative pool, the State of California and the OCWD do not contract for the delivery of all desalted water made available by Chino

II Desalter and the Chino I Expansion, other persons may purchase the water.

(c) The terms and conditions for the purchase and sale of desalted water from Future Desalters are contingent upon IEUA and WMWD acting independently or, in their complete discretion, acting through PC14, securing sufficient funding to pay the capital costs of transporting the desalted water from the Chino II Desalter and Chino I Expansion to other parties to the Judgment that are members of the Appropriative Pool and that desire to purchase desalted water. If sufficient funding is acquired, then other parties to the Judgment that are members of the Appropriative Pool shall have the right to purchase desalted water under the terms and conditions provided in this Article.

(d) The price of desalted water to the parties to the Judgment that are members of the Appropriative Pool, the State of California and OCWD when purchasing water pursuant to Section 7.6(b)2 above, shall be the actual cost of providing the water but shall not exceed $375.00 per acre foot, as adjusted by the purchase and sale agreement between IEUA, WMWD, PC14 and the purchasing party, but in no event shall such adjustment exceed the annual consumer's price index for the LA/Anaheim/ Riverside Area or the percent increase in the MWD treated water rates, or its equivalent, whichever is less as measured from the Effective Date.

(i) If a party to the Judgment elects to Produce water for the Chino II Desalter, the Chino I Expansion or Future Desalters they shall be entitled to a credit against the purchase price in an amount equivalent to the cost of alternative Replenishment Water then available from MWD as interruptible, untreated water or the then pre-

vailing value of the avoided Replenishment obligation, whichever is less;

(ii) If the purchaser is a person other than a party to the Judgment, the price shall be no less than the cost of the alternative water supplies with comparable reliability and quality or if no purchasers are identified then at the highest price that may be attained under the circumstances;

(iii) Fifty percent of any annual revenues received by the Project 14 Committee in excess of the actual ongoing operation, maintenance and Replenishment expenses which revenues are derived from sales of water to any person not a Producer under the Judgment, or the OCWD, shall be provided to Watermaster for use as an off-set against any future assessments against the Parties by Watermaster.

(e) The term of such Water Supply Contract shall be not less than 30 years if requested by a Party to this Agreement.

VIII
TERM

8.1 Commencement. This Agreement shall become effective on the Effective Date and shall expire on the Termination Date.

8.2 Expiration. Unless extended pursuant to paragraph 8.3, this Agreement shall expire and thereupon terminate on December 31 of the thirtieth (30th) calendar year starting on January 1, of the first calendar year following the Effective Date.

8.3 Meet and Confer. The Parties agree to meet and confer during the 25th year of this Agreement to discuss any new or modified terms which may be requested or required by each Party in order to continue the term of this Agreement. However, no Party shall be required to modify or amend a term of this Agreement as a precondition to exercising their right to one thirty (30) year extension as provided in 8.4 below.

8.4 Independent Right to Extend. The term of this Agreement may be extended for a period of an additional thirty (30) years, upon the unilateral election of either the Appropriative or Agricultural Pool, (as a Pool only and not the individual members of either Pool) acting in accordance with Watermaster procedures under the Judgment, prior to the end of the twenty-fifth (25th) year. The election shall be made in writing with a copy to be sent to the Watermaster and all Parties to this Agreement. In the event an election is made to continue this Agreement, the Agreement shall continue for the extended term on the same terms and conditions as existed during the first thirty (30) years of the Agreement.

8.5 Force Majeure.

(a) If the performance, in whole or in part, of the obligations of the respective Parties is prevented by act or failure to act of any agency other than a Party to this Agreement, court or any other person, by natural disaster or catastrophic event (such as earthquake, fire, drought or flood), contamination, war, strikes, lockouts, acts of God, or acts of civil or military authority, by the operation of applicable law, or by any other cause beyond the control of the affected Party or Parties, whether similar to the causes specified herein or not, the obligation of the affected Party or Parties to perform an act or actions under this Agreement shall be suspended from the time and to the extent that the performance thereof is prevented, but reasonable diligence

shall be observed by the affected Party or Parties, so far as it lies in their power, in performing such respective obligations in whole or in part under this Agreement.

(b) In the event performance is prevented as described above, the Parties agree actively to cooperate and use their Best Efforts to resume performance.

8.6 Only One Mandatory Extension. In no event shall a Party be required to extend performance under this Agreement beyond the first two terms of this Agreement, irrespective of the existence of force majeure. Any further extensions under this Agreement shall be consensual among the Parties to such an agreement.

8.7 Effect of Termination. Upon termination of this Agreement further performance by the Parties under the Agreement shall be excused. Performance under the Agreement shall not be the cause of any action or claim other than as expressly provided herein. Other than as provided in paragraph 8.8, upon termination of this Agreement, the legal rights, remedies, responsibilities and authorities of all Parties regarding the Judgment, interpretation of the Judgment and the powers and authority of Watermaster or the Court, in existence on the Date of Execution, whatever they may be, are expressly reserved and shall be as they existed on the Date of Execution, provided that such rights and remedies shall not be a basis to challenge a Party's performance under this Agreement.

8.8 Rescission of Resolutions 84-2 and 88-3. Upon termination of this Agreement, the members of the Appropriative Pool shall have no obligation to pay the Watermaster Assessments for the members of the Agricultural Pool. The provisions of Resolution 84-2 and 88-3 shall be rescinded and except as provided for in Section V above,

pertaining to "Early Transfers" of Safe Yield during the term of this Agreement, the members of the Appropriative Pool shall not be entitled to further Early Transfers of water from the Agricultural Pool. Upon the termination of this Agreement, the Parties agree that no further Early Transfers of unallocated Safe Yield shall occur. The determination of the Safe Yield as provided for in the Judgment at Paragraph 44 shall be construed to mean that the Appropriative Pool shall receive no Transfers of unallocated Safe Yield from the Agricultural Pool for a period of five (5) consecutive years after the termination of this Agreement, at which time the Appropriative Pool shall receive the difference between 414,000 acre-feet allocated to the Agricultural Pool and the actual water used by the Agricultural Pool for the first five consecutive calendar years immediately following the termination of this Agreement.

8.9 Mediation Upon Failure to Secure Capital Funding for Future Desalters. If IEUA or WMWD have not acquired the funding within thirty-six (36) months of the date of the Watermaster determination regarding the need for the Future Desalters as provided in Article VII, then the members of the Appropriative Pool, Non-Agricultural Pool and IEUA and WMWD will exercise Best Efforts to negotiate new terms and conditions for the capital costs for any such Future Desalters.

8.10 Parties Rights Unaffected Upon Termination. Each Party's rights shall be unaffected by their having approved, executed or implemented this Agreement pursuant to their mutual consent other than as provided is Section 8.8.

IX
CONFLICTS

9.1 Events Constituting a Default by a Party. Each of the following constitutes a "default" by a Party under this Agreement.

(a) A Party fails to perform or observe any term, covenant, or undertaking in this Agreement that it is to perform or observe and such failure continues for ninety (90) days from a Notice of Default being sent in the manner prescribed in Section 10.13.

9.2 Remedies Upon Default. In the event of a default, each Party shall have the following rights and remedies:

(a) Specific Performance. Each Party agrees and recognizes that the rights and obligations set forth in this Agreement are unique and of such a nature as to be inherently difficult or impossible to value with money. If one Party does not perform in accordance with the specific wording of any of the provisions in this Agreement applicable to that Party, defaults, or otherwise breaches this Agreement, an action at law for damages or other remedies at law would be wholly inadequate to protect the unique rights and interests of the other Party to the Agreement. Accordingly, in any court controversy concerning this Agreement, the Agreement's provisions will be enforceable in a court of equity by specific performance. This specific performance remedy is not exclusive and is in addition to any other remedy available to the Parties to enforce the terms of this Agreement.

(b) Injunction. Each Party agrees and recognizes that the rights and obligations set forth in this Agreement are material to another Party and of such a nature that there will be substantial

reliance upon the terms of this Agreement. If one Party does not perform in accordance with specific wording of any of the provisions of this Agreement applicable to that Party, defaults, or otherwise breaches this Agreement, an action at law for damages or other remedies at law would be wholly inadequate to prevent substantial and irreparable harm to another Party to the Agreement. Accordingly, in any court controversy concerning this Agreement, the Agreement's provisions will be enforceable in a court of equity by mandatory and prohibitory injunction. This mandatory and prohibitory injunction remedy is not exclusive and is in addition to any other remedy available to the Parties to enforce the terms of this Agreement.

(c) Cumulative Rights and Remedies. The Parties do not intend that any right or remedy given to a Party on the breach of any provision under this Agreement be exclusive; each such right or remedy is cumulative and in addition to any other remedy provided in this Agreement or otherwise available at law or in equity. If the non-breaching Party fails to exercise or delays in exercising any right or remedy, the non-breaching Party does not thereby waive that right or remedy. Furthermore, no single or partial exercise of any right, power, or privilege precludes any further exercise of a right, power, or privilege granted by this Agreement or otherwise.

(d) Attorneys' Fees. In any adversarial proceedings between the Parties other than the dispute resolution procedure set forth below and under the Judgment, the prevailing Party shall be entitled to recover their costs, including reasonable attorneys' fees. If there is no clear prevailing Party, the Court shall determine the prevailing Party and provide for the award of costs and reasonable attorneys' fees. In considering the reasonableness of either Party's request for attorneys' fees as a prevailing Party, the Court shall consider the quality, efficiency, and

value of the legal services and similar/prevailing rate for comparable legal services in the local community.

9.3 Dispute Resolution.

(a) Scope of Dispute Resolution. Disputes (Disputes) between the Parties other than those constituting a "Default", or "Exclusion" (defined below), shall be resolved pursuant to the provisions of this Section.

(b) Exclusions:

(i) Emergency. An emergency event which, if not promptly resolved may result in imminent danger to the public health, safety or welfare shall not be subject to dispute resolution.

(ii) Complete Discretion. Those matters reserved to the complete discretion of a Party under this Agreement shall not be subject to dispute resolution.

(iii) Review Under the Judgment Unaffected. The rights and remedies of the parties to the Judgment to seek review of Watermaster actions shall not be subject to dispute resolution.

(c) Disputes.

(i) Each Party to this Agreement may submit any Dispute related to or arising under this Agreement to non-binding mediation by delivering a Notice of Dispute to the other Party;

(ii) The written Notice of Dispute prepared by the Party shall be delivered to the other Party in accordance with Section 10.13. The Notice of Dispute shall clearly describe the basis of the dispute and the Sections of the Agreement under which the Dispute arises;

(iii) The non-binding mediation shall be conducted by Judicial Arbitration Mediation Services (JAMS) or an equivalent mediation service agreed to by the Parties;

(iv) Unless otherwise agreed, a mediator shall be appointed within forty-five (45) days of the date the Notice of Dispute is delivered to hear the dispute and provide a written determination. The mediator shall be chosen jointly by the Parties. If the Parties cannot agree, the Court shall appoint the mediator. Employees or agents of Watermaster or any Party are ineligible to serve as the mediator;

(v) The mediation shall be held within ninety (90) days of the date the Notice of Dispute is delivered;

(vi) Any statute of limitations applicable to any claims, rights, causes of action, suits, or liabilities of whatever kind or nature, in law, equity or otherwise, whether known or unknown, shall be tolled during the mediation process. For purposes of this Section, the mediation process shall commence upon the service of a Notice of Dispute to the other Party pursuant to Section 9.3c(i) above. For purposes of this Section, the mediation process shall be deemed complete ten (10) days after service of the mediator's written notice of the conclusion of the mediation;

X
GENERAL PROVISIONS

10.1 Supersedence. Upon execution of this Agreement, any and all existing agreements or contracts between the Parties concerning the precise subject matter of this Agreement are hereby rescinded to the extent that they conflict with express terms herein.

10.2 Applicability to Others.

(a) After the Date of Execution, each Party agrees that any other agreement or contract relating to the subject matter of this Agreement, or the Judgment, to which it is a party, shall be consistent with the provisions of this Agreement, unless all other Parties consent to the inconsistent agreement or contract.

(b) After the Date of Execution, each Party reserves complete discretion to enter into other agreements or contracts on subject matter not covered by the terms of this Agreement.

10.3 Admissions by Parties. Nothing in this Agreement constitutes an admission of liability by any Party hereto for any prior or past acts that preceded the Date of Execution. This Agreement and any documents prepared in connection herewith may not be used as evidence in any litigation, except as necessary to interpret or enforce the terms of this Agreement.

10.4 Construction of Agreement. Each Party, with the assistance of competent legal counsel, has participated in the drafting of this Agreement and any ambiguity should not be construed for or against any Party on account of such drafting.

10.5 Each Party Bears Own Costs. Each Party is to bear its own costs, expenses, and attorneys' fees arising out of or in connection with the subject matter of this Agreement and the negotiation, drafting, and execution of this Agreement. Each of the Parties understands that this Agreement includes all claims for loss, expense and attorneys' fees, taxable or otherwise, incurred by it or arising out of any matters leading up to the execution of this Agreement.

10.6 Waiver of Breach. No waiver or indulgence of any breach or series of breaches of this Agreement shall be deemed or construed as a waiver of any other breach of the same or any other provision hereof or affect the enforceability of any part or all of this Agreement. No waiver shall be valid unless executed in writing by the waiving Party.

10.7 Awareness of Contents/Legal Effect. The Parties expressly declare and represent that they have read the Agreement and that they have consulted with their respective counsel regarding the meaning of the terms and conditions contained herein. The Parties further expressly declare and represent that they fully understand the content and effect of this Agreement and they approve and accept the terms and conditions contained herein, and that this Agreement is executed freely and voluntarily.

10.8 Agreement Binding On All. This Agreement shall be binding upon and shall inure to the benefit of each of the Parties, and each of their respective agents, employees, directors, officers, attorneys, representatives, principals, shareholders, sureties, parents, subsidiaries, affiliates, successors, predecessors, assigns, trustees or receivers appointed to administer their assets, and attorneys of any and all such individuals and entities. All the covenants contained in this Agreement are for the express benefit of each and all such persons described in this Section. This Agreement is not intended to benefit any third parties.

10.9 Counterparts. This Agreement may be executed in counterparts. This Agreement shall become operative as soon as one counterpart hereof has been executed by each Party. The counterparts so executed shall constitute one Agreement notwithstanding that the signatures of all Parties do not appear on the same page.

10.10 Captions. The captions contained herein are included solely for convenience and shall not be construed as part of this Agreement or as full or accurate descriptions of the terms hereof.

10.11 Choice of Law. This Agreement shall be construed and enforced pursuant to the laws of the State of California.

10.12 Authority to Enter into This Agreement. Each Party represents and warrants that its respective obligations herein are legal and binding obligations of such Party; that each Party is fully authorized to enter into this Agreement, and that the person signing this Agreement hereinafter for each Party has been duly authorized to sign this Agreement on behalf of said Party.

10.13 Notice.

(a) Any notice required under this Agreement shall be written and shall be served either by personal delivery, mail or fax.

(b) In the case of service by personal delivery or fax, no additional time, in days, shall be added to the time in which a right may be exercised or an act may be done.

(c) In the case of service by mail, notice must be deposited in a post office, mailbox, sub post-office, substation, or mail chute, or other like facility regularly maintained by the United States Postal Service, in a sealed envelope, with postage paid, addressed to the representative(s) of the Party

on whom it is to be served, at their place of business. The service is complete at the time of deposit. Any period of notice and any right or duty to do any act or make any response within any period or on a date certain after service of notice by mail shall be extended five days. Any period of notice and any right or duty to do any act or make any response within any period or on a date certain after service of notice by Express mail or other method of delivery providing for overnight delivery shall be extended by two court days.

10.14 Amendments and/or Changes to Agreement.

(a) Any amendments and/or changes to this Agreement must be in writing, signed by a duly authorized representative of the Parties hereto, and must expressly state the mutual intent of the Parties to amend this Agreement as set forth herein. The Parties to this Agreement recognize that the terms and conditions of this Agreement, which are set forth herein in the Sections preceding this Section have been arrived at through the collective negotiations by the Parties.

(b) The Parties hereby agree that no amendments and/or changes may be made to this Agreement without the express written approval of each Party to this Agreement, provided that upon request, no such approval shall be unreasonably withheld.

XI
ACKNOWLEDGMENTS: CONFIRMATION OF RIGHTS

11.1 Each Party's rights to water it presently holds in storage with Watermaster are confirmed and protected.

11.2 The Parties confirm that in addition to the benefits received by the State under this Agreement, including an exemption from the payment of Watermaster Assessments as a member of the Agricultural Pool, the rights of the State of California under the Judgment to Produce water are not modified or altered by this Agreement. For all purposes of the Judgment all future Production by the State or its departments or agencies, including but not limited to the Department of Corrections, Department of Fish and Game, Youth Authority, Department of Parks and Recreation, Department of Toxic Substances Control, and Department of Transportation as set forth in Paragraph 10 of the Judgment, for overlying use on State-owned lands, shall be considered use by the Agricultural Pool. This Agreement is not intended to limit the State or its departments or agencies including but not limited to, the Department of Corrections, Department of Fish and Game, Youth Authority, Department of Parks and Recreation, Department of Toxic Substances Control, and Department of Transportation from exercising the State's rights of future Production for overlying use on State-owned lands as set forth in Paragraph 10 of the Judgment. The Parties agree that they will not oppose the State's exercise of its rights pursuant to the Judgment. The State of California is not executing this Agreement on behalf of the State Water Resources Control Board, the Department of Water Resources, Department of Toxic Substances Control, or the California Regional Water Quality Control Board or the Department of Fish and Game except as stated above. Nothing in this Agreement shall be construed in any way as modifying, altering or limiting the regulatory and trustee obligations, legal rights or duties of any State Agencies, including the Department of Fish and Game, the State Water Resources Control, the California Regional Water Quality Control Boards, the Department of Toxic Substances Control and Department of Water Resources. This Agreement does not limit in any way, and expressly recognizes the rights and ability of the Department of Water Resources to make application to

Watermaster to use groundwater storage space in the Chino Basin as described in Water Code Section 11258 and as provided in Section 5.2(c) herein.

11.3 Nothing in this Agreement shall be construed as modifying, altering, or limiting CBWCD from carrying out its obligations under general law.

IN WITNESS WHEREOF, the Parties hereto have set forth their signatures as of the date written below:

DATED: 7/31/00

CITY OF ONTARIO

By _____

DATED:

CITY OF POMONA

By _____

DATED:

CITY OF UPLAND

By _____

[Signatures continued on following pages]

Watermaster to use groundwater storage space in the Chino Basin as described in Water Code Section 11258 and as provided in Section 5.2(c) herein.

11.3 Nothing in this Agreement shall be construed as modifying, altering, or limiting CBWCD from carrying out its obligations under general law.

IN WITNESS WHEREOF, the Parties hereto have set forth their signatures as of the date written below:

DATED: **CITY OF ONTARIO**

By_____

DATED: **CITY OF POMONA**

7-31-2000

By_____

DATED: **CITY OF UPLAND**

By_____

[Signatures continued on following pages]

Watermaster to use groundwater storage space in the Chino Basin as described in Water Code Section 11258 and as provided in Section 5.2(c) herein.

11.3 Nothing in this Agreement shall be construed as modifying, altering, or limiting CBWCD from carrying out its obligations under general law.

IN WITNESS WHEREOF, the Parties hereto have set forth their signatures as of the date written below:

DATED: **CITY OF ONTARIO**

By_____

DATED: **CITY OF POMONA**

By_____

DATED: 7/24/00 **CITY OF UPLAND**

By Robert R. Nolan

[Signatures continued on following pages]

DATED: 8/1/00

STATE OF CALIFORNIA

By Marilyn H. Levin

DATED:

CITY OF CHINO

By_____

DATED:
07/31/00

CUCAMONGA COUNTY WATER DISTRICT

By Jerome M. Wilson

DATED:

MONTE VISTA WATER DISTRICT

By_____

DATED: 7-27-2000

FONTANA UNION WATER COMPANY

By Ronald J. Black

[Signatures continued on following pages]

DATED: **STATE OF CALIFORNIA**

By_____

DATED: **CITY OF CHINO**

By_____

DATED: **CUCAMONGA COUNTY WATER DISTRICT**

By_____

DATED: **MONTE VISTA WATER DISTRICT**

By_____

DATED: **FONTANA UNION WATER COMPANY**

By_____

[Signatures continued on following pages]

DATED: **STATE OF CALIFORNIA**

By_____

DATED: **CITY OF CHINO**

By_____

DATED: **CUCAMONGA COUNTY WATER DISTRICT**

By_____

DATED: 7/31/00 **MONTE VISTA WATER DISTRICT**

By_____

DATED: **FONTANA UNION WATER COMPANY**

By_____

[Signatures continued on following pages]

DATED: **CITY OF CHINO HILLS**

By_____

DATED: **JURUPA COMMUNITY SERVICES DISTRICT**

By_____

DATED: **AGRICULTURAL POOL**

By_____

DATED: **APPROPRIATIVE POOL**

By_____

DATED: 7/27/00 **NON-AGRICULTURAL POOL**

By_____

[Signatures continued on following pages]

DATED: 7/31/00

CITY OF CHINO HILLS

By_____

DATED:

JURUPA COMMUNITY SERVICES DISTRICT

By_____

DATED:

AGRICULTURAL POOL

By_____

DATED:

APPROPRIATIVE POOL

By_____

DATED:

NON-AGRICULTURAL POOL

By_____

[Signatures continued on following pages]

DATED:
July 31, 2000

INLAND EMPIRE UTILITY AGENCY

By John L. Anderson

DATED:

THREE VALLEYS MUNICIPAL WATER DISTRICT

By_____

DATED:

KAISER VENTURES, INC.

By_____

DATED:

WESTERN MUNICIPAL WATER DISTRICT

By_____

[Signatures continued on following pages]

DATED:

INLAND EMPIRE UTILITY AGENCY

By_____

DATED:

THREE VALLEYS MUNICIPAL WATER DISTRICT

By_____

DATED: 7/31-00

KAISER VENTURES, INC.

By_____

DATED:

WESTERN MUNICIPAL WATER DISTRICT

By_____

[Signatures continued on following pages]

DATED:

INLAND EMPIRE UTILITY AGENCY

By_____

DATED:

THREE VALLEYS MUNICIPAL WATER DISTRICT

By_____

DATED:

KAISER VENTURES, INC.

By_____

DATED:

WESTERN MUNICIPAL WATER DISTRICT

By_____

[Signatures continued on following pages]

DATED: 7/31/00

SAN ANTONIO WATER COMPANY

By Tom Thomas

DATED:

CHINO BASIN WATER CONSERVATION DISTRICT

By_____

DATED:

[Signatures continued on following pages]

DATED:

SAN ANTONIO WATER COMPANY

By_____

DATED: 7/28/2000

CHINO BASIN WATER CONSERVATION DISTRICT

By_____

DATED:

[Signatures continued on following pages]

EXHIBIT A

WATERMASTER RESOLUTION
NO. 2000-__

RESOLUTION OF THE CHINO BASIN WATERMASTER TO ADOPT THE GOALS AND PLANS OF THE PHASE I REPORT AS IMPLEMENTED BY THE OBMP IMPLEMENTATION PLAN, CONSISTENT WITH THE PEACE AGREEMENT AS ITS OBMP ("OBMP"), TO ADOPT THE REQUISITE POLICIES AND PROCEDURES TO IMPLEMENT THE PROVISIONS SET FORTH IN ARTICLE V OF THE PEACE AGREEMENT ON OR BEFORE DECEMBER 31, 2000, AND TO APPROVE THE "PEACE AGREEMENT."

WHEREAS, the Judgment in the Chino Basin Adjudication, *Chino Basin Municipal Water District v. City of Chino, et al.*, San Bernardino Superior Court No. 164327, created the Watermaster and directed it to perform the duties as provided in the Judgment or ordered or authorized by the Court in the exercise of the Court's continuing jurisdiction; and

WHEREAS, the Judgment directs Watermaster to develop an OBMP subject to the limitations contained in the Judgment; and

WHEREAS, Watermaster and prepared and submitted a Phase I Report regarding the OBMP to the Court; and

WHEREAS, the Court ordered the Inland Empire Utilities Agency (IEUA) to act as "lead agency" for the purposes of preparing any applicable environmental review for the OBMP in the form of a Programmatic Environmental Impact Report (PEIR) and the Court is exercising continuing jurisdiction over this matter; and

WHEREAS, the parties developed a Memorandum of Principles which articulated a framework of an agreement which the Watermaster Board

articulated a framework of an agreement which the Watermaster Board unanimously approved on May 26, 2000; and

WHEREAS, the parties have reduced the principles into a more definitive agreement and an OBMP Implementation Plan.

WHEREAS, the goals and plans in the Phase I Report implemented consistent with the OBMP Implementation Plan and the Peace Agreement constitute the OBMP; and

WHEREAS, the IEUA has prepared and circulated a draft PEIR and held a public meeting to take public comment on the OBMP on June 28, 2000; and

WHEREAS, the parties to the Peace Agreement and the parties to the Judgment have requested Watermaster to approve the Peace Agreement and the OBMP Implementation Plan and to implement the goals and plans contained in the OBMP Phase I Report in a manner consistent with the Peace Agreement and the OBMP Implementation Plan.

NOW, THEREFORE, IT IS HEREBY RESOLVED AND DETERMINED THAT:

1. The goals and plans in the Phase I Report and their implementation as provided in and consistent with the Implementation Plan and the Peace Agreement are in furtherance of the physical solution set forth in the Judgment and Article X, Section 2 of the California Constitution.

2. Although not a signatory, the Chino Basin Watermaster Board supports and approves the Peace Agreement negotiated by the parties thereto.

3. Subject to the satisfaction of all conditions precedent set forth in the Peace Agreement and the unanimous approval of the Peace Agreement by the Parties thereto no later than August 1, 2000:

   a. Watermaster adopts the goals and plans of the Phase I Report consistent with the Implementation Plan and the Peace Agreement.

   b. The Watermaster will proceed in accordance with the OBMP Implementation Plan and the Peace Agreement.

   c. Watermaster will comply with the conditions described in Article V of the Peace Agreement labeled, "Watermaster Performance" and Watermaster shall adopt all necessary policies and procedures in order to implement the provisions set forth in Article V on or before December 31, 2000, unless an earlier date is specified in the Peace Agreement or the OBMP Implementation Plan.

4. The Watermaster Board will transmit a request to the Court to issue an Order authorizing and directing Watermaster to proceed in accordance with this Resolution.

5. In approving this Agreement, Watermaster is not committing to carry-out any project within the meaning of CEQA unless and until environmental review and assessments required by CEQA

for that defined "project" have been completed. Any future actions that meet the definition of a "project" under CEQA shall be subject to environmental documentation.

California Regional Water Quality Control Board
Santa Ana Region

RESOLUTION NO. R8-2004-0001

Resolution Amending the Water Quality Control Plan for the Santa Ana River Basin to Incorporate an Updated Total Dissolved Solids (TDS) and Nitrogen Management Plan for the Santa Ana Region Including Revised Groundwater Subbasin Boundaries, Revised TDS and Nitrate-Nitrogen Quality Objectives for Groundwater, Revised TDS and Nitrogen Wasteload Allocations, and Revised Reach Designations, TDS and Nitrogen Objectives and Beneficial Uses for Specific Surface Waters

WHEREAS, the California Regional Water Quality Control Board, Santa Ana Region (hereinafter Regional Board), finds that:

1. An updated Water Quality Control Plan for the Santa Ana River Basin (Basin Plan) was adopted by the Regional Board on March 11, 1994, approved by the State Water Resources Control Board (SWRCB) on July 21, 1994, and approved by the Office of Administrative Law (OAL) on January 24, 1995.

2. The updated Basin Plan incorporated the revised Total Inorganic Nitrogen (TIN) wasteload allocation that had been adopted and incorporated in the Basin Plan in 1991. The updated Basin Plan also included a revised Nitrogen and TDS management plan, including a revised TDS wasteload allocation for discharges to the Santa Ana River and its tributaries, revised findings regarding Nitrogen and TDS assimilative capacity in groundwater, and a plan for wastewater reclamation in the Region.

3. During consideration of adoption of the updated Basin Plan, watershed stakeholders questioned the validity of the groundwater quality objectives for TDS and nitrate-nitrogen and the Regional Board's Nitrogen/TDS management plan that implemented those objectives. A principal underlying concern was that the updated Basin Plan resulted in inappropriate constraints on wastewater recycling opportunities. Reuse of recycled water is a critical component of many agencies' plans to meeting rapidly increasing water demands in the Region. In response to these concerns, the Regional Board agreed to make the review of the objectives a high triennial review priority.

4. The Nitrogen/TDS Task Force (Task Force) was formed in 1995-96 to conduct studies regarding the TDS and nitrate-nitrogen objectives and other components of the N/TDS management plan. The Task Force was comprised of 22 water supply and wastewater agencies throughout the Region. The Task Force effort was coordinated by the Santa Ana Watershed Project Authority. Regional Board staff were active participants in the Task Force effort. Findings and recommendations based on the Task Force studies were presented to the Regional Board at numerous public workshops during the course of the studies.

5. The Task Force studies were guided by current law and regulation. The Task Force recommendations for changes to the TDS and nitrate-nitrogen water quality objectives for groundwater within the Region are based on consideration of the factors specified in Water Code Section 13241 and the state's antidegradation policy (SWRCB Resolution No. 68-16). The economic implications of all recommended changes to the N/TDS management plan were also considered. The Task Force studies were based on sound and objective science.

6. The Basin Plan amendments delineated in the attachment to this Resolution and described in detail in accompanying staff reports are the culmination of the multi-year, multi-million dollar (approximately $3.5 million) studies conducted by the Task Force to review groundwater TDS and nitrate-nitrogen objectives, groundwater subbasin boundaries, the TIN and TDS wasteload allocations and other components of the N/TDS management plan.

7. The Basin Plan amendments will assure the reasonable protection of the beneficial uses of surface and groundwaters within the Region and are consistent with the state's antidegradation policy (SWRCB Resolution No. 68-16).

8. The proposed amendment to the Basin Plan was developed in accordance with the California Water Code, Section 13240 et seq.

9. The Regional Board has considered the costs associated with implementation of this amendment and finds the costs to be reasonable.

10. The proposed amendment results in no potential for adverse effects, either individually or cumulatively, on fish and/or wildlife species.

11. The proposed amendment meets the "Necessity" standard of the Administrative Procedure Act, Government Code, Section 11352, subdivision (b).

12. The Regional Board submitted the relevant technical documents that serve as the basis for the proposed amendment to an external scientific review panel and has considered the comments and recommendations of that panel in drafting the amendment.

13. The proposed amendment will result in revisions to Basin Plan Chapter 3 "Beneficial Uses", Chapter 4 "Water Quality Objectives, and Chapter 5 "Implementation" .

14. The Regional Board discussed this matter at a workshop conducted on November 21, 2003 after notice was given to all interested persons in accordance with Section 13244 of the California Water Code. Based on the discussion at that workshop, the Board directed staff to prepare the appropriate Basin Plan amendment and related documentation to incorporate language authorizing an update of the total dissolved solids/nitrogen management plan for the Santa Ana Region.

15. The Regional Board prepared and distributed written reports (staff reports) regarding adoption of the Basin Plan amendment in accordance with applicable state and federal environmental regulations (California Code of Regulations, Section 3775, Title 23, and 40 CFR Parts 25 and 131).

16. The process of basin planning has been certified by the Secretary for Resources as exempt from the requirement of the California Environmental Quality Act (Public Resources Code Section 21000 et seq.) to prepare an Environmental Impact Report or Negative Declaration. The Basin Plan amendment package includes staff reports, an Environmental Checklist, an assessment of the potential environmental impacts of the Basin Plan amendment, and a discussion of alternatives. The Basin Plan amendment, Environmental Checklist, staff reports, and supporting documentation are functionally equivalent to an Environmental Impact Report or Negative Declaration.

17. On January 22, 2004, the Regional Board held a Public Hearing to consider the Basin Plan amendment. Notice of the Public Hearing was given to all interested persons and published in accordance with Water Code Section 13244.

18. The Basin Plan amendment must be submitted for review and approval by the State Water Resources Control Board (SWRCB), and Office of Administrative Law (OAL) and U.S. Environmental Protection Agency (USEPA). Once approved by the SWRCB, the amendment is submitted to OAL and USEPA. The Basin Plan amendment will become effective upon approval by OAL and USEPA. A Notice of Decision will be filed.

NOW, THEREFORE, BE IT RESOLVED THAT:

1. Pursuant to Sections 13240 and 13241 of the California Water Code, the Regional Board, after considering the entire record, including oral testimony provided at the public hearing, adopts the amendment to the Water Quality Control Plan for the Santa Ana River Basin as set forth in the Attachment.

2. The Executive Officer is directed to forward copies of the Basin Plan amendment to the SWRCB in accordance with the requirements of Section 13245 of the California Water Code.

3. The Regional Board requests that the SWRCB approve the Basin Plan amendment in accordance with the requirements of Sections 13245 and 13246 of the California Water Code and forward it to the Office of Administrative Law and the USEPA for approval.

4. If during its approval process the SWRCB or OAL determines that minor, non-substantive corrections to the language of the amendment are needed for clarity or consistency, the Executive Officer may make such changes, and shall inform the Regional Board of any such changes.

5. The Executive Officer is authorized to sign the Department of Fish and Game Certificate of Fee Exemption.

I, Gerard J. Thibeault, Executive Officer, do hereby certify that the foregoing is a full, true and correct copy of a resolution adopted by the California Regional Water Quality Control Board, Santa Ana Region, on January 22, 2004.

(original signed by)
Gerard J. Thibeault
Executive Officer

Attachment to Resolution No. R8-2004-0001

(Proposed Basin Plan amendment changes are shown as ~~strikeout~~ for deletions and underline for additions)

Chapter 3, "Beneficial Uses":

- **p. 3-3:** **"**More than one beneficial use may be identified for a given waterbody. The most sensitive use must be protected. ~~Water quality objectives are established (Chapter 4) which are sufficiently stringent to protect the most demanding use.~~ The Regional Board reserves the right to resolve any conflicts among beneficial uses based on the facts in a given case."

Add the following new sections prior to "Beneficial Use Tables" on page 3-5:

GROUNDWATER

Groundwater subbasin boundaries included in the 1975 and 1984 Basin Plans, and initially in this 1995 Basin Plan, were, for the most part, based on data and information collected in the 1950's and 1960's. Since these boundaries were first established in the 1975 Basin Plan, a considerable amount of new water level, water quality and geologic data has become available. As part of the 2004 update of the TDS/Nitrogen management plan in the Basin Plan (see further discussion of this work in Chapter 5 – Salt Management Plan), these new data were used to review and revise the sub-basin boundaries.

To accomplish this task, all available geologic studies of the Santa Ana Region, through 1995, were gathered and re-analyzed. A comprehensive database of water level and water quality data and well drilling logs was created and utilized to delineate revised groundwater subbasin boundaries, now designated as groundwater "Management Zones". The groundwater Management Zones are shown in Figures 3-3 through 3-7.

The specific technical basis for distinguishing each groundwater Management Zone is provided in the report entitled "TIN/TDS Study – Phase 2A Final Technical Memorandum," Wildermuth Environmental, Inc., July 2000. In general, the new groundwater Management Zone boundaries were defined on the basis of (1) separation by impervious rock formations or other groundwater barriers, such as geologic faults; (2) distinct flow systems defined by consistent hydraulic gradients that prevent widespread intermixing, even without a physical barrier; and (3) distinct differences in water quality. Groundwater flow, whether or not determined by a physical barrier, was the principal characteristic used to define the Management Zones. Water quality data were used to support understanding of the flow regime and to assure that unusually high or poor quality waters were distinguished for regulatory purposes.

In addition to these technical considerations, water and wastewater management practices and goals for the Chino Basin were considered and used to define an alternative set of Management Zone boundaries for that area. These so-called "maximum benefit" Management Zone delineations , shown in Figure 3-5a, were developed as part of recommendations by the Chino Basin Watermaster and the Inland Empire Utilities Agency (IEUA) to implement a "maximum benefit" proposal, including an Optimum Basin Management Plan (OBMP), for the area. These agencies have committed to the implementation of a specific set of projects and requirements in order to demonstrate that the "maximum benefit"

Management Zone boundaries , and particularly the "maximum benefit" nitrate-nitrogen and TDS objectives for these Zones (see Chapter 4), assure protection of beneficial uses and are of maximum benefit to the people of the state (see Chapter 5, VII. Maximum Benefit Implementation Plans for Salt Management, A. Salt Management – Chino Basin and Cucamonga Basin). These "maximum benefit" Management Zone boundaries apply for regulatory purposes provided that the Regional Board continues to find that the Watermaster and IEUA are demonstrating "maximum benefit" by timely and appropriate implementation of these agencies' commitments. If the Regional Board finds that these commitments are not being met and that "maximum benefit" is not being demonstrated, then the Management Zone boundaries for the Chino Basin shown in Figure 3-5b apply for regulatory purposes.

PRADO BASIN MANAGEMENT ZONE (PBMZ)

The flood plain behind Prado Dam has unique hydraulic characteristics. Chino Creek, Cucamonga Creek (which flows into Mill Creek) and Temescal Creek join the Santa Ana River behind the dam. Flood control operations at the dam, coupled with an extremely shallow groundwater table and an unusually thin aquifer, significantly affect these surface flows, as well as subsurface flows in the area. Depending on how the dam is operated, surface waters may or may not percolate behind the dam. There is little or no groundwater storage in the flood plain behind the dam. Any groundwater in storage is forced to the surface because the foot of Prado Dam extends to bedrock and subsurface flows cannot pass through the barrier created by the dam and the surrounding hills. Given these characteristics, this area is designated as a surface water management zone, rather than a groundwater management zone. The Prado Basin Management Zone is generally defined by the 566-foot elevation above mean sea level. It extends from Prado Dam up Chino Creek, Reach 1A and 1B to the concrete-lined portion near the road crossing at Old Central Avenue, up the channel of Mill Creek (Prado Area) to where Mill Creek becomes named as Cucamonga Creek and the concrete-lined portion near the crossing at Hellman Road, up what was formerly identified as Temescal Creek, Reach 1A (from the confluence with the Santa Ana River upstream of Lincoln Avenue) (this area is indistinguishable because of shifting topography and is now considered a part of the Prado Basin Management Zone), and up the Santa Ana River, Reach 3 to the 566-foot elevation (just west of Hamner Avenue). The Prado Basin Management Zone encompasses the Prado Flood Control Basin, which is a created wetlands as defined in this Plan (see the discussion of wetlands elsewhere in this Chapter). Orange County Water District's wetlands ponds are also located within the Prado Basin Management Zone.

The beneficial uses of the proposed PBMZ include all of the beneficial uses currently designated for the surface waters identified above. The PBMZ also incorporates the Prado Flood Control Basin. The beneficial uses previously identified for this Basin are designated also for the Zone (See Table 3-1, Beneficial Uses, page 3-25).

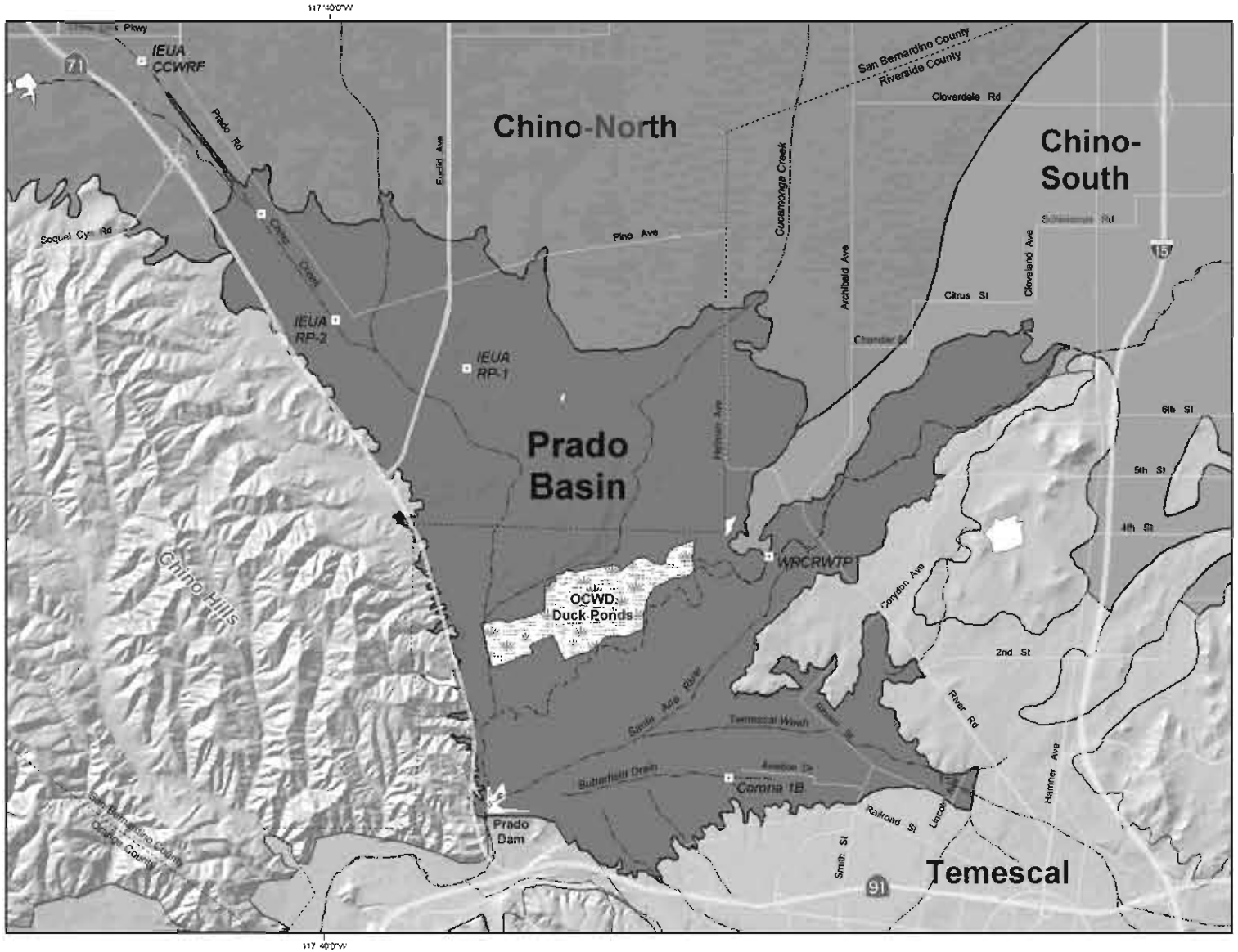
The Prado Basin Management Zone is shown in Figure 3-2.

Insert the following Figures:

- Figure 3-2 Prado Basin Management Zone Boundaries
- Figure 3-3 Management Zone Boundaries San Bernardino Valley and Yucaipa/Beaumont Plains
- Figure 3-4 Management Zone Boundaries – San Jacinto Basins
- Figure 3-5a Management Zone Boundaries – Chino (Maximum Benefit), Colton and Riverside Basins
- Figure 3-5b Management Zone Boundaries – Chino (Antidegradation), Colton and Riverside Basins
- Figure 3-6 Management Zone Boundaries – Elsinore – Temescal Valleys
- Figure 3-7 Management Zone Boundaries – Orange County Basins

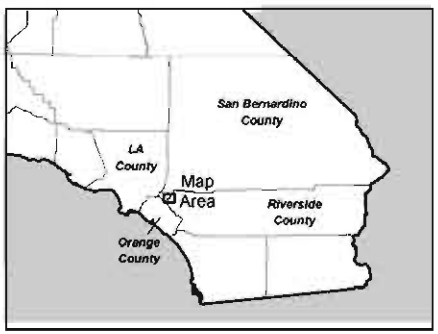
- **Revise p. 3-17, 3-18, 3-19 and 3-25 (Table 3-1 BENEFICIAL USES – INLAND SURFACE STREAMS AND WETLANDS) as shown in the following pages.**

- **Delete pages 3-26 through 3-28, Table 3-1 BENEFICIAL USES - GROUNDWATER SUBBASINS and replace with the following new pages 3-26 through 3-28. NOTE: Big Bear Valley, Garner Valley and Idyllwild Area are identified in the current Basin Plan as groundwater subbasins. They are identified as groundwater management zones in the new pages, shown below. No changes to the boundaries of these groundwater bodies are proposed.**



Map Explanation

- Management Zone Boundary
- Rivers & Streams
- Recycled Water Discharge Location



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Author: AEM
Date: 20001113
File: Figure_3-2.mxd

0 1 Miles
0 2 KM

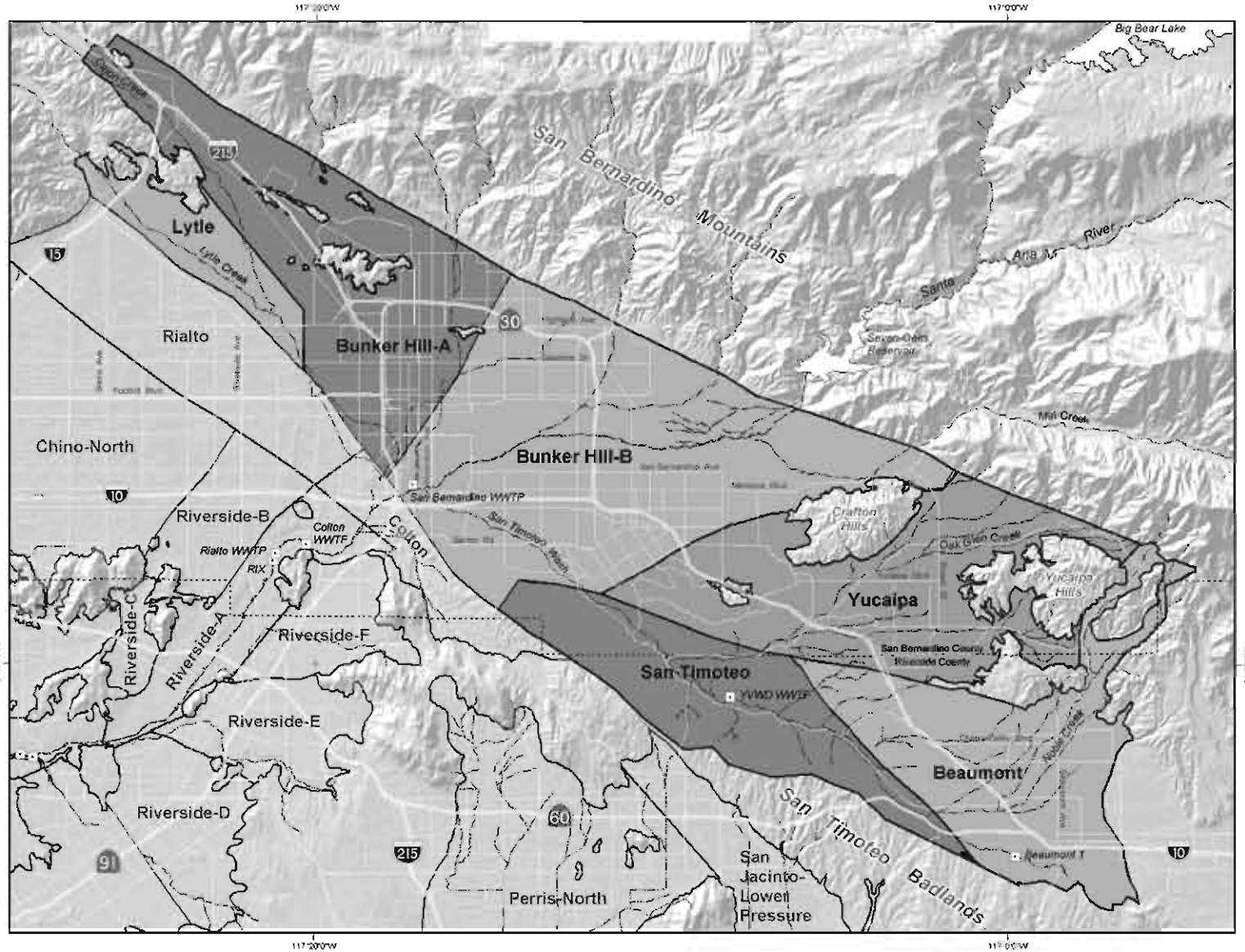
Produced for

TIN/TDS Task Force

TIN/TDS Study Phase 2A – Task 3
Develop Updated Boundary Maps for Management Zones (as Ammended and Revised)

Prado Basin Management Zone Boundaries

Figure 3-2



Map Explanation

Management Zone Boundary

Rivers & Streams

Recycled Water Discharge Location

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File: Figure_3-3.mxd

0 1 2 3 4 5 6 Miles
0 2 4 6 8 10 KM

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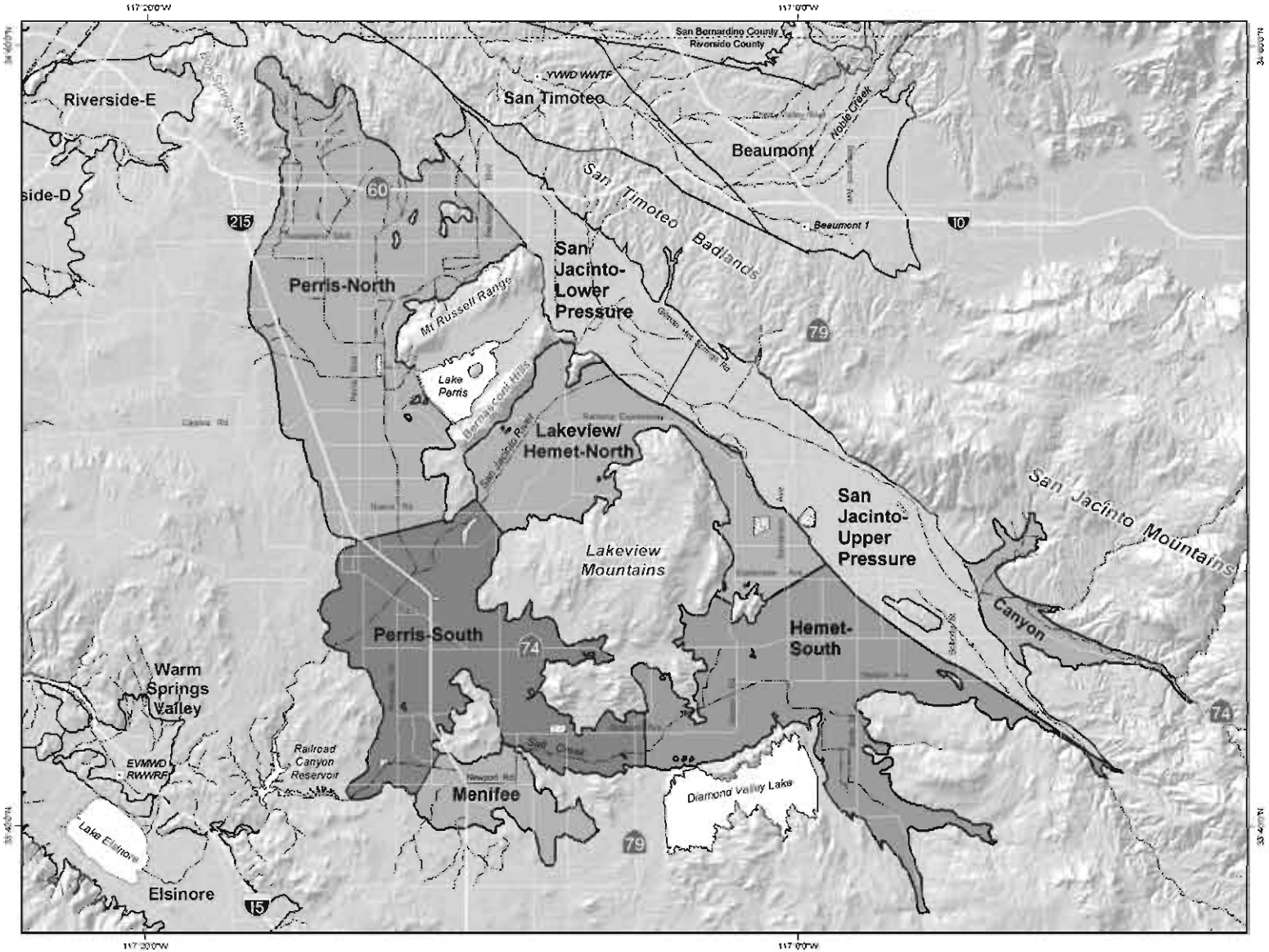
Develop Updated Boundary Maps for Management Zones (as Ammended and Revised)

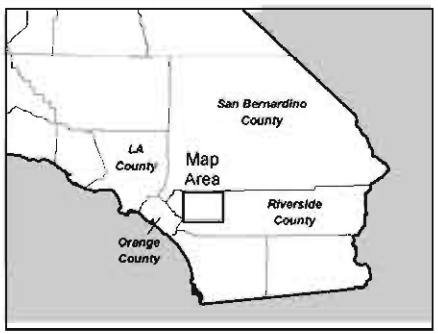
Management Zone Boundaries
San Bernardino Valley & Yucaipa/Beaumont Plains

Figure 3-3



Map Explanation

- Management Zone Boundary
- Rivers & Streams
- Recycled Water Discharge Location
- Recycled Water Pond



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0 1 2 3 4 5 6 Miles
0 2 4 6 8 10 KM

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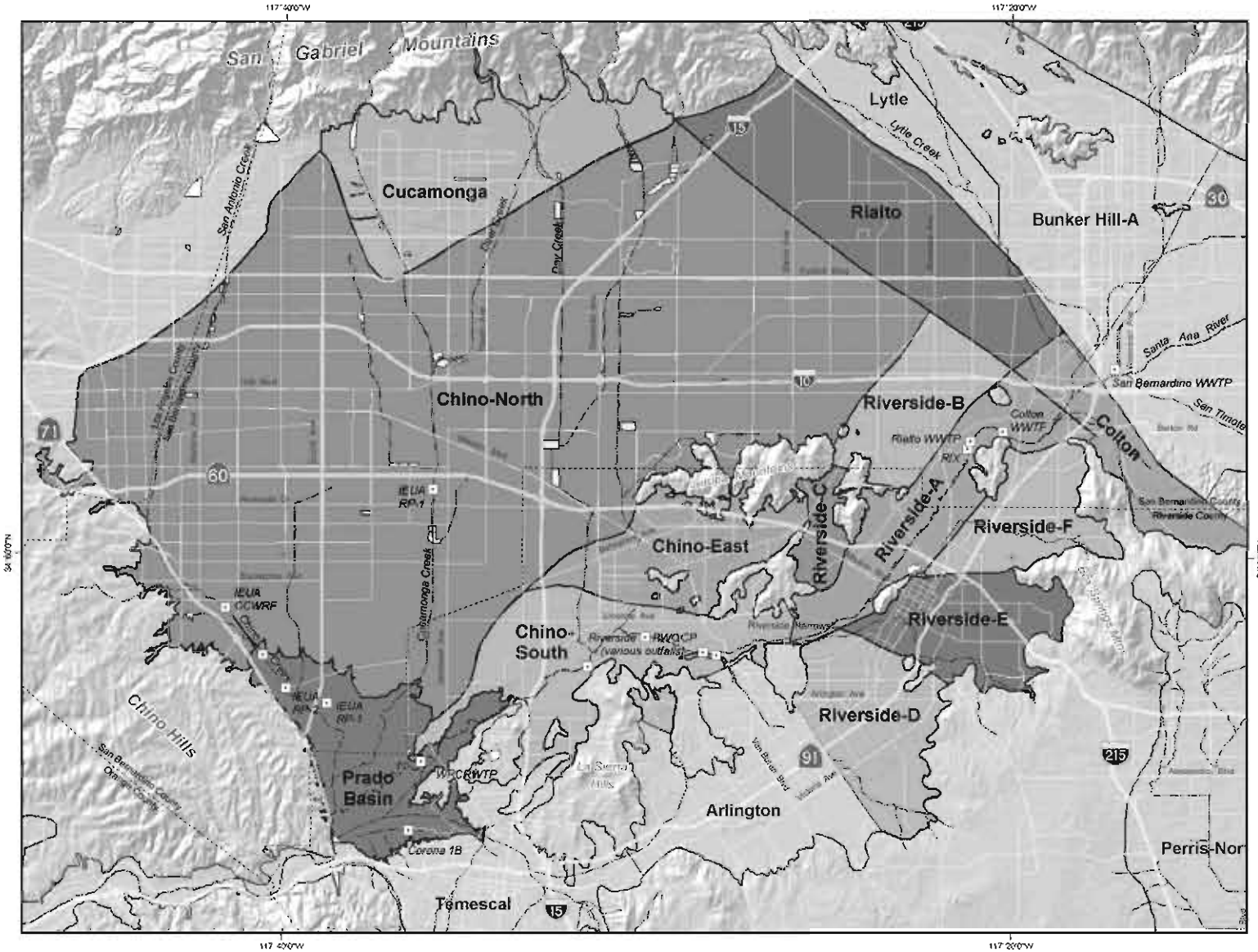
TIN/TDS Study Phase 2A – Task 3
Develop Updated Boundary Maps for Management Zones (as Ammended and Revised)

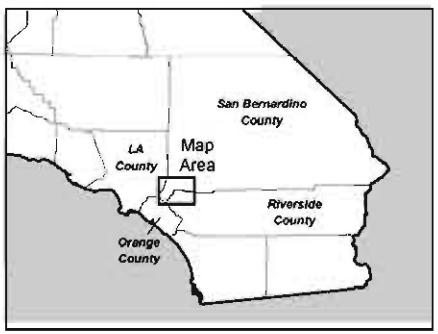
Management Zone Boundaries
San Jacinto Basins

Figure 3-4



Map Explanation

- Management Zone Boundary
- Rivers & Streams
- Recycled Water Discharge Location



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File: Figure_3-5a.mxd

0 1 2 3 4 5 6 Miles
0 2 4 6 8 10 KM

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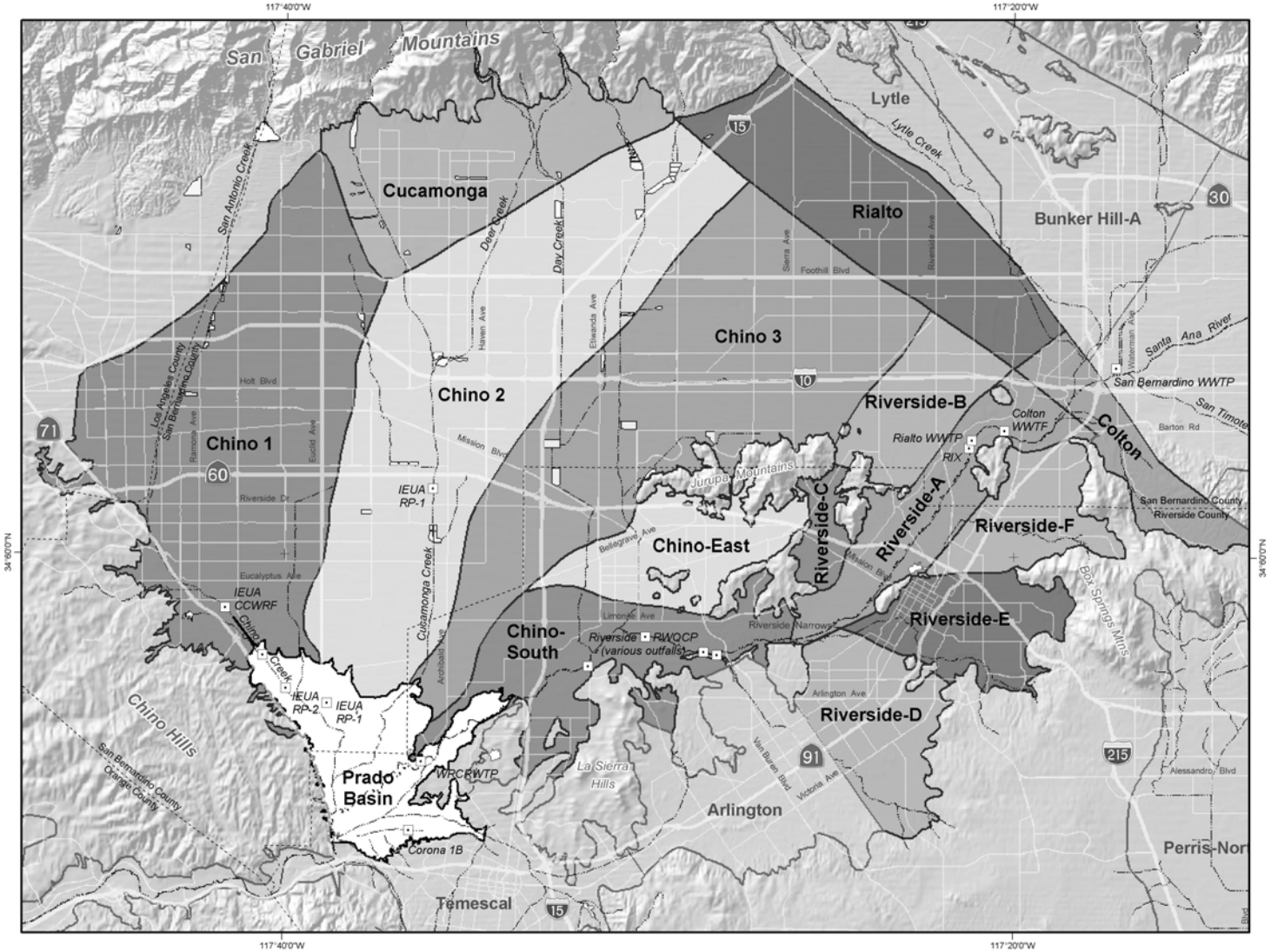
TIN/TDS Study Phase 2A – Task 3
Develop Updated Boundary Maps for Management Zones (as Ammended and Revised)

Management Zone Boundaries
Chino (Maximum Benefit), Rialto-Colton, & Riverside Basins

Figure 3-5a



Map Explanation

- Management Zone Boundary
- Rivers & Streams
- Recycled Water Discharge Location

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0 1 2 3 4 5 6 Miles
0 2 4 6 8 10 KM

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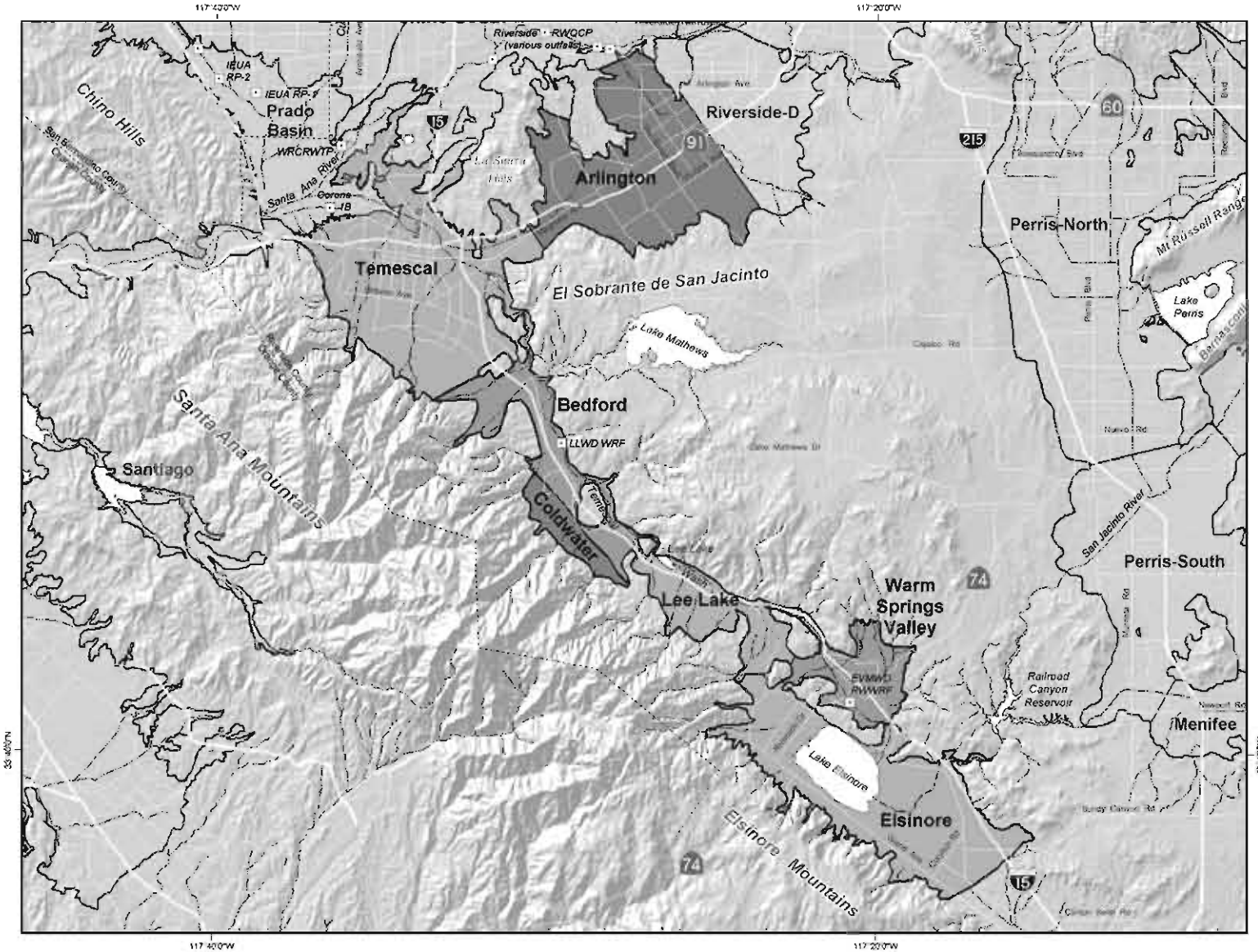
TIN/TDS Study Phase 2A -- Task 3
Develop Updated Boundary Maps for Management Zones (as Ammended and Revised)

Management Zone Boundaries
Chino (Anti-degradation), Rialto-Colton, & Riverside Basins

Figure 3-5b



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0 1 2 3 4 5 6 Miles
0 2 4 6 8 10 KM

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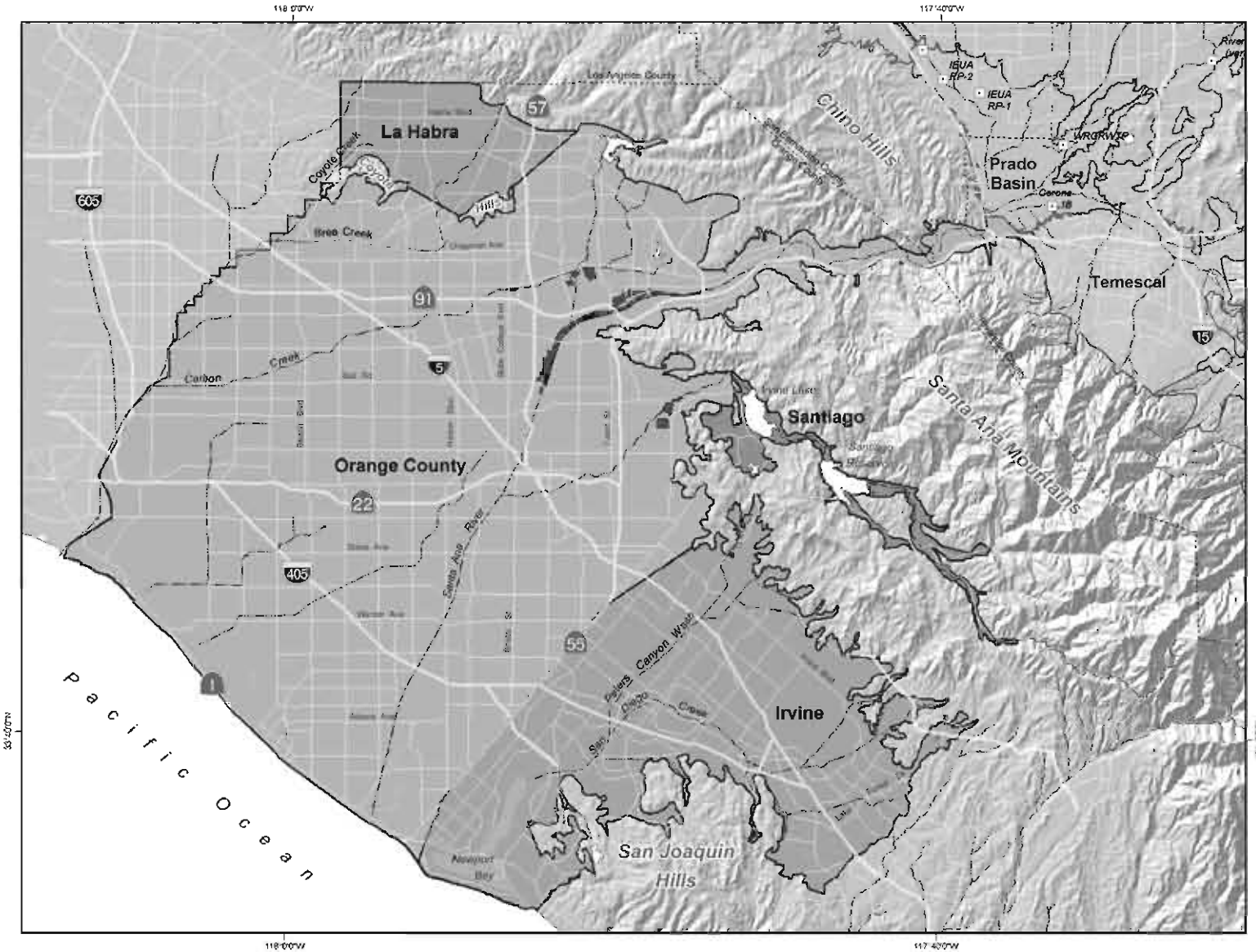
TIN/TDS Study Phase 2A – Task 3
Develop Updated Boundary Maps for Management Zones (as Ammended and Revised)

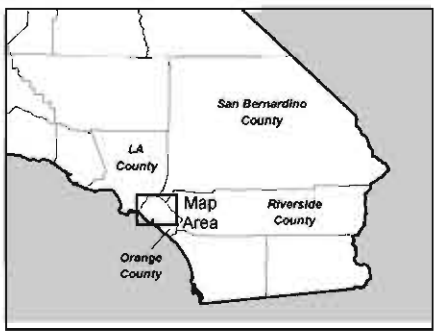
Management Zone Boundaries
Elsinore/Temescal Valleys

Figure 3-6



Map Explanation

- Management Zone Boundary
- Rivers & Streams
- Recycled Water Discharge Location
- Orange County Water District Forebay Recharge Facilities



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0 1 2 3 4 5 6 Miles
0 2 4 6 8 10 KM

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TIN/TDS Study Phase 2A – Task 3
Develop Updated Boundary Maps for Management Zones (as Ammended and Revised)

Management Zone Boundaries
Orange County Basins

Figure 3-7

Table 3-1 Beneficial Uses

Excerpt, Page 3-17, 3-18

INLAND SURFACE STREAMS	BENEFICIAL USE																				HYDROLOGIC UNIT		
	MUN	AGR	IND	PROC	GWR	NAV	POW	REC1	REC2	COMM	WARM	LWRM	COLD	BIOL	WILD	RARE	SPWN	MAR	SHEL	EST	Primary	Secondary	
San Timoteo Area Streams																							
San Timoteo Creek																							
~~Reach 1 - Santa Ana River Confluence to Gage at San Timoteo Canyon Road~~	~~+~~	~~I~~			~~I~~			~~I~~[3]	~~I~~		~~I~~				~~I~~						~~801.52~~	~~801.53~~	
Reach 1A – Santa Ana River Confluence to Barton Road	+	I						I[3]	I		I				I						801.52		
Reach 1B – Barton Road to Gage at San Timoteo Canyon Rd	+	I			I			I[3]	I		I				I						801.52		
Reach 2 - Gage at San Timoteo Canyon Road to Confluence with Yucaipa Creek	+				X			X	X		X				X						801.61		
Reach 3 - Confluence with Yucaipa Creek to ~~Bunker Hill II Groundwater Subbasin Boundary (T2S/R3W-24)~~ confluence with Little San Gorgonio and Noble Creeks (Headwaters of San Timoteo Creek)	+				X			X	X		X				X						801.61		
~~Reach 4 - Bunker Hill II Groundwater Subbasin Boundary (T2S/R3W-24) to Confluence with Little San Gorgonio and Noble Creeks (Headwaters of San Timoteo Creek)~~	~~+~~				~~X~~			~~X~~	~~X~~		~~X~~				~~X~~						~~801.62~~		

[3] Access prohibited in some portions by San Bernardino County Flood Control District

X Present or Potential Beneficial Use I Intermittent Beneficial Use + Excepted from MUN (see text)

Table 3-1 Beneficial Uses

Excerpt, Page 3-19

INLAND SURFACE STREAMS	BENEFICIAL USE																				HYDROLOGIC UNIT	
	MUN	AGR	IND	PROC	GWR	NAV	POW	REC1	REC2	COMM	WARM	LWRM	COLD	BIOL	WILD	RARE	SPWN	MAR	SHEL	EST	Primary	Secondary
Prado Area Streams																						
Chino Creek																						
~~Reach 1 - Santa Ana River confluence to beginning of concrete-lined channel south of Los Serranos Rd.~~	~~+~~							~~X~~	~~X~~		~~X~~				~~X~~	~~X~~					~~801.21~~	
Reach 1A - Santa Ana River confluence to downstream of confluence with Mill Creek (Prado Area)	+							X	X		X				X	X					801.21	
Reach 1B - Confluence with Mill Creek (Prado Area) to beginning of concrete-lined channel south of Los Serranos Rd.**	+							X	X		X				X	X					801.21	
Reach 2 - Beginning of concrete-lined channel south of Los Serranos Rd. to confluence with San Antonio Creek	+							X[1]	X			X			X						801.21	
Temescal Creek																						
~~Reach 1A – Santa Ana River Confluence to Lincoln Ave.~~	~~+~~	~~X~~	~~X~~		~~X~~			~~X~~[4]	~~X~~		~~X~~				~~X~~	~~X~~	~~X~~				~~801.25~~	
Reach 1~~B~~ – Lincoln Ave. to Riverside Canal	+							X[4]	X		X				X						801.25	

[3] Access prohibited in some portions by San Bernardino County Flood Control District
[4] Access prohibited in some portions by Riverside County Flood Control
** The confluence of Mill Creek is in Chino Creek, Reach 1B

X Present or Potential Beneficial Use I Intermittent Beneficial Use + Excepted from MUN (see text)

Table 3-1 Beneficial Uses

Excerpt, Page 3-25

WETLANDS (INLAND)	BENEFICIAL USE																				HYDROLOGIC UNIT	
	MUN	AGR	IND	PROC	GWR	NAV	POW	REC1	REC2	COMM	WARM	LWRM	COLD	BIOL	WILD	RARE	SPWN	MAR	SHEL	EST	Primary	Secondary
San Joaquin Freshwater Marsh**	+							X	X		X			X	X	X					801.11	801.14
Shay Meadows	I							I	I				I		I						801.73	
Stanfield Marsh**	X							X	X				X		X	X					801.71	
~~Prado Flood Control Basin**~~ Prado Basin Management Zone @	+							X	X		X				X	X					~~801.25~~802.21	
San Jacinto Wildlife Preserve**	+							X	X		X			X	X	X					802.21	802.14
Glen Helen	X							X	X		X				X						801.59	

** This is a created wetlands as defined in the wetlands discussion

@ The Prado Basin Management Zone includes the Prado Flood Control Basin, a created wetland as defined in the Basin Plan (see Chapter 3, pages 3-3 through 3-5)

X Present or Potential Beneficial Use I Intermittent Beneficial Use + Excepted from MUN (see text)

Table 3-1 Beneficial Uses, Page 3-26

~~GROUNDWATERS SUBBASIN~~ Groundwater Management Zones	BENEFICIAL USE																				HYDROLOGIC UNIT	
	MUN	AGR	IND	PROC	GWR	NAV	POW	REC1	REC2	COMM	WARM	LWRM	COLD	BIOL	WILD	RARE	SPWN	MAR	SHEL	EST	Primary	Secondary
UPPER SANTA ANA RIVER BASIN																						
Big Bear Valley	X			X																	801.71	801.73
Beaumont	X	X	X	X																	801.62	801.63, 801.69
Bunker Hill – A	X	X	X	X																	801.52	801..52
Bunker Hill – B	X	X	X	X																	801.52	801.53, 801.54, 801.57, 801.58
Colton	X	X	X	X																	801.44	801.45
Chino North "maximum benefit" ++	X	X	X	X																	801.21	481.21, 481.23,
Chino 1 – "antidegradation" ++	X	X	X	X																	801.21	481.21
Chino 2 – "antidegradation" ++	X	X	X	X																	801.21	
Chino 3 – "antidegradation" ++	X	X	X	X																	801.21	
Chino East @	X	X	X	X																	801.21	801.27
Chino South @	X	X	X	X																	801.21	801.25, 801.26
Cucamonga	X	X	X	X																	801.24	801.21
Lytle	X	X	X	X																	801.59	801.42
Rialto	X	X	X	X																	801.44	801.21, 801.43
San Timoteo	X	X	X	X																	801.62	801.61
Yucaipa	X	X	X	X																	801.61	801.55, 801.63, 801.67

++ Chino North "maximum benefit" management zone applies unless Regional Board determines that lowering of water quality is not of maximum benefit to the people of the state; in that case, the Chino 1, 2 and 3 "antidegradation" management zones would apply (see also discussion in Chapter 5).

@ Chino East and South are the designations in the Chino Basin Watermaster "maximum benefit" proposal (see Chapter 5) for the management zones identified by Wildermuth Environmental, Inc. (July 2000) as Chino 4 and 5, respectively.

X Present or Potential Beneficial Use I Intermittent Beneficial Use + Excepted from MUN (see text)

Table 3-1 Beneficial Uses, Page 3-27

Groundwater Management Zones	BENEFICIAL USE																				HYDROLOGIC UNIT	
	MUN	AGR	IND	PROC	GWR	NAV	POW	REC1	REC2	COMM	WARM	LWRM	COLD	BIOL	WILD	RARE	SPWN	MAR	SHEL	EST	Primary	Secondary
MIDDLE SANTA ANA RIVER BASIN																						
Arlington	X	X	X	X																	801.26	
Bedford	X	X	X	X																	801.32	801.31
Coldwater	X	X	X	X																	801.31	
Elsinore	X	X		X																	802.31	
Lee Lake	X	X	X	X																	801.34	
Riverside – A	X	X	X	X																	801.27	801.44
Riverside – B	X	X	X	X																	801.27	801.44
Riverside – C	X	X	X	X																	801.27	
Riverside – D	X	X	X	X																	801.27	801.26
Riverside – E	X	X	X	X																	801.27	
Riverside – F	X	X	X	X																	801.27	
Temescal	X	X	X	X																	801.25	

X Present or Potential Beneficial Use I Intermittent Beneficial Use + Excepted from MUN (see text)

Table 3-1 Beneficial Uses, Page 3-28

Groundwater Management Zones	BENEFICIAL USE																				HYDROLOGIC UNIT	
	MUN	AGR	IND	PROC	GWR	NAV	POW	REC1	REC2	COMM	WARM	LWRM	COLD	BIOL	WILD	RARE	SPWN	MAR	SHEL	EST	Primary	Secondary
SAN JACINTO RIVER BASIN																						
Garner Valley	X	X																			802.22	
Idyllwild Area	X		X																		802.22	802.21
Canyon	X	X	X	X																	802.21	
Hemet - South	X	X	X	X																	802.15	802.13, 802.21
Lakeview – Hemet North	X	X	X	X																	802.14	802.15
Menifee	X	X		X																	802.13	
Perris North	X	X	X	X																	802.11	
Perris South	X	X																			802.11	802.12, 802.13
San Jacinto – Lower	X	X	X																		802.21	802.11
San Jacinto – Upper	X	X	X	X																	802.21	802.23
LOWER SANTA ANA RIVER BASIN																						
La Habra	X	X																			845.62	
Santiago	X	X	X																		801.12	801.11
Orange	X	X	X	X																	801.11	801.13, 801.14, 845.61, 845.63
Irvine	X	X	X	X																	801.11	

X Present or Potential Beneficial Use I Intermittent Beneficial Use + Excepted from MUN (see text)

Chapter 4, Water Quality Objectives

- **p. 4-1:** "The narrative water quality objectives below are arranged alphabetically. They vary in applicability and scope, reflecting the variety of beneficial uses of water ~~which~~ that have been identified (Chapter 3). Where numerical ~~limits~~ objectives are ~~specified~~ specified, they generally represent the ~~maximum~~ levels that will protect ~~allow the~~ beneficial uses. ~~to continue unimpaired~~. However, in establishing waste discharge requirements for specific discharges, the Regional Board may find that more stringent levels are necessary to protect beneficial uses."

- **p. 4-11**, GROUNDWATERS: "The narrative objectives ~~which~~that are included below apply to all groundwaters, as noted. In addition, specific numerical objectives are listed in Table 4-1. With the exception of the "maximum benefit" objectives identified in this Table (see further discussion below and in Chapter 5), w~~W~~here more than one objective is applicable, the stricter shall apply."

- **Revise the following groundwater narrative water quality objectives**

Chloride
Excess chloride concentrations lead primarily to economic damage rather than public health hazards. Chlorides are considered to be among the most troublesome anion in water used for industrial or irrigation purposes since they significantly affect the corrosion rate of steel and aluminum and can be toxic to plants. A safe value for irrigation is considered to be less than 175mg/L of chloride. Excess chlorides affect the taste of potable water, so drinking water standards are generally based on potability rather than on health. The secondary drinking water standard for chloride is 500mg/L.

~~The chloride objectives listed in Table 4-1~~ Chloride concentrations shall not ~~be~~ exceed~~ed~~ 500 mg/L in groundwaters of the region designated MUN as a result of controllable water quality factors.

Dissolved Solids, Total (Total Filtrable Residue)
The Department of Health Services recommends that the concentration of total dissolved solids (TDS) in drinking water be limited to ~~1000~~ 500 mg/L (secondary drinking water standard), due to taste considerations. For most irrigation uses, water should have a TDS concentration under 700 mg/L. Quality related consumer cost analyses have indicated that a benefit to consumers exists if water is supplied at or below 500mg/L TDS.

The dissolved mineral content of the waters of the region, as measured by the total dissolved solids test ("Standard Methods for the Examination of Water and Wastewater, 20~~16~~th Ed.," ~~1985~~1998: ~~209B~~2540C (180˚C), p.~~95~~2-56), shall not exceed the specific objectives listed in Table 4-1 as a result of controllable water quality factors. (See also discussion of management zone TDS and nitrate nitrogen water quality objectives below).

Hardness (as $CaCO_3$)
The major detrimental effect of hardness is economic. Any concentration (reported as mg/L $CaCO_3$) greater than 100mg/L results in the increased use of soap, scale buildup in utensils in domestic uses, and in plumbing. Hardness in industrial cooling waters is generally objectionable above 50mg/L.

~~The objectives listed in Table 4-1 shall not be exceeded as a result of controllable water quality factors. If no hardness objective is listed in Table 4-1, the~~ The hardness of receiving waters used for municipal supply (MUN) shall not be increased as a result of waste discharges to levels that adversely affect beneficial uses.

Nitrate
High nitrate concentrations in domestic water supplies can be toxic to human life. Infants are particularly susceptible and may develop methemoglobinemia (blue baby syndrome). The primary drinking water standard for nitrate (as NO_3) is 45 mg/L or 10 mg/L (as N).

Nitrate-nitrogen concentrations listed in Table 4-1 shall not be exceeded as a result of controllable water quality factors. ***(See also discussion of management zone TDS and nitrate nitrogen water quality objectives below).***

Sodium
The presence of sodium in drinking water may be harmful to persons suffering from cardiac, renal and circulatory diseases. It can contribute to taste effects, with the taste threshold depending on the specific sodium salt. Excess concentrations of sodium in irrigation water reduce soil permeability to water and air. The deterioration of soil quality because of the presence of sodium in irrigation water is cumulative and is accelerated by poor drainage.

The California Department of Health Services and the U.S. Environmental Protection Agency have not provided a limit on the concentration of sodium in drinking water. ~~The sodium objectives listed in Table 4-1~~ Sodium concentrations shall not ~~be~~ exceed~~ed~~ 180 mg/L in groundwaters designated MUN as a result of controllable water quality factors.

Groundwaters designated AGR shall not exceed a sodium absorption ratio (SAR[1]) of 9 as a result of controllable water quality factors.

Sulfate
Excessive sulfate, particularly magnesium sulfate ($MgSO_4$), in potable waters can lead to laxative effects, but this effect is temporary. There is some taste effect from magnesium sulfate in the range of 400-600mg/L as $MgSO_4$. The secondary drinking water standard for sulfate is 500mg/L. Sulfate concentrations in waters native to this region are normally low, less than 40mg/L, but imported Colorado River water contains approximately 300mg/L of sulfate.

~~The objectives listed in Table 4-1~~ Sulfate concentrations shall not ~~be~~ exceed~~ed~~ 500 mg/L in groundwaters of the region designated MUN as a result of controllable water quality factors.

- **Add the following at the end of the GROUNDWATERS objectives:**

Management Zone TDS and Nitrate-nitrogen Water Quality Objectives

The TDS and nitrate-nitrogen objectives specified in the 1975 and 1984 Basin Plans, and initially in this 1995 Basin Plan, were based on an evaluation of groundwater samples from the five year period 1968 through 1972. This period represented ambient quality at the time of preparation of the 1975 Basin Plan. As part of the 2004 update of the TDS/Nitrogen management plan in the Basin Plan, historical ambient quality was reviewed using additional data and rigorous statistical procedures. This update also included characterization of current water quality. A comprehensive description of the methodology employed is published in the "Final Technical Memorandum for Phase 2A of the Nitrogen-TDS Study" (Wildermuth

[1] Sodium absorption ratio (SAR) = $\frac{Na}{[1/2\,(Ca + Mg)]^{1/2}}$.

where Sodium (Na), Calcium (Ca) and Magnesium (Mg) are concentrations in milliequivalents per liter

Environmental Inc., July 2000). This effort, coupled with "maximum benefit" demonstrations by certain agencies in the watershed (see further discussion below and in Chapter 5), culminated in the adoption of the TDS and nitrate-nitrogen objectives specified in Table 4-1.

For the most part, the TDS and nitrate-nitrogen water quality objectives for each management zone are based on historical concentrations of TDS and nitrate-nitrogen from 1954 through 1973. This period brackets 1968, when the State Board adopted Resolution No. 68-16, "Policy with Respect to Maintaining High Quality Waters". This Resolution establishes a benchmark for assessing and considering authorization of degradation of water quality. The 20-year period was selected in order to ensure that at least 3 data points in each management zone would be available to calculate historical ambient quality. In general, the following steps were taken to calculate the TDS and nitrate objectives:

a. Annual average TDS and nitrate-nitrogen data from 1954 – 1973 for each well in a management zone were compiled;
b. For each well, the data were statistically analyzed. The mean plus "t" (Student's t) times the standard error of the mean was calculated;
c. A rectangular grid across all management zones was overlaid. Groundwater storage within each grid was computed; and,
d. The volume-weighted TDS and nitrate-nitrogen concentration for each management zone was computed. These concentrations are the calculated historical ambient quality for each zone. [2]

These volume-weighted TDS and nitrate-nitrogen concentrations for each management zone were typically identified as the appropriate objectives. However, it is important to note that if the calculated nitrate-nitrogen concentration exceeded 10 mg/L, the nitrate-nitrogen objective was set to 10 mg/L to be consistent with the primary drinking water standard.

Finally, in some cases, certain agencies proposed alternative, less stringent TDS and nitrate-nitrogen objectives for specific management zones, based on additional consideration of antidegradation requirements and the factors specified in Water Code Section 13241 (see below and Chapter 5). Table 4-1 includes both the historical ambient quality TDS and nitrate-nitrogen objectives (the "antidegradation" objectives) and the objectives based on this additional consideration (the "maximum benefit" objectives) for specific management zones. Chapter 5 specifies detailed requirements pertaining to the implementation of these objectives.

- **Revise the requirements pertaining to Santa Ana River baseflow sampling (p. 4-15) as follows:**

Base flow sampling…. Excerpt, p. 4-15, 4-16.

~~The quantity and quality of base flow is most consistent during the month of August. At that time of year the influence of storm flows and nontributary flows is at a minimum. There is usually no water impounded behind Prado Dam. The volumes of rising water and nonpoint source discharges tend to be low during that time. The major component of base flow in August, therefore, is municipal wastewater. For these reasons, this period has been selected as the time when base flow will be measured and its quality determined. This information will subsequently allow the evaluation of available assimilative capacity, which serves to verify~~

[2] In limited cases, data for ammonia-nitrogen and nitrite-nitrogen as well as nitrate-nitrogen were available and included in the analysis. The ammonia-nitrogen and nitrite-nitrogen values were insignificant. The objectives are thus expressed as nitrate-nitrogen, even where ammonia-nitrogen and nitrite-nitrogen data were included in the analysis.

~~the accuracy of the wasteload allocation. In order to determine whether the water quality and quantity objectives for base flow in Reach 3 are being met, the Regional Board will collect a series of grab and composite samples during August of each year. The results will also be compared with the continuous monitoring data collected by USGS and data from other sources. Additional sampling in Reach 3 will help evaluate the effects of the various constituents of base flow.~~

In order to determine whether the water quality and quantity objectives for base flow in Reach 3 are being met, the Regional Board will collect a series of grab and composite samples when the influence of storm flows and nontributary flows is at a minimum. This typically occurs during August and September. At this time of year, there is usually no water impounded behind Prado Dam. The volumes of storm flows, rising water and nonpoint source discharges tend to be low. The major component of base flow at this time is municipal wastewater. The results of this sampling will be compared with the continuous monitoring data collected by USGS and data from other sources. These data will be used to evaluate the efficacy of the Regional Board's regulatory approach, including the TDS and nitrogen wasteload allocations (see Chapter 5). Additional sampling in Reach 3 by the Board and other agencies will help evaluate the fate and effects of the various constituents of base flow, including the validity of the 50% nitrogen loss coefficient (discussed in Chapter 5).

- **Add the following at the end of Chapter 4 (before Table 4-1)**

Prado Basin Management Zone

As discussed in Chapter 3 – Beneficial Uses, the Prado Basin Management Zone (PBMZ) is generally defined as a surface water feature within the Prado Basin. It is defined by the 566-foot elevation above mean sea level along the Santa Ana River and the four tributaries to the Santa Ana River in the Prado Basin (Chino Creek, Temescal Creek, Mill Creek and Cucamonga Creek). Nitrogen, TDS and other water quality objectives that have been established for these surface waters that flow within the proposed PBMZ are shown in Table 4-1. For the purpose of regulating discharges that would affect the PBMZ and downstream waters, these surface water objectives apply. This application of the existing surface water objectives assures continued water quality and beneficial use protection for waters within and downstream of the PBMZ.

"MAXIMUM BENEFIT" WATER QUALITY OBJECTIVES

As part of the 2004 update of the TDS/Nitrogen Management plan in the Basin Plan, several agencies proposed that alternative, less stringent TDS and/or nitrate-nitrogen water quality objectives be adopted for specific groundwater management zones and surface waters. These proposals were based on additional consideration of the factors specified in Water Code Section 13241 and the requirements of the State's antidegradation policy (State Board Resolution No. 68-16). Since the less stringent objectives would allow a lowering of water quality, the agencies were required to demonstrate that their proposed objectives would protect beneficial uses, and that water quality consistent with maximum benefit to the people of the state would be maintained.

Appropriate beneficial use protection/maximum benefit demonstrations were made by the Chino Basin Watermaster/Inland Empire Utilities Agency, the Yucaipa Valley Water District and the City of Beaumont/San Timoteo Watershed Management Authority to justify alternative "maximum benefit" objectives for the Chino North, Cucamonga, Yucaipa, Beaumont and San Timoteo groundwater management zones. These "maximum benefit" proposals, which are described in detail in Chapter 5 – Implementation, entail commitments by the agencies to implement specific projects and programs. While these agencies' efforts to develop these proposals indicate their strong interest to proceed with these

commitments, unforeseen circumstances may impede or preclude it. To address this possibility, this Plan includes both the "antidegradation" and "maximum benefit" objectives for the subject waters (See Table 4-1). Chapter 5 specifies the requirements for implementation of these objectives. Provided that these agencies' commitments are met, then the agencies have demonstrated maximum benefit, and the "maximum benefit" objectives included in Table 4-1 for these waters apply for regulatory purposes. However, if the Regional Board finds that these commitments are not being met and that "maximum benefit" is thus not demonstrated, then the "antidegradation" objectives for these waters will apply. Chapter 5 also describes the mitigation requirements that will apply should discharges based on "maximum benefit" objectives occur unsupported by the demonstration of "maximum benefit".

- **Delete FIGURE 4-1 SANTA ANA REGION GROUNDWATER BASINS (there is no textual reference to this figure)**
- **Delete FIGURE 4-2 SANTA ANA REGION GROUNDWATER BASINS (TDS, mg/L) (there is no textual reference to this figure)**
- **Delete FIGURE 4-3 SANTA ANA REGION GROUNDWATER BASINS (NO_3-**N mg/L) there is no textual reference to this figure)
- **Revise p. 4-30, 4-31, 4-32, 4-38 (Table 4-1 WATER QUALITY OBJECTIVES – INLAND SURFACE STREAMS AND WETLANDS) as shown in the following pages.**
- **Delete pages 4-39 through 4-41, Table 4-1 WATER QUALITY OBJECTIVES - GROUNDWATER SUBBASINS and replace with the following new pages 4-39 through 4-41.**

Table 4-1 WATER QUALITY OBJECTIVES, excerpt, page 4-30, 4-31

INLAND SURFACE STREAMS	Water Quality Objective (mg/L)							HYDROLOGIC UNIT	
	TDS	Hard.	Na	Cl	TIN	SO_4	COD	Primary	Secondary
San Timoteo Area Streams									
San Timoteo Creek									
~~Reach 1 - Santa Ana River Confluence to Gage at San Timoteo Canyon Road~~	~~290~~	~~175~~	~~60~~	~~60~~	~~6~~	~~45~~	~~15~~	~~801.52~~	~~801.53~~
Reach 1A – Santa Ana River Confluence to Barton Road	--	--	--	--	--	--	--	801.52	801.53
Reach 1B – Barton Road to Gage at San Timoteo Canyon Rd. u/s of Yucaipa Valley WD discharge	--	--	--	--	--	--	--	801.52	801.53
Reach 2 - Gage at San Timoteo Canyon Road to Confluence with Yucaipa Creek	~~290~~--	~~175~~--	~~60~~--	~~60~~--	~~6~~--	~~45~~--	~~15~~--	801.52	801.62
Reach 3 - Confluence with Yucaipa Creek to ~~Bunker Hill II Groundwater Subbasin Boundary(T2S/R3W-24)~~ confluence with Little San Gorgonio and Noble Creeks (Headwaters of San Timoteo Creek)	~~290~~--	~~175~~--	~~60~~--	~~60~~--	~~6~~--	~~45~~--	~~15~~--	801.62	
~~Reach 4 - Bunker Hill II Groundwater Subbasin Boundary (T2S/R3W-24) to Confluence with Little San Gorgonio and Noble Creeks (Headwaters of San Timoteo Creek)~~	~~290~~	~~175~~	~~60~~	~~60~~	~~6~~	~~45~~	~~15~~	~~801.62~~	

\+ Numeric objectives have not been established; narrative objectives apply

** Surface water objectives not established; underlying Management Zone objectives apply. Biological quality protected by narrative objectives

Table 4-1 WATER QUALITY OBJECTIVES, excerpt, page 4-32

INLAND SURFACE STREAMS	Water Quality Objective (mg/L)							HYDROLOGIC UNIT	
	TDS	Hard.	Na	Cl	TIN	SO4	COD	Primary	Secondary
Prado Area Streams									
Chino Creek									
~~Reach 1 – Santa Ana River confluence to beginning of concrete-lined channel south of Los Serranos Rd.~~	~~550~~	~~240~~	~~75~~	~~75~~	~~8~~	~~60~~	~~15~~	~~801.21~~	
Reach 1A – Santa Ana River confluence to downstream of confluence with Mill Creek (Prado Area) – Base Flow *	700	350	110	140	10**	150	30	801.21	
Reach 1B - Confluence of Mill Creek (Prado Area) to beginning of concrete-lined channel south of Los Serranos Rd.	550	240	75	75	8	60	15	801.21	
Reach 2 - Beginning of concrete-lined channel south of Los Serranos Rd. to confluence with San Antonio Creek +								801.21	
Temescal Creek									
~~Reach 1A – Santa Ana River Confluence to Lincoln Ave.~~	~~800~~	~~400~~	~~100~~	~~200~~	~~6~~	~~70~~	~~–~~	~~801.25~~	
Reach 1~~B~~ - Lincoln Ave. to Riverside Canal+	--	--	--	--	--	--	--	801.25	

* Additional objective: Boron 0.75 mg/L
** Total nitrogen, filtered sample
\+ Numeric objectives have not been established; narrative objectives apply

Table 4-1 Water Quality Objectives, excerpt, page 4-38

WETLANDS (INLAND)	Water Quality Objective (mg/L)		HYDROLOGIC UNIT	
	TDS	TIN	Primary	Secondary
San Joaquin Freshwater Marsh** ##	2000	13	801.11	
Shay Meadows+	--	--	801.73	
Stanfield Marsh+**	--	--	801.71	
~~Prado Flood Control Basin **~~ Prado Basin Management Zone @	--	--	~~802.15~~801.21	
San Jacinto Wildlife Preserve+**	--	--	802.21	802.14
Glen Helen+	--	--	801.59	

Additional objective for San Joaquin Freshwater Marsh: COD 90 mg/L.
+ Numeric objectives have not been established; narrative objectives apply
** This is a created wetlands as defined in the wetlands discussion (see Chapter 3)
@ includes the Prado Flood Control Basin, a created wetland as defined in the wetlands discussion (see chapter 3). Chino Creek, Reach 1A, Chino Creek, 1B, Mill Creek (Prado Area) and Santa Ana River, Reach 3 TDS and TIN numeric objectives apply (see discussion).

Table 4-1 Water Quality Objectives, Page 4-39

Groundwater Management Zones	Water Quality Objective (mg/L)		HYDROLOGIC UNIT	
	TDS	NO_3-N	Primary	Secondary
UPPER SANTA ANA RIVER BASIN				
Big Bear Valley*	220	5.0	801.71	801.73
Beaumont "maximum benefit"++	330	5.0	801.62	801.63, 801.69
Beaumont "antidegradation"++	230	1.5	801.62	801.63, 801.69
Bunker Hill – A	310	2.7	801.51	801.52
Bunker Hill – B	330	7.3	801.52	801.53, 801.54, 801.57, 801.58
Colton	410	2.7	801.44	801.45
Chino – North "maximum benefit"++	420	5.0	801.21	481.21, 481.23, 481.22, 801.21, 801.23, 801.24, 801.27
Chino 1– "antidegradation"++	280	5.0	802.21	481.21
Chino 2 – "antidegradation"++	250	2.9	801.21	
Chino 3 – "antidegradation"++	260	3.5	801.21	
Chino – East @	730	10.0	801.21	801.27
Chino – South @	680	4.2	801.21	801.26
Cucamonga "maximum benefit"++	380	5.0	801.24	801.21
Cucamonga "antidegradation"++	210	2.4	801.24	801.21
Lytle	260	1.5	801.41	801.42
Rialto	230	2.0	801.41	801.42

* Additional objectives for Bear Valley: Hardness 225 mg/L; Sodium 20 mg/L; Chloride 10 mg/L; Sulfate 20 mg/L

++ "Maximum benefit" objectives apply unless Regional Board determines that lowering of water quality is not of maximum benefit to the people of the state; in that case, "antidegradation" objectives apply (For Chino North, antidegradation objectives for Chino 1, 2, 3 would apply if maximum benefit is not demonstrated). (see discussion in Chapter 5).

@ Chino East and South are the designations in the Chino Basin Watermaster "maximum benefit" proposal (see Chapter 5) for the management zones identified by Wildermuth Environmental, Inc., (July 2000) as Chino 4 and Chino 5, respectively.

Table 4-1 WATER QUALITY OBJECTIVES, page 4-40

Groundwater Management Zones	Water Quality Objective (mg/L)		HYDROLOGIC UNIT	
	TDS	NO_3-N	Primary	Secondary
San Timoteo "maximum benefit" ++	400	5.0	801.62	
San Timoteo "antidegradation" ++	300	2.7	801.62	
Yucaipa "maximum benefit" ++	370	5.0	801.61	801.55,801.54, 801.56, 801.63, 801.65, 801.66, 801.67
Yucaipa "antidegradation" ++	320	4.2	801.61	801.55,801.54, 801.56, 801.63, 801.65, 801.66, 801.67
MIDDLE SANTA ANA RIVER BASIN				
Arlington	980	10	801.26	
Bedford **	--	--	801.32	
Coldwater	380	1.5	801.31	
Elsinore	480	1.0	802.31	
Lee Lake**	--	--	801.34	
Riverside – A	560	6.2	801.27	
Riverside – B	290	7.6	801.27	
Riverside – C	680	8.3	801.27	
Riverside – D	810	10.0	801.27	
Riverside – E	720	10.0	801.27	
Riverside – F	660	9.5	801.27	
Temescal	770	10.0	801.25	

** Numeric objectives not established; narrative objectives apply
++ "Maximum benefit" objectives apply unless Regional Board determines that lowering of water quality is not of maximum benefit to the people of the state; in that case, "antidegradation" objectives would apply (see discussion in Chapter 5).

Table 4-1 WATER QUALITY OBJECTIVES, page 4-41

Groundwater Management Zones	Water Quality Objective (mg/L)		HYDROLOGIC UNIT	
	TDS	NO_3-N	Primary	Secondary
SAN JACINTO RIVER BASIN				
Garner Valley*	300	2.0	802.22	
Idyllwild Area**	--	--	802.22	802.21
Canyon	230	2.5	802.21	
Hemet - South	730	4.1	802.15	802.21
Lakeview – Hemet North	520	1.8	802.14	802.15
Menifee	1020	2.8	802.13	
Perris North	570	5.2	802.11	
Perris South	1260	2.5	802.11	802.12, 802.13
San Jacinto – Lower	520	1.0	802.21	
San Jacinto – Upper	320	1.4	802.21	802.23
LOWER SANTA ANA RIVER BASIN				
La Habra**	--	--	845.62	
Santiago **	--	--	801.12	
Orange	580	3.4	801.11	801.13, 845.61, 801.14
Irvine	910	5.9	801.11	

* Additional objectives for Garner Valley: Hardness 100 mg/L; Sodium 65 mg/L; Chloride 30 mg/L; Sulfate 40 mg/L
** Numeric objectives not established; narrative objectives apply

Chapter 5 Implementation

Page 5-8 ff.: ~~**SALT BALANCE AND ASSIMILATIVE CAPACITY – UPPER Santa Ana Basin**~~**TOTAL DISSOLVED SOLIDS AND NITROGEN MANAGMENT**

I. Background

The 1975 and 1983 Basin Plans for the Santa Ana River Basin reported that the most serious problem in the basin was the build up of dissolved minerals, or salts, in the ground and surface waters. Sampling and computer modeling of groundwaters showed that the levels of dissolved minerals, generally expressed as total dissolved solids (TDS) or total filterable residue (TFR), were exceeding water quality objectives, or would do so in the future, unless appropriate controls were implemented. Nitrogen levels in the Santa Ana River, largely in the form of nitrate, were likewise projected to exceed objectives. As was discussed in Chapter 4, high levels of TDS and nitrate adversely affect the beneficial uses of ground and surface waters. The mineralization of the Region's waters, and its impact on beneficial uses, remains a significant problem.

Each use of water adds an increment of dissolved minerals. Significant increments of salts are added by municipal and industrial use, and the reuse and recycling of the wastewater generated as it moves from the hydrologically higher areas of the Region to the ocean. Wastewater and recycled water percolated into groundwater management zones is typically pumped and reused a number of times before reaching the ocean, resulting in increased salt concentrations. ~~These salts may be added to the water as it is used, or t~~The concentration of dissolved minerals can also be increased by ~~reducing the volume, such as by~~ evaporation or evapotranspiration. One of the principal causes of the mineralization problem in the Region is historic irrigated agriculture, particularly citrus, which, in the past, required large applications of water to land, causing large losses by evaporation and evapotranspiration. TDS and nitrate concentrations are increased both by this reduction in the total volume of return water and by the direct application of these salts in fertilizers. Dairy operations, which began in the Region ~~about forty years ago~~ in the 1950's and continue today, also contribute large amounts of salts to the basin. ~~Significant increments of salts have been added by municipal and industrial wastewaters and the reuse and recycling of these waters as they move from the higher areas of the basin towards the ocean. Salts are added as waters are use for municipal or industrial purposes; in some cases, the wastewaters generated were discharged to the same ground water subbasins from which the source waters were derived. These subbasins were then pumped and the water used again, adding additional salts.~~

The implementation chapters of ~~both~~ the 1975 and 1983 Basin Plans focused on recommended plans to address the mineralization problem. The 1975 Plan initiated a total watershed approach to salt source control. Both ~~the 1975 and 1983~~ Plans called for controls on salt loadings from all water uses including residential, commercial, industrial and agricultural (including dairies). The plans included: measures to improve water supply quality, including the import of high quality water from the State Water Project; waste discharge regulatory strategies (e.g., wasteload allocations, allowable mineral increments for uses of water); and recharge projects and other remedial programs to correct problems in specific areas. These Plans also carefully limited reclamation activities and the recycling of wastewaters into the local groundwater basins.

These salt management plans were developed using a complex set of groundwater computer models and programs, known collectively as the Basin Planning Procedure (BPP). ~~For the 1983 Basin Plan, a surface water model, QUAL-II, was used to evaluate quality conditions in the Santa Ana River. Updated and improved versions of these models were used to develop the revised salt management plans specified in this Basin Plan.~~

~~II.Computer Simulation of the Basin~~

~~The Basin Planning Procedure, or BPP, is used to project the quality and quantity of groundwaters in the basin given various assumptions about the ways water is supplied and used, and how wastewater is managed. A complex set of data goes into the BPP, including: current and projected landuse information and associated salt loads; population estimates; the location, quantity, and quality of waste discharges; the quantity and quality of water supply sources which are or will be used in the area; data on hydrology, including rainfall and deep percolation of precipitation into underlying groundwater; etc. This and other information is integrated into the BPP to make projections of future quality in each groundwater subbasin. For the upper Santa Ana Basin, the BPP also provides data on the location, quality and quantity of groundwater which rises into the Santa Ana River and becomes part of the River's surface flows.~~

~~The BPP projects where water quality problems will arise unless changes in water quality management are made. Such changes can include revisions in the requirements governing waste discharges, changes in water supply sources and quality, and the implementation of special projects or programs. Alternative management practices and projects are entered into the BPP, the BPP is run, and the effectiveness of the proposed alternatives in addressing identified problems is evaluated. Subsequent runs of the BPP incorporate and assess additional alternatives. Ultimately, a recommended plan for the management of salts in groundwater is developed.~~

The modeling work ~~leading to the development of the 1975 and 1983 Basin plans~~ focused on the upper Santa Ana Basin and, to a ~~smaller~~ lesser extent, on the San Jacinto Basin, where the BPP ~~is~~was less developed and refined. The constituent modeled ~~for~~ in those Plans was TDS.

For ~~this~~ the salt management plan specified initially in the 1995 Basin Plan, when the Plan was adopted and approved in 1994 and 1995, modeling was conducted with the BPP for both the upper Santa Ana and San Jacinto Basins. However, most of the attention was again directed to the upper Santa Ana Basin, for which significant improvements to the BPP were made under a joint effort by the Santa Ana Watershed Project Authority, the Santa Ana River Dischargers Association, the Metropolitan Water District of Southern California, and the Regional Board. The most significant change to the BPP was the addition of a nitrogen modeling component so that projections of the nitrogen (nitrate) quality of groundwaters could be made, in addition to TDS. This enabled the development of a management plan for nitrogen, as well as TDS. ~~The salt management plan for the upper Santa Ana Basin specified in this Basin Plan now addresses the correction and prevention of both nitrogen and TDS groundwater quality problems.~~

The BPP has not been used to model groundwater quality conditions in the lower Santa Ana Basin. For that Basin, the Regional Board's TDS and nitrogen management plans have relied~~s~~, in large part, on the control of the quality of the Santa Ana River flows, which are a major source of recharge in the Basin. As discussed in Chapter 4, most of the baseflow (80-90%) is composed of treated sewage effluent; it also includes nonpoint source inputs and rising groundwater. Baseflow generally provides 70% or more of the water recharged in the Orange County Management Zone. In rare wet years, baseflow accounts for a smaller, but still significant, percentage (40%) of the recharge on an annual basis. Therefore, to protect Orange County groundwater, it is essential to control the quality of baseflow. To do so, baseflow TDS and nitrogen objectives are specified in this Plan for Reach 3 of the River. Wasteload allocations have been established and periodically revised to meet those and other Santa Ana River objectives.

~~The QUAL – II model and its derivatives are used to assess water quality conditions in the Santa Ana River (see below). Other TDS and nitrogen management activities in the lower Santa Ana Basin, conducted principally by the Orange County Water District are described later in this chapter and in Chapter 7.~~

For the 1983 Basin Plan, ~~The~~ QUAL-II, a surface water model~~,~~ developed initially by the US EPA, was calibrated for the Santa Ana River and used to make detailed projections of River quality (TDS and nitrogen) and flow. ~~for the 1983 Basin Plan.~~ The model was used to develop wasteload allocations for TDS and nitrogen discharges to the River that were approved as part of that Plan. (Wasteload allocations are discussed in detail in Section III of this Chapter). An updated version of the model, QUAL-2e, was used to revise these wasteload allocations, which were included as part of the initial salt management plan in the 1995 Basin Plan. The models were used to integrate ~~reflects~~ the quantity and quality of inputs to the River from various sources, including the headwaters, municipal wastewater treatment plant discharges, and rising groundwater, based on the water supply and wastewater management plans used in the BPP. Data on rising groundwater quality and quantity ~~is~~ were provided to the QUAL-II/2e models by the BPP. As with the BPP, the QUAL-II/2e model projections ~~are~~ were used to identify water quality problems and to assess the effectiveness of changes in TDS and nitrogen management strategies~~,~~. ~~such as revised waste discharge requirements. The 1983 Basin Plan specified TDS and nitrogen management strategies for the Santa Ana River, known as wasteload allocation, which were developed with this model.~~

~~An improvement version of the model, called QUAL2E, was subsequently developed and calibrated for the Santa Ana River as part of the join BPP improvement effort noted above. This new QUAL2E model is the principal tool used to develop the revised TDS and nitrogen wasteload allocations which are contained in this Basin Plan and which are described in more detail later in this section.~~

~~III.~~ II. Update of the Total Dissolved Solids/Nitrogen Management Plan ~~– Upper Santa Ana Basin~~

The studies conducted to update the TDS/Nitrogen Management Plans in the 1983 and 1995 Basin Plans were not designed to validate or revise the TDS or nitrate-nitrogen objectives for groundwater. Rather, the focus of the studies was to determine how best to meet those established objectives. During public hearings to consider adoption of the 1995 Basin Plan, a number of water supply and wastewater agencies in the region commented that the TDS and nitrate-nitrogen objectives for groundwater should be reviewed, considering the estimated cost of complying with them (several billion dollars). In response, the Regional Board identified the review of these objectives as a high Basin Plan triennial review priority, and stakeholders throughout the Region agreed to provide sufficient resources to perform the necessary studies. ~~After the 1983 Basin Plan was adopted, a number of agencies in the Santa Ana River watershed expressed concerns about certain aspects of the Plan, including the limitations placed on wastewater reclamation and the equity of the wasteload allocations for the Santa Ana River.~~ In December 1995, these agencies, under the auspices of ~~In response, a consortium of agencies, including~~ the Santa Ana Watershed Project Authority (SAWPA),~~the Santa Ana River Dischargers Association (SARDA), the Metropolitan Water District of Southern California (MWD-SC), and the Regional Board, undertook studies to update the Plan for the upper basin [Ref. 1-4].~~ formed the Nitrogen/Total Dissolved Solids (TDS) Task Force (Task Force) to undertake a watershed-wide study (Nitrogen/TDS Study) to review the groundwater objectives and the TDS/Nitrogen Management Plan in the Basin Plan as a whole. SAWPA managed the study, and Risk Sciences and Wildermuth Environmental, Inc., served as project consultants. Major tasks included review of the groundwater subbasin boundaries, development of recommendations for revised boundaries, development of appropriate TDS and nitrate-nitrogen objectives for the subbasins (management zones), and update of the TDS and TIN wasteload allocations to ensure compliance with both the established objectives for the Santa Ana River and tributaries and the recommended groundwater objectives. A complete list of all tasks completed in Phases 1A & 1B and 2A & 2B is included in the Appendix. The Task Force effort resulted in substantive proposed changes to the Basin Plan, including new groundwater management zones (Chapter 3) and new nitrate-nitrogen and TDS objectives for the management zones (Chapter 4). These changes necessitated the update and revision of the TDS/Nitrogen Management Plan, which is described below.

The Task Force studies, including the technical methods employed, are documented in a series of reports (Ref. 1-5). The Task Force studies differed from prior efforts to review the TDS and nitrogen management plans in that the BPP was not utilized. A revised model approach, not involving use of the QUAL-2e model, was used to update the wasteload allocations for the Santa Ana River. The Task Force concluded that the BPP no longer remained a viable tool for water quality planning purposes, and also concluded that the development of a new model was beyond the scope and financial capabilities of the Task Force. The efficacy of modeling to formulate and update salt management plans in this Region has been well demonstrated; in the future, priority should be given to the development of a new model that would assist with future Basin Plan reviews.

~~As already noted, this update effort included substantial improvements to the ground and surface water models. These improved models were then used to evaluate future water quality conditions in the upper basin.~~

~~The modeling work began with the evaluation of a baseline plan, the set of present water supply and wastewater management practices which are extended into the future (to the year 2015) to project water quality and quantity conditions. The baseline plan results indicated where water quality (and quantity) problems would arise if no water quality management changes were made. The findings showed that substantial degradation of the nitrogen and TDS quality of most of the groundwater subbasins in the upper basin would occur over time. Meanwhile, annual sampling of the Santa Ana River at Prado Dam (see Chapter 4) had shown that the nitrogen quality of the River exceeded the objective. These monitoring and modeling results demonstrated that changes were necessary in the TDS and nitrogen management strategy employed in the upper basin.~~

~~A series of alternative TDS and nitrogen management alternatives were then developed and evaluated using the models. A recommended alternative, Alternative 5C, was selected, based on its predicted ability to protect and maintain water quality, and based also on the feasibility and likelihood of its implementation. The projects and plans incorporated in this alternative are described below.~~

~~Additional work with the QUAL2E model was conducted to refine the recommended nitrogen wasteload allocation for the Santa Ana River. Alternative 5C was used as the basis for these additional sensitivity runs. Again, a recommended alternative (Alternative 5C-10) was selected; the nitrogen wasteload allocation specified in this alternative was adopted by the Regional Board on November 15, 1991 (Resolution No. 91-125). This wasteload allocation is also described below.~~

~~IV.~~III. ~~Recommended~~ TDS/Nitrogen Management Plan ~~– Upper Santa Ana basin~~

TDS and nitrogen management in this Region involves both regulatory actions by the Regional Board and actions by other agencies to control and remediate salt problems. Regulatory actions include the adoption of appropriate TDS and nitrogen limitations in requirements issued for waste disposal and municipal wastewater recycling, and the adoption of waste discharge prohibitions. These regulatory steps are described earlier in this Chapter. Actions by other agencies include projects to improve water supply quality and the construction of groundwater desalters and brine lines to remove highly saline wastes from the watershed. The following sections discuss these programs in greater detail.

~~The Recommended TDS/Nitrogen Management Plan (Recommended Plan, or 5C/5C-10) is a composite of plans, projects, assumptions, ongoing programs, and projections, and is therefore very difficult to define succinctly. The closest on can come is to say that the Recommended Plan is the entire package of data which is fed into the models (BPP and QUAL2E) and the products of those models, for the selected alternative. The BPP considers the municipal, industrial, agricultural and other water supplies in the basin, and the available imported water. A Water Supply Plan is developed and is part of the~~

~~Recommended Plan. Similarly, the BPP and QUAL2E consider data on present and projected waste discharges and a Wastewater Management Plan is developed. This too is an essential component of the Recommended Plan. Assumption on hydrology, natural and artificial recharge, replenishment, extraction, and remediation go into the models and become part of the Groundwater Management Plan. These plans – all the assumptions which were included, all the facilities which need to be built – are part of the Recommended Plan. The BPP and QUAL2E, then, are integral parts of this Basin Plan.~~

~~The upper Santa Ana Basin study reports cited previously and the associated task reports and computer printouts specify all the details of 5C and 5C-10. Included here are summary descriptions of the following elements:~~

~~A.Water Supply Plan~~

~~B.Wastewater Management Plan~~

~~C.Groundwater Management Plan~~

~~These descriptions include discussions of the regulatory provisions included in 5C and 5C-10. Other important aspects of the Recommended Plan and its implementation are also discussed. These include the concepts of salt assimilative capacity and of the reasonable use of water, with allowable mineral increments (additions). These factors play a significant role in the Regional Board's issuance of waste discharge requirements. Finally, specific water quality problems and the steps being taken to address them are also summarized.~~

A. Water Supply Quality ~~Plan~~

~~The water supply plan is an essential part of the Recommended Plan.~~ Water supply quality has a ~~plans~~ direct~~ly~~ affect on the quality of discharges from municipal wastewater treatment plants, discrete industrial discharges, returns to groundwater from homes using septic tank systems, returns from irrigation of landscaping in sewered and unsewered areas, and returns to groundwater from commercial irrigated agriculture. Water supply quality is an important determinant of the extent to which wastewater can be reused and recycled without resulting in adverse impacts on affected receiving waters. This is particularly true for TDS, since it is a conservative constituent, less likely than nitrogen to undergo transformation and loss as wastewater is discharged or recycled, and typically more difficult than nitrogen to treat and remove. ~~In fact, sensitivity runs using the BPP for projects in the upper Santa Ana watershed show that water supply is the single most important variable in Basin-wide TDS quality management planning.~~

~~This Recommended Plan integrates the water supply systems with the area of use, type of use, salt additions from use, the specific point of discharge after use, reclamation, and downstream uses.~~ Water supplies~~y~~ ~~plans~~ cannot be directly regulated by the Regional Board; however, limitations in waste discharge requirements, including ~~and~~ NPDES permits, may necessitate efforts to improve source water quality. These efforts may include drilling new wells, implementing alternative blending strategies, importing higher quality water when it is available, and constructing desalters to create or augment water supplies

~~Limits on TDS and specific mineral constituents are based on consideration of the quality of waters supplied in the discharger's service area and on the quality of the receiving waters and whether or not those waters have assimilative capacity (see below). Detailed water supply plans for the water purveyors and irrigation water distributors in the upper Santa Ana Basin are included in Appendix VI. These include each agency's water supply sources, the quality and quantity of those supplies, and~~

~~allocations of the supplies to municipal, industrial, and agricultural uses within the agency's service area. In a number of cases, water purveyors are also responsible for wastewater treatment and disposal. Water purveyors/wastewater managers are not compelled to follow the water supply plans in this Recommended Plan. However, if a violation of the mineral limits in a discharger's waste discharge requirements occurs or is threatened, the water supply plans for the discharger's service area will be reviewed by Regional Board staff and discussed with this discharger. In these cases, the discharger will be expected to make best efforts to improve the quality of the waters used in the source area and influent to the treatment facility.~~

Imported water supplies are an important part of salt management strategies in the region ~~this Recommended Plan,~~ from both a quantity and quality standpoint. Imported water is needed by many agencies to supplement local sources and satisfy ~~the~~ ever-increasing demands. The import~~ation~~ of high quality State Water Project water, with a long-term TDS average less than 300 mg/L, ~~(water that is low in salt content)~~ is particularly essential. The use of State Water Project water allows maximum reuse of water supplies without aggravating the mineralization problem. It is also used for recharge and replenishment to improve the quality of local water supply sources, which might otherwise be unusable. Thus, the use of high quality State Water Project water in the Region has water supply benefits that extend far beyond the actual quantity imported.

In some cases, the TDS quality of water supplies in a wastewater treatment service area may make it infeasible for the discharger to comply with TDS limits specified in waste discharge requirements. In other cases, the discharger may add chemicals that enable compliance with certain discharge limitations, but also result in TDS concentrations in excess of waste discharge requirements. The Board recognizes these problems and incorporates provisions in waste discharge requirements to address them. These and other aspects of the Board's regulatory program are described next.

~~The water supply plan specifies the quality and quantity of both State Water Project and Colorado River water which is expected to be used in the upper Santa Ana Basin. The plan assumes that the quality of imported water from the State Water Project will be 250mg/L TDS. This value is close to the long-term average for water delivered to this area and the 10-year average in the State Water Project contract. However, in recent drought years, the TDS values were in the 400mg/L range. The plan provides for importing approximately 192,600 acre-feet per year by the year 2000 for use in the upper Santa Ana Basin. Minimum use is about 138,000 acre-feet per year, of which 34,000 is to be used for groundwater replenishment (Table 5-3).~~

~~Table 5-3~~

~~Upper Santa Ana Basin Recommended Plan 5C Imported Water~~

~~Groundwater Replenishment Volume~~

~~Subbasin~~	~~Groundwater Replenishment AF/Y~~
~~San Timoteo~~	~~0~~
~~Lytle Creek~~	~~0~~
~~Bunker Hill Pressure~~	~~0~~
~~Bunker Hill II~~	~~0~~
~~Rialto~~	~~5,000~~

~~Colton~~	~~5,000~~
~~Riverside I~~	~~0~~
~~Riverside II~~	~~0~~
~~Riverside III~~	~~0~~
~~Arlington~~	~~0~~
~~Chino I~~	~~19,000~~
~~Chino II~~	~~0~~
~~Chino III~~	~~0~~
~~Cucamonga~~	~~5,000~~
~~Upper Temescal~~	~~0~~
~~Temescal~~	~~0~~
~~**TOTAL**~~	~~**34,000**~~

B. ~~Wastewater Management Plan~~ TDS and Nitrogen Regulation

~~The recommended wastewater management plan for the upper Santa Ana Basin has a number of components, including wastewater disposal to the ground and surface waters of the upper Santa Ana Basin, export of wastewaters outside the basin, and reclamation. The fundamental philosophy of the recommended plan is to allow a reasonable use of the water supplied, to treat it adequately, and to allow it to flow downstream (or to lower groundwater basins) for reuse.~~

~~Projections of the present and future methods of wastewater disposal and the quantity and quality of the wastewaters are included in the BPP. Details of the individual wastewater management plans of the many municipalities and wastewater entities are included in Appendix VI. In part, these plans are the basis for the Regional Board's development and adoption of waste discharge requirements.~~

~~The contributions of return flows and discharges from agriculture and industry are also included in the BPP, as are those from developed areas which are likely to remain unsewered. Waste discharges in these unsewered areas are governed, in part, by the Regional Board's "Guidelines for Sewage Disposal from Land Developments" [Ref. 5], which are hereby incorporated by reference, and by the Regional Board's minimum lot size requirements for septic system use (see Nonpoint Source section of this chapter). As previously described, waste discharge prohibitions have been established for septic system use in certain areas. These prohibitions are a part of the wastewater management plan (pg. 5-5).~~

~~Those industries which discharge to municipal wastewater facilities (POTWs) are required by the Clean Water Act to develop and implement pretreatment programs which protect the POTWs' treatment processes from shock or upset and which also allow the discharger to comply with their waste discharge requirements (including mineral limits). Another important component of industrial waste management is the use of pipelines to transport brine wastes out of the basin for treatment and disposal to the ocean. There are two such lines in the Region, the Santa Ana Regional Interceptor~~

~~(SARI) and the Chino Basin Non-Reclaimable Line (NRL). Discharges of brines and other mineralized wastewaters to the SARI and NRL are encouraged.~~

As required by the Water Code (Section 13263), the Regional Board must assure that its regulatory actions implement the Basin Plan. Waste discharge requirements must specify limitations that, when met, will assure that water quality objectives will be achieved. Where the quality of the water receiving the discharge is better than the established objectives, the Board must assure that the discharge is consistent with the state's antidegradation policy (SWRCB Resolution No. 68-16). The Regional Board must also separately consider beneficial uses, and where necessary to protect those uses, specify limitations more stringent than those required to meet established water quality objectives. Of course, these obligations apply not only to TDS and nitrogen but also to other constituents that may adversely affect water quality and/or beneficial uses.

As indicated previously, the Regional Board's regulatory program includes the adoption of waste discharge prohibitions. The Board has established prohibitions on discharges of excessively saline wastes and, in certain areas, on discharges from subsurface disposal systems (see "Waste Discharge Prohibitions," above). The Board has also adopted other requirements pertaining to the use of subsurface disposal system use, both to assure public health protection and to address TDS and nitrogen-related concerns. These include the Regional Board's "Guidelines for Sewage Disposal from Land Developments" [Ref. 6], which are hereby incorporated by reference, and the minimum lot size requirements for septic system use (see Nonpoint Source section of this Chapter).

However, the principal TDS and nitrogen regulatory tool employed by the Regional Board is the issuance of appropriate discharge requirements, in conformance with the legal requirements identified above. Several important aspects of the~~e~~is permitting program ~~wastewater management plan~~ warrant additional discussion:

1. Salt assimilative capacity
2. Mineral increments
3. Nitrogen loss coefficients
~~3.~~4. TDS and nitrogen wasteload allocations
~~4.~~5. Wastewater reclamation
6. Special considerations – subsurface disposal systems

1. Salt Assimilative Capacity

~~Because the waters of this Region are reused as they flow from the higher areas of the basin toward the ocean, the concept of a "reasonable use" of the water was developed and included in the 1983 Basin Plan. This concept is also an important part of the TDS (and nitrogen) management strategy in this Basin Plan.~~

~~Most of the so-called biological characteristics (BOD, ammonia, etc.) of wastewater are readily treatable, while many of the inorganic or mineral characteristics are not. For this reason, reasonable use is generally described in terms of mineral additions.~~ Some waters in the Region have assimilative capacity for additions of TDS and/or nitrogen ~~(N)~~; that is, wastewaters with higher TDS/~~N~~nitrogen concentrations than the receiving waters are diluted sufficiently by natural processes, including rainfall or recharge, such that the TDS and nitrogen objectives of the receiving waters are met. The amount of assimilative capacity, if any, varies ~~widely,~~ depending on the individual characteristics of the waterbody in question.

~~A number of factors were considered in determining which waterbodies in the upper Santa Ana Basin do not have assimilative capacity for TDS and/or nitrogen inputs. For groundwaters, the results of the BPP for the Recommended Plan (5C) were used initially. The year 2010[1] quality (TDS and nitrate) projections for each subbasin were compared to their respective subbasin objectives to determine whether the objectives would be met and whether there was any evidence of degradation. Also considered was the existing quality of the subbasins, as shown by the BPP input data and recent field studies. This evidence was reviewed in light of the Regional Board's knowledge of a number of additional factors, including: the past, present, and future waste loads to each subbasin; subbasin hydrology; and the uncertainties associated with modeling procedures. Based on considerations of these factors, the following subbasins in the upper Santa Ana Basin lack assimilative capacity for TDS:~~

~~Bunker Hill II and Pressure~~
~~Riverside I~~
~~Colton~~
~~Rialto~~
~~Chino II and III~~

~~The following subbasins lack assimilative capacity for nitrogen:~~

~~Bunker Hill I, II, and Pressure~~
~~Colton~~
~~Rialto~~
~~Riverside I, II, and III~~
~~Temescal~~
~~Chino II, and III~~

~~The remaining subbasins in the upper Santa Ana Basin have assimilative capacity for TDS and nitrogen. However, these findings of assimilative capacity are contingent on the actual implementation of the Recommended Plan, according to the schedule provided therein. That is assimilative capacity exists in the remaining subbasins if and only if the quantity and quality of waste loads and methods of disposal, the quantity and quality of water supplies, groundwater management projects (see below), and other components of the Recommended Plan are implemented. If these measures are not implemented, the Regional Board will reconsider its findings of assimilative capacity.~~

The adoption of new groundwater management zone boundaries (Chapter 3) and new TDS and nitrate-nitrogen objectives for these management zones (Chapter 4), pursuant to the work of the Nitrogen/TDS Task Force, necessitated the re-evaluation of the assimilative capacity findings initially incorporated in the 1995 Basin Plan. To conduct this assessment, the Nitrogen-TDS study consultant calculated current ambient TDS and nitrate-nitrogen water quality using the same methods and protocols as were used in the calculation of historical ambient quality (see Chapter 4). The analysis focused on representing current water quality as a 20-year average for the period from 1978 through 1997. [Ref. 1]. For each management zone, current TDS and nitrate-nitrogen water quality were compared to water

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~~1 The planning period evaluated by the BPP extended to the year 2015. The water supply and wastewater management practices assumed for the year 2010 were simply extended to the year 2015. Given the uncertainties about such long-range projections, Regional Board staff determined that the use of the year 2010 projections would be more appropriate for the determination of assimilative capacity. Findings with respect to assimilative capacity will be reviewed again in the future.~~

quality objectives (historical water quality)[2]. Assimilative capacity was also assessed relative to the "maximum benefit" objectives established for certain management zones. If the current quality of a management zone is the same as or poorer than the specified water quality objectives, then that management zone does not have assimilative capacity. If the current quality is better than the specified water quality objectives, then that management zone has assimilative capacity. The difference between the objectives and current quality is the amount of assimilative capacity available.

Tables 5-3 and 5-4 show the water quality objectives and the current ambient quality for TDS and nitrate-nitrogen, respectively, for each management zone. These tables also list the TDS and nitrate-nitrogen assimilative capacity of the management zones, if any. Of the thirty-seven (37) management zones, twenty-seven (27) lack assimilative capacity for TDS, and thirty (30) lack assimilative capacity for nitrate-nitrogen (this assumes the "maximum benefit" objectives are in effect). There are five (5) management zones for which there were insufficient data to calculate TDS and/or nitrate-nitrogen water quality objectives and, therefore, assimilative capacity. For regulatory purposes, these 5 management zones are assumed to have no assimilative capacity. Dischargers to these management zones may demonstrate that assimilative capacity for TDS and/or nitrate-nitrogen is available. If the Regional Board approves this demonstration, then the discharger would be regulated accordingly.

As indicated in Table 5-3, it will be assumed for most regulatory purposes that there is no assimilative capacity for TDS in the Orange County groundwater management zone. The 20 mg/L of management zone-wide TDS assimilative capacity calculated for this zone will be allocated to discharges resulting from groundwater remediation and other legacy contaminant removal projects implemented within the Orange County Management Zone.

Tables 5-3 and 5-4 show the assimilative capacity available in management zones for which "maximum benefit" objectives have been specified. As described in Chapter 4 and later in this Chapter, the application of these objectives is contingent on the implementation of certain projects and programs by specific dischargers as part of their maximum benefit demonstrations. Assimilative capacity created by these projects/programs will be allocated to the party(-ies) responsible for implementing them.

Chapter 3 delineates the Prado Basin Management Zone, and Chapter 4 identifies the applicable TDS and nitrogen objectives for this Zone (the objectives for the surface waters that flow in this Zone). No assimilative capacity exists in this zone.

These assimilative capacity findings are significant from a regulatory perspective. ~~Water Code Section 13263 requires that waste discharge requirements implement relevant water quality control plans (basin plans). Therefore, waste discharge requirements must be related directly to water quality objectives in the Basin Plan.~~ If there is assimilative capacity in the receiving waters for TDS, nitrogen or other constituents, ~~the~~ a ~~allowed~~ waste discharge may be of ~~lower~~ poorer quality than the objectives for those constituents for the receiving waters, as long as the discharge does not cause violation of the objectives and provided that antidegradation requirements are met. However, if there is no assimilative capacity in the receiving waters, such as the management zones ~~subbasins identified above~~identified in Tables 5-3 and 5-4, the numerical limits in the discharge requirements

[2] As noted in Chapter 4, ammonia-nitrogen and nitrite-nitrogen data were also included in the analysis, where available. This occurred for a very limited number of cases and ammonia-nitrogen and nitrite-nitrogen concentrations were insignificant.

cannot exceed the receiving water objectives or the degradation process would be accelerated.[3] This rule was expressed clearly by the State Water Resources Control Board in a decision regarding the appropriate TDS discharge limitations for the Rancho Caballero Mobilehome park located in the Santa Ana Region (Order No. 73-4, the so called "Rancho Caballero decision") [Ref. ~~6~~7]. However, this rule is not meant to restrict overlying agricultural irrigation, or similar activities, such as landscape irrigation. Even in management zones ~~subbasins~~ without assimilative capacity, groundwater may be pumped, ~~and~~ used for agricultural purposes in the area and returned to the management zone from which it originated.

In regulating waste discharges to waters with assimilative capacity, the Regional Board will proceed as follows. (see also Section III.B.6., Special Considerations – Subsurface Disposal Systems).

If a discharger proposes to discharge wastes that are at or below (i.e., better than) the current ambient TDS and/or nitrogen water quality, then the discharge will not be expected to result in the lowering of water quality, and no antidegradation analysis will be required. TDS and nitrogen objectives are expected to be met. Such discharges clearly implement the Basin Plan and the Board can permit them to proceed. Of course, other pertinent requirements, such as those of the California Environmental Quality Act (CEQA) must also be satisfied. For groundwater management zones, current ambient quality is as defined in Table 5-3 and Table 5-4, or as these Tables may be revised (through the Basin Plan amendment process) pursuant to the detailed monitoring program to be conducted by dischargers in the watershed (see Section V., Salt Management Plan – Monitoring Program Requirements).

If a discharger proposes to discharge wastes that exceed the current ambient TDS and/or nitrogen quality, then the Board will require the discharger to conduct an appropriate antidegradation analysis. The purpose of this analysis will be to demonstrate whether and to what extent the proposed discharge would result in a lowering of ambient water quality in affected receiving waters. That is, to what extent, if any, would the discharge use available assimilative capacity. If the discharger demonstrates that no lowering of water quality would occur, then antidegradation requirements are met, water quality objectives will be achieved, and the Regional Board can permit such discharges to proceed. If the analysis indicates that a lowering of current ambient water quality would occur, other than on a minor or temporally or spatially limited basis, then the discharger must demonstrate that: (1) beneficial uses would continue to be protected and the established water quality objectives would be met; and (2) that the resultant water quality would be consistent with maximum benefit to the people of California; and, (3) that best practicable treatment or control has been implemented. Best practical treatment or control means levels that can be achieved using best efforts and reasonable control methods. For affected receiving waters, the discharger must estimate the amount of assimilative capacity that would be used by the discharger. The Regional Board would employ its discretion in determining the amount of assimilative capacity that would be allocated to the discharger. Rather than allocating assimilative capacity, the Regional Board may require the discharger to mitigate or offset discharges that would result in the lowering of water quality.

Again, discharges to waters without assimilative capacity for TDS and/or nitrogen must be held to the objectives of the affected receiving waters (with the caveat identified in footnote 3 below). In some cases, compliance with ~~subbasin~~ management zone TDS objectives for discharges to waters without

[3] A discharger may conduct analyses to demonstrate that discharges at levels higher than the objectives would not cause or contribute to the violation of the established objectives. See, for example, the discussion of wasteload allocations for discharges to the Santa Ana River and its tributaries (Section III. B. 4.) If the Regional Board approves this demonstration, then the discharger would be regulated accordingly.

assimilative capacity may be difficult to achieve. Poor quality water supplies or the need to add certain salts ~~in~~during the treatment process to achieve compliance -with other discharge limitations (e.g., addition of ferric chloride) could render compliance with strict TDS limits ~~impossible~~ very difficult. The Regional Board addresses such situations by providing dischargers with the opportunity to participate in TDS offset programs, such as the use of desalters, in lieu of compliance with numerical TDS limits. These offset provisions are incorporated into waste discharge requirements. Provided that the discharger takes all reasonable steps to improve the quality of the waters influent to the treatment facility (such as through source control or improved water supplies), and provided that chemical additions are minimized, the discharger can proceed with an acceptable program to offset the effects of TDS discharges in excess of the permit limits.

Similarly, compliance with the nitrate-nitrogen objectives for groundwaters specified in this Plan would be difficult in many cases. ~~These objectives, which were established in 1975 based on the relatively data available at the time, are generally very low concentrations, most below the drinking water standard. In adopting the wasteload allocation for total inorganic nitrogen, which is described in detail in the next section, the Regional Board specified that nitrogen discharges to the groundwaters of the upper Santa Ana Basin be held to 10mg/L (total inorganic nitrogen).~~ Offset provision may apply to nitrogen discharges as well.

An alternative that dischargers might pursue in these circumstances is revision of the TDS or nitrogen objectives, through the Basin Plan amendment process. Consideration of less stringent objectives would necessitate comprehensive antidegradation review, including the demonstrations that beneficial uses would be protected and that water quality consistent with maximum benefit to the people of the State would be maintained. As discussed in Chapter 4 and later in this Chapter, a number of dischargers have pursued this "maximum benefit objective" approach, leading to the inclusion of "maximum benefit" objectives and implementation strategies in this Basin Plan. Discharges to areas where the "maximum benefit" objectives apply will be regulated in conformance with these implementation strategies. Any assimilative capacity created by the maximum benefit programs will be allocated to the parties responsible for implementing them.

~~The Santa Ana River lacks assimilative capacity for nitrogen inputs, as shown by violation if its nitrogen objective at Prado Dam. This problem is addressed through the implementation of the total inorganic nitrogen wasteload allocation (see section 3).~~

~~The TDS objective for the River at Prado Dam is being met as a result of the implementation of a TDS wasteload allocation (also described in section 3). This Plan incorporates a revised TDS wasteload allocation to ensure continued compliance with the objective.~~

Table 5-3
Total Dissolved Solids (TDS) Assimilative Capacity Findings

Management Zone	Water Quality Objective (mg/L)	Current Ambient (mg/L)	Assimilative Capacity (mg/L)
UPPER SANTA ANA RIVER BASIN			
Beaumont – "max benefit" [3]	330	290	40
Beaumont – "antideg"	230	290	None
Bunker Hill A	310	350	None
Bunker Hill B	330	260	70
Colton	410	430	None
Chino North – "max benefit"	420	300	120
Chino 1 – "antideg"	280	310	None
Chino 2 – "antideg"	250	300	None
Chino 3 – "antideg"	260	280	None
Chino South	680	720	None
Chino East	730	760	None
Cucamonga – "max benefit" [3]	380	260	120
Cucamonga – "anti-deg"	210	260	None
Lytle	260	240	20
Rialto	230	230	None
San Timoteo – "max benefit" [3]	400	300	100
San Timoteo – "anti-deg"	300	300	None
Yucaipa – "max benefit" [3]	370	330	40
Yucaipa – "antideg"	320	330	None
MIDDLE SANTA ANA RIVER BASIN			
Arlington	980	--[1]	None
Bedford	--[1]	--[1]	None
Coldwater	380	380	None
Elsinore	480	480	None
Lee Lake	--[1]	--[1]	None
Riverside A	560	440	120
Riverside B	290	320	None
Riverside C	680	760	None
Riverside D	810	--[1]	None
Riverside E	720	720	None
Riverside F	660	580	80
Temescal	770	780	None
Warm Springs	--[1]	--[1]	None
SAN JACINTO RIVER BASINS			
Canyon	230	220	10
Hemet South	730	1030	None
Lakeview – Hemet North	520	830	None
Menifee	1020	3360	None
Perris North	570	750	None
Perris South	1260	3190	None
San Jacinto Lower	520	730	None
San Jacinto Upper	320	370	None
LOWER SANTA ANA RIVER BASINS			
Irvine	910	910	None
La Habra	--[1]	--[1]	None
Orange County[2]	580	560	None[2]
Santiago	--[1]	--[1]	None

[1] Not enough data to estimate TDS concentrations; management zone is presumed to have no assimilative capacity. If assimilative capacity is demonstrated by an existing or proposed discharger, that discharge would be regulated accordingly.

[2] For the purposes of regulating discharges other than those associated with projects implemented within the Orange County Management Zone to facilitate remediation projects and/or to address legacy contamination, no assimilative capacity is assumed to exist.

[3] Assimilative capacity created by "maximum benefit" objectives is allocated solely to agency(ies) responsible for "maximum benefit" implementation (see Section VI.).

Table 5-4
Nitrate Nitrogen (NO_3-N) Assimilative Capacity Findings

Management Zone	Water Quality Objective (mg/L)	Current Ambient (mg/L)	Assimilative Capacity (mg/L)
UPPER SANTA ANA RIVER BASINS			
Beaumont – "max benefit" [3]	5.0	2.6	2.4
Beaumont – "antideg"	1.5	2.6	None
Bunker Hill A	2.7	4.5	None
Bunker Hill B	7.3	5.5	1.8
Colton	2.7	2.9	None
Chino North – "max benefit" [3]	5.0	7.4	None
Chino 1 – "antideg"	5.0	8.4	None
Chino 2 – "antideg"	2.9	7.2	None
Chino 3 – "antideg"	3.5	6.3	None
Chino South	4.2	8.8	None
Chino East	10	29.1	None
Cucamonga – "max benefit" [3]	5.0	4.4	0.6
Cucamonga – "anti-deg"	2.4	4.4	None
Lytle	1.5	2.8	None
Rialto	2.0	2.7	None
San Timoteo – "max benefit" [3]	5.0	2.9	2.1
San Timoteo – "anti-deg"	2.7	2.9	None
Yucaipa – "max benefit" [3]	5.0	5.2	None
Yucaipa – "antideg"	4.2	5.2	None
MIDDLE SANTA ANA RIVER BASINS			
Arlington	10.0	--[1]	None
Bedford	--[1]	--[1]	None
Coldwater	1.5	2.6	None
Elsinore	1.0	2.6	None
Lee Lake	--[1]	--[1]	None
Riverside A	6.2	4.4	1.8
Riverside B	7.6	8.0	None
Riverside C	8.3	15.5	None
Riverside D	10.0	--[1]	None
Riverside E	10.0	14.8	None
Riverside F	9.5	9.5	None
Temescal	10.0	13.2	None
Warm Springs	--[1]	--[1]	None
SAN JACINTO RIVER BASINS			
Canyon	2.5	1.6	0.9
Hemet South	4.1	5.2	None
Lakeview – Hemet North	1.8	2.7	None
Menifee	2.8	5.4	None
Perris North	5.2	4.7	0.5
Perris South	2.5	4.9	None
San Jacinto Lower	1.0	1.9	None
San Jacinto Upper	1.4	1.9	None
LOWER SANTA ANA RIVER BASINS			
Irvine	5.9	7.4	None
La Habra	--[1]	--[1]	None
Orange County	3.4	3.4	None
Santiago	--[1]	--[1]	None

[1] Not enough data to estimate nitrate nitrogen concentrations
[2] Assimilative capacity created by "maximum benefit" objectives is allocated solely to agency(ies) responsible for "maximum benefit" implementation (see Section VI.).

2. Mineral Increments

The fundamental philosophy of TDS management plans in Santa Ana Region Basin Plans to date has been to allow a reasonable use of the water, to treat the wastewater generated appropriately, and to allow it to flow downstream (or to lower groundwater basins) for reuse. "Reasonable use" is defined in terms of appropriate mineral increments that can be applied to water supply quality in setting discharge limitations.

The Department of Water Resources has recommended values for the maximum use incremental additions of specific ions ~~and characteristics which~~ that should be allowed through use, based on detailed study of water supplies and wastewater quality in the Region [Ref. ~~7~~8]. Their recommendations are as follows:

Sodium	70 mg/L
Sulfate	40 mg/L
Chloride	65 mg/L
TDS	250 mg/L
Total Hardness	30 mg/L

These mineral increments ~~have been in effect since the late 1960s and~~ were ~~also~~ incorporated into the 1983 Basin Plan. They will be incorporated into waste discharge requirements when ~~as~~ appropriate and necessary.

3. Nitrogen Loss Coefficients

The Regional Board's regulatory program has long recognized that some nitrogen transformation and loss can occur when wastewater is discharged to surface waters or reused for landscape irrigation. For example, the Total Inorganic Nitrogen (TIN) wasteload allocation adopted for the Santa Ana River in 1991 included unidentified nitrogen losses in the surface flows in Reach 3 of the River. Waste discharge requirements have allowed for nitrogen losses due to plant uptake when recycled water is used for irrigation.

In contrast, nitrogen has been considered a conservative constituent in the subsurface, not subject to significant transformation or loss, and no such losses have been identified or assumed for regulatory purposes.

One of the tasks included in the Nitrogen/TDS Task Force studies leading to the 2004 update of the N/TDS Management Plan was the consideration of subsurface transformation and loss. One objective of this task was to determine whether dischargers might be required to incur costs for additional treatment to meet the new groundwater management zone nitrate-nitrogen objectives (Chapter 4), or whether natural, subsurface nitrogen losses could achieve any requisite reductions. The second objective was to develop a nitrogen loss coefficient that could be used with certainty to develop appropriate limits for nitrogen discharges throughout the Region.

To meet these objectives, the Nitrogen/TDS study consultant, Wildermuth Environmental, Inc. (WEI), evaluated specific recharge operations (e.g., the Orange County Water District recharge ponds overlying the Orange County Forebay), wastewater treatment wetlands (e.g., the Hidden Valley Wildlife Area, operated by the City of Riverside) and Santa Ana River recharge losses (for the Santa Ana River, water quality in reaches where recharge is occurring ("losing" reaches) was compared with local well data). In each case, WEI evaluated long-term (1954 to 1997) nitrogen surface water quality data and compared those values to long-term nitrogen data for adjacent wells.

Based on this evaluation, a range of nitrogen loss coefficients was identified. [Ref. 1] In light of this

variability, the N/TDS Task Force recommended that a conservative approach to be taken in establishing a loss coefficient. The Task Force recommended that a region-wide default nitrogen loss of 25% be applied to all discharges that affect groundwater in the Region. The Task Force also recommended that confirmatory, follow-up monitoring be required when a discharger requested and was granted the application of a nitrogen loss coefficient greater than 25%, based on site-specific data submitted by that discharger.

The City of Riverside also presented data to the Task Force regarding nitrogen transformation and losses associated with wetlands. These data support a nitrogen loss coefficient of 50%, rather than 25%, for the lower portions of Reach 3 of the Santa Ana River that overlie the Chino South groundwater management zone. [Ref. 9]. In fact, the data indicate that nitrogen losses from wetlands in this part of Reach 3 can be greater than 90%. However, given the limited database, the Task Force again recommended a conservative approach, i.e., 50% in this area, with confirmatory monitoring.

The 25% and, where appropriate, 50% nitrogen loss coefficients will be used in developing nitrogen discharge limits. These coefficients will be applied to discharges that affect groundwater management zones with and without assimilative capacity.

For discharges to groundwater management zones with assimilative capacity, the TIN discharge limitation would be calculated as follows:

TIN Discharge Limit (mg/) = management zone nitrate-nitrogen current ambient water quality
(1- nitrogen loss coefficient)

The Regional Board will employ its discretion in specifying a higher TIN limit that would allocate some of the available assimilative capacity.

For discharges to groundwater management zones without assimilative capacity, the TIN discharge limitation would be calculated as follows:

TIN Discharge Limit (mg/) = management zone nitrate-nitrogen water quality objective
(1- nitrogen loss coefficient)

These coefficients do not apply to discharges specifically addressed by the TIN wasteload allocation, described in the next section, since surface and subsurface nitrogen losses were accounted for in developing this allocation.

~~3.~~4. TDS and Nitrogen Wasteload Allocations for the Santa Ana River

Wasteload allocations for regulating discharges of TDS and total inorganic nitrogen (TIN) to the Santa Ana River, and thence to groundwater management zones recharged by the River, are ~~another~~ an important component of ~~the wastewater~~ salt management ~~plan~~ for the ~~upper~~ Santa Ana Basin. As described earlier, the Santa Ana River is a significant source of recharge to groundwater management zones underlying the River and, downstream, to the Orange County ground-water ~~basin. Therefore, the~~basin. The quality of the River thus has a significant effect on the quality of the Region's groundwater, which is used by more than 5 million people. Control of River quality is appropriately one of the Regional Board's highest priorities. ~~that groundwater and must be properly controlled.~~

~~As described earlier, s~~Sampling and modeling analyses conducted in the 1980's and early 1990's indicated that the TDS and total nitrogen ~~two~~ water quality objectives for the Santa Ana River~~, those for TDS and total nitrogen,~~ were being violated or were in danger of being violated. Under the Clean Water Act (Section 303(d)(1)(c); 33 USC 466 *et seq*.), violations of water quality objectives for surface waters must be addressed by the calculation of the maximum wasteloads ~~which~~ that can be

discharged to achieve and maintain compliance. Accordingly, TDS and nitrogen wasteload allocations were developed and included in the 1983 Basin Plan. The nitrogen wasteload allocation was updated in 1991; an updated TDS wasteload allocated was included in the 1995 Basin Plan when it was adopted and approved in 1994/1995. ~~Revised wasteload allocations for these constituents are included in this Plan.~~

The wasteload allocations distribute a share of the total TDS and TIN ~~nitrogen~~ wasteloads ~~to the River~~ to each of the discharges to the River or its tributaries. The allocations are implemented principally through TDS and nitrogen limits in waste discharge requirements issued to municipal wastewater treatment facilities (Publicly Owned Treatment Works or POTWs) ~~which~~ that discharge to the River, either directly or indirectly[4]. Nonpoint source inputs of TDS and nitrogen to the River are also considered in the development of these wasteload allocations. Controls on these inputs are more difficult to identify and achieve and may be ~~. In part, these controls are~~ addressed ~~via the Groundwater Management Plan (below), and~~ through the areawide stormwater permits issued to the counties by the Regional Board or through other programs. For example, the Orange County Water District has constructed and operates more than 400 acres of wetlands ponds in the Prado Basin Management Zone to remove nitrogen in flows diverted from, and then returned to, the Santa Ana River.

Because of the implementation of these wasteload allocations, the Orange County Water District wetlands and other measures, the TDS and TIN water quality objectives for the Santa Ana River at Prado Dam are no longer being violated, as shown by annual sampling of the River at the Dam by Regional Board staff [Ref. 10A]. However, as part of the Nitrogen/TDS Task Force studies to update the TDS/nitrogen management plan for the Santa Ana Basin, a review of the TDS and TIN wasteload allocations initially contained in this Basin Plan was conducted. In part, this review was necessary in light of the new groundwater management zones and TDS and nitrate-nitrogen objectives for those zones recommended by the N/TDS Task Force (and now incorporated in Chapters 3 and 4). The wasteload allocations were evaluated and revised to ensure that the POTW discharges would assure compliance with established surface water objectives and would not cause or contribute to violation of the groundwater management zone objectives. The Task Force members also recognized that this evaluation was necessary to determine the economic implications of assuring conformance with the new management zone objectives. Economics is one of the factors that must be considered when establishing new objectives (Water Code Section 13241).

WEI performed the wasteload allocation analysis for both TDS and TIN [Ref. 3, 5], In contrast to previous wasteload allocation work, the QUAL-2e model was not used for this analysis. Further, the Basin Planning Procedure (BPP) was not used to provide relevant groundwater data. Instead, WEI developed a projection tool using a surface water flow/quality model and a continuous-flow stirred-tank reactor (CFSTR) model for TDS and TIN. The surface water Waste Load Allocation Model (WLAM) is organized into two major components – RUNOFF (RU) and ROUTER (RO). RU computes runoff from the land surface and RO routes the runoff estimated with RU through the drainage system in the upper Santa Ana watershed. Both the RU and RO models contain hydrologic, hydraulic and water quality components.

To ensure that all hydrologic regimes were taken into account, hydrologic and land use data from 1950 through 1999 were used in the analysis. The analysis took into account the TDS and nitrogen quality of wastewater discharges, precipitation and overland runoff, instream flows and groundwater.

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[4] With some exceptions that may result from groundwater pumping practices, t~~T~~he ground and surface waters in the upper Santa Ana Basin (upstream of Prado Dam) eventually enter the Santa Ana River and flow through Prado Dam. Discharges to these waters will therefore eventually affect the quality of the River and must be regulated so as to protect both the immediate receiving waters and other affected waters, including the River.

Off-stream and in-stream percolation rates, rising groundwater quantity and quality, and the 25% and 50% nitrogen loss coefficients described in the preceding section were also factored into the analysis. The purpose of the modeling exercise was to estimate discharge, TDS and TIN concentrations in the Santa Ana River and tributaries and in stream bed recharge. These data were then compared to relevant surface and groundwater quality objectives to determine whether changes in TDS and TIN regulation were necessary.

Discharges from POTWs to the Santa Ana River or its tributaries were the focus of the analysis. POTW discharges to percolation ponds were not considered. The wasteload allocation analysis assumed, correctly, that these direct groundwater discharges will be regulated pursuant to the management zone objectives, findings of assimilative capacity and nitrogen loss coefficients identified in Chapter 4 and earlier in this Chapter.

The surface waters evaluated included the Santa Ana River, Reaches 3 and 4, Chino Creek, Cucamonga/Mill Creek and San Timoteo Creek. Management zones that are directly under the influence of these surface waters and that receive wastewater discharges were evaluated. These included the San Timoteo, Riverside A, Chino South, and Orange County Management Zones[5]. In addition, wastewater discharges to the Prado Basin Management Zone were also evaluated.

WEI performed three model evaluations in order to assess wasteload allocation scenarios through the year 2010. These included a "baseline plan" and two alternative plans ("2010-A" and "2010-B"). The baseline plan generally assumed the TDS and TIN limits and design flows for POTWs specified in waste discharge requirements as of 2001. These limits implemented the wasteload allocations specified in the 1995 Basin Plan when it was approved in 1995. A TDS limit of 550 mg/L was assumed for the Rapid Infiltration and Extraction Facility (RIX) and the analysis assumed a 540 mg/L TDS for the City of Beaumont. The baseline plan also assumed reclamation activities at the level specified in the 1995 Basin Plan, when it was approved. The purpose of the baseline plan assessment was to provide an accurate basis of comparison for the results of evaluation of the two alternative plans. For alternative 2010-A, it was generally assumed that year 2001 discharge effluent limits for TDS and TIN applied to POTW discharges, but projected year 2010 surface water discharge amounts were applied. TDS limits of 550 mg/L and 540 mg/L were again assumed for RIX and the City of Beaumont discharges. The same limited reclamation and reuse included in the baseline plan was assumed (see Table 5-7 in Section III.B.5.). For alternative 2010-B, POTW discharges were also generally limited to the 2001 TDS and TIN effluent limits (RIX was again held to 550 mg/L and Beaumont to 540 mg/L). However, in this case, large increases in wastewater recycling and reuse were assumed (Table 5-7), resulting in the reduced surface water discharges projected for 2010.

Analysis of the model results demonstrated that the TDS and nitrogen objectives of affected surface waters would be met and that water quality consistent with the groundwater management zone objectives would be achieved under both alternatives. It is likely that water supply and wastewater agencies will implement reclamation projects with volumes that are in the range of the two alternatives. The wasteload allocations would be protective throughout the range of surface water discharges identified. The year 2010 flow values are not intended as limits on POTW flows; rather, these flows were derived from population assumptions and agency estimates and are used in the models for quality projections. Surface water discharges significantly different than those projected

[5] The City of Beaumont discharges to Coopers Creek in a subunit of the Beaumont Management Zone. However, for analytical and regulatory purposes, it is considered a discharge to the San Timoteo Management Zone since it enters that Management Zone essentially immediately. Recharge of wastewater discharges by YVWD and Beaumont in downgradient management zones that may be affected by surface water discharges (e.g., Bunker Hill B, Colton), is not expected to be significant. Therefore, these management zones were not evaluated as part of the wasteload allocation analysis.

will necessitate additional model analyses to confirm the propriety of the allocations.

The wasteload allocations for TDS and TIN are specified in Table 5-5. Allocations based on the 2010-A and 2010-B alternatives are shown for both TDS and TIN to reflect the expected differences in surface water discharge flows that would result from variations in the amount of wastewater recycling actually accomplished in the Region. As shown in this Table, irrespective of these differences, the TDS and TIN allocations remain the same.

It is essential to point out that the wasteload allocations in Table 5-5 will be not be used to specify TDS and TIN effluent limitations for wastewater recycling (reuse for irrigation) and recharge by the listed POTWs, but will be applied only to the surface water discharges by these POTWs to the Santa Ana River and its tributaries. TDS and TIN limitations for wastewater recycling and recharge by these POTWs will be based on the water quality objectives for affected groundwater management zones or, where appropriate, surface waters. These limitations are likely to be different than the wasteload allocations specified in Table 5-5.

For most dischargers, the allocations specified in Table 5-5 are the same as those specified in the prior 1995 Basin Plan TDS and TIN wasteload allocations. However, for certain dischargers, two sets of TDS and TIN wasteload allocations are shown in Table 5-5. One set is based on the assumption that the "maximum benefit" objectives defined in Chapter 4 for the applicable groundwater management zones are in effect. The other set of wasteload allocations applies if maximum benefit is not demonstrated and the antidegradation objectives for these management zones are therefore in effect. Maximum benefit implementation is described in Section VI. of this Chapter.

In addition, in contrast to the prior wasteload allocations, a single wasteload allocation for TDS and TIN that would be applied on a flow-weighted average basis to all of the treatment plants operated by the Inland Empire Utilities Agency as a whole is specified. These allocations are based on the water quality objectives for Chino Creek, Reach 1B (550 mg/L TDS and 8 mg/L TIN), to which the IEUA discharges occur, directly or indirectly. As described in Section VI, IEUA proposes to implement a "maximum benefit" program to support the implementation of the "maximum benefit" TDS and nitrate-nitrogen objectives for the Chino North and Cucamonga Management Zones. Separate "maximum benefit" and "antidegradation" wasteload allocations are not necessary for IEUA, as they are for YVWD and Beaumont. This is because the IEUA wasteload allocations are based solely on the Chino Creek objectives and are not contingent on "maximum benefit" objectives or implementation. The IEUA surface water discharges do not affect the groundwater management zones for which "maximum benefit" objectives are to be implemented.

Finally, the TDS wasteload allocation for the RIX facility is less stringent (550 mg/L) than the prior wasteload allocation. The new allocation will assure beneficial use protection and will not result in a significant lowering of water quality. As such, it is consistent with antidegradation requirements. Given this, the less stringent effluent limitation can be specified pursuant to the exception to the prohibition against backsliding established in the Clean Water Act, Section 303(d)(4)(a).
In most cases, the surface water discharges identified in Table 5-5 will affect or have the potential to affect groundwater management zones without assimilative capacity for TDS and/or nitrogen. As discussed earlier in this section, the lack of assimilative capacity normally dictates the application of the water quality objectives of the affected receiving waters as the appropriate waste discharge limitations. However, as shown in Table 5-5, the TIN and, in some cases, TDS wasteload allocations for these discharges exceed the objectives for these management zones. This is because the wasteload allocation analysis conducted by WEI demonstrated that POTW discharges at these higher-than-objective levels will not result in violations of the TDS and nitrate-nitrogen objectives of the affected management zones, or surface waters. Accordingly, these wasteload allocations will be used for surface water discharge regulatory purposes, rather than the underlying groundwater management zone objectives. If the extensive monitoring program to be conducted by the dischargers (see Salt

Management Plan – Monitoring Program Requirements, below) indicates that this strategy is not effective, then this regulatory approach will be revisited and revised accordingly.

~~Periodic review and update of the wasteload allocations is necessary to reflect changing conditions in the watershed, including increasing municipal wastewater flows, changes in water supply sources (which may affect the total dissolved solids quality of the wastewaters), and changes in the quality of the River. In part, review of the total dissolved solids wasteload allocation was initiated in response to equity concerns expressed by the dischargers. In the case of nitrogen, evidence that the nitrogen objective for the River was being exceeded prompted Regional Board staff to begin the review process [Ref. 8].~~

~~Both the TDS and nitrogen wasteload allocations were developed with the QUAL2E model, using the water supply and wastewater management plans specified in Alternative 5C. Input on rising groundwater was provided by the BPP. The ability of the individual wastewater treatment plants to meet the limits specified in the revised allocations and the facility/operational costs associated with compliance were carefully considered by both the Regional Board and the dischargers.~~

~~a.Total Dissolved Solids Wasteload Allocation~~

~~The revised wasteload allocation for TDS discharges to the Santa Ana River is shown in Table 5-4.~~

~~The 1992 baseflow TDS quality of the Santa Ana River at Prado Dam was 648mg/L, which is below the objective specified in this Basin Plan (700mg/L). The revised wasteload allocation will ensure continued compliance with the objective.~~

~~As noted in Table 5-4, footnote 1, certain discharges affect groundwater subbasins without TDS assimilative capacity (see list on page 5-14). These dischargers will be held to the affected subbasin objectives, rather than the wasteload allocations specified for them, unless the dischargers participate in acceptable salt offset programs (see section B.1. for discussion of assimilative capacity and waste discharge requirements). If approved by the Regional Board, salt offset programs can include studies to determine appropriate offset quantities (which may entail a review of subbasin water quality objectives) and project alternatives.~~

~~Where difficulties with compliance with this allocation arise, the Regional Board has determined that additional consideration should be given. As discussed earlier, the Regional Board incorporates provisions in waste discharge requirements which allow dischargers to participate in acceptable programs to offset the water quality impacts of TDS discharges in excess of specified limits. Provided that the discharger has taken all appropriate steps to minimize TDS concentrations in the wastewater, and provided that the discharger participates in a salt offset program, the Regional Board has indicated its intent not to enforce violations of the numeric TDS limits in waste discharge requirements, thereby preventing undue hardship to dischargers.~~

~~Table 5-4~~

~~Wasteload Allocation for Discharges of Total Dissolved Solids to the Santa Ana River and its Tributaries~~

~~DISCHARGER (NOTE#)~~	~~DISCHARGE TO~~	~~HISTORIC DATA~~		~~WASTELOAD ALLOCATION~~		~~FUTURE PROJECTIONS~~	
		~~1990 FLOW (MGD)~~	~~1990 TDS (mg/L)~~	~~1995 FLOW (11) (MGD)~~	~~1995 TDS (mg/L)~~	~~2000 FLOW (11) (MGD)~~	~~2000 TDS (mg/L)~~
~~BEAUMONT (1)~~	~~STC~~	~~0.0(9)~~	~~0~~	~~1.9~~	~~540~~	~~2.2~~	~~540~~
~~YUCAIPA VALLEY CWD (1)~~	~~STC~~	~~0.0(9)~~	~~0~~	~~3.0~~	~~540~~	~~4.0~~	~~540~~
~~REDLANDS TO PONDS (1)~~	~~R 5~~	~~6.8~~	~~465~~	~~6.0~~	~~465~~	~~5.0~~	~~515~~
~~REDLANDS TERTIARY (1)~~	~~R 5~~	~~0~~	~~0~~	~~1.6~~	~~465~~	~~3.6~~	~~515~~
~~SAN BERNARDINO~~	~~R 4~~	~~27.6~~	~~535~~	~~2.5(2)~~	~~535~~	~~4.0(2)~~	~~540~~
~~COLTON~~	~~R 4~~	~~5.1~~	~~590~~	~~0~~	~~0~~	~~0~~	~~0~~
~~SAWPA (S.B. & Colton) (1)~~	~~R 4 (3)~~	~~0~~	~~0~~	~~32.9~~	~~510~~	~~0~~	~~0~~
~~SAWPA (S.B. & Colton) (1)~~	~~R 3~~	~~0~~	~~0~~	~~0~~	~~0~~	~~37.2~~	~~550~~
~~RIALTO~~	~~R 4~~	~~6.3~~	~~530~~	~~8.0~~	~~490~~	~~13.0~~	~~400~~
~~RIVERSIDE REGIONAL~~	~~R 3~~	~~34.2~~	~~650~~	~~36.0~~	~~650~~	~~38.0~~	~~650~~
~~JURUPA CSD INDIAN HILLS~~	~~R 3~~	~~0.1~~	~~650~~	~~0.6~~	~~650~~	~~1.0~~	~~650~~
~~CHINO BASIN MWD RP3~~	~~R 3~~	~~0~~	~~0~~	~~0~~	~~0~~	~~8.0~~	~~650~~
~~WESTERN RIVERSIDE~~	~~R 3~~	~~0~~	~~0~~	~~7.0~~	~~625~~	~~10.0~~	~~625~~
~~CORONA TERTIARY~~	~~TMS~~	~~0~~	~~0~~	~~1.0~~	~~700~~	~~5.0~~	~~650~~
~~CORONA TO PONDS~~	~~R 3~~	~~7.4~~	~~700~~	~~10.0~~	~~700~~	~~10.0~~	~~650~~
~~LEE LAKE WD~~	~~TMS~~	~~0.3~~	~~650~~	~~1.3~~	~~650~~	~~2.0~~	~~675~~
~~ELSINORE VALLEY MWD~~	~~TMS~~	~~2.0~~	~~700~~	~~7.0~~	~~700~~	~~9.0~~	~~675~~
~~EASTERN MWD (4)~~	~~TMS~~	~~0.0(10)~~	~~0~~	~~16.0~~	~~650~~	~~28.0~~	~~650~~
~~CHINO BASIN MWD RP2A (5)~~	~~CHN~~	~~0~~	~~0~~	~~7.7~~	~~555~~	~~10.4~~	~~560~~
~~CHINO BASIN MWD RP2~~	~~CHN~~	~~6.6~~	~~610~~	~~6.3~~	~~610~~	~~7.0~~	~~600~~
~~CHINO BASIN MWD RP1~~	~~CHN (6)~~	~~17.8~~	~~515~~	~~24.2~~	~~515~~	~~16.7~~	~~540~~
~~CHINO BASIN MWD RP1~~	~~CUC (7)~~	~~19.8~~	~~515~~	~~21.4~~	~~515~~	~~18.1~~	~~540~~
~~CHINO BASIN MWD RP4~~	~~CUC (8)~~	~~0~~	~~0~~	~~0~~	~~0~~	~~13.4~~	~~505~~
~~**TOTAL**~~		~~**134.2**~~		~~**194.4**~~		~~**245.6**~~	

~~NOTES~~

~~STC SAN TIMOTEO CREEK R 5 REACH 5 SANTA ANA RIVER R 4 REACH 4 SANTA ANA RIVER R 3 REACH 3 SANTA ANA RIVER~~
~~TMS TEMESCAL CREEK CHN CHINO CREEK CUC CUCAMONGA (Mill) CREEK~~

~~(**1**) These discharges affect subbasins that do not have assimilative capacity for TDS. TDS wasteload allocations apply to these discharges in lieu of direct application of groundwater objectives, only if these dischargers participate in approved mitigation (offset) programs (see discussion re: Rancho Caballero decision on p. 5-15)~~

~~(**2**) Local reclamation. (**3**) At RIX site, (lower part of Colton Subbasin). (**4**) San Jacinto River Basin. (**5**) Carbon Canyon Plant. (**6**) Prado Park Lake.~~
~~(**7**) Near HWY 60 Xing. (**8**) Via Deer Creek. (**9**) Flows from Beaumont and Yucaipa are shown as zero since they are not always continuous with the river.~~
~~(**10**) EMWD's present discharges are reclaimed or percolated. (**11**) Flow estimates used for model projections, TDS limits apply to all flows up to and including estimated values.~~

Table 5-5

Alternative Wasteload Allocations through 2010
based on "Maximum Benefit" or "Antidegradation" Water Quality[1]

Publicly Owned Treatment Works (POTW)	Alternative 2010A – Reclamation in 1995 Basin Plan			Alternative 2010B – Reclamation Plans Advocated by POTWs/others		
	Surface Water Discharge (MGD)	TDS (mg/L)	TIN (mg/L)	Surface Water Discharge (MGD)	TDS (mg/L)	TIN (mg/L)
Beaumont – "max benefit" [2]	2.3	490	6.0	1.0	490	6.0
Beaumont – "antideg" [2, 3]	2.3	320[3]	4.1[3]	1.0	320[3]	4.1[3]
YVWD – Wochholz – "max benefit"	5.7	540	6.0	0.0	540	6.0
YVWD – Wochholz – "antideg" [3]	5.7	320[3]	4.1[3]	0.0	320[3]	4.1[3]
Rialto	12.0	490	10.0	10.0	490	10.0
RIX	49.4	550	10.0	28.2	550	10.0
Riverside Regional WQCP	35.0	650	13.0	26.1	650	13.0
Western Riverside Co. WWTP	4.4	625	10.0	3.3	625	10.0
EMWD[4]	43	650	10.0	6.0	650	10.0
EVMWD – Lake Elsinore Regional	7.2	700	13.0	2.0	700	13.0
Lee Lake WRF	1.6	650	13.0	1.6	650	13.0
Corona WWTP # 1	3.6	700	10.0	2.0	700	10.0
Corona WWTP # 2	0.2	700	10.0	0.5	700	10.0
Corona WWTP # 3	2.0	700	10.0	0.5	700	10.0
IEUA Facilities [5]	80.0	550	8.0	37.4	550	8.0

1. "Antidegradation" wasteload allocation is the default allocation if the Regional Board determines that "maximum benefit" commitments are not being met.
2. Beaumont discharges to Coopers Creek, a tributary of San Timoteo Creek, Reach 4, it is a *de facto* discharge to San Timoteo Creek/San Timoteo Management Zone.
3. "Antidegradation" wasteload allocations for City of Beaumont and YVWD based on additional model analysis performed by WEI (WEI, October 2002).
4. EMWD discharges are expected to occur only during periods of wet weather.
5. IEUA facilities include the RP#1, Carbon Canyon WRP, RP#4 and RP#5; These facilities are to be regulated as a bubble (see text).

~~a.Nitrogen Wasteload Allocation~~

~~Because so much of the water in the Santa Ana River is made up of treated municipal effluent (particularly during low flow periods), there is the threat of significant nitrogen discharge impacts on the groundwaters of both the upper Santa Ana Basin and Orange County, and on the aquatic fauna of the River itself. The latter impact is related to discharges of ammonia, one of the components of nitrogen which dissociates under certain conditions to the toxic un-ionized form.~~

~~To address these concerns, a total inorganic nitrogen wasteload allocation, including specific limits on nitrate and ammonia, was included in the 1983 Basin Plan. However, as previously noted, evidence that the nitrogen objective for the River was being violated indicated that review and revision of that wasteload allocation was necessary. That review was conducted as part of the comprehensive TDS and Nitrogen Management Studies for the upper Santa Watershed [Ref. 1-4]. In addition, a revised objective for un-ionized ammonia is specified in this Plan, necessitating revision of ammonia effluent limits.~~

~~1)Total Inorganic Nitrogen~~

~~In 1991, the Regional Board adopted a revised total inorganic nitrogen (TIN) wasteload allocation (Resolution No. 91-125). After extensive analysis of alternatives and discussions with dischargers, the TIN allocation selected was the one specified in Alternative 5C-10, a part of the Recommended Plan in this Basin Plan. Under Alternative 5C-10, wastewater discharges to Reaches 4 and 5 of the River and tributaries thereto are limited to 10mg/L TIN; for discharges to Reach 3, existing[3] POTW flows are limited to 13mg/L TIN, while new[4] flows are limited to 10mg/L. The Recommended Plan also specifies that all wastewater discharges to percolation ponds (existing and new) be limited to 10mg/L TIN.~~

~~In contrast to its predecessor in the 1983 Basin Plan, this revised allocation addresses compliance with nitrogen objectives throughout the River system and not only at Prado Dam. In addition, the revised total inorganic nitrogen allocation addresses the severe groundwater nitrate problems identified in the comprehensive TDS and nitrogen management studies for the upper Santa Ana Watershed. The total nitrogen objectives for the various reaches of the River were established to protect the use of the River for groundwater recharge (**GWR**) and, by extension, the quality of underlying groundwater. As shown on page 5-14, many of the groundwater subbasins in the upper Santa Ana Basin, including those affected by Santa Ana River flows, exceed their respective nitrate objectives. This requires that the Regional Board impose limits on wastewater discharges which are sufficient to ensure compliance with water quality objectives throughout the River system. The historic focus on objective compliance at Prado is no longer adequate. This is reflected in the TIN limits specified in the wasteload allocation. In addition, the revised total inorganic nitrogen wasteload allocation addresses the ground water nitrate problem by specifying the wastewater discharges to percolation ponds not exceed 10mg/L TIN. The groundwater subbasins of the upper Santa Ana Basin are designated for use for municipal and domestic supply (**MUN**). The 10mg/L TIN concentration is essentially comparable to the nitrate drinking water standard which protects the **MUN** use. By holding wastewater discharges to percolation ponds to 10mg/L TIN, the Regional Board ensures that **MUN** use will not be adversely affected by those discharges, and that~~

~~[3] For the purposes of this allocation "existing" POTW flows are defined as the wastewater flows projected in the model up to the year 2000. Projected wastewater flows are shown in Table 5-5~~

~~[4] For the purpose of this allocation, "new" flows are defined as flows from new treatment facilities projected to come on-line during the planning period (1990-2000) (*e.g.*, Chino Basin MWD RP2A and RP4), flows from existing wastewater treatment plants not previously discharged to the Santa Ana River system (*e.g.*, Eastern Municipal Water District), and any flows from operating POTWs which are in excess of existing flows, as defined (see footnote 3).~~

~~cleanup of currently unusable groundwater will not be encumbered by percolation of wastewater with nitrogen in excess of potable standards.~~

~~The wasteload allocation is shown in Table 5-5. The salient features of this table are:~~

- ~~Present and projected wastewater discharges to the middle Santa Ana River and its tributaries are listed in the left column. The total inorganic nitrogen wasteload allocation to be used to establish effluent limitations for these discharges is the set of total inorganic nitrogen concentrations shown for the year 1995 discharges.~~
- ~~The Cities of Redlands and Corona currently discharge to percolation ponds. Corona's discharge is considered as a direct discharge to the Santa Ana River. In the future, portions of the flow from both communities will receive tertiary treatment with discharge to the Santa Ana River.~~
- ~~Year 1990 and projected years (1995 and 200) wastewater flows for each of the discharges are listed. Year 1990 wastewater flows (and total inorganic nitrogen concentrations) are shown for information only. The years 1995 and 2000 flow values are not intended as limits on POTW flows. Rather, these flows were derived from population assumptions and are used in the models for quality projections. Wastewater flows significantly in excess of those projected will necessitate additional model analysis to confirm the propriety of the allocation.~~
- ~~Year 2000 wastewater flows and total inorganic nitrogen concentrations are listed in Table 5-5. These values may be revised.~~

~~2)~~Ammonia

Total inorganic nitrogen is used for regulatory purposes in wasteload allocations and surface water discharge limits. It is the sum of nitrate, nitrite and ammonia. Ammonia dissociates under certain conditions to the toxic un-ionized form. Thus, nitrogen discharges to the Santa Ana River and other surface waters pose a threat to aquatic life and instream beneficial uses, as well as to the beneficial uses of affected groundwater.

~~The u~~Un-ionized ammonia objectives are specified in Chapter 4 of this Basin Plan for warmwater aquatic habitats, such as the Santa Ana River system. Table 5-6 specifies the ammonia limits necessary to achieve these objectives. These limits were derived using QUAL2E, the Colorado Ammonia Model, water quality data on the River and effluent quality.

The un-ionized ammonia objectives have not been approved by the United State Environmental Protection Agency (USEPA), which recommends that the objectives be reviewed and revised based on the Agency's revised national ammonia criteria. A review of the un-ionized ammonia objectives is included in the Regional Board's 2002 Triennial Review Priority List. Any revised objectives and revised ammonia effluent limits needed to achieve the revised objectives will be incorporated in future amendments to this Plan once the requisite review is completed.~~, is more stringent than that found in the 1983 Basin Plan. The ammonia limits in the 1983 wasteload allocation will not ensure compliance with the new objective.~~

~~Revised ammonia effluent limits for discharges to the Santa Ana River system are incorporated in this Plan (Table 5-6). The revised limits were derived using QUAL2E, the Colorado Ammonia Model, water quality data on the River and effluent quality.~~

Table 5-6

Effluent Limits for Total Ammonia Nitrogen[1]

Discharge Location	Effluent Limit - Total Ammonia Nitrogen[2] (mg/L)	
	Year 1995	Year 2000
San Timoteo Wash	5.0	4.5
Santa Ana River - Reach 4	5.0	4.5
Santa Ana River - Reach 3	5.0	5.0
Chino Creek	5.0	4.5
Mill Creek (Prado Area)	5.0	4.5
Temescal Creek	5.0	4.5
Other **WARM** designated waterbodies	Determined on a case-by-case basis	

1 Total Ammonia Nitrogen Wasteload Allocation is specified in order to meet the site-specific Santa Ana River un-ionized ammonia objective (See Chapter 4).

2 Total Ammonia Nitrogen = Un-ionized Ammonia Nitrogen (NH_3-N) + Ammonium Nitrogen (NH_4^+-N).

~~Table 5-5~~

~~Wasteload Allocation for Discharges of Total Inorganic Nitrogen (TIN) to the Santa Ana River and its Tributaries~~

~~DISCHARGER (NOTE #)~~	~~DISCHARGE TO~~	~~HISTORIC DATA~~		~~WASTELOAD ALLOCATION~~		~~FUTURE PROJECTION~~	
		~~1990 FLOW (MGD)~~	~~1990 TIN (mg/L)~~	~~1995 FLOW (10) (MGD)~~	~~1995 TIN (mg/L)~~	~~2000 FLOW (10) (MGD)~~	~~2000 TIN (mg/L)~~
~~BEAUMONT~~	~~STC~~	~~0 (8)~~	~~0~~	~~2.0~~	~~10~~	~~2.2~~	~~10~~
~~YUCAIPA VALLEY CWD~~	~~STC~~	~~0~~	~~0~~	~~5.5~~	~~10~~	~~6.0~~	~~10~~
~~REDLANDS TO PONDS (1)~~	~~R 5~~	~~6.8~~	~~23~~	~~5.1~~	~~10~~	~~5.1~~	~~10~~
~~REDLANDS TERTIARY~~	~~R 5~~	~~0~~	~~0~~	~~2.7~~	~~10~~	~~3.6~~	~~10~~
~~SAN BERNARDINO~~	~~EWC~~	~~27.6~~	~~22~~	~~17.7~~	~~10~~	~~17.7~~	~~10~~
~~COLTON~~	~~R 4~~	~~5.1~~	~~16~~	~~0~~	~~0~~	~~0~~	~~0~~
~~SAN BERNARDINO TERTIARY (2)~~	~~R 3~~	~~0~~	~~0~~	~~15.7~~	~~13~~	~~17.7~~	~~13~~
~~COLTON TERTIARY (2)~~	~~R 3~~	~~0~~	~~0~~	~~6.0~~	~~13~~	~~6.8~~	~~13~~
~~RIALTO TERTIARY~~	~~R 4~~	~~6.3~~	~~20~~	~~8.8~~	~~10~~	~~11.6~~	~~10~~
~~RIVERSIDE REGIONAL~~	~~R 3~~	~~34.2~~	~~16~~	~~35.9~~	~~13~~	~~38.0~~	~~13~~
~~JURUPA CSD INDIAN HILLS~~	~~R 3~~	~~0.1~~	~~10~~	~~0.7~~	~~10~~	~~0.7~~	~~10~~
~~CHINO BASIN MWD RP3~~	~~R 3~~	~~0~~	~~0~~	~~8.0~~	~~10~~	~~11.8~~	~~10~~
~~WESTERN RIVERSIDE REGIONAL~~	~~R 3~~	~~0~~	~~0~~	~~6.8~~	~~10~~	~~8.4~~	~~10~~
~~CORONA TERTIARY~~	~~TMS~~	~~0~~	~~0~~	~~1.0~~	~~10~~	~~4.6~~	~~10~~
~~CORONA TO PONDS (1)~~	~~R 3~~	~~7.4~~	~~18~~	~~10.2~~	~~13~~	~~9.0~~	~~13~~
~~LEE LAKE WD~~	~~TMS~~	~~0.3~~	~~10~~	~~1.3~~	~~13~~	~~1.7~~	~~13~~
~~ELSINORE VALLEY MWD~~	~~TMS~~	~~2.0~~	~~10~~	~~7.2~~	~~13~~	~~8.8~~	~~13~~
~~EASTERN MWD (3)~~	~~TMS~~	~~0 (9)~~	~~0~~	~~16.6~~	~~10~~	~~27.9~~	~~10~~
~~CHINO BASIN MWD RP2A (4)~~	~~CHN~~	~~0~~	~~0~~	~~6.4~~	~~10~~	~~9.6~~	~~10~~
~~CHINO BASIN MWD RP2~~	~~CHN~~	~~6.6~~	~~17~~	~~6.8~~	~~13~~	~~6.7~~	~~13~~
~~CHINO BASIN MWD RP1 (5)~~	~~CHN~~	~~17.8~~	~~19~~	~~17.5~~	~~13~~	~~17.0~~	~~13~~
~~CHINO BASIN MWD RP1 (6)~~	~~CUC~~	~~19.8~~	~~19~~	~~17.5~~	~~13~~	~~17.4~~	~~13~~
~~CHINO BASIN MWD RP4 (7)~~	~~CUC~~	~~0~~	~~0~~	~~3.1~~	~~10~~	~~6.3~~	~~10~~
~~**TOTAL**~~		~~**134.2**~~		~~**202.2**~~		~~**238.3**~~	

~~NOTES~~
~~Total inorganic nitrogen (TIN) is the sum of the nitrate-N, nitrite-N, and ammonia-N in a filtered sample of water.~~

~~STC - SAN TIMOTEO CREEK~~
~~R 5 - REACH 5 SANTA ANA RIVER~~
~~EWC - EAST WARM CREEK~~
~~R 3 - REACH 3 SANTA ANA RIVER~~
~~R 4 - REACH 4 SANTA ANA RIVER~~
~~TMS - TEMESCAL CREEK~~
~~CHN - CHINO CREEK~~
~~CUC - CUCAMONGA (MILL) CREEK~~

~~(1) Indirect load~~
~~(2) Diverted to R 3~~
~~(3) San Jacinto River Basin~~
~~(4) Carbon Canyon Plant~~
~~(5) Near Hwy 60 Xing~~
~~(6) Prado Park Lake~~
~~(7) Via Deer Creek~~
~~(8) Flows from Beaumont and Yucaipa are shown as zero since they are not always continuous with the River.~~
~~Actual 1990 discharges: Beaumont 1.0 MGD; Yucaipa 2.5 MGD.~~
~~(9) EMWD's present discharges are reclaimed or percolated.~~
~~A surface discharge may be made in the future.~~
~~(10) Flow estimates used for model projections.~~
~~TIN limits apply to all flows up to and including estimated values.~~

~~4.~~5. Wastewater Reclamation

Reclamation of wastewater for reuse (recycled water) is an important feature of ~~the W~~wastewater ~~Management Plan~~ and water management for the ~~upper~~ Santa Ana ~~Basin~~ Region. ~~and, indeed, for the Region as a whole.~~ The California Legislature has declared the primary interest of the people of California in the development of facilities to recycle wastewater to supplement existing water supplies and to meet future water demands (Water Code Section 13510-13512). State policy (State Board Resolution No. 77-1) affirms this commitment to encourage recycled water use. ~~strongly supports reclamation.~~ However, because reclamation projects tend to add to the salt balance problem in the Region, they must be carefully planned and implemented. The significant benefits~~, which~~ that result from such projects, include:

- The total water supply can be effectively increased, reducing the need for imports;
- Wastewater treatment costs can be reduced in some cases. Meeting the level of treatment required for discharge to surface waters may be more expensive than treating the effluent for use in irrigation;
- Stream flows can be established or enhanced, providing aquatic riparian habitat and allowing recreation and other beneficial uses of the stream;
- Downstream delivery commitments can often be met by discharges of appropriately treated wastewater.

Concerns related to wastewater reclamation projects include:

1. Mineral Quality Effects

The mineral quality of the receiving water (surface or groundwater) can be adversely affected. Each cycle of water use increases the salinity of the water. The amount of the increase depends on the type of use; normal domestic use generally adds 200-300mg/L of TDS to the initial concentration. Agricultural use generally doubles the salinity, while industrial uses most often degrade water quality to a level where it may be unsuitable for discharge. Therefore, it is important that the type of reclaimed wastewater use and the likely effects on water quality be evaluated carefully prior to initiating such reuse. Certain waters in the upper Santa Ana Basin do not have assimilative capacity to accept the additional salinity ~~which~~ that would be expected to ~~probably~~ result from reclamation.

2. Public Health Effects

Municipal wastewaters contain significant concentrations of bacteria, viruses, and organics. These wastewaters must be treated extensively to remove pathogens before they can be reclaimed. Stable organics in reclaimed water are also cause for considerable concern. Chlorination of treated wastewater effluents can produce chlorinated hydrocarbons, some of which are carcinogenic. For this reason, the California State Department of Health Services is concerned with proposals ~~which~~ that would return a high proportion of treated wastewater effluent into domestic water supply aquifers. Adequate treatment and dilution of the wastewater is essential. The Department is developing guidelines for the purposed use of reclaimed wastewater for groundwater recharge.

Because of the high percentage of wastewater in river baseflow, the Santa Ana River Water Quality and Health (SARWQH) Study was initiated by OCWD in 1994 to evaluate the use of the Santa Ana River to recharge the Orange County groundwater basin. The goal of the SARWQH

Study was to characterize the quality of the Santa Ana River water and the quality of the groundwater basin it recharges. The study included an examination of hydrogeology, microbiology, water chemistry, toxicology and public health. The results of the study indicate that current recharge practices using Santa Ana River water are protective of public health.

3. Land Use Considerations

One of the major problems facing the future of wastewater reclamation is a decrease in the total amount of agricultural land in the basin. As the population of the basin increases, commercial and residential developments eliminate agricultural land and the need for irrigation waters. Some reclaimed wastewater may be used for irrigating landscaping in the new developments, but the volume utilized will almost certainly be reduced.

4. The Prado Settlement

On October 18, 1963, the Orange County Water District filed a class action lawsuit against the water users in the upper Santa Ana Basin, seeking an adjudication of water rights against substantially all the water users in the area tributary to Prado Dam in the Santa Ana River watershed. As a result of the 1969 settlement of this case, the wastewater dischargers in the upper basin are required to provide 42,000 acre-feet at Prado Dam. This can consist of treated wastewater effluent or imported water as well as certain natural flows (*e.g.,* rising water); stormflows are not included. The amount of flow delivered is subject to adjustment based upon the TDS content of the water. Reclamation uses within the upper basin are thus limited to a degree by the need to ensure compliance with this settlement.

Wastewater is presently being reclaimed in the ~~upper~~ Santa Ana ~~Basin~~ Watershed ~~(and elsewhere in the Region)~~ in a number of different ways:

1. Irrigation of Agricultural Land and Landscaping

Most of the direct reclamation of wastewater in the Region occurs as part of commercial agricultural and landscape irrigation, although this will change as recharge projects using recycled water are implemented (see below). This use is conducted under ~~W~~water ~~R~~reclamation ~~R~~requirements issued by the Regional Board, typically as part of Waste Discharge Requirements and NPDES permits. In the San Jacinto Watershed, most of the wastewater is reclaimed for agricultural uses.

2. Discharge to the Santa Ana River

Although it is not widely considered as such, discharges of treated wastewater to Reaches 3, 4 and 5 of the Santa Ana River constitute the largest single reclamation activity in the Region. These discharges make up as much as 95 percent of the river's dry weather flow and enhance the in-stream beneficial uses of the river throughout its 26-mile length (San Bernardino to Prado Dam). Essentially all of this water is recharged into the groundwater basin in Orange County~~.~~

3. Groundwater Recharge by Percolation

This type of reclamation is common throughout the Region. Most wastewater treatment plants ~~which~~ that do not discharge directly to the River discharge their effluent to percolation ponds. All of the treated wastewater in the upper Santa Ana Basin ~~which~~ that is not directly reclaimed for commercial agricultural and landscape irrigation purposes, or discharged directly to the Santa Ana River, is

returned to local or downstream groundwater ~~subbasins~~ management zones by percolation. In Orange County, reclaimed water is used for greenbelt and landscape irrigation, and injected into coastal aquifers to control sea water intrusion.

Significant additional reclamation activities are planned in the Region, as reflected in Table 5-7. The Chino Basin Watermaster, Inland Empire Utilities Agency, Yucaipa Valley Water District, the City of Beaumont and the San Timoteo Watershed Management Authority propose to implement extensive groundwater recharge projects using recycled water. To accommodate these projects and other water and wastewater management strategies, these agencies have made the requisite demonstrations necessary to support the "maximum benefit" TDS and nitrate-nitrogen water quality objectives specified in this Plan for certain groundwater management zones (see Chapter 4). The recharge projects will provide reliable sources of additional water supply needed to support expected development within the agencies' areas of jurisdiction. These agencies' "maximum benefit" programs are described in detail in Section VI. of this Chapter.

In Orange County, significant reclamation activities include the implementation of the Groundwater Replenishment System, a joint effort of the Orange County Water District and Orange County Sanitation District. Treated wastewater provided by the Sanitation District will receive extensive advanced treatment, including microfiltration, reverse osmosis, and disinfection using ultraviolet light and hydrogen peroxide. In the first phase of the project, approximately 70, 000 acre-feet per year of highly treated recycled water will be produced and distributed to groundwater recharge facilities and to injection wells used to maintain a seawater intrusion barrier. The System will enhance both the quality and quantity of groundwater resources, the major source of water supply in the area. It will reduce the need for imported water and prevent, or at least delay, the need for an additional ocean outfall for disposal of the wastewater treated by the Sanitation District. Implementation of the GWR System will be phased. Operation of Phase 1 will begin in 2007. Future phases to expand the capacity of the GWR System are possible.

4. Dual Water Supply Systems

Given increasing demands for water supply but diminishing resources, there is great interest in using reclaimed water in office buildings and the like for flushing toilets and urinals. Clearly, the addition of this water supply source must be carefully planned and overseen to prevent ~~any~~ public health problems. No dual systems have been implemented as yet in the upper basin; in Orange County, the Irvine Ranch Water District has implemented dual systems (a reclaimed water system in addition to a potable supply) in a number of office buildings in its service area, with the approval of the Department of Health Services and the Regional Board.

~~As discussed in a later section regarding TDS and nitrogen management activities in the lower Santa Ana Basin, wastewater is also reclaimed and used to control saltwater intrusion into the coastal aquifers of the Region.~~

The ~~Recommended~~ Salt Management Plan draws a balance between the benefits and problems of reclamation by including carefully planned ~~and limited~~ reclamation activities in the ~~upper basin~~watershed. The Recommended Plan provides for reclamation within the upper basin, as shown in Table 5-7. All recycled water recharge projects will be regulated pursuant to the process identified in the discussion regarding assimilative capacity, and in accordance with the "maximum benefit" implementation strategies identified later in this Chapter (see section VI., Maximum Benefit Implementation Plans for Salt Management). ~~Discharges associated with large scale reclamation projects which are not identified in the recommended plan and which have the potential to significantly~~

~~affect the surface or groundwater quality must be subjected to further analysis prior to their implementation to evaluate the water quality impacts.~~

Recycled water used for landscape irrigation deserves special regulatory consideration. As discussed in the section on nitrogen loss coefficients, the Regional Board does not regulate nitrogen in recycled water used for landscape irrigation, recognizing the nitrogen losses that will occur as the result of plant uptake. The Nitrogen /TDS Task Force sponsored update of the TDS/Nitrogen Management Plan demonstrated that it is appropriate also to apply a 25 percent nitrogen loss coefficient to recycled water discharges applied to land to account for subsurface transformation and loss. Nitrogen losses due to plant uptake and subsurface transformation justify the Board's regulatory approach. With respect to TDS, the water quality effects of recycled water used for landscape irrigation will be evaluated on a case-by-case basis and regulated accordingly.

6. Special Considerations – Subsurface Disposal Systems

In addition to establishing prohibitions and minimum lot size requirements for the use of subsurface disposal systems for sanitary wastes, the Regional Board issues waste discharge requirements where necessary to assure the protection of water quality and public health. In most cases, these requirements have been issued for commercial and industrial facilities, including mobile home parks, RV parks and truck washing operations, where the volume of waste is high and/or there is the potential for the discharge of wastes other than domestic sewage. Waste discharge requirements for individual residential systems and low volume (less than 500 gallons per day) domestic waste discharges from industrial and commercial facilities have been largely waived, pursuant to the waiver provisions of the Water Code (see discussion of waivers in the "Implementation through Waste Discharge Requirements" section, above). These waivers are conditional and may be revoked by the Regional Board at any time.

The Board has included TDS limitations in these waste discharge requirements in order to assure that the discharges are consistent with the TDS objectives of the affected receiving waters. These limits are expressed as both a maximum value that is based on the TDS objective of the receiving water, and a value that allows a reasonable use increment of 250 mg/L TDS above water supply quality. The more restrictive of the two TDS limits controls the allowed quality of the discharges.

TDS and nitrogen contributions from domestic waste discharges to existing commercial, industrial and residential subsurface disposal systems are reflected in the determinations of current ambient ground water quality and assimilative capacity (see preceding section – B.1.) on assimilative capacity). These determinations were made as part of the N/TDS Task Force sponsored update of the TDS/nitrogen management plan in this Basin Plan. These contributions are expected to decline over time as these discharges are eliminated through the expansion of regional sewer systems.

Compliance with TDS limits by these facilities is particularly problematic, since these facilities typically have little or no control over the TDS quality of water supplied to them, unlike POTWs. Further, sewering of the discharges is often not an option, at least at the present time, although this is changing as rapid new development in many parts of the region continues to drive the expansion of sewer facilities. As systems expand, many of these discharges will be eliminated as they are connected to the sewers. Finally, the offset provisions that are applied to POTWs are unnecessary for existing residential commercial and industrial domestic waste discharges, given that they are addressed as part of the Regional Board's minimum lot size program for subsurface disposal systems and through the updated TDS and nitrogen management plan in this Basin Plan as part of the overlying land-use considerations and ambient water quality determinations.

Taking these factors into consideration, the waste discharge requirements that have been issued and will be updated periodically for domestic waste discharges from these existing residential, commercial and industrial facilities will include TDS requirements that specify a maximum mineral increment of 250 mg/L TDS to the water supply quality. This will assure reasonable use and prevent the disposal of highly saline wastes. Existing facilities are defined as those for which waste discharge requirements have been issued, or that have been built as of [*the effective date of this Basin Plan amendment*].

Table 5-7

Wastewater Reclamation ~~as Specified in Alternative 5C Upper Santa Ana Basin~~

Subbasin (Management Zone) Receiving Reclaimed Water	Source	Amount AF/Y ~~Period 1995-2000~~2010-A[1]	Amount AF/Y 2010-B[2]
~~San Timoteo~~Beaumont MZ	Beaumont, City of	250	1,500
Yucaipa MZ	Yucaipa Valley Water District	--	6,400
~~Bunker Hill II~~Bunker Hill B MZ	San Bernardino, City of and Colton, City of	117	26,200
Colton MZ	~~Colton~~Rialto, City of	200	
~~Chino II and III~~Chino North MZ	IEUA~~Chino Basin MWD~~ RP-1	1,200	48,000
~~Chino II and III~~Chino North MZ	IEUA~~Chino Basin MWD~~ RP-2A	2,470	
~~Chino II and III~~Chino North MZ	IEUA~~Chino Basin MWD~~ RP-4	3,300	
~~Chino III~~Chino North MZ	California Institute for Men	650	650
~~Chino I~~Chino North MZ	Upland Golf Course	31	31
Temescal MZ	Corona, City of	1,000	3,100
	TOTAL	**9,218**	**86,000**

[1] wastewater reclamation assumed in 2010-A is the same as that assumed in the 1995 Basin Plan when approved in 1994/1995 (also known as Table 5-7)
[2] wastewater reclamation assumed in 2010-B as identified by POTWs (see Ref. 3, 5).

~~C.~~V. ~~Groundwater Management Plan~~Other Projects and Programs

In addition to the regulatory efforts of the Regional Board described in the preceding section, water and wastewater purveyors and other parties in the watershed have implemented, and propose to implement, facilities and programs designed to address salt problems in the groundwater of the Region. These include the construction of brine lines and groundwater desalters, implementation of programs to enhance the recharge of high quality stormwater and imported water, where available, and re-injection of

recycled water to maintain salt water intrusion barriers in coastal areas. These projects and programs are motivated by the need to protect and augment water supplies, as well as to facilitate compliance with waste discharge requirements.

A. Brine lines

There are two brine line systems in the Region, the Santa Ana Regional Interceptor (SARI) and the older Chino Basin Non-Reclaimable Line (NRL). These lines are used to transport brine wastes out of the basin for treatment and disposal to the ocean. They are a significant part of industrial waste management and essential for operation of desalters in the upper watersheds. The SARI Line was constructed and is owned by SAWPA. It is approximately 93 miles of 16 inch to 84 inch pipeline connected to the Orange County Sanitation District treatment facilities. SAWPA owns capacity rights in SARI downstream of Prado Dam. The line extends from the Orange County Line near Prado Dam northeast to the San Bernardino area. Recently, the SARI Line has been extended to serve the San Jacinto Watershed. SARI Reach 5 extends up the Temescal Canyon from the City of Corona to the Eastern Municipal Water District (EMWD) brine line terminus in the Lake Elsinore area. EMWD's Menifee Desalter and other high salinity discharges from EMWD and Western Municipal Water District now have access to the brine line.

The Chino Basin Non-Reclaimable Line (NRL) is connected to the Los Angeles County Sanitation District sewer system in the Pomona area. The NRL, which is owned and operated by Inland Empire Utilities Agency, exports non-reclaimable industrial wastes and brine from the Chino Basin. It extends eastward from the Los Angeles County Line to the City of Fontana. It was originally built to serve industries including the Kaiser Steel Company and Southern California Edison Power Plants.

B. Groundwater desalters

The studies leading to the development of the TDS/Nitrogen management plan included in this Basin Plan when it was approved in 1995 demonstrated that it was not realistic to achieve compliance with all the nitrogen and TDS objectives for the groundwater subbasins then identified within the Region. Long-term historic land use practices, particularly agriculture, have left an enormous legacy of salts that are now in the unsaturated soils overlying the groundwater subbasins (now, newly defined groundwater management zones). A significant amount of these salts will, over time, degrade groundwater quality. The programs of groundwater extraction, treatment, and replenishment needed to completely address these historic salt loads were shown to far exceed the resources available to implement them.

While the boundaries of the groundwater management zones have been revised and new TDS and nitrate-nitrogen water quality objectives established, the salt legacy problem remains. The construction and operation of groundwater desalters to extract and treat poor quality groundwater continues to be an essential component of salt management in the Region. Such projects will be increasingly important to protect local water supplies and to provide supplemental, reliable sources of potable supplies.

~~The Groundwater Management Plan attempts to balance natural recharge, artificial recharge, groundwater pumping, surface water use, imported water use, and wastewater reclamation in order to optimize water quality and quantity. In essence, it is an integration of the Water Supply Plan and the Wastewater Management Plan. In addition, where necessary, the Groundwater Management Plan includes specific remediation programs and projects, such as groundwater extraction and treatment. The Basin Planning Procedure (BPP) is used to balance these various Plan components.~~

~~One of the most important aspects of groundwater management planning in the basin has been the ongoing effort (since 1971 Interim Plan) to move once used water downstream rather than recycling it back to the local groundwater basins. Careful management of reuse and reclamation within any one subbasin reduces the problem of excessive mineralization. This approach does not require more imported water if the needs of both the upper and lower basin are considered. In this Recommended Plan, most municipal wastewater is exported directly from the upper basin, reducing groundwater quality degradation and localized high groundwater problems. This Plan also includes adequate recharge of groundwater basins with food quality water.~~

~~The Recommended Plan includes five specific groundwater extraction and treatment projects (desalters), as shown in Table 5-8. The Arlington Desalter is already in operation; the Recommended Plan assumes that the remaining facilities will be in place by 1995. Two chino desalters are in advanced planning stages~~. A number of groundwater desalters have already been constructed, and more are planned. These facilities are described below.

1. Upper Santa Ana Basin

In the Upper Santa Ana Basin, the Santa Ana Watershed Project Authority constructed and operates the Arlington desalter. This desalter, with a capacity of about 7 MGD, treats water extracted from the Arlington Management Zone, which was heavily impacted by historic agricultural activities.

In the Chino Basin, the Chino Desalter Authority operates the Chino 1 desalter, which is planned for expansion from 8 MGD to 13 MGD capacity. Additional desalters and desalter capacity will be constructed as part of a "maximum benefit" proposal by the Chino Basin Watermaster and the Inland Empire Utilities Agency (see section VI., Maximum Benefit Implementation Plans for Salt Management).

The City of Corona began operation of the Temescal desalter in late 2001. The desalter has a capacity of 10 MGD. The City is currently expanding the desalter by 5 MGD. It is expected to be operational in the early 2004. The product water is used to supplement current municipal supplies. The improved TDS quality of these supplies is an important part of the City's efforts to assure compliance with waste discharge requirements.

In the San Timoteo Watershed areas, desalters will be implemented as necessary for the Yucaipa and Beaumont areas, as discussed in detail in Section VI., Maximum Benefit San Timoteo Watershed Salt Management Plan.

2. San Jacinto Watershed

EMWD operates the Menifee desalter, which has a capacity of about 3 MGD. Product water is added to the EMWD municipal supply system, and the waste brine is discharged to a non-reclaimable waste disposal system that is ultimately connected to the SAWPA SARI system. The desalter extracts groundwater from the Perris South and Menifee Management Zones, both of which are adversely affected by historic salt loads contributed largely by agricultural activities.

EMWD plans to construct a desalter with capacity of about 4.5 MGD to treat poor quality water extracted from the Perris South and Lakeview/Hemet North Management Zones. The purpose of this facility is to stop subsurface migration of poor quality groundwater from the Perris South Management Zone into the Lakeview/Hemet North Management Zone.

~~Table 5-8~~

~~Recommended Plan – Groundwater Extraction and Desalting Facilities[1]~~
~~Upper Santa Ana Basin~~

~~Groundwater Desalter~~	~~Approximate Poor Quality Extraction Amount (AF/Y)~~	~~Product Water Flow (MGD)~~	~~**Community Served**~~
~~Arlington[2]~~	~~7,800~~	~~6.3~~	~~Orange County Groundwater~~
~~Southwest Chino[3]~~	~~16,000~~	~~10.7~~	~~City of Chino; San Bernardino County Water Works No. 8~~
~~Southeast Chino[3]~~	~~30,000~~	~~24.2~~	~~Jurupa CSD; City of Norco~~
~~Riverside/Colton~~	~~28,000~~	~~18.9~~	~~City of Riverside~~
~~Temescal~~	~~25,000~~	~~19.5~~	~~City of Corona~~
~~**TOTAL**~~	~~**106,800**~~	~~**80.0**~~	~~——~~

~~[1] Recommended Plan (Alternative 5C), Year 2000.~~
~~[2] The Arlington Desalter is currently in operation.~~
~~[3] Phase II figures for the Chino Basin Desalters. At the completion of Phase I, the desalters will extract approximately 7,000 AF/Y each and produce a total of approximately 10.7 MGD of product water.~~

~~1.Arlington Desalter~~

~~The water quality of the Arlington Subbasin has been degraded by historic agricultural activities. Agricultural drainage has increased salt level in the groundwater to the point that the water is no longer a viable drinking water source.~~

~~To reclaim the use of this subbasin, the Santa Ana Watershed Project Authority (SAWPA), in cooperation with the Metropolitan Water District of Southern California and the State Water Resources Control Board, constructed the Arlington desalter. This facility is now in operation. At full production, this desalter produces 6 million gallons per day of potable water [Ref. 9].~~

~~The operation of the desalter will reduce the amount of salts entering the Santa Ana River, provide a potable water supply, and help to restore the quality of the groundwater subbasin. The BPP results show that this subbasin has assimilative capacity for both TDS and nitrate, apparently made available by the operation of this facility.~~

~~2.Chino Basin Desalter Projects~~

~~Two Chino Basin desalters are now being planned by SAWPA and other local and regional agencies. In the first phase, these facilities will extract and treat approximately 14,000 acre-feet per year of brackish groundwater from the Chino III Subbasin. The objectives of the desalters are to protect and create potable water supplies and to intercept poor quality rising groundwater and improve the quality of the Santa Ana River baseflow. When operational, these facilities will~~

~~remove about 15,000 tons of salts from the Basin annually. It is expected that these facilities will be expanded in the future.~~

~~3. Riverside/Colton Desalter~~

~~The Recommended Plan includes a desalter to address the severe TDS and nitrate problems in the Colton and Riverside Subbasins, caused largely by historic agriculture and long-term recharge of these subbasins by wastewater effluents. As proposed in the Recommended Plan, this desalter would improve the quality of the waters in the subbasin and the quality of both the drinking water supplies and wastewaters of the City of Riverside and the Rubidoux Community Service District.~~

~~An intensive study of water sources management for the Colton and Riverside Subbasins in now underway (see Chapter 7). This study may result in additional or alternative recommendations or water quality management in this area. Revisions to this Recommended Plan can be considered on the basis of the results and recommendations of this study.~~

~~4.Temescal Desalter~~

~~The Recommended Plan also includes a desalter for the Temescal Subbasin. This desalter would: improve the drinking water and wastewater quality for the City of Corona; reduce that City's reliance on Colorado River water as a source of supply (Colorado River Water is high in TDS content); and finally, improve the quality of the subbasin.~~

~~5.Special Studies~~

~~A number of studies are in progress to investigate in greater detail the TDS and nitrogen problems in the Upper Santa Ana Basin and to identify solutions. The results of these studies may lead to changes in this Basin Plan, including new regulatory strategies or other implementation measures.~~

~~These efforts include the development and evaluation of water resources management plans for the Chino Basin (Chino Basin Water Resources Management Study) and for the Colton-Riverside Subbasins (Colton-Riverside Basin Conjunctive Use Study). Studies are also in progress to evaluate total inorganic nitrogen and total organic carbon removal in the Prado Basin (Santa Ana River TIN/TOC Study). A brief description of each of these programs is included in Chapter 7.~~

~~SALT BALANCE AND ASSIMILATIVE CAPACITY – San Jacinto Basin~~

~~The groundwater subbasins in the San Jacinto Watershed were evaluated for water quality and assimilative capacity in a study conducted by SAWPA from 1987-1989. The study covered both TDS and nitrate quality of groundwaters. For the San Jacinto Basin, the study was only superficial in depth and extent. There have been many changes in water supply, wastewater disposal, and reclamation since that time.~~

~~The Graben area, which consists of the Canyon, Intake, Upper Pressure, and Lower Pressure Subbasins, was modeled with moderate detail; the other seven subbasins in the San Jacinto watershed were modeled in less detail. The data available for nitrate modeling was meager and therefore the nitrate quality projections should be considered only approximate.~~

~~Results of projected subbasin groundwater quality for TDS indicated that all of the San Jacinto groundwater basins with the exception of the Canyon Subbasin have assimilative capacity for~~

~~planned TDS wasteloads. The Canyon Subbasins exceeds the TDS water quality objective at the present time and at the end of the planning period (2005). Lakeview and Hemet Subbasins exceed their respective TDS water quality objective at the present time (1990 and 1995), but do show improvement in the future. There are mitigation programs being developed for the Hemet Subbasin, as described below.~~

~~Based on model projections, the following subbasins in the San Jacinto watershed have no assimilative capacity for nitrate:~~

~~Canyon~~	~~Menifee I~~
~~Perris, North~~	~~Menifee II~~
~~Hemet~~	~~Lakeview~~

~~Presently, Eastern Municipal Water District is conducting studies of the Hemet Subbasin which should provide a better understanding of the quality problems and alternative mitigation measures (see Special Studies discussion). A desalter is planned for the Menifee I Subbasin. When these studies and efforts are completed or are further in the planning stages, any changes in the San Jacinto Management Plan will be incorporated into the Basin Plan.~~

~~Surface Water Management~~

~~Surface waters of the San Jacinto watershed are tributary to the Santa Ana River via Temescal Creek and therefore all probable flows from the watershed are incorporated into the Santa Ana River wasteload allocation for TDS and nitrate (see Tables 5-4 and 5-5).~~

~~Special Studies and Projects~~

~~Eastern Municipal Water District is involved in a number of studies and projects related to TDS and nitrogen management in the San Jacinto watershed. The results of these studies may lead to changes in the Basin Plan. Descriptions of these studies are included in Chapter 7.~~

~~Menifee Basin Desalter~~

~~A desalter in the Menifee I Subbasin is being planned by Eastern Municipal Water District as part of an effort to decrease dependency on costly and unreliable imported water and to recover high TDS groundwater in the Menifee Subbasin. Agricultural activities and the hydrologic nature of the basin have caused TDS concentrations to rise to an average of 2000mg/L.~~

~~The Menifee Desalter would extract approximately 3MGD of degraded water. The water would be treated by either reverse osmosis (RO) or electrodialysis. The product water would be blended with groundwater source with TDS averaging 500mg/L. The waste brine would be disposed of via the Santa Ana Regional Interceptor line (SARI line).~~

~~SALT BALANCE AND ASSIMILATIVE CAPACITY – LOWER Santa Ana Basin~~

~~The Santa Ana River recharges Orange County groundwater subbasins. Rapid percolation basins located in the Santa Ana River streambed are operated and maintained by Orange County Water District (OCWD). OCWD also owns and operates a number of other recharge pits, ponds, and basins in the Santa Ana Forebay area which are supplied with the Santa Ana River water via pipelines.~~

~~Groundwater makes up approximately 63% of the total product water supply for the OCWD area. The river and several very small tributaries provide about half of the groundwater recharge. The River flow is made up of base flow and storm flow components. Baseflow generally provides 70% or~~

~~more of the water recharged. In rare wet years, baseflow accounts for a smaller, but still significant percentage (40%) of the recharge. Therefore, to protect Orange County groundwater it is essential to control the quality of baseflow. Most of the baseflow (80-90%) is composed of treated sewage effluent; it also includes nonpoint source inputs and rising groundwater in the river.~~

~~In part, water quality objectives are established for the Santa Ana River in order to protect the Orange County aquifers (see discussion in Chapter 4). In addition, water quality objectives are specified for the Santa Ana Forebay. The relationship between the water quality of the Santa Ana River and the Orange County subbasin quality needs to be investigated in order to assure that water quality objectives and control measures are appropriate.~~

~~**Special Projects**~~

3. Orange County

~~Water Factory 21~~
~~Water Factory 21, which has been in operation since 1976, provides advanced treatment of wastewater for groundwater injection. Water Factory 21 produces 75,000 acre-feet of highly treated reclaimed wastewater for injection into the OCWD's seawater intrusion barrier. This highly treated water serves not only to keep salt water from contaminating inland wells, but also adds to the supply of available groundwater.~~

~~Tustin Nitrate Removal Project~~
The Tustin Nitrate Removal project, ~~which was completed in 1990~~ which began operation in 1996 , ~~will~~ added approximately 3,000 acre-feet of water annually to Tustin's domestic water supply. Treatment systems employing reverse osmosis and ion exchange are operating at two wells that had been shut down because of excessive nitrate concentrations.

~~Irvine Desalter~~
The Orange County Water District and Irvine Ranch Water District (IRWD) are moving forward with the Irvine Desalter, a dual-purpose regional groundwater remediation and water supply project located in the City of Irvine and its sphere of influence. The project consists of an extensive seven-well groundwater extraction and collection system, a treatment system, a five-mile brine disposal pipeline, a finished water delivery system, and ancillary facilities. While providing approximately 6,700 acre-feet per year to IRWD for potable supply, the ~~project~~ desalter will extract and treat brackish groundwater and ~~as well as~~ capture an overlapping regional plume of TCE-contaminated groundwater demonstrated to have originated from the U.S. Marine Corps Air Station-El Toro. ~~Approximately 5,400 tons of salt per year will be removed from the basin with this project. The Irvine Desalter is expected to be on line by February 1996.~~

~~Frances Groundwater Desalter~~
~~IRWD is planning the Frances Groundwater Desalter, a dual-purpose regional groundwater remediation and water supply project located in the City of Tustin and the City of Irvine. The project consists of an extensive six-well groundwater extraction and collection system, a treatment system, a brine disposal pipeline, a finished water delivery system, and ancillary facilities. While providing approximately 11,300 acre-feet per year to IRWD for potable supply, the project will extract and treat water with nitrate concentrations above the drinking water standard (45mg/L). Approximately 4,100 tons of salt per year will be removed from the basin with this project. The Frances Groundwater Desalter is planned to be on line in 1995.~~

C. Recharge of Stormwater and/or Imported Water

The Orange County Water District, San Bernardino Valley Water Conservation District and other agencies in the Region operate extensive facilities designed to enhance the capture and recharge of high quality stormwater. More such facilities are planned as part of "maximum benefit" proposals by the Chino Basin Watermaster/Inland Empire Utilities Agency, Yucaipa Valley Water District, San Timoteo Watershed Management Authority and the City of Beaumont (section VI., Maximum Benefit Implementation Plans for Salt Management). These proposals also include efforts to import and recharge high quality State Water Project water, when it is available. These activities increase both the quantity and quality of available groundwater resources.

D. Sea Water Intrusion Barriers

The Orange County Water District operates advanced facilities designed to provide significantly enhanced tertiary treatment of secondary treated municipal wastewater from the Orange County Sanitation District's (Sanitation District) Fountain Valley Reclamation Plant No. 1. The recycled water is injected into a series of wells located along Ellis Avenue in the City of Fountain Valley to maintain the Talbert Gap Seawater Intrusion Barrier. The treatment facility, currently known as Water Factory 21, will be supplanted by the Groundwater Replenishment System (GWRS) being constructed jointly by Orange County Water District and the Sanitation District (see preceding section on wastewater reclamation).

V. Salt Management Plan -- Monitoring Program Requirements

California Water Code Section 13242 specifies that Basin Plan implementation plans must contain a description of the monitoring and surveillance programs to be undertaken to determine compliance with water quality objectives. The adoption of new groundwater TDS and nitrate-nitrogen water quality objectives (Chapter 4) in response to the studies sponsored by the N/TDS Task Force triggered the need to develop and implement a new, watershed-wide nitrogen/TDS monitoring program. The Task Force provided additional impetus for this comprehensive monitoring program. The Task Force recommended that future review and update of the salt management plan, including findings of assimilative capacity, appropriate changes to the wasteload allocations, etc., should be based on real-time data obtained through a rigorous monitoring program, rather than on model projections. As discussed earlier (see Section II., Update of the Total Dissolved Solids/Nitrogen Management Plan), the Task Force concluded that the development of new, workable modeling tools to assist in this review was beyond the scope and financial capability of the Task Force.

The monitoring program must consist of both surface water and groundwater components. Some of these are already being implemented, including the annual sampling of the Santa Ana River, Reach 3 at Prado Dam by Regional Board staff (see Chapter 4 and below). Certain agencies have committed to conduct monitoring of specific water bodies as part of their "maximum benefit" proposals (see Section VI., Maximum Benefit Implementation Plans for Salt Management, below). The N/TDS Task Force members, and other parties as appropriate, will be required to propose a comprehensive monitoring program that would integrate these existing commitments with other monitoring recommendations. These parties will be required to implement this program upon approval by the Regional Board.

A. Surface Water Monitoring Program Requirements for TDS and Nitrogen

Implementation of a surface water monitoring program is needed to determine compliance with the nitrogen and TDS objectives of the Santa Ana River, and thereby, the effectiveness of the wasteload

allocations. It is also needed to provide data required to evaluate the effects of surface water discharges on affected groundwater management zones. In particular, data are needed to confirm the validity of the 50% nitrogen loss coefficient that will be applied in regulating discharges to that part of Reach 3 of the River that overlies the Chino South groundwater management zone (see Section III.B.3., Nitrogen loss coefficients).

As discussed in Chapter 4, the Basin Plan specifies baseflow TDS and total nitrogen objectives for Reach 3 of the River. For Reach 2, a TDS objective based on a five-year moving average of the annual TDS concentration is specified. Use of this moving average allows the effects of wet and dry years to be integrated over the five-year period and reflects the actual long-term quality of water recharged by Orange County Water District downstream of Prado Dam.

The Basin Plan specifies a monitoring program to determine compliance with the Reach 3 baseflow objectives at Prado Dam (see Chapter 4). As noted above, Regional Board staff conducts this program on an annual basis. Measurement of baseflow quality, rather than the quality of flows in Reach 2, has long been used to indicate the effects of recharge of Santa Ana River flows on Orange County groundwater. The efficacy of this approach was evaluated as part of the 2004 update of the TDS/nitrogen management plan in the Basin Plan. Insufficient data were available to draw a direct correlation between the long-term TDS and nitrogen quality of River flows at Prado Dam and that of affected Orange County groundwater. However, the conclusion drawn was that reliance on the Reach 3 baseflow objectives to protect Orange County groundwater, and the existing monitoring program designed to measure compliance, is adequate.

In addition to this baseflow sampling program and the surface water monitoring commitments associated with certain agencies' "maximum benefit" programs, the comprehensive monitoring program to be proposed and implemented by the Task Force members, and other agencies as appropriate, must include an evaluation of compliance with the TDS and nitrogen objectives for Reaches 2, 4 and 5 of the Santa Ana River. Compliance with the Reach 2 TDS objective can be determined by evaluation of data collected by the Santa Ana River Watermaster, Orange County Water District, the United States Geological Survey, and others.

Surface water monitoring program requirements for TDS and nitrogen are as follows:

1. No later than (**3 months from effective date of this Basin Plan amendment* *), Orange County Water District, Inland Empire Utilities Agency, Chino Basin Watermaster, City of Riverside, City of Corona, Elsinore Valley Municipal Water District, Eastern Municipal Water District, City of Colton, City of San Bernardino Municipal Water Department, City of Redlands, Jurupa Community Services District, Western Riverside County Regional Wastewater Authority , Lee Lake Water District, Yucaipa Valley Water District, City of Beaumont, the San Timoteo Watershed Management Authority and the City of Rialto shall submit to the Regional Board for approval, a proposed surface water TDS and nitrogen monitoring program that will provide an evaluation of compliance with the TDS and nitrogen objectives for Reaches 2, 4 and 5 of the Santa Ana River.

   In lieu of this coordinated monitoring plan, one or more of the parties identified in the preceding paragraph may submit an individual or group monitoring plan. Any such individual or group monitoring plan shall also be submitted no later than (**3 months from effective date of this Basin Plan amendment* *).

2. By April 15th of each year, the Orange County Water District, Inland Empire Utilities Agency, City of Riverside, City of Corona, Elsinore Valley Municipal Water District, Eastern Municipal

Water District, Lee Lake Water District, City of Colton, City of San Bernardino Municipal Water Department, Jurupa Community Services District, Western Riverside County Wastewater Agency, Yucaipa Valley Water District, City of Beaumont, the San Timoteo Watershed Management Authority and the City of Rialto, shall submit an annual report of Santa Ana River, Reach 2 , 4 and 5 water quality. Data evaluated shall include that collected by the Santa Ana River Watermaster, Orange County Water District, and the US Geologic Survey, at a minimum.

In lieu of this coordinated annual report, one or more of the parties identified in the preceding paragraph may submit an individual or group annual report. Any such individual or group report shall also be submitted by February 15th of each year.

Additional surface water monitoring programs may be specified by the Regional Board depending upon watershed conditions, waste discharge specifications and/or any special studies related to TDS and nitrogen.

B. Groundwater Monitoring Program for TDS and Nitrogen

Implementation of a watershed-wide TDS/nitrogen groundwater monitoring program is necessary to assess current water quality, to determine whether TDS and nitrate-nitrogen water quality objectives for management zones are being met or exceeded, and to update assimilative capacity findings. Groundwater monitoring is also needed to fill data gaps for those management zones with insufficient data to calculate TDS and nitrate-nitrogen historical quality and current quality. Finally, groundwater monitoring is needed to assess the effects of POTW discharges to surface waters on affected groundwater. In particular, monitoring is needed to confirm the 50% nitrogen loss coefficient for discharges to that part of the Santa Ana River, Reach 3 that affect the Chino South Management Zone.

Groundwater monitoring requirements for TDS and nitrogen are as follows:

1. No later than (**6 months from effective date of this Basin Plan amendment* *), Orange County Water District, Irvine Ranch Water District, Inland Empire Utilities Agency, Chino Basin Watermaster, City of Riverside, City of Corona, Elsinore Valley Municipal Water District, Eastern Municipal Water District, City of Colton, City of San Bernardino Municipal Water Department, City of Redlands, Jurupa Community Services District, Western Riverside County Regional Wastewater Authority , Lee Lake Water District, Yucaipa Valley Water District, City of Beaumont, the San Timoteo Watershed Management Authority and the City of Rialto shall submit to the Regional Board for approval, a proposed watershed-wide TDS and nitrogen monitoring program that will provide data necessary to review and update the TDS/nitrogen management plan. Data to be collected and analyzed shall address, at a minimum: (1) determination of current ambient quality in groundwater management zones; (2) determination of compliance with TDS and nitrate-nitrogen objectives for the management zones; (3) evaluation of assimilative capacity findings for groundwater management zones; and (4) assessment of the effects of recharge of surface water POTW discharges on the quality of affected groundwater management zones. The determination of current ambient quality shall be accomplished using methodology consistent with that employed by the Nitrogen/TDS Task Force (20-year running averages) to develop the TDS and nitrogen water quality objectives included in this Basin Plan. [Ref. 1] The determination of current ambient groundwater quality throughout the watershed must be reported by July 1, 2005, and, at a minimum, every three years thereafter.

   In lieu of this coordinated monitoring plan, one or more of the parties identified in the preceding paragraph may submit an individual or group monitoring plan. Any such individual or group

monitoring plan shall also be due no later than (*6 months from effective date of this Basin Plan amendment *).

Details to be included in the proposed monitoring program shall include, but not be limited to, the following:

- Monitoring program goals
- responsible agencies
- groundwater water sampling locations
- surface water sampling locations (if appropriate)
- water quality parameters
- sampling frequency
- quality assurance/quality control
- database management
- data analysis and reporting

Within 30 days of Regional Board approval of the proposed monitoring plan, the monitoring plan must be implemented.

2. No later than (*6 months from effective date of this Basin Plan amendment *) the City of Colton, City of San Bernardino Municipal Water Department, City of Riverside, Jurupa Community Services District, Western Riverside County Wastewater Agency and the City of Rialto, shall submit to the Regional Board for approval, a monitoring program that will be utilized to confirm the 50% Santa Ana River, Reach 3 nitrogen loss coefficient.

   In lieu of this coordinated monitoring plan, one or more of the parties identified in the preceding paragraph may submit an individual or group monitoring plan. Any such individual or group monitoring plan shall also be due no later than (*6 months from effective date of this Basin Plan amendment *).

   Within 30 days of Regional Board approval of the monitoring plan, the monitoring program must be implemented.

Additional groundwater monitoring programs may be specified by the Regional Board depending upon watershed conditions, waste discharge specifications and/or any special studies related to TDS and nitrogen.

VI. Maximum Benefit Implementation Plans for Salt Management

As discussed in Chapter 4, with some limited exceptions, TDS and nitrate-nitrogen objectives for groundwater management zones in the Santa Ana Region were established to ensure that historical quality is maintained, pursuant to the State's antidegradation policy (State Board Resolution No. 68-16). However, alternative, less stringent "maximum benefit" objectives are also specified in Chapter 4 for certain groundwater management zones. These "maximum benefit" objectives, which would allow the lowering of water quality, were established based on demonstrations by the agencies recommending them that antidegradation requirements were satisfied. First, these agencies demonstrated that beneficial uses would continue to be protected. Second, these agencies showed that water quality consistent with

maximum benefit to the people of the state would be maintained. Other factors, such as economics, the need to use recycled water, and the need to develop housing in the area were also taken into account in establishing the objectives (see Chapter 4).

The demonstrations of "maximum benefit" by these agencies are contingent on the implementation of specific projects and programs by the agencies. As discussed in Chapter 4, if these projects and programs are not implemented to the Regional Board's satisfaction, then the alternative "antidegradation" objectives apply to these waters for regulatory purposes.

This section identifies the specific commitments by the Chino Basin Watermaster and Inland Empire Utilities Agency, the Yucaipa Valley Water District, the City of Beaumont and the San Timoteo Water Management Authority to implement projects and programs to support the "maximum benefit" objectives established for groundwater management zones affected by their wastewater and water management practices.

A. Salt Management – Chino Basin and Cucamonga Basin

As shown in Chapter 4, both "antidegradation" and "maximum benefit" objectives for TDS and nitrate-nitrogen are specified in this Plan for certain parts of the Chino Basin and the Cucamonga groundwater Management Zone. The application of the "maximum benefit" objectives relies on the implementation by the Chino Basin Watermaster and the Inland Empire Utilities Agency of a specific program of projects and requirements [Ref. 10B], which are an integral part of the Chino Basin Optimum Basin Management Program (OBMP) [Ref. 10C]. The OBMP was developed by the Watermaster under the supervision of the San Bernardino County Superior Court. The OBMP is a comprehensive, long-range water management plan for the Chino Basin as a whole, including the Chino North (or Chino 1, 2, and 3) and Cucamonga Management Zones. The OBMP includes the use of recycled water for basin recharge, initially in the Chino North Management Zone. Recycled water recharge in the Cucamonga Management Zone may be pursued in the future. The OBMP also includes the capture of increased quantities of high quality storm water runoff, recharge of imported water when its TDS concentrations are low, improvement of water supply by desalting poor quality groundwater, and enhanced wastewater pollutant source control programs. The OBMP maps a strategy that will provide for enhanced yield for the Chino Basin and seeks to provide reliable water supplies for development expected to occur within the Basin. The OBMP also includes the implementation of management activities that would result in the hydraulic isolation of Chino Basin groundwater from the Orange County Management Zone, thus insuring the protection of downstream beneficial uses and water quality.

Table 5-8a identifies the projects and requirements that must be implemented to demonstrate that water quality consistent with maximum benefit to the people of the state will be maintained. An implementation schedule is also specified. The Regional Board will revise IEUA's waste discharge requirements, issue appropriate permits to the Chino Basin Watermaster, and utilize the authority provided by Section 13267 of the Water Code as necessary to require that these commitments be met. It is assumed that maximum benefit is demonstrated, and that the "maximum benefit" TDS and nitrate-nitrogen objectives apply to the Chino North and Cucamonga Management Zones as long as the schedule is being met. If the Regional Board determines that the maximum benefit program is not being implemented effectively in accordance with the schedule shown in Table 5-8a, then maximum benefit is not demonstrated, and the "antidegradation" TDS and nitrate-nitrogen objectives for the Chino 1, 2, and 3 and Cucamonga Management Zones apply. In this situation, the Regional Board will require mitigation for TDS and nitrate-nitrogen discharges to these management zones that took place in excess of limits based on the "antidegradation" objectives.

Table 5-8a

Chino Basin Maximum Benefit Commitments

Description of Commitment	**Compliance Date – as soon as possible, but no later than**
1. Surface Water Monitoring Program	
a. Submit Draft Monitoring Program to Regional Board	a. *(*30 days from date of approval of this amendment*)*
b. Implement Monitoring Program	b. Within 30 days from date of Regional Board approval of monitoring plan
c. Quarterly data report submittal	c. April 15, July 15, October 15, January 15
d. Annual data report submittal	d. February 15th
2. Groundwater Monitoring Program	
a. Submit Draft Monitoring Program to Regional Board	a. *(*30 days from date of approval of this amendment*)*
b. Implement Monitoring Program	b. Within 30 days from date of Regional Board approval of monitoring plan
c. Annual data report submittal	c. February 15th
3. Chino Desalters	
a. Chino 1 desalter expansion to 10 MGD	a. Prior to recharge of recycled water
b. Chino 2 desalter at 10 MGD design	b. Recharge of recycled water allowed once award of contract and notice to proceed issued for construction of desalter treatment plant
4. Future desalters plan and schedule submittal	October 1, 2005 Implement plan and schedule upon Regional Board approval
5. Recharge facilities (17) built and in operation	June 30, 2005
6. IEUA wastewater quality improvement plan and schedule submittal	60 days after agency-wide 12 month running average effluent TDS quality equals or exceeds 545 mg/L for 3 consecutive months or agency-wide 12 month running average TIN equals or exceeds 8 mg/L in any month. Implement plan and schedule upon approval by Regional Board

Table 5-8a

Chino Basin Maximum Benefit Commitments (cont.)

Description of Commitment	**Compliance Date – as soon as possible, but no later than**
7. Recycled water will be blended with other recharge sources so that the 5-year running average TDS and nitrate-nitrogen concentrations of water recharged are equal to or less than the "maximum benefit" water quality objectives for the affected Management Zone (Chino North or Cucamonga).	Compliance must be achieved by end of 5th year after initiation of recycled water recharge operations.
a. Submit a report that documents the location, amount of recharge, and TDS and nitrogen quality of stormwater recharge before the OBMP recharge improvements were constructed and what is projected to occur after the recharge improvements are completed	a. Prior to initiation of recycled water recharge
b. Submit documentation of amount, TDS and nitrogen quality of all sources of recharge and recharge locations. For stormwater recharge used for blending, submit documentation that the recharge is the result of CBW/IEUA enhanced recharge facilities.	b. Annually, by February 15th, after initiation of construction of basins/other facilities to support enhanced stormwater recharge.
8. Hydraulic Control Failure	
a. Plan and schedule to correct loss of hydraulic control	a. 60 days from Regional Board finding that hydraulic control is not being maintained
b. Achievement and maintenance of hydraulic control	b. In accordance with plan and schedule approved by Regional Board. The schedule shall assure that hydraulic control is achieved as soon as possible but no later than 180 days after loss of hydraulic control is identified.
c. Mitigation plan for temporary failure to achieve/maintain hydraulic control	c. By *(*30 days from effective date of this Basin Plan amendment*)*. Implement plan upon Regional Board determination that hydraulic control is not being maintained.
9. Ambient groundwater quality determination	July 1, 2005 and every 3 years thereafter

Description of Chino Basin Watermaster and Inland Empire Utilities Agency Commitments

1. Surface Water Monitoring Program (Table 5-8a #1)

The Chino Basin Watermaster (Watermaster), in conjunction with staff of the Orange County Water District and Regional Board, has developed a proposed surface water monitoring program. By (*30 days from date of approval of this amendment*) and prior to the discharge of recycled water to the Chino Basin, Watermaster shall submit the recommended surface water monitoring program to the Regional Board for approval. The monitoring program must be implemented within 30 days of Regional Board approval, and six months of data must be generated prior to the discharge of recycled water to the Chino Basin.

At a minimum, the surface water monitoring program shall include the collection of bi-weekly measurements of general minerals and nitrogen components at the locations listed in Table 5-8b. Data reports shall be submitted to the Regional Board Executive Officer by April 15, July 15, October 15, and January 15 each year. An annual report summarizing all data collected for the year and evaluating compliance with relevant surface water objectives shall be submitted by February 15th of each year.

2. Groundwater Monitoring Program (Table 5-8a, #2)

The purpose of the Groundwater Monitoring Program is to (1) identify potential impacts from implementation of the Chino Basin "maximum benefit" water quality objectives on water levels and water quality within the Chino Basin and in downgradient basins and (2) determine whether hydraulic control (see # 8, below) is being achieved and maintained. By (*within 30 days from date of approval of this amendment*) and prior to the discharge of recycled water to the Chino Basin, Watermaster shall submit to the Regional Board for approval a proposed groundwater monitoring program to determine hydraulic control and ambient water quality in the Chino North and Cucamonga Management Zones. Within 30 days of Regional Board approval of the monitoring plan, the groundwater monitoring program must be implemented.

An annual report, including all raw data and summarizing the results of the approved groundwater monitoring program, shall be submitted to the Regional Board by February 15th of each year.

3. Chino 1 and Chino 2 Desalters (Table 5-8a, # 3)

Prior to the recharge of recycled water in the Chino Basin, the Chino 1 desalter must be expanded and in operation at a capacity of 10 million gallons per day (MGD). Also, contracts for the construction of the Chino 2 desalter treatment plant must be awarded and a notice to proceed with the construction must be given prior to recharge of recycled water.

4. Future Desalter Development (Table 5-8a, # 4)

No later than October 1, 2005, the schedule for implementation of the next 20 MGD of desalter capacity, pursuant to the Peace Agreement that implements the Chino Basin OBMP, and as required by the San Bernardino Superior Court, must be submitted to the Regional Board by the Chino Basin Watermaster. IEUA and/or the Chino Basin Watermaster and/or other responsible parties deemed acceptable by the Executive Officer, will initiate building of the next desalter when the 12-month running average effluent concentration (measured as an average for all IEUA wastewater treatment facilities) reaches 545 mg/L TDS for three consecutive months.

Table 5-8b

Surface Water Monitoring Sites for Monitoring of Surface Water and Groundwater Quality Near the River to Determine the Presence and Source of Rising Groundwater

Site Name	Discharge	Owner	Type	Discharge Monitoring		Water Quality Monitoring		
				Frequency	Period	Frequency	Period	Analyses
11066460	Santa Ana Riv.	USGS	Total Discharge	Daily	Jan - Dec	Bi-weekly	Jan - Dec	Gen. Min. & Physical
11072100	Temescal Cr.	USGS	Total Discharge	Bi-weekly	Jan - Dec	Bi-weekly	Jan - Dec	Gen. Min. & Physical
11073495	Cucamonga Cr.	USGS	Total Discharge	Bi-weekly	Jan - Dec	Bi-weekly	Jan - Dec	Gen. Min. & Physical
11073440	Chino Cr.	USGS	Total Discharge	Bi-weekly	Jan - Dec	Bi-weekly	Jan - Dec	Gen. Min. & Physical
11074000	Santa Ana Riv.	USGS	Total Discharge	Bi-weekly	Jan - Dec	Bi-weekly	Jan - Dec	Gen. Min. & Physical
RWQCP Direct	Recycled Water	Riverside	Recycled Water	Daily	Jan - Dec	Bi-weekly	Jan - Dec	Gen. Min. & Physical
RWQCP Hidden Valley	Recycled Water	Riverside	Recycled Water	Daily	Jan - Dec	Bi-weekly	Jan - Dec	Gen. Min. & Physical
Corona RW	Recycled Water	Corona	Recycled Water	Daily	Jan - Dec	Bi-weekly	Jan - Dec	Gen. Min. & Physical
RP1 Cucamonga	Recycled Water	IEUA	Recycled Water	Daily	Jan - Dec	Bi-weekly	Jan - Dec	Gen. Min. & Physical
RP1 Prado	Recycled Water	IEUA	Recycled Water	Daily	Jan - Dec	Bi-weekly	Jan - Dec	Gen. Min. & Physical
RP2	Recycled Water	IEUA	Recycled Water	Daily	Jan - Dec	Bi-weekly	Jan - Dec	Gen. Min. & Physical
Carbon Canyon	Recycled Water	IEUA	Recycled Water	Daily	Jan - Dec	Bi-weekly	Jan - Dec	Gen. Min. & Physical
RP5	Recycled Water	IEUA	Recycled Water	Daily	Jan - Dec	Bi-weekly	Jan - Dec	Gen. Min. & Physical
WRCRWTP	Recycled Water	WR-JPA	Recycled Water	Daily	Jan - Dec	Bi-weekly	Jan - Dec	Gen. Min. & Physical
SAR-MWDXING	Santa Ana Riv.	OCWD	Total Discharge	Daily	Jan - Dec	Bi-weekly	Jan - Dec	Gen. Min. & Physical
SAR-HOLELK-01	Hole Lake	OCWD	Total Discharge	Bi-weekly	May-Sep	Bi-weekly	Jan - Dec	Gen. Min. & Physical
SAR-VANBUREN	Santa Ana Riv.	OCWD	Total Discharge	Bi-weekly	May-Sep	Bi-weekly	Jan - Dec	Gen. Min. & Physical
SAR-ETIWANDA-01	Santa Ana Riv.	OCWD	Total Discharge	Bi-weekly	May-Sep	Bi-weekly	Jan - Dec	Gen. Min. & Physical
SAR-HAMNER-01	Santa Ana Riv.	OCWD	Total Discharge	Bi-weekly	May-Sep	Bi-weekly	Jan - Dec	Gen. Min. & Physical
SAR-RIV.RD	Santa Ana Riv.	OCWD	Total Discharge	Daily	Jan - Dec	Bi-weekly	Jan - Dec	Gen. Min. & Physical
SAR-DIV-PRADOWTLNDS	Santa Ana Riv.	OCWD	Total Discharge	Daily	Jan - Dec	Bi-weekly	Jan - Dec	Gen. Min. & Physical
SAR-BELOWDAM-01	Santa Ana Riv.	OCWD	Total Discharge	Daily	Jan - Dec	Bi-weekly	Jan - Dec	Gen. Min. & Physical
CK-CHINO	Chino Cr.	OCWD	Total Discharge	Bi-weekly	May-Sep	Bi-weekly	Jan - Dec	Gen. Min. & Physical
CK-MILL	Cucamonga Cr.	OCWD	Total Discharge	Bi-weekly	May-Sep	Bi-weekly	Jan - Dec	Gen. Min. & Physical
CK-TEMESCAL	Temescal Cr.	OCWD	Total Discharge	Bi-weekly	May-Sep	Bi-weekly	Jan - Dec	Gen. Min. & Physical

(Source: Ref. 10B)

5. Recharge Facilities (Table 5-8a, # 5)

By June 30, 2005, or no later than one year from the start of discharge of recycled water, the 17 recharge facilities identified in the August 2001 Watermaster Recharge Master Plan and as updated by the Watermaster and IEUA, must be completed and operated to maximize the capture of storm water in the Chino Basin. The Watermaster has also committed to optimize the recharge of imported water in the Chino Basin based on the goal of maximizing recharge of State Project water when the TDS of that water is lowest

The Watermaster proposal recognizes the importance and necessity of recharge of both storm water and imported water to meet the water supply demands on the Chino Basin. Recharge of high quality supplies to the Chino Basin is necessary to offset the quality effects of recycled water and to achieve an ambient water quality equal to or better than the "maximum benefit" TDS and nitrate-nitrogen water quality objectives.

6. IEUA Wastewater Effluent Quality (Table 5-8a, # 6)

Within 60 days after the IEUA 12-month running average effluent concentration (measured as an average for all IEUA wastewater treatment facilities) for TDS exceeds 545 mg/L for 3 consecutive months, or the 12-month running average total inorganic nitrogen (TIN) concentration (measured as an average for all IEUA wastewater treatment facilities) exceeds 8 mg/L in any month, the IEUA shall submit to the Regional Board a plan and time schedule for implementation of measures to insure that the12-month running average agency wastewater effluent quality does not exceed 550 mg/L and 8 mg/L for TDS and TIN, respectively. The Plan and schedule are to be implemented upon Regional Board approval.

7. Recycled Water Use (Table 5-8a, # 7)

The use and recharge of recycled water within the Chino Basin is a critical component of the Watermaster OBMP and is necessary to maximize the use of the water resources of the Chino Basin. The demonstration of maximum benefit, and the continued application of the "maximum benefit" TDS and nitrate-nitrogen water quality objectives, depends on the recharge to the Chino North Management Zone of 5-year annual average (running average) TDS and nitrogen concentrations of no more than 420 mg/L and 5 mg/L, respectively. If and when recycled water recharge in the Cucamonga Management Zone is pursued, the application of the "maximum benefit" objectives will depend on the recharge to that zone of 5-year running average TDS and nitrogen concentrations no greater than 380 mg/L and 5 mg/L, respectively. IEUA has committed to meeting these levels and recognizes that the maximum benefit objectives depend on achieving these 5-year running average concentrations.

Accordingly, the use of recycled water for groundwater recharge shall be limited to the amount that can be blended on a volume-weighted basis with other sources of recharge to the management zone to achieve a 5-year running average concentration equal to or less than the "maximum benefit" TDS and nitrogen water quality objectives of the affected Management Zone (Chino North or Cucamonga) The 25% nitrogen loss coefficient will be applied to calculate recycled water nitrogen quality when determining the amount of recharge of other water sources that must be achieved to meet the 5-year running averages.

8. Hydraulic Control (Table 5-8a, # 8)

"Hydraulic Control" is defined as eliminating groundwater discharge from the Chino Basin to the Santa Ana River, or controlling the discharge to *de minimis* levels. The surface water and groundwater

monitoring programs described above are intended to demonstrate whether hydraulic control is achieved and maintained. In the event that the Regional Board finds that hydraulic control is not being accomplished, the Watermaster shall submit to the Regional Board within 60 days of that finding a plan and time schedule to correct (within 180 days from the Regional Board approval of the plan and schedule) the failure to achieve and maintain hydraulic control.

By (*within 30 days of the approval of this Basin Plan amendment*), the Watermaster and IEUA shall prepare a proposed plan and schedule to mitigate temporary losses of hydraulic control. These agencies must implement this plan upon a determination by the Regional Board that hydraulic control is not being achieved or maintained.

9. Ambient Groundwater Quality Determination (Table 5-8a, # 9)

By July 1, 2005, and every three years thereafter, Watermaster shall submit a determination of ambient TDS and nitrate-nitrogen quality in the Chino North and Cucamonga Management Zones. This determination shall be accomplished using methodology consistent with the determinations (20-year running averages) used by the TDS/Nitrogen Task Force to develop the "antidegradation" TDS and nitrate-nitrogen water quality objectives for groundwaters subbasins within the Region. [Ref. 1].

Implementation by Regional Board

1. Revision of the Inland Empire Utilities Agency NPDES Permits

To implement the "maximum benefit" objectives, the Regional Board will revise the NPDES permits for IEUA wastewater discharges to reflect the commitments described above, as appropriate. This includes the following. TDS and TIN (includes nitrate-nitrogen) limits of 550 mg/L and 8 mg/L, respectively, will be specified as an agency-wide, volume weighted-average. The limits will be expressed as 12-month running averages. These limits implement the wasteload allocations for IEUA surface water discharges (see Table 5-5), and are not contingent on the "maximum benefit" objectives or demonstration[6]. IEUA will be required to implement measures to improve effluent quality when the 12 month running average effluent concentration (measured as an average for all IEUA treatment facilities) exceeds 545 mg/L for 3 consecutive months, or when the 12-month running average total inorganic nitrogen concentration (also measured as an average for all IEUA treatment facilities) exceeds 8 mg/L in any month. The permits will require that recycled water used for recharge shall be limited to the amount that can be blended in the management zone with other water sources, such as stormwater or imported water, to achieve 5-year running average concentrations equal to or less than the "maximum benefit" TDS and nitrate-nitrogen objectives for the affected management zone (Chino North or Cucamonga). Recycled water recharge is not currently contemplated in other parts of the Chino Basin. Alternative TDS and nitrate-nitrogen limitations based on the "antidegradation" objectives will also be specified for recycled water recharge in the Chino 1, 2 and 3 and Cucamonga Management Zones. These limits will apply should the Regional Board find that maximum benefit is not demonstrated. If recharge projects are implemented elsewhere in the Chino Basin, TDS and TIN limits will be based on the TDS and nitrate-nitrogen objectives of the affected management zones.

The effluent limits for IEUA, which establish an upper limit on TDS and TIN concentrations of recycled water discharged in the basin, are a cornerstone of the maximum benefit demonstration. The

[6] Surface water discharges by IEUA do not affect the groundwater management zones for which "maximum benefit" objectives are specified. Thus, the wasteload allocations do not vary depending on whether or not the "maximum benefit" objectives apply.

cap on effluent TDS and TIN concentrations provides a controlling point for management of TDS and nitrogen water quality in the Chino Basin. The TDS in IEUA's effluent is expected to reach 550 mg/L before the groundwater in the Chino North Management Zone or the Cucamonga Management Zone reaches the "maximum benefit" objectives of 420 mg/L and 380 mg/L, respectively. The IEUA/Chino Basin Watermaster maximum benefit proposal commits to the initiation of construction of another Chino Basin desalter when the TDS in IEUA's effluent reaches 545 mg/L for three consecutive months. This desalter may be constructed by IEUA and/or Chino Basin Watermaster and/or other responsible parties deemed acceptable by the Executive Officer. Further, IEUA will immediately implement a salt management program to reduce the salts, including nitrogen, entering IEUA's wastewater treatment plants. This salt management program will include: 1) connection of new industries that have wastewater discharges with TDS greater than 550 mg/L to the brine line; 2) regulation of the use of new and existing water softeners to the extent allowed by law, with incentives provided for the removal of on-site regenerative water softeners and the use of exchange canisters or other off-site regenerative systems; 3) connection of existing domestic system industries with high TDS waste discharges to the brine lines; 4) percolation of State Water Project water into the Chino Basin when that water is low in TDS; and 5) development of a plan for sewering areas presently served by septic tanks to reduce the nitrogen loading into the Chino and Cucamonga Management Zones. IEUA's permits will reflect these commitments.

Implementing these measures will assure that the groundwater quality remains at or below the Chino North Management Zone objective of 420 mg/L and the Cucamonga Management Zone objective of 380 mg/L. Maintenance of this ambient groundwater quality is necessary, in turn, to assure that IEUA's wastewater treatment facilities are able to meet the effluent TDS limits. Chino Basin groundwater is a significant component of the water supplied in IEUA's service area and its quality thus has an important effect on effluent quality. Poor ambient water quality will preclude IEUA from meeting effluent limits, without desalting. IEUA can revise treatment plant operations to assure that the TIN limit is achieved. These TDS and TIN limitations assure beneficial use protection for Chino Basin and downstream Orange County groundwater, as well as surface waters (including Chino Creek and the Santa Ana River) affected by IEUA discharges.

IEUA's revised permits will also reflect the surface and groundwater monitoring program requirements described above.

2. Issuance of permits to Chino Basin Watermaster

The Regional Board will issue appropriate permits to the Watermaster, individually or jointly with IEUA, for the recharge of recycled water in the Basin. These permits will implement the commitments described above for recharge of other water sources to offset the quality of the recycled water. The parties will be required to document the amount, quality and location of recharge of these other sources, and to demonstrate that stormwater recharge used for blending purposes occurred as the result of the parties' efforts to enhance such recharge. Other "maximum benefit" commitments will be reflected in these permits, or in other orders of the Regional Board, as appropriate.

3. Review of Project Status

No later than 2005, and every three years thereafter (to coincide with the Regional Board's triennial review process), the Regional Board intends to review the status of the activities planned and executed by the Watermaster and IEUA to demonstrate maximum benefit and to justify continued implementation of the "maximum benefit" water quality objectives. This review is intended to determine whether the commitments specified above and summarized in Table 5-8a are met. If, as a result of this review, the Regional Board finds that the Watermaster and IEUA commitments are not

met, the Regional Board will make a finding that the lowering of water quality associated with TDS and nitrate-nitrogen water quality objectives that are higher than historical water quality (the "antidegradation" objectives") is not of maximum benefit to the people of the state. By default, the scientifically derived, "antidegradation objectives" for the Chino 1, 2 and 3 and Cucamonga Management Zones would become effective (280 mg/L, 250 mg/L, 260 mg/L and 210 mg/L TDS respectively; 5.0 mg/L, 2.9 mg/L, 3.5 mg/L and 2.4 mg/L for nitrate-nitrogen – see Chapter 4).

The Watermaster and IEUA have made clear commitments to the implementation of projects and management strategies to achieve the "maximum benefit" objectives. A finding of "maximum benefit to the people of the state" is also a very strong commitment of support by the Regional Board for the goals, vision and future plans of the Watermaster and IEUA. Watermaster and IEUA have indicated that the supervision of the Watermaster program by the San Bernardino County Superior Court will ensure that the Watermaster and IEUA commitments are met. However, people change, commitments may be changed, and public agency decisions may certainly change. If the commitments are not met and "maximum benefit" is not demonstrated, then the Regional Board will require that Watermaster and IEUA mitigate the effects of discharges of recycled and imported water that took place under the maximum benefit objectives. Under this circumstance, mitigation will be required such that, after mitigation, the salt and nitrogen loads to the basin from imported water, newly captured stormwater inputs under the Watermaster enhanced stormwater interception program, and recycled water are made to be equivalent to the salt loads that would have been allowed to the Chino Basin under the antidegradation objectives. Discharges in excess of the antidegradation objectives that must be considered for mitigation include both recycled water and imported water at TDS concentrations in excess of the antidegradation objectives. Mitigation by groundwater extraction and desalting must be adjusted to address concentrations of salt and nitrogen in the basin, not simply salt load. (Desalting will be an effective mitigation strategy, but desalting removes water, as well as salt, and the resulting salt concentrations in the groundwater will not completely mitigate the effects of the maximum benefit discharges, if mitigation is considered simply on a salt load, rather than concentration, basis.) This remediation will be required of the agencies that were responsible for the discharge of recycled and imported water (waste discharge permit holders) under the maximum benefit objectives. The remediation must be completed within a 10-year period following the finding by the Regional Board that the antidegradation objectives apply. The Regional Board will also require mitigation of any adverse effects on water quality downstream of the Chino Basin that result from failure to implement the "maximum benefit" commitments.

B. Salt Management - San Timoteo Watershed

1. San Timoteo and Yucaipa Management Zone - Yucaipa Valley Water District

Two sets of objectives have been adopted for the San Timoteo and Yucaipa Management Zones; the "maximum benefit" objectives and objectives based on historic ambient quality ("antidegradation" objectives) (see Chapter 4). The application of the "maximum benefit" objectives relies on the implementation by the Yucaipa Valley Water District (YVWD) (and in the case of the San Timoteo Management Zone, by the City of Beaumont/STWMA (see discussion below)) of a specific program of projects and requirements [Ref. 10D]. This program is a part of a watershed-scale water resources management plan designed by YVWD and other members of the San Timoteo Watershed Management Authority (STWMA) (the City of Beaumont, the Beaumont-Cherry Valley Water District and the South Mesa Water Company) to assure reliable supplies to meet present and anticipated demands. The projected water demands for the Yucaipa area for the year 2030 require approximately an additional 10,000 AF/Y of supplemental water, including State Water Project water, water imported from local sources, recharged storm water and recycled water. YVWD is in the process of implementing the water

resources management plan, which includes enhanced recharge of stormwater and recycled water, optimizing direct use of recycled and imported water, and conjunctive use.

In addition to its water supply responsibilities, YVWD provides sewage collection and treatment services within its service area. YVWD operates a wastewater treatment facility that currently discharges tertiary treated wastewater to San Timoteo Creek, Reach 3. This unlined reach of the Creek overlies and recharges the San Timoteo groundwater management zone.

Table 5-9a identifies the projects and requirements that must be implemented by YVWD to demonstrate that water quality consistent with maximum benefit to the people of the state will be maintained. An implementation schedule is also specified. The Regional Board will revise YVWD's waste discharge requirements to require that these commitments be met. It is assumed that maximum benefit is demonstrated, and that the "maximum benefit" water quality TDS and nitrate-nitrogen objectives apply to the Yucaipa and San Timoteo Management Zones, as long as the schedule is being met[7]. If the Regional Board determines that the maximum benefit program is not being implemented effectively in accordance with the schedule shown in Table 5-9a (and in the case of the San Timoteo Management Zone, the commitments and schedule shown in Table 5-10a (see next section)), then maximum benefit is not demonstrated and the "antidegradation" TDS and nitrate-nitrogen objectives apply. In this situation, the Regional Board will require mitigation for TDS and nitrate-nitrogen discharges affecting these management zones that took place in excess of limits based on the "antidegradation" objectives. As for Chino Basin Watermaster and Inland Empire Utilities Agency, discharges in excess of the antidegradation objectives that must be considered for mitigation include both recycled water and imported water, at TDS concentrations in excess of the antidegradation objectives. Mitigation by groundwater extraction and desalting must be adjusted to address concentrations of salt and nitrogen in the basin, not simply salt load.

[7] Application of "maximum benefit" objectives for the San Timoteo Management Zone is also contingent on the timely implementation of the commitments by the City of Beaumont and the San Timoteo Watershed Management Authority which are discussed in the next section.

Table 5-9a

Yucaipa Valley Water District Maximum Benefit Commitments

Description of Commitment	**Compliance Date – as soon as possible, but no later than**
1. Surface Water Monitoring Program	
a. Submit Draft Monitoring Program to Regional Board	a. (*30 days from effective date of this Basin Plan amendment*)
b. Implement Monitoring Program	b. Within 30 days from Regional Board approval of monitoring plan
c. Quarterly data report submittal	c. April 15, July 15, October 15, January 15
d. Annual data report submittal	d. February 15th
2. Groundwater Monitoring Program	
a. Submit Draft Monitoring Program to Regional Board	a. (*30 days from effective date of this Basin Plan amendment*)
b. Implement Monitoring Program	b. Within 30 days from Regional Board approval of monitoring plan
c. Annual data report submittal	c. February 15th
3. Desalter(s) and Brine Disposal Facilities	
a. Submit plan and schedule for construction of desalter(s) and brine disposal facilities. Facilities are to operational as soon as possible but no later than 7 years from date of Regional Board approval of plan/schedule.	a. Within 6 months of either of the following: i. When YVWD's effluent 5-year running average TDS exceeds 530 mg/L; and/or ii.. When volume weighted average concentration in the Yucaipa MZ of TDS exceeds 360 mg/L
b. Implement the plan and schedule	b. Within 30 days from Regional Board approval of monitoring plan
4. Non-potable water supply	
Implement non-potable water supply system to serve water for irrigation purposes. The non-potable supply shall comply with a 10-year running average TDS concentration of 370 mg/L or less	(*10 years from effective date of this Basin Plan amendment*)

Description of Commitment	**Compliance Date – as soon as possible, but no later than**	
5. Recycled water recharge The recharge of recycled water in the Yucaipa or San Timoteo Management Zones shall be limited to the amount that can be blended with other recharge sources to achieve a 5-year running average equal to or less than the "maximum benefit" objectives for TDS and nitrate-nitrogen for the relevant Management Zone(s). a. Submit baseline report of amount, locations, and TDS and nitrogen quality of stormwater/imported water recharge. b. Submit documentation of amount, TDS and nitrogen quality of all sources of recharge and recharge locations. For stormwater recharge used for blending, submit documentation that the recharge is the result of YVWD enhanced recharge facilities/programs	Compliance must be achieved by end of 5th year after initiation of recycled water use/recharge operations. a. Prior to initiation of construction of basins/other facilities to support enhanced stormwater/imported water recharge. b. Annually, by January 15th, after initiation construction of facilities/implementation of programs to support enhanced recharge.	
6. Ambient groundwater quality determination	July 1, 2005 and every 3 years thereafter	
7. Replace denitrification facilities (necessary to comply with TIN wasteload allocation specified in Table 5-5)	New facilities shall be operational no later than (*3 years from effective date of this Basin Plan amendment*)	
8. YVWD recycled water quality improvement plan and schedule a. Submit plan and schedule b. Implement plan and schedule	a. 60 days after the TDS 12-month running average effluent quality equals or exceeds 530 mg/L for 3 consecutive months and/or the 12-month running average TIN concentration equals or exceeds 6 mg/L in any month (once replacement denitrification facilities are in place) b. Upon approval by Regional Board	
9. Remove/reduce the discharge of YVWD effluent from the unlined portion of San Timoteo Creek a. Submit proposed plan/schedule	a. (*6 months from effective date of this Basin Plan amendment)	

Description of Commitment	**Compliance Date – as soon as possible, but no later than**
b. Implement plan/schedule	b. Upon Regional Board approval
10. Construct the Western Regional Interceptor for Dunlap Acres a. Submit proposed construction plan and schedule. The schedule shall assure the completion of construction as soon as possible but no later than January 1, 2010. b. Implement plan and schedule	 a. *(*6 months from effective date of this Basin Plan amendment)* b. Upon Regional Board approval

A. Description of Yucaipa Valley Water District Commitments

1. Surface Water Monitoring Program (Table 5-9a, # 1)

The YVWD shall develop and submit for Regional Board approval a surface water monitoring program for San Timoteo Creek and the Santa Ana River Reaches 4 and 5. The monitoring program must be implemented within 30 days of Regional Board approval of the monitoring plan, and six months of data must be generated prior to the implementation of any changes made to the effluent discharge points and before any recycled water is used in the Yucaipa or San Timoteo Management Zones.

At a minimum, the surface water monitoring program shall include the collection of monthly measurements of TDS and nitrogen components in San Timoteo Creek and Santa Ana River, Reaches 4 and 5 (see Table 5-9b). Data reports shall be submitted to the Regional Board's Executive Officer by April 15, July 15, October 15 and January 15 each year. An annual report summarizing all data collected for the year and evaluating compliance with relevant surface water objectives shall be submitted by February 15th of each year.

2. Groundwater Monitoring Program (Table 5-9a, #2)

The purpose of the Groundwater Monitoring Program is to identify the effects of the implementation of the San Timoteo and Yucaipa Management Zones maximum benefit water quality objectives on water levels and water quality within the San Timoteo and Yucaipa Management Zones. Prior to discharge of recycled water to the San Timoteo and/or Yucaipa Management Zones, YVWD shall submit to the Regional Board for approval a groundwater monitoring program to determine ambient water quality in the San Timoteo and Yucaipa Management Zones . The groundwater monitoring program must be implemented within 30 days of approval by the Regional Board.

An annual report, including all raw data and summarizing the results of the approved groundwater monitoring program, shall be submitted to the Regional Board by February 15th of each year.

3. Desalters and Brine Disposal (Table 5-9a, #3)

YVWD anticipates that demineralization of groundwater or recycled water will be necessary in the future. YVWD is committed to construct and operate desalting and brine disposal facilities when:

1) The 5-year running average TDS concentration in recycled water produced at the YVWD wastewater treatment plant exceeds 530 mg/L; or

2) The volume-weighted TDS concentration in the Yucaipa Management Zone reaches or exceeds 360 mg/L

The construction of these facilities will be in accordance with a plan and schedule submitted by YVWD and approved by the Regional Board. The schedule shall assure that these facilities are in place within 7 years of Regional Board approval. These facilities shall be designed to stabilize or reverse the degradation trend evidenced by effluent and/or management zone quality.

4. Non-potable water supply distribution system (Table 5-9a, # 4)

A key element of the YVWD's water resources management plan is the construction of a non-potable supply system to serve a mix of recycled water and un-treated imported water for irrigation uses. The intent of blending these sources is to minimize the impact of recycled water use on the Yucaipa and San Timoteo Management Zones.

Parts of this system are under design and construction. A higher proportion of State Project water will be used in wet, surplus years, while larger amounts of recycled water will be used in dry, deficit years. YVWD will produce a non-potable supply with a running ten-year average TDS concentration less than the "maximum benefit" objective for the Yucaipa Management Zone (370 mg/L).

Table 5 – 9b

Surface Water Monitoring Sites for Monitoring Water Quality and Quantity
Yucaipa Valley Water District

Site Name	Discharge	Owner	Type	Discharge Monitoring		Water Quality Monitoring		
				Frequency	Period	Frequency	Period	Analyses
11057500, Gage	San Timoteo Creek	USGS	Total Discharge	Bi-weekly	Jan-Dec	Bi-weekly	Jan-Dec	TDS, TIN, Physical
At Barton Rd.	San Timoteo Creek	YVWD	Total Discharge	Bi-weekly	Jan-Dec	Bi-weekly	Jan-Dec	TDS, TIN, Physical
At San Timoteo Canyon Rd.	San Timoteo Creek	YVWD	Total Discharge	Bi-weekly	Jan-Dec	Bi-weekly	Jan-Dec	TDS, TIN, Physical
Above confluence Yucaipa Creek	San Timoteo Creek	YVWD	Total Discharge	Bi-weekly	Jan-Dec	Bi-weekly	Jan-Dec	TDS, TIN, Physical
Above YVWD Discharge	San Timoteo Creek	YVWD	Total Discharge	Bi-weekly	Jan-Dec	Bi-weekly	Jan-Dec	TDS, TIN, Physical
11059300 Gage	Santa Ana River	USGS	Total Discharge	Bi-weekly	Jan-Dec	Bi-weekly	Jan-Dec	TDS, TIN, Physical
At Waterman Ave	Santa Ana River	YVWD	Total Discharge	Bi-weekly	Jan-Dec	Bi-weekly	Jan-Dec	TDS, TIN, Physical
Recharged to Yucaipa MZ	State Water Project	YVWD	Total Discharge	Monthly	Jan-Dec	Monthly	Jan-Dec	TDS, Nitrate-N
Recharged to Yucaipa MZ	Storm water	YVWD	Total Discharge	Monthly	Jan-Dec	Monthly	Jan-Dec	TDS, Nitrate-N

5. Recycled Water Use (Table 5-9a, # 5)

The use and recharge of recycled water within the Yucaipa Management Zone is a critical component of the YVWD water management plan and is necessary to maximize the use of the water resources of the Yucaipa area. The demonstration of "maximum benefit" and the continued application of the "maximum benefit" objectives depends on the combined recharge (recycled water, imported water, storm water) to the Yucaipa Management Zone of a 5-year annual average (running average) TDS concentration of 370 mg/L and nitrate-nitrogen concentration of 5 mg/L. If recycled water recharge in the proposed San Timoteo Management Zone is pursued, then the application of the "maximum benefit" objectives will depend on the combined recharge to that Zone of 5-year annual average (running average) concentrations of 400 mg/L or less TDS, and 5 mg/L or less nitrate-nitrogen.

To meet this requirement, YVWD will establish a fund to purchase imported water from local sources and/or the State Water Project and will recharge water with a TDS concentration less than 300 mg/L (recent long term historical average of water delivered from the State Project). YVWD will also pursue

implementation, with the City of Yucaipa and the San Bernardino County Flood Control District, of the *Yucaipa Water Capture and Resource Management Complex* by December 31, 2010.

Accordingly, the use of recycled water for groundwater recharge in the Yucaipa or San Timoteo Management Zone shall be limited to the amount that can be blended in the management zone on a volume-weighted basis with other sources of recharge to achieve 5-year running average concentrations less than or equal to the "maximum benefit" objectives for the affected groundwater management zone. The 25% nitrogen loss coefficient will be applied in determining the amount of recharge of other water sources that must be achieved to meet the 5-year running average nitrogen concentrations.

6. Ambient Groundwater Quality Determination (Table 5-9a, # 6)

By July 1, 2005, and every three years thereafter, YVWD shall submit a determination of ambient TDS and nitrate-nitrogen quality in the San Timoteo and Yucaipa Management Zones. This determination shall be accomplished using methodology consistent with the calculation (20-year running averages) used by the Nitrogen/TDS Task Force to develop the TDS and nitrate-nitrogen "antidegradation" water quality objectives for groundwater management zones within the region. [Ref. 1].

7. Replacement of Denitrification Facilities (Table 5-9a, #7)

YVWD shall replace existing denitrification facilities to provide effluent total inorganic nitrogen quality (6 mg/L) needed to assure compliance with the "maximum benefit" nitrate-nitrogen objective of the San Timoteo and Yucaipa Management Zones (see Wasteload Allocation section of this Chapter). A maximum three year schedule for completion of these facilities will be required. This schedule will be specified in a revised NPDES permit for YVWD's discharges to San Timoteo Creek.

8. YVWD Recycled Water Management (Table 5-9a, #8)

YVWD expects to limit the TDS concentration in its effluent to less than or equal to 540 mg/L by using a low TDS source water supply for potable uses, selective desalting of either source water and/or recycled waters, and minimizing the TDS waste increment. YVWD is currently constructing a 12-MGD treatment plant to treat and serve State Project Water. The plant will also be able to treat low TDS Mill Creek and Santa Ana River water. When necessary, YVWD will construct desalters to reduce either the TDS concentration in water supplied to customers or the TDS concentration in the effluent. YVWD will also use best efforts to enact ordinances and other requirements to minimize the TDS use increment.

Within 60 days after the YVWD 12-month running average concentration for TDS equals or exceeds 530 mg/L for 3 consecutive months, or the 12-month running average TIN concentration equals or exceeds 6 mg/L in any month (once replacement denitrification facilities are in place), YVWD shall submit to the Regional Board a plan and time schedule for implementation of measures to insure that the average agency wastewater effluent quality does not exceed 540 mg/L and 6 mg/L for TDS and TIN, respectively. The plan and schedule are to be implemented upon approval by the Regional Board.

9. Relocation of San Timoteo Creek Discharge (Table 5-9a, #9)

YVWD has established the goal of eliminating its discharge to the unlined reach of San Timoteo Creek by 2008. First priority will be given to the direct reuse and limited recharge of this recycled water in the YVWD service area (principally the area overlying the Yucaipa Management Zone). The District may construct a pipeline to convey the recycled water to the San Jacinto watershed for reuse. The District is also planning the construction of a pipeline to convey recycled water downstream to the lined reach of the Creek (Reach 1A) to minimize recycled water effects on the San Timoteo Management Zone. In the

long-term, discharges to this area of the Creek are likely to be infrequent and limited to the wintertime, when the recycled water cannot be used in the YVWD (or potentially, the San Jacinto) service areas. . However, YVWD is obligated to maintain flows in the Creek to support existing riparian habitat (State Board Order No. WW-26) and may need to continue recycled water discharges at some level. Groundwater and imported State Project water may also be used as alternative water sources.

Whole or partial removal of the discharge from the unlined reach of San Timoteo Creek would improve the quality of groundwater in the San Timoteo Management Zone and supplement recycled water supplies available for reuse elsewhere in the service area.

By *(6 months from effective date of this Basin Plan amendment)* YVWD shall submit a proposed plan and schedule to remove/reduce the discharge of recycled water to the unlined reach of San Timoteo Creek. The plan and schedule shall be implemented upon Regional Board approval.

9. Construction of Western Regional Interceptor (Table 5-9a, # 10)

YVWD will construct the Western Regional Interceptor to provide wastewater collection and treatment services to Dunlap Acres in order to mitigate what has been identified as a poor quality groundwater area due to prior agricultural use and existing septic systems. The Dunlap Acres area was inadvertently omitted from the Yucaipa-Calimesa septic tank subsurface disposal system prohibition established by the Regional Board in 1973. The interceptor includes the construction of a major wastewater interceptor pipeline, a force main and pump station. YVWD committed to complete construction of these facilities prior to 2010. Regional Board action may be necessary to require connection of properties to the wastewater collection system, when it is completed.

By *(6 months from effective data of this Basin Plan amendment)*, YVWD shall submit a plan and schedule for construction of the Interceptor. The Interceptor is to be complete no later than January 1, 2010. YVWD shall implement the plan and schedule upon Regional Board approval.

B. Implementation by Regional Board

1. Revision to Yucaipa Valley Water District NPDES Permit

To implement the "maximum benefit" objectives, the Regional Board will revise the NPDES permit for YVWD wastewater discharges to reflect the commitments described above, as appropriate. This includes the following.

The discharge limits for TDS and TIN will be specified as an annual volume-weighted average not to exceed 540 mg/L TDS and 6 mg/L TIN. These limits are based on the "maximum benefit" wasteload allocations shown in Table 5-5. A schedule not to exceed *(three years from the effective date of this Basin Plan amendment)* for compliance with this TIN limit shall be included in the permit. This schedule will enable YVWD to replace its existing denitrification facilities. Alternative TDS and nitrate-nitrogen limitations based on the "antidegradation" objectives will also be specified and will apply should the Regional Board find that maximum benefit is not demonstrated. These alternative limits are also specified in Table 5-5. Compliance schedules for these alternative limits will be specified in YVWD's waste discharge requirements, as necessary.

YVWD will be required to implement measures to improve effluent quality when the 12-month running average effluent TDS quality equals or exceeds 530 mg/L for 3 consecutive months, and/or when the 12-month running average TIN concentration equals or exceeds 6 mg/L in any month (once replacement denitrification facilities are in place).

YVWD's waste discharge requirements will require that recycled water used for recharge shall be limited to the amount that can be blended with other water sources, such as stormwater or imported water, to achieve 5-year running average concentrations equal to or less than the "maximum benefit" TDS and nitrate-nitrogen objectives for the affected management zone (Yucaipa or San Timoteo). Alternative TDS and nitrate-nitrogen limitations based on the "antidegradation" objectives will also be specified for recycled water recharge in these management zones.

The effluent limits for YVWD, which establish an upper limit on TDS and TIN concentrations of recycled water discharged in the Yucaipa and/or San Timoteo Management Zones, are a cornerstone of the maximum benefit demonstration. The cap on effluent TDS and TIN concentrations provides a controlling point for management of TDS and nitrogen water quality. YVWD will be required to initiate the building of a desalter and brine disposal line when the 5-year running average TDS in YVWD's effluent reaches 530 mg/L, or when the volume weighted-average TDS concentration in the Yucaipa Management Zone reaches 360 mg/L. YVWD will immediately implement a salt management program to reduce the salts entering the District's wastewater treatment plant. This salt management program will include: 1) provision of incentives for the removal of on-site regenerative water softeners and the use of off-site regenerative systems; and 2) percolation of State Water Project water into the Yucaipa Management Zone when State Water Project water has low TDS. Implementing these measures will assure that the groundwater quality remains at or below the Yucaipa Management Zone objective of 360 mg/L TDS. Maintenance of this ambient groundwater quality is necessary, in turn, to assure that YVWD's wastewater treatment facility is able to meet the effluent TDS limits. Yucaipa Management Zone groundwater is a significant component of the water supplied in YVWD's service area, and its quality thus has an important effect on effluent quality. Poor ambient quality will preclude YVWD from meeting effluent limits without desalting.

YVWD will be required to submit proposed plans and schedules for the removal/reduction of its wastewater discharges from the unlined reach of San Timoteo Creek and for the construction of the Western Regional Interceptor. YVWD's revised permit will also reflect the surface and groundwater monitoring program requirements described above. This includes the determination of ambient quality in the San Timoteo and Yucaipa Management Zones.

2. Review of Project Status

No later than 2005, and every three years thereafter (to coincide with the Regional Board's triennial review process), the Regional Board intends to review the status of the activities planned and executed by the YVWD to demonstrate maximum benefit and justify continued implementation of the "maximum benefit" water quality objectives. This review is intended to determine whether the commitments specified above and summarized in Table 5-9a are met. As indicated above, if, as a result of this review, the Regional Board finds that the YVWD commitments are not met, the Regional Board will make a finding that the lowering of water quality associated with TDS and nitrate-nitrogen water quality objectives that are higher than historical water quality (the "antidegradation" objectives) is not of maximum benefit to the people of the state. By default, the scientifically derived "antidegradation" objectives for the San Timoteo (300 mg/L for TDS, 2.7 mg/L for nitrate-nitrogen) and Yucaipa (320 mg/L for TDS and 4.2 mg/L for nitrate-nitrogen Management Zones would become effective (see Chapter 4).

Furthermore, in the event that the projects and actions specified in Table 5-9a are not implemented, the Regional Board will require that the YVWD mitigate the adverse water quality effects, both on the immediate and downstream waters, that resulted from the recycled water discharges based on the "maximum benefit" objectives.

2. San Timoteo and Beaumont Management Zones – City of Beaumont and San Timoteo Watershed Management Authority (STWMA)

As shown in Chapter 4, two sets of TDS and nitrate-nitrogen objectives have been adopted for both the San Timoteo and Beaumont Management Zones: the "maximum benefit" objectives and objectives based on historic ambient quality (the "antidegradation" objectives). The application of the "maximum benefit" objectives for these Management Zones is contingent on the implementation of commitments by the City of Beaumont/STWMA (and, in the case of the San Timoteo Management Zone, by the Yucaipa Valley Water District (YVWD; see preceding discussion)) to implement a specific water and wastewater resources management program [Ref. 10E]. This program is part of a coordinated effort by the member agencies of STWMA to develop and implement projects that will assure reliable water supplies to meet rapidly increasing demands in this area. The San Timoteo Watershed Management Program (STWMP) developed by STWMA entails enhanced recharge of native and recycled water, maximizing the direct use of recycled water, optimizing the direct use of imported water, recharge and conjunctive use.

Wastewater collection and treatment services in the STWMA service area are provided by the City of Beaumont, as well as YVWD. Beaumont discharges tertiary treated wastewater to Coopers Creek, a tributary of San Timoteo Creek, Reach 3. This unlined reach of the Creek overlies and recharges the San Timoteo groundwater management zone.

Table 5-10a identifies the projects and requirements that must be implemented by Beaumont/STWMA to demonstrate that water quality consistent with maximum benefit to the people of the state will be maintained. STWMA, acting for all its member agencies, has committed to conduct the regional planning and monitoring activities necessary to implement these "maximum benefit" commitments, and the San Timoteo Watershed Management Program as a whole. Table 5-10a also specifies an implementation schedule. The Regional Board will revise the City of Beaumont's waste discharge requirements and take other actions as necessary to require that these commitments be met. It is assumed that maximum benefit is demonstrated, and that the "maximum benefit" water quality TDS and nitrate-nitrogen objectives apply to the Beaumont and San Timoteo Management Zones, as long as the schedule is being met[8]. If the Regional Board determines that the maximum benefit program is not being implemented effectively in accordance with the schedule shown in Table 5-10a (and in the case of the San Timoteo Management Zone, the commitments and schedule shown in Table 5-9a (see preceding section)), then maximum benefit is not demonstrated, and the "antidegradation" TDS and nitrate-nitrogen objectives apply. In this situation, the Regional Board will require mitigation for TDS and nitrate-nitrogen discharges affecting these management zones that took place in excess of limits based on the "antidegradation" objectives.

[8] Application of "maximum benefit" objectives for the San Timoteo Management Zone is also contingent on the timely implementation of the commitments by the Yucaipa Valley Water District which are discussed in the preceding section.

Table 5-10a

City of Beaumont and San Timoteo Watershed Management Authority
Maximum Benefit Commitments

Description of Commitment	**Compliance Date – as soon as possible, but no later than**
1. Surface Water Monitoring Program	
a. Submit Draft Monitoring Program to Regional Board	a. (*30 days from effective date of this Basin Plan amendment*)
b. Implement Monitoring Program	b. Within 30 days from Regional Board approval of monitoring plan
c. Quarterly data report submittal	c. April 15, July 15, October 15, January 15
d. Annual data report submittal	d. February 15th
2. Groundwater Monitoring Program	
a. Submit Draft Monitoring Program to Regional Board	a. (*30 days from effective date of this Basin Plan amendment*)
b. Implement Monitoring Program	b. Within 30 days from Regional Board approval of monitoring plan
c. Annual data report submittal	c. February 15th
3. Desalter(s) and Brine Disposal Facilities	
a. Submit plan and schedule for construction of desalter(s) and brine disposal facilities. Facilities are to be operational as soon as possible but no later than 7 years from date of Regional Board approval of plan/schedule.	a. Within 6 months of either of the following: i. When Beaumont's effluent 5-year running average TDS exceeds 480 mg/L; and/or ii. When volume weighted average concentration in the Yucaipa MZ of TDS exceeds 320 mg/L
b. Implement the plan and schedule	b. Within 30 days from Regional Board approval of monitoring plan
4. Non-potable water supply	
Implement non-potable water supply system to serve water for irrigation purposes. The non-potable supply shall comply with a 10-year running average TDS concentration of 330 mg/L or less	(*10 years from effective date of this Basin Plan amendment*)

Description of Commitment	**Compliance Date – as soon as possible, but no later than**	
5. Recycled water recharge The recharge of recycled water in the Beaumont or San Timoteo Management Zones shall be limited to the amount that can be blended with other recharge sources to achieve a 5-year running average equal to or less than the "maximum benefit" objectives for TDS and nitrate-nitrogen for the relevant Management Zone(s). a. Submit baseline report of amount, locations, and TDS and nitrogen quality of stormwater/imported water recharge. b. Submit documentation of amount, TDS and nitrogen quality of all sources of recharge and recharge locations. For stormwater recharge used for blending, submit documentation that the recharge is the result of City of Beaumont/STWMA enhanced recharge facilities/programs	Compliance must be achieved by end of 5th year after initiation of recycled water use/recharge operations. a. Prior to initiation of construction of basins/other facilities to support enhanced stormwater/imported water recharge. b. Annually, by January 15th, after initiation construction of facilities/implementation of programs to support enhanced recharge.	
6. Ambient groundwater quality determination	July 1, 2005 and every 3 years thereafter	
7. Replace denitrification facilities (if necessary to comply with TIN wasteload allocation specified in Table 5-5)	Compliance with 6 mg/L TIN limitation to be achieved by *(*3 years from effective date of this Basin Plan amendment*)*	
8. City of Beaumont recycled water quality improvement plan and schedule a. Submit plan and schedule b. Implement plan and schedule	a. 60 days after the TDS 12-month running average effluent quality equals or exceeds 480 mg/L for 3 consecutive months and/or the 12-month running average TIN concentration equals or exceeds 6 mg/L in any month (once facility/operational changes needed to achieve 6 mg/L TIN are in place) b. Upon approval by Regional Board	
9. Remove/reduce the discharge of Beaumont's effluent from the unlined portion of San Timoteo Creek a. Submit proposed plan/schedule b. Implement plan/schedule	a. *(*6 months from effective date of this Basin Plan amendment*)* b. Upon Regional Board approval	

A. Description of City of Beaumont, San Timoteo Watershed Authority Commitments

1. Surface Water Monitoring Program (Table 5-10a, #1)

The City of Beaumont and the STWMA shall develop and submit for Regional Board approval a surface water monitoring program for San Timoteo, Little San Gorgonio and Noble Creeks at the locations listed in Table 5-10b. The monitoring program must be implemented within 30 days of Regional Board approval of the monitoring plan, and six months of data must be generated prior to the implementation of any changes to the effluent discharge points and before any recycled water is used in the Beaumont or San Timoteo Management Zones.

At a minimum, the surface water monitoring program shall include the collection of monthly measurements of TDS and nitrogen components at locations in San Timoteo, Little San Gorgonio and Noble Creeks (see Table 5-10b). Data reports shall be submitted to the Regional Board's Executive Officer by April 15, July 15, October 15 and January 15 each year. An annual report summarizing all data collected for the year and evaluating compliance with relevant surface water objectives shall be submitted February 15th of each year.

2. Groundwater Monitoring Program (Table 5-10a. #2)

The purpose of the groundwater monitoring program is to identify the effects of the implementation of the Beaumont and San Timoteo Management Zone maximum benefit TDS and nitrate-nitrogen water quality objectives on water levels and water quality within the Beaumont and San Timoteo Management Zones. Prior to discharge of recycled water to the Beaumont and/or San Timoteo Management Zone, the City of Beaumont and the STWMA shall submit to Regional Board for approval a groundwater monitoring program to determine ambient water quality in the Beaumont and San Timoteo Management Zones. The groundwater monitoring program must be implemented within 30 days of approval by the Regional Board.

An annual report, including all raw data and summarizing the results of the approved groundwater monitoring program, shall be submitted to the Regional Board by February 15th of each year.

3. Desalters and Brine Disposal (Table 5-10a. #3)

The City of Beaumont and the STWMA shall construct and operate desalting facilities and brine disposal facilities when:

a. The 5-year running average TDS concentration in recycled water produced at the City of Beaumont wastewater treatment plant exceeds 480 mg/L, or

b. The volume-weighted TDS concentration in the Beaumont Management Zone equals or exceeds 320 mg/L.

The construction of these facilities will be in accordance with a plan and schedule submitted by Beaumont/STWMA and approved by the Regional Board. The schedule shall assure that these facilities are in place within 7 years of Regional Board approval. These facilities shall be designed to stabilize or reverse the degradation trend evidenced by effluent and/or management zone quality.

Table 5 – 10b

Surface Water Monitoring Sites for Monitoring Water Quality and Quantity
City of Beaumont & San Timoteo Watershed Management Authority

Site Name	Discharge	Owner	Type	Discharge Frequency	Monitoring Period	Water Quality Monitoring Frequency	Water Quality Monitoring Period	Analyses
Above confluence With Coopers Cr.	San Timoteo Creek	Beaumont & STWMA	Total Discharge	Bi-weekly	Jan-Dec	Bi-weekly	Jan-Dec	TDS, TIN, Physical
Near Hinda Sec.35 T2S,R2W	San Timoteo Creek	Beaumont & STWMA	Total Discharge	Bi-weekly	Jan-Dec	Bi-weekly	Jan-Dec	TDS, TIN, Physical
Above confluence With San Timoteo Creek	Coopers Creek	Beaumont & STWMA	Total Discharge	Bi-weekly	Jan-Dec	Bi-weekly	Jan-Dec	TDS, TIN, Physical
At Freeway 10	Little San Gorgonio Cr.	Beaumont & STWMA	Total Discharge	Bi-weekly	Jan-Dec	Bi-weekly	Jan-Dec	TDS, TIN, Physical
At Freeway 10	Noble Creek	Beaumont & STWMA	Total Discharge	Bi-weekly	Jan-Dec	Bi-weekly	Jan-Dec	TDS, TIN, Physical
Recharged to Beaumont MZ	State Water Project	Beaumont & STWMA	Total Discharge	Bi-weekly	Jan-Dec	Monthly	Jan-Dec	TDS, Nitrate-N
Recharged to Beaumont MZ	Storm water	Beaumont & STWMA	Total Discharge	Bi-weekly	Jan-Dec	Monthly	Jan-Dec	TDS, Nitrate-N

4. Non-potable water supply distribution system (Table 5-10a, #4)

Like YVWD, the City of Beaumont is constructing a non-potable water system that will convey untreated State Project water and recycled water for irrigation within its service area. The intent of blending these sources is to minimize the impact of recycled water use on groundwater quality in the proposed Beaumont and San Timoteo Management Zones. A higher proportion of State Project water will be used in wet, surplus years, while larger amounts of recycled water will be used in dry, deficit years.

5. Recycled Water Use (Table 5-10a, #5)

The use of recycled water within the Beaumont Management Zone is a critical component of the City of Beaumont and STWMA water management plan and is necessary to maximize the use of the water resources of the Beaumont area.

The demonstration of "maximum benefit" and the continued application of the "maximum benefit" objectives depends on the combined recharge (recycled water, imported water, storm water) to the Beaumont Management Zone of a 5-year annual average (running average) TDS concentration of 330 mg/L and a nitrate-nitrogen concentration of 5 mg/L. If recycled water recharge in the San Timoteo

Management Zone is pursued, then the application of the "maximum benefit" objectives will depend on the combined recharge to that Zone of 5-year annual average (running average) concentrations of 400 mg/L or less TDS, and 5 mg/L or less nitrate-nitrogen.

To comply with this requirement, the STWMA member agencies are developing plans to recharge and store State Project water in the proposed Beaumont Management Zone. The Beaumont-Cherry Valley Water District (BCVWD) is developing a new 80-acre groundwater recharge project that will increase storm water recharge in the Beaumont Basin by 4,100 acre-ft/yr. This facility will also be used to recharge State Water project water. The City of Beaumont is also developing storm water recharge in facilities in newly developing areas, which is expected to result in the recharge of an additional 2,400 acre-ft/yr of stormwater runoff.

Accordingly, the use of recycled water for use or recharge in the Beaumont or San Timoteo Management Zone shall be limited to the amount that can be blended on a volume-weighted basis with other sources of recharge to achieve 5-year running average concentrations less than or equal to the "maximum benefit" objectives for the affected groundwater management zone. The 25% nitrogen loss coefficient will be applied in determining the amount of recharge of other water sources that must be achieved to meet the 5-year running average nitrogen concentrations.

6. Ambient Groundwater Quality Determination (Table 5-10a, # 6)

By July 1, 2005, and every three years thereafter, the City of Beaumont and STWMA shall submit a determination of ambient TDS and nitrate-nitrogen quality in the Beaumont and San Timoteo Management Zones. This determination shall be accomplished using methodology consistent with the calculation (20-year running averages) used by the Nitrogen /TDS Task Force to develop the TDS and nitrate-nitrogen "antidegradation" water quality objectives for groundwater management zones within the region [Ref. 1].

7. Replacement/modification of denitrification facilities (Table 5-10a, #7)

The City of Beaumont has committed to produce recycled water with a 12-month average TIN concentration of 6 mg/L or less by 2008. This may be accomplished via operational changes, or may require the installation/modification of facilities. This TIN effluent quality is specified in the TIN wasteload allocation (see Table 5-5) and is necessary to assure compliance with the proposed "maximum benefit" nitrate-nitrogen objective for the Beaumont and San Timoteo Management Zones (5 mg/L). An appropriate schedule, not to exceed *(3 years from effective date of this Basin Plan amendment)* for compliance with this effluent limit will be specified in a revised NPDES permit for the City.

8. City of Beaumont Wastewater Management (Table 5-10a, #8)

Beaumont expects to limit the TDS concentration in its effluent to less than or equal to 490 mg/L by using a low TDS source water supply for potable uses, selective desalting of either source water and/or recycled waters, and minimizing the TDS waste increment.

Within 60 days after the Beaumont 12-month running average concentration for TDS equals or exceeds 480 mg/L for 3 consecutive months, or the 12-month running average TIN concentration equals or exceeds 6 mg/L in any month (once facility/operational changes needed to achieve 6 mg/L TIN are in place), the City of Beaumont shall submit to the Regional Board a plan and time schedule for implementation of measures to insure that the average agency wastewater effluent quality does

not exceed 490 mg/L and 6 mg/L for TDS and TIN, respectively. The plan and schedule are to be implemented upon approval by the Regional Board.

9. Relocation of San Timoteo Creek Discharge (Table 5-10a, #9)

Like YVWD, Beaumont has established the goal of eliminating its discharge to the unlined reach of San Timoteo Creek by 2008 to minimize the impacts of these discharges on the San Timoteo Management Zone. The STWMP anticipates that Beaumont's recycled water will be almost completely reused within the Beaumont area for landscape irrigation, habitat enhancement, and potentially for groundwater recharge. Like YVWD, Beaumont and STWMA are also considering the export of a portion of Beaumont's surplus recycled water to the San Jacinto basin, where the TDS objectives are higher than those for the Beaumont Management Zone and recycled water demands are greater than supplies. Some limited recycled water discharge to Coopers Creek and thence /San Timoteo Creek may need to be continued to support existing riparian habitat.

Whole or partial removal of the discharge from the unlined reach of San Timoteo Creek would improve the quality of groundwater in the San Timoteo Management Zone and supplement recycled water supplies available for reuse elsewhere in the service area.

By *(*6 months from effective date of this Basin Plan amendment)* Beaumont/STWMA shall submit a proposed plan and schedule to remove/reduce the discharge of recycled water to the unlined reach of San Timoteo Creek. The plan and schedule shall be implemented upon Regional Board approval.

B. Implementation by Regional Board

1. Revision of City of Beaumont NPDES Permit

To implement the "maximum benefit" objectives, the Regional Board will revise the NPDES permit for the City of Beaumont wastewater discharge to reflect the commitments described above, as appropriate. This includes the following.

The discharge limits for TDS and TIN will be specified as an annual volume-weighted average not to exceed 490 mg/L TDS and 6 mg/L TIN. These limits are based on the wasteload allocation shown in Table 5-5. A schedule not to exceed *(three years from the effective date of this Basin Plan amendment)* for compliance with this TIN limit shall be included in the permit. This schedule will enable Beaumont to make the necessary facility/operational changes. Alternative TDS and nitrate-nitrogen limitations based on the "antidegradation" objectives will also be specified and will apply should the Regional Board find that maximum benefit is not demonstrated. These alternative limits are also specified in Table 5-5. Compliance schedules for these alternative limits will be specified in Beaumont's waste discharge requirements, as necessary.

Beaumont will be required to implement measures to improve effluent quality when the 12-month running average effluent TDS quality equals or exceeds 480 mg/L for 3 consecutive months, and/or when the 12-month running average TIN concentration equals or exceeds 6 mg/L in any month (once the facility/operational changes necessary to assure compliance with the 6 mg/L limit are in place).

Beaumont's waste discharge requirements will require that recycled water used for recharge shall be limited to the amount that can be blended with other water sources, such as stormwater or imported water, to achieve 5-year running average concentrations equal to or less than the "maximum benefit" TDS and nitrate-nitrogen objectives for the affected management zone (Beaumont or San Timoteo).

The effluent limits for the City of Beaumont, which establish an upper limit on TDS and TIN concentrations of recycled water discharged in the management zones, are a key part of the maximum benefit demonstration. The cap on effluent TDS and TIN concentrations provides a controlling point for management of TDS and nitrogen water quality. The City of Beaumont has committed to initiate the building of a groundwater desalter and brine disposal line when the TDS in the City's effluent reaches 480 mg/L. Further, the City will immediately implement a salt management program to reduce the salts entering the City's wastewater treatment plant. This salt management program will include: 1) provision of incentives for the removal of on-site regenerative water softeners and the use of off-site regenerative systems; and 2) percolation of State Water Project water into the Beaumont Management Zone when State Water Project water has low TDS. Implementing these measures will assure that the groundwater quality remains at or below the Beaumont management zone objective of 330 mg/L TDS. Maintenance of this ambient groundwater quality is necessary, in turn, to assure that the City's wastewater treatment facility is able to meet the effluent TDS limits. Beaumont Management Zone groundwater is a component of the water supplied to the City and its quality thus has an important effect on the effluent quality. Poor ambient quality will preclude the City from meeting effluent limits without desalting.

Beaumont will be required to submit a proposed plan and schedule for the removal/reduction of its wastewater discharges from the unlined reach of San Timoteo Creek. Beaumont's revised permit will also reflect the surface and groundwater monitoring program requirements described above. This includes the determination of ambient quality in the San Timoteo and Beaumont Management Zones.

2. Review of Project Status

No later than 2005, and every three years thereafter (to coincide with the Regional Board's triennial review process), the Regional Board intends to review the status of the activities planned and executed by the City of Beaumont and STWMA to demonstrate maximum benefit and justify continued implementation of the "maximum benefit" water quality objectives. This review is intended to determine whether the commitments specified above and summarized in Table 5-10a are met. As indicated above, if, as a result of this review, the Regional Board finds that the City of Beaumont and STWMA commitments are not met, the Regional Board will make a finding that the lowering of water quality associated with TDS and nitrate-nitrogen water quality objectives that are higher than historical water quality (the "antidegradation" objectives) is not of maximum benefit to the people of the state. By default, the scientifically derived "antidegradation" objectives for the Beaumont and San Timoteo Management Zones would become effective (230 mg/L TDS and 1.5 mg/L nitrate-nitrogen for the Beaumont Management Zone; 300 mg/L TDS and 2.7 mg/L nitrate-nitrogen for the San Timoteo Management Zone (see Chapter 4).

Furthermore, in the event that the projects and actions specified in Table 5-10a are not implemented, the Regional Board will require that the City of Beaumont and STWMA mitigate the adverse water quality effects, both on the immediate and downstream waters, that resulted from the recycled water discharges based on the "maximum benefit' objectives. As for CBW/IEUA and YVWD, discharges in excess of the antidegradation objectives that must be considered for mitigation include both recycled water and imported water, at TDS concentrations in excess of the antidegradation objectives. Mitigation by groundwater extraction and desalting must be adjusted to address concentrations of salt and nitrogen in the basin, not simply salt load.

(End of Salt Management Plan Section)

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REFERENCES (excerpt): Revise the References as follows:

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2. ~~Wildermuth, Mark J., "Final Summary Report, TDS and Nitrogen Studies, Santa Ana Watershed," February 1991.~~Wildermuth Environmental, Inc., "Santa Ana Watershed Data Collection and Management Program, Final Technical Memorandum," October 2001.

3. ~~California Regional Water Quality Control Board – Santa Ana Region, Staff Report, "Nitrogen and TDS Studies, Upper Santa Ana Watershed," April 1991.~~Wildermuth Environmental, Inc., "TIN/TDS Study - Phase 2B of the Santa Ana Watershed, Wasteload Allocation Investigation Memorandum," October 2002.

4. ~~California Regional Water Quality Control Board – Santa Ana Region, Staff Report, "Nitrogen and TDS Studies, Upper Santa Ana Watershed," July 1991.~~Wildermuth Environmental, Inc., Memo to TIN/TDS Task Force, "Transmittal of Final Tables, Figures and CD in Support of Basin Plan Amendments – TIN/TDS Study," October 2002.

5. Wildermuth Environmental, Inc., "June 2003 Addendum TIN/TDS Study – Phase 2B of the Santa Ana Watershed Wasteload Allocation Investigation," July 2003

6. California Regional Water Quality Control Board – Santa Ana Region, "Guidelines for Sewage Disposal from Land Developments," January 1979.

~~6.~~7. State Water Resources Control Board, "Order No. 73-4, Rancho Caballero Decision," April 1972.

~~7.~~8. Department of Water Resources, "Mineral Increases from Municipal Use of Water in the Santa Ana River Basin," Memorandum Report, June 1982.

9. ~~California Regional Water Quality Control Board – Santa Ana Region, Staff Report, "Santa Ana River at Prado Dam, Results of Annual Water Quality Sampling for 1990," December 1990.~~City of Riverside, Memo from Rod Cruze to TIN/TDS Task Force," Nitrogen Loss Assumptions for Reach 3 of the Santa Ana River," April 2002.

10A. ~~Santa Ana Watershed Project Authority, "Arlington Desalter, Project Facts," undated.~~California Regional Water Quality Control Board – Santa Ana Region, Staff Report, "Santa Ana River at Prado Dam, Results of Annual Water Quality Sampling for 2002", April 2003.

10B. Chino Basin Watermaster, Letter to Gerard Thibeault, "Chino Basin Watermaster Proposal for New Total Dissolved Solids (TDS) and Nitrogen Water Quality Objectives for the Chino and Cucamonga Basins Based on Maximum Beneficial Use," December 2002.

10C. Chino Basin Watermaster, "Chino Basin Optimum Basin Management Plan," 1999.

10D. Yucaipa Valley Water District, Letter to Gerard Thibeault, "Yucaipa Valley Water District Proposal for New Total Dissolved Solids (TDS) and Total Inorganic Nitrogen Water Quality Objectives for the San Timoteo and Yucaipa Management Zones Based on Maximum Beneficial Use," January 2002.

10E. San Timoteo Watershed Management Agency, Letter to Gerard Thibeault, "Revised San Timoteo Watershed Management Agency Proposal for New Total Dissolved Solids (TDS) and Total Inorganic Nitrogen Water Quality Objectives for the Beaumont, San Timoteo and Yucaipa Management Zones Based on Maximum Beneficial Use," December 2002 (Revised November 11, 2003).

(Chapter 5 – Implementation Plan References continue)

MUTUAL AID AGREEMENT

THIS AGREEMENT is by and between Inland Empire Utilities Agency and the Regional Contracting Agencies consisting of Cities of Chino, Chino Hills, Fontana, Montclair, Ontario, Upland, and Cucamonga Valley Water District.

RECITALS

Whereas, Inland Empire Utilities Agency and the Regional Contracting Agencies are public agencies and each has certain equipment and personnel under its management and control; and

Whereas, the equipment and personnel may be available to assist each agency in the event of a disruption which would affect the water service, sewer service or sewage treatment service provided by each agency to its customers; and

Whereas, neither party should be placed in a position of depleting unreasonably its own resources, facilities, or services in providing such mutual aid; and

Whereas, Inland Empire Utilities Agency and the Regional Contracting Agencies desire to cooperate in providing and sharing available equipment upon request of the other agency under the terms of this Agreement.

NOW, THEREFORE, the undersigned parties hereto agree as follows:

1.

a. In the event of any disruption or damage to the ability of either the Inland Empire Utilities Agency or the Regional Contracting Agencies to continue to serve the public or its customers with water service, sewage service or sewage treatment service, the other party will cooperate to a maximum extent possible, as determined in its discretion, to provide mutual aid assistance as requested.

b. Each party's obligation hereunder shall be expressly contingent upon its manpower and equipment availability, as determined by the responding party in its sole and absolute discretion. Each party's response within the jurisdictional limits of the other party may not interfere with the responding party's responsibility or ability to respond to emergencies or other calls within its own jurisdictional area. Each party shall endeavor to notify the other party in advance when it knows that its equipment or manpower will not be available to respond within the jurisdictional limits of the other party.

2. In the context of this Agreement, "natural or man-made disaster" shall mean a situation or set of circumstances in which property damage or personal injury has occurred or is likely

to occur, the occurrence of which will disrupt the services provided by the Inland Empire Utilities Agency and the Regional Contracting Agencies.

3.

a. Each party to this Agreement shall provide the name(s), address(es), telephone number(s), and title(s) of the responsible employee(s) authorized to request or respond to requests for mutual aid assistance on or before thirty (30) days have elapsed from the date of approval of this Agreement by the last party to approve this Agreement. Only employees of each respective party are eligible. No contract workers shall be assigned.

b. The requesting party agrees to pay as allowed by applicable law, all direct, indirect, administrative and contracted costs of assisting the requesting party incurred by the responding party as a result of providing assistance pursuant to this Agreement, based upon responding party's internal rates or charges for material, equipment, and personnel. Payment shall be made within sixty (60) days after receipt of a detailed invoice. The detailed invoice shall include personnel assigned, classification, dates and hours worked, hourly billing rate and equipment used. The requesting party shall not assume any liability for the direct payment of any salary or wages to any officer or employee of the responding party. The rates, charges and costs referenced herein shall be set forth in exhibits 1 through 8 attached hereto and incorporated herein. Said exhibits may be updated from time to time as needed. If the changes in the exhibits are greater than 10 percent of the previously stated rates, the said changes need to be agreed to by the parties.

c. The party requesting assistance shall specify the type and duration of assistance required.

d. The party responding to the request shall designate the person responsible for the direction and supervision of the personnel and equipment provided to the requesting party, and the requesting party shall direct the disposition and utilization of personnel, equipment and materials furnished in response to such request only through the person so designated.

e. The personnel, equipment, and materials furnished in response to the request for mutual aid shall be released by the requesting party when no longer needed or when the responding party requires return or as required by law.

4. The responsible managing employees of each of the parties to this Agreement shall consult with each other at least one (1) time each calendar year to update the equipment and personnel list, and revise any procedures for requesting and obtaining mutual aid assistance. The equipment and personnel list for each party shall be attached to this agreement as Exhibits 1 through 8.

5. It is agreed by the parties hereto that protection, maintenance, and repair of their own systems and facilities will receive priority in responding to any request for mutual aid assistance.

   a. Each party to this Agreement shall maintain in full force and effect workers compensation insurance without cost to the other party which covers the personnel involved in a response to provide mutual assistance, and therefore each party to this Agreement waives all claims against the other for compensation for any loss, damage, personal injury, or death occurring as a consequence of the performance of this Agreement to the extent that such liability is caused by the other party or its employees, directors commissioners, officials, officers, agents, and volunteers. Failure to provide adequate workers compensation insurance by a party shall obligate that party for any and all liabilities that may arise. Each party shall defend, indemnify and hold harmless, pursuant to Section 6 (b) below, the other party with respect to workers' compensation claims filed by their own employees.

   b. The requesting party shall hold harmless, indemnify, and defend the responding party, its elected officials, officers, agents employees, contractors, volunteers and agencies, against all liability, claims, losses, demands or actions for injury to, or death of, a person or persons, or damages to property arising out of, or alleged to arise out of or in consequence of, this Agreement, except to the extent that such liability is caused by the negligence or willful misconduct of the responding party, its elected officials, officers, agents, employees, contractors or volunteers.

   c. The requesting party will pay for any damage to the equipment and material provided by the responding party that occurs during the requested assistance period.

6. No provision of this Agreement and no action taken or personnel, equipment or material furnished pursuant to any such provision shall be construed to make the officer, employee, or agent of either party to this Agreement, the officer, employee or agent of the other party to this Agreement. Furthermore, the parties shall pay all wages, salaries, and other amounts due to their own personnel in connection with any and all services under the Agreement, as well as that which may be required by law. Each party shall be responsible for all reports and obligations respecting their own personnel, including, but not limited to, social security taxes, income tax withholding, unemployment insurance, benefits and workers' compensation insurance. Employees or agents of one party shall not be deemed employees of the other for any purpose.

7. This Agreement shall be effective as of the date all parties have executed the Agreement and shall continue to be in force with respect to all parties signing hereunder, unless terminated by consent of all the parties. Notwithstanding the foregoing, any party may terminate its participation in this agreement upon sixty (60) days written notice of termination to the remaining parties. Termination by any party or parties shall not affect the rights and obligations of any of the remaining parties under this agreement.

8. All notices permitted or required under this Agreement shall be given to the respective parties at the following address, or at such other address as the respective parties may provide in writing for this purpose:

INLAND EMPIRE UTILITIES AGENCY
Inland Empire Utilities Agency
6075 Kimball Avenue
Chino, CA 91709
Attn: Richard Atwater, CEO/General Manager

CITY OF CHINO
City of Chino
P. O. Box 667
Chino, CA 91708-0667
Attn: Jim Hill, Assistant Director of Public Works/Assistant City Engineer

CITY OF CHINO HILLS
City of Chino Hills
2001 Grand Avenue
Chino Hills, CA 91709
Attn: Mike Maestas, Water and Sewer Manager

CITY OF FONTANA
City of Fontana
16489 Orange Way
Fontana, CA 92335
Attn: Curtis Aaron, Director of Public Services

CITY OF MONTCLAIR
City of Montclair
5111 Benito Street
Montclair, CA 91763
Attn: Marilyn Staats, Director of Redevelopment / Public Works

CITY OF ONTARIO
City of Ontario
1425 South Bon View Avenue
Ontario, California 91761
Attn: Kenneth L. Jeske, Director of Public Works

CITY OF UPLAND
City of Upland
460 North Euclid Avenue
Upland, CA 91786
Attn: Rob Turner, Public Works Director

CUCAMONGA VALLEY WATER DISTRICT
Cucamonga Valley Water District
10440 Ashford Street
Rancho Cucamonga, CA 91730
Attn: Robert A. DeLoach, General Manager / CEO

Any notice required to be given hereunder to either party shall be given by personal delivery or by depositing such notice in the US Mail to the address listed with first class postage pre-paid. Such notice shall be deemed made when personally delivered or when mailed. Actual notice shall be deemed adequate notice on the date actual notice occurred, regardless of the method of service.

9. Inland Empire Utilities Agency and the Regional Contracting Agencies agree that the provisions of this Agreement are not intended to create or clarify any rights in third parties not a party to this Agreement. In addition, no third party shall have the right of action hereunder. This Agreement shall not be enforceable by any parties other than Inland Empire Utilities Agency and the Regional Contracting Agencies.

10. All privileges and immunities of Inland Empire Utilities Agency and the Regional Contracting Agencies provided by state or federal law shall remain in full force and effect.

11. If either party commences an action against the other party, either legal, administrative or otherwise, arising out of or in connection with this Agreement, the prevailing party in such litigation shall be entitled to have and recover from the losing party reasonable attorney's fees and all other costs of such action.

12. This Agreement contains the entire Agreement of the parties with respect to the subject matter hereof, and supersedes all prior negotiations, understandings or agreements. This Agreement may only be modified by a writing signed by both parties.

13. This Agreement shall be governed by the laws of the State of California. Venue shall be in San Bernardino County.

14. This Agreement shall be binding on the successors and assigns of the parties, and shall not be assigned by either party without the prior written consent of the other.

15. This Agreement may be executed in counterparts, each of which shall constitute an original.

16. In the event that any provision or portion of this Agreement is determined by a court of competent jurisdiction to be invalid, illegal or unenforceable for any reason, such provision or portion shall be severable from this Agreement. Such invalidity, legality or unenforceability shall not be construed to have any effect on the validity, legality or enforceability of the remaining provisions or portions of this Agreement.

WHEREFORE, the parties hereto have caused this Agreement to be executed in counterpart as the dates indicated.

INLAND EMPIRE UTILITIES AGENCY

I **HEREBY CERTIFY** that the foregoing agreement was duly executed pursuant to authorization by the Inland Empire Utilities Agency Board of Directors, at a regular meeting thereof held on the 21st day of, April 2004.

John L. Anderson

John Anderson
President, Board of Directors

April 21, 2004
Date

ATTEST:

Richard Atwater

Richard Atwater
CEO / General Manager

April 21, 2004
Date

CITY OF CHINO

I HEREBY CERTIFY that the foregoing agreement was duly executed pursuant to authorization by the City Council of the City of Chino, at a regular meeting thereof held on the 17th day of, February 2004.

Glen Rojas
City Manager

2-23-04
Date

APPROVED AS TO CONTENT:

Patrick J. Glover, P.E.
Director of Public Works/City Engineer

2.10.04
Date

APPROVED AS TO FORM:

Jimmy L. Gutierrez
City Attorney

Date

ATTEST:

Lenna J. Tanner
City Clerk

2-23-04
Date

CITY OF CHINO HILLS

I HEREBY CERTIFY that the foregoing agreement was duly executed pursuant to authorization by the City Council of the City of Chino Hills, at a regular meeting thereof held on the 27th day of, January 2004.

Douglas N. LaBelle
City Manager

1/27/04
Date

ATTEST:

Mary McDuffee
City Clerk

02/10/04
Date

CITY OF FONTANA

I **HEREBY CERTIFY** that the foregoing agreement was duly executed pursuant to authorization by the City Council of the City of Fontana, at a regular meeting thereof held on the _____ day of, _____ 2004.

Kenneth R. Hunt
City Manager

Date 3/16/09

ATTEST:

Beatrice Watson
City Clerk

Date

CITY OF MONTCLAIR

I **HEREBY CERTIFY** that the foregoing agreement was duly executed pursuant to authorization by the City Council of the City of Montclair, at a regular meeting thereof held on the 20th day of, January 2004.

Lee C. McDougal
City Manager

1/26/04
Date

ATTEST:

Donna Jackson
City Clerk

1/26/04
Date

CITY OF ONTARIO

I **HEREBY CERTIFY** that the foregoing agreement was duly executed pursuant to authorization by the City Council of the City of Ontario, at a regular meeting thereof held on the 3rd day of, February 2004.

Gregory C. Devereaux
City Manager

2/3/04
Date

ATTEST:

City Clerk

2/3/04
Date

CITY OF UPLAND

I HEREBY CERTIFY that the foregoing agreement was duly executed pursuant to authorization by the City Council of the City of Upland, at a regular meeting thereof held on the 12th day of, January 2004.

John V. Pomierski 1/14/04

John V. Pomierski
Mayor

Date

ATTEST:

Stephanie A. Mendenhall 1/14/04

Stephanie A. Mendenhall
City Clerk

Date

CUCAMONGA VALLEY WATER DISTRICT

I **HEREBY CERTIFY** that the foregoing agreement was duly executed pursuant to authorization by the Board of Directors of the Cucamonga Valley Water District, at a regular meeting thereof held on the 10th day of, February 2004.

Henry L. Stoy

Henry L. Stoy
President, Board of Directors

February 10, 2004
Date

ATTEST:

Robert A. DeLoach

Robert A. DeLoach
Secretary / General Manager

February 10, 2004
Date