City of Lincoln
Urban Water Management Plan

Adopted
November 22, 2005

City of Lincoln

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This Urban Water Management Plan was developed and adopted through the efforts of the staff and elected officials at the City of Lincoln, water agencies that provide water to the City, consultants and members of the Lincoln community.

City of Lincoln

Elected Officials:	Tom Cosgrove, Mayor Ray Sprague, Mayor Pro Tem Kent Nakata, Councilmember Primo Santini, Councilmember Spencer Short, Councilmember
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Plan Review

Placer County Water Agency

Nevada Irrigation District

Placer County

Members of the Lincoln Community

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INTRODUCTION

Purpose

In 1983, the California Urban Water Management Planning Act was added to the California Water Code (Division 6 Part 2.6) with the signing of Assembly Bill 797. The Act has been amended several times. The Act requires water suppliers with over 3,000 customers or that supply over 3,000 acre-feet of water annually to prepare Urban Water Management Plans (UWMP) and submit the plans to the California Department of Water Resources (DWR). The plans must be updated at least every five years in years that end in 0 or 5. This plan is an update to the 2002 Lincoln UWMP.

Changes made in late 2001 (Senate Bill 610) now require Urban Water Management Plans to include additional information. If updated plans are not submitted by December 31, 2005 or do not contain the required information, the urban water supplier will be prohibited from receiving specified funds (including Proposition 50 and the Local Groundwater Assistance Fund) administered by DWR. A copy of the current Act, including amendments is included in Appendix A.

"The conservation and efficient use of urban water supplies are of statewide concern; however, the planning for that use and the implementation of those plans can best be accomplished at the local level." California Water Code

This UWMP was prepared for the City of Lincoln (City) in order to comply with the current version of the California Urban Water Management Act.

Scope

The tasks described below constitute the scope of work. These tasks were the components of the California Urban Water Management Planning Act and amendments in effect as of October, 2005.

Plan Development

1. Make the plan available for public inspection before its adoption.
2. Provide the plan to the City for adoption as prepared or as modified after the public hearing.
3. Coordinate the preparation of the plan with other appropriate agencies, including direct and indirect suppliers, wastewater, groundwater, and planning agencies.

Lincoln Service Area

4. Provide current and projected population in 5-year increments to 20 years.
5. Describe the climate and other demographic factors.

Water Supply

6. Identify and quantify the existing and planned sources of water available in 5-year increments to 20 years.
7. Describe opportunities for exchanges or transfers of water on short-term or long-term basis.
8. A description of all water supply projects and programs that may be undertaken to meet total projected water use and how these projects and programs increase water supplies to meet total projected water use.
9. A description of the estimated implementation timeline for each future water supply project and program.
10. A copy of any groundwater management plan adopted by the urban water supplier.
11. A description of the groundwater basin.
12. For non-adjudicated basins, information from DWR documents regarding existing or anticipated overdraft.
13. Detailed descriptions of efforts to eliminate long-term overdraft, if it exists.
14. Copies of any legal decrees related to groundwater.
15. A detailed description and analysis of amount and location of groundwater pumped by the urban water supplier in the last five years.

16. A detailed description and analysis of location, amount, and sufficiency of groundwater projected to be pumped by the urban water supplier.

Water Quality

17. Information, to the extent practicable, relating to the quality of existing water supply sources over the next 20 years in five-year increments.
18. A description of the manner in which water quality affects water management strategies.
19. A description of the manner in which water quality affects supply reliability.

Demand

20. Identify projected water uses among water use sectors in 5-year increments to 20 years.
21. Describe average, single dry and multiple dry water year data.
22. Describe any plans to replace inconsistent water sources.
23. Provide minimum water supply estimates based on driest three-year historic sequence.
24. Describe the reliability of water supply.
25. Describe the vulnerability of water supply to seasonal or climatic shortage.

Water Recycling

26. Describe the wastewater collection and treatment systems in the City's service area.
27. Quantify the amount of wastewater collected and treated in the City's service area.
28. Describe the methods of wastewater disposal in the City's service area.
29. Describe the type, place, and quantity of recycled water currently used in the City's service area.
30. Describe and quantify potential uses of recycled water in 5-year increments to 20 years.
31. Describe the technical and economic feasibility of serving the potential users of recycled water.
32. Describe the actions that may be taken to encourage recycled water use.
33. Provide the projected acre-feet results of recycled water used per year.
34. Provide a plan for optimizing the use of recycled water in the City's service area.

35. Provide actions to facilitate the installation of dual distribution systems and to promote recirculating uses.

Supply and Demand Comparison

36. Provide an assessment of the reliability of the City's water service to its customers during normal, single dry, and multiple dry water years.
37. Compare the total water supply sources available to the City with the total projected water use over the next 20 years, in 5-year increments.
38. Compare normal, single dry, and multiple dry water year projected water supply sources available to the City with the normal, single dry, multiple dry water year projected water uses.
39. Identification of specific future water supply projects and programs that may be implemented to increase the amount of water available during average, single-dry and multiple-dry water years.
40. A description of the increase in water supply that is expected to be available from each of the specific future water supply projects and programs.

Water Shortage Contingency

41. Provide actions the City will take to prepare for a catastrophe.
42. Provide a copy of a draft water shortage contingency resolution or ordinance.
43. Provide water shortage stages of action, including up to a 50 percent reduction outlining specific water supply conditions at each stage.

Water Conservation

44. Provide mandatory prohibitions against wasteful practices.
45. Provide penalties or charges for wasting water.
46. Provide a description of consumption reduction methods.
47. Provide an analysis of the impacts on the City revenues and expenditures from reductions in water deliveries.
48. Provide measures to overcome revenue and expenditure impacts.
49. Provide a mechanism for determining actual reductions in water use.

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Plan Development

Public Participation

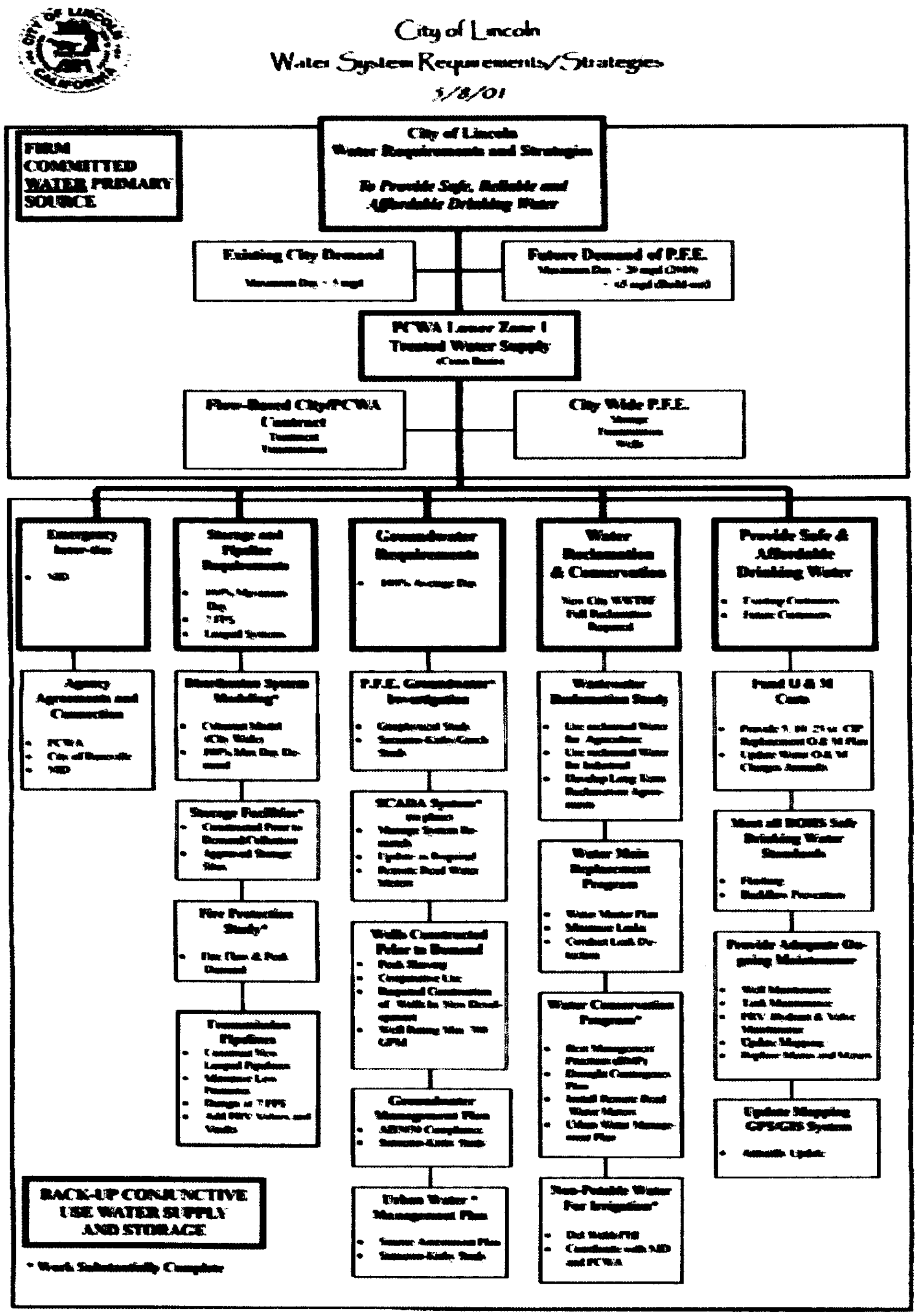
The City of Lincoln actively encouraged public participation in its urban water management planning efforts. The Lincoln City Council held a public hearing on November 22, 2005 for review and comment on the draft plan prior to adoption. Notices that included the time and place of the hearing were published in the local newspaper on November 3rd and 10th and a notice was posted at City Hall. Copies of the draft plan were available for review at City Hall and the Lincoln Library from November 8, 2005 through November 22, 2005.

A copy of the November 22 Council Resolution 2005 – XXX, adopting the plan and copies of the published notices are included in Appendix B.

Plan Coordination

Coordination Within the City

Staff of the Lincoln Public Works Department developed a Strategic Plan for the City with the goal "To provide safe, reliable and affordable drinking water." The Strategic Plan was subsequently presented to the Lincoln City Council. One element of the Strategic Plan was development of an Urban Water Management Plan. This Urban Water Management Plan was developed in close coordination with staff of the City of Lincoln Public Works Department and serves as an integral element of the City's Strategic Plan. The Strategic Plan is outlined in a flow chart presented as Figure 1.



Water System Requirements/Strategies
Organizational Chart

City of Lincoln 2005 Urban Water Management Plan

Figure 1
Date: November 2005
Prepared by: HP

In the development of the plan, input was also sought from staff of the Lincoln Community Development, Finance, and Planning departments.

Coordination with Other Agencies

The plan was developed with input from the Placer County Water Agency, a wholesaler of surface water to the City, Nevada Irrigation District, and Placer County.

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LINCOLN SERVICE AREA DESCRIPTION

Climate

The climate in Lincoln is characterized as the Mediterranean type. Average monthly temperatures range from above freezing in winter to the upper 90's in the summer. Daily extremes range from below freezing in the winter to over 100 degrees Fahrenheit in the summer. Winter storms generally occur between November and April. Average annual precipitation for the Lincoln area is approximately 22 inches (WRCC, 2005).

A summary of climate data is presented in Table 1. Temperature and precipitation data are from the Western Regional Climate Center in Rocklin (WRCC, 2005). Reference evapotranspiration (ETo) data are from the Department of Water Resources' Model Landscape Ordinance (DWR, 1992). Evapotranspiration is the sum of surface evaporation and transpiration through vegetation. Reference evapotranspiration is a term used to describe the evapotranspiration rate from a known crop, such as grass or alfalfa and is useful in estimating landscape irrigation requirements. Monthly ETo minus monthly precipitation represents an estimate of the amount of irrigation needed.

Table 1: Summary of Climate Data

Month	Temperature (°F)		Precipitation	ETo
	Avg. Max	Avg. Min	(Inches)	(Inches)
JAN	52.9	33.3	4.94	1.2
FEB	59.0	36.5	3.29	1.6
MAR	63.5	38.7	2.98	2.8
APR	70.9	42.0	1.82	4.7
MAY	80.2	47.8	0.51	6.1
JUN	89.5	53.5	0.21	7.4
JUL	97.2	57.6	0.07	8.4
AUG	95.8	56.6	0.06	7.3
SEP	90.2	52.7	0.26	5.4
OCT	78.3	45.3	1.36	3.7
NOV	64.2	38.8	3.16	1.9
DEC	53.7	34.5	3.82	1.2
Average			**22.48**	**51.7**

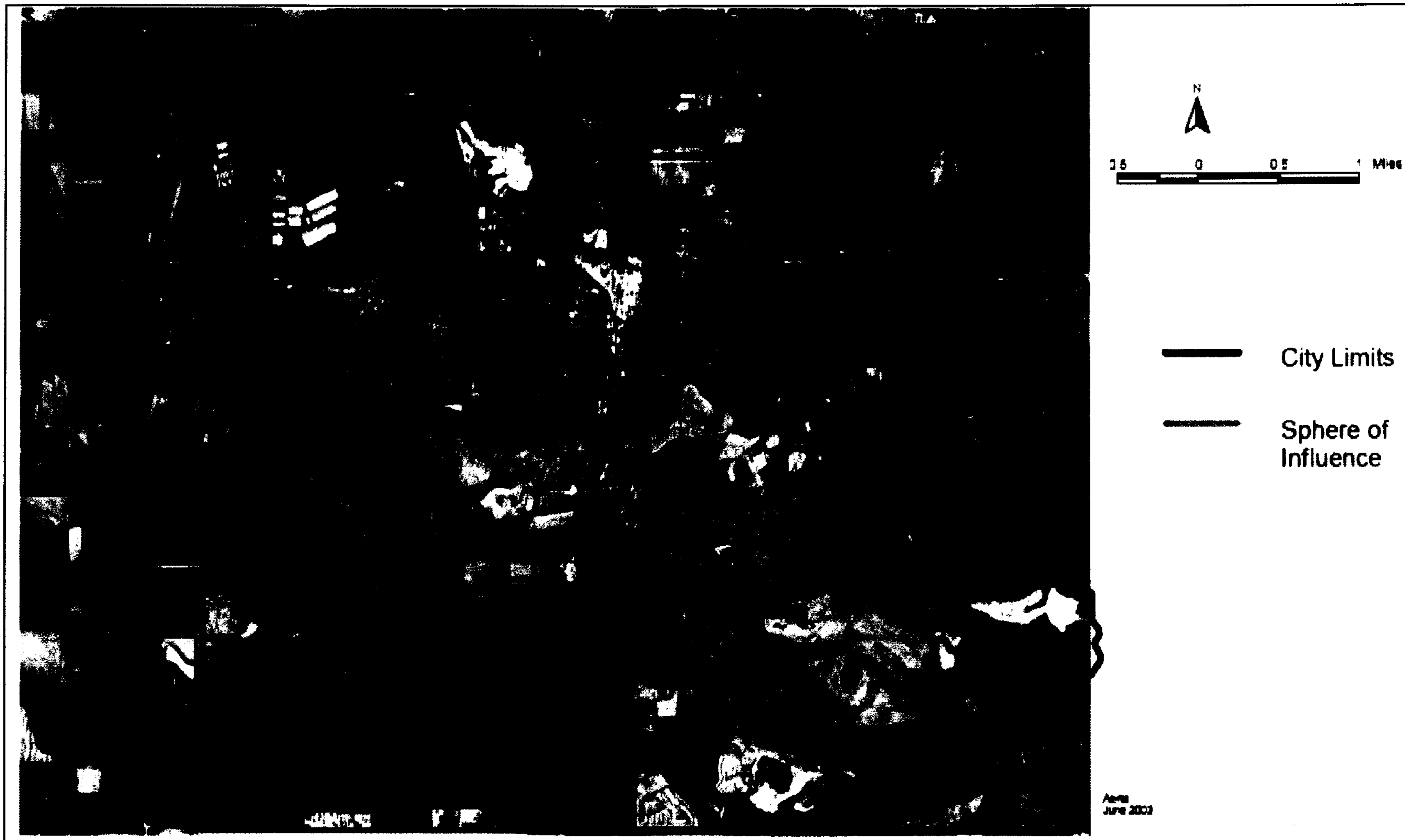
Demographic Factors

Location

The City of Lincoln is located in western Placer County on the eastern edge of the Sacramento Valley and at the base of the Sierra Nevada foothills. The City is approximately 10 miles northwest of Interstate 80 and 25 miles northeast of Sacramento. Lincoln was incorporated in 1890, and has grown to encompass approximately 30 square miles. The City boundaries are shown in Figure 2.

Urbanization within the City originally occurred near the downtown area. Land uses in the downtown area include commercial, residential, industrial, public and open space. Several large planned subdivisions have resulted in urbanization of land south and west of the downtown area.

Land uses outside of the downtown area include commercial, industrial and residential developments, cultivated and idle farmland, grazing, public, golf course, airport and open space.



Lincoln

Lincoln Sphere of Influence and City Limits

City of Lincoln 2005 Urban Water Management Plan

Figure 2
Date: November 2005
Prepared by: HP

Population

The annual average growth rate for Lincoln was approximately 5% from the early 1970's through the late 1990's. Since 1998, several large planned subdivisions have contributed to Lincoln's growth, and during 2000, the City's growth rate increased to approximately 30%. At the end of 2000, there were 5,217 single-family dwellings, 969 multiple-family dwellings and 69 mobile homes. By 2005 there were 11,600 housing units.

Figure 3 shows how the number of housing units (both single family dwellings and multi-family dwellings) has changed over time.

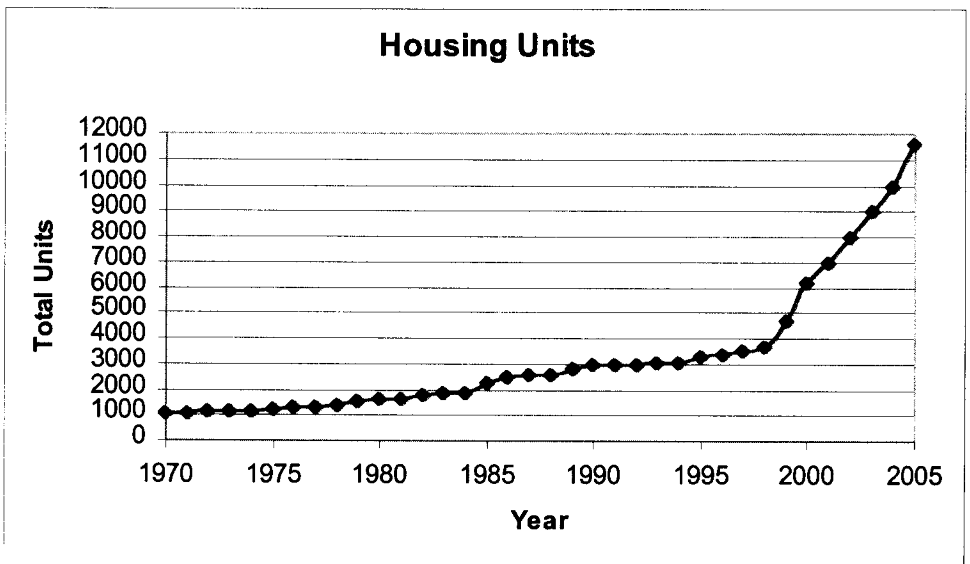


Figure 3: Total number of Housing Units

Table 2 shows the population based on projections made by the Sacramento Area Councils of Government (SACOG, 2004).

Table 2: Current and Projected Population

Year	2005	2010	2015	2020	2025
Service Area Population	26,661	28,364	29,833	31,582	33,211

Lincoln demographic data from the 2000 U.S. Census are provided in Table 3.

Table 3: Demographic Characteristics

Subject	Number
Median age (years)	32.4
18 years old and over (%)	70.0
21 years old and over (%)	65.7
62 years old and over (%)	13.8
65 years old and over (%)	11.3
Average household size of owner-occupied units (persons)	2.81
Average household size of renter-occupied units (persons)	2.97
Average household size (persons)	2.86
Average family size (persons)	3.20
Owner-occupied housing units (%)	66.8
Renter-occupied housing units (%)	33.2
Homeowner vacancy rate (%)	2.6
Rental vacancy rate (%)	2.8

Groundwater Basin

Regional Physiographic Setting

The Lincoln service area is located in the northeastern part of California's Central Valley, bordering the foothills of the Sierra Nevada Mountain Range. The Central Valley is referred to as the Great Valley geomorphic province – a large structural depression underlain and bounded on the east by the gently westward-dipping Sierra Nevada and on the west by the complexly folded-faulted Coast Ranges (DWR, 1995). The surrounding mountains are generally composed of non-water bearing rocks, whereas the Great Valley is filled with water-bearing sediments accumulating from the surrounding mountains since the Cretaceous geologic period (140 to 65 million years ago). Most of the surface water within the Great Valley is derived from rivers and streams descending from the surrounding mountains and uplands. The Sacramento Valley, which the Lincoln service area is part of, comprises the northern one-third of the Great Valley.

> "The average change in storage across the Lincoln area is small, suggesting the localized groundwater system is stable over the long term."
> IGSM Modeling Study, 1995

The large accumulation of sediments within the Great Valley were originally deposited in a marine environment from the Cretaceous to the Eocene period (the latter period spanning 60.5 to 38.6 million years ago), and as late as the Pliocene (6.7 to 3.4 million years ago) in some places; these sediments compose the lower layers of the Valley and contain predominantly brackish or saline water. From the mid-Eocene into the Miocene period (the latter spanning 29.3 to 6.7 million years ago) volcanic eruptions in the Sierra Nevada deposited pyroclastic rocks, lava flows, and mudflows down the western slopes; these volcanic rocks were eroded and deposited in marine and continental environments within the Great Valley. The Sacramento Valley was in its current configuration by the Pliocene period and fluvial (river and stream) sediment deposition dominated from that time forward. The Miocene-Pliocene age and younger volcanogenic and fluvial sediments, deposited in a continental environment, dominate the Sacramento Valley freshwater aquifer system. The base of freshwater deepens westward from about 400 ft. below sea level near the Sierra Nevada foothills to over 1200 ft. at the axis of the valley (approximately the location of the Sacramento River).

The Lincoln service area is located in the eastern central part of the Sacramento Valley Groundwater Basin, within the North American Sub-Basin as defined by DWR (2002).

Sacramento

The Sacramento Valley Groundwater Basin is an important resource, estimated by DWR to contain approximately 114 million acre-feet of water. Several fresh water-bearing zones (aquifers) are present within the 15,500 square mile surface area Basin, ranging in depth from near surface to 3,000 feet below surface.

North American Sub-Basin

The North American Groundwater Sub-basin lies within Sutter, Placer, and Sacramento Counties and is delimited by the Bear River on the north, the Feather River and the Sacramento River on the west, the American River on the south, and the Sierra Nevada foothills on the east. The eastern boundary represents the approximate edge of the alluvial basin, where little or no groundwater flows into or out of the groundwater basin from the Sierra Nevada basement rock; this boundary passes about 2 miles east of the town of Lincoln (DWR, 2002). The other boundaries – all major perennial rivers – represent partial groundwater divides, where at shallow depths there is little groundwater flow from the aquifer system on one side of the river to the aquifer system on the other side; however, at deeper depths there is groundwater flow across these boundaries. The eastern portion of the subbasin is characterized by low rolling dissected uplands. The western portion is nearly a flat flood basin for the Bear, Feather, Sacramento and American rivers, and several small east side tributaries. The general direction of drainage (land surface slope) is west-southwest at an average grade of about 5 percent. The approximate total storage of the North American Sub-Basin is 4.9 million acre-feet of water, assuming an aquifer thickness of 200 ft. across the total 351,000 acres of the basin and a specific yield of 7% (DWR, 2002).

Lincoln Sphere of Influence

Most of the Lincoln Sphere of Influence (SOI) lies within the North American Groundwater Sub-basin, although parts of the eastern section extend beyond the water-bearing sediments of the subbasin into the western reaches of the Sierra Nevada foothills. A number of studies related to groundwater have been performed recently in, or included, the Lincoln area. A fairly extensive aquifer mapping investigation of the Lincoln SOI, that incorporated geophysical surveys, drill hole and geology analysis, was carried out by a consultant to the City of Lincoln, Spectrum-Gasch, Inc. (1999), for purposes of assessing groundwater resources and identifying where they can best be developed. Earlier, a groundwater investigation was performed in the vicinity of Lincoln Airport by Boyle Engineering Corporation (1990), as a consultant to the City of Lincoln, to assess the groundwater production capability in that area. A comprehensive integrated ground-surface water model (IGSM) for the Northern American River service area, comprising western Placer and southern Sutter counties, was developed by Montgomery Watson (1995), an engineering consulting company, and included a fairly extensive study of hydrogeology and hydrology of the region to provide proper input and calibration data for the model. This model has subsequently been used for a number of regional groundwater studies (DWR, 1995; Montgomery Watson, 1996). Localized hydrogeologic field investigations and groundwater modeling analysis have been conducted in the area just north of Lincoln by Teichert, Inc. and their consultant, Luhdorff & Scalmanini (1997), to evaluate the potential impacts of proposed aggregate mining in the area. As part of a recent grant, Lincoln worked cooperatively with DWR to characterize the subsurface during drilling for five new monitoring wells. The final report is due out in early 2006.

Aquifers

Groundwater aquifers can be confined (capped by an impervious layer) or unconfined (in direct communication with the surface, under atmospheric pressure conditions), and a confined aquifer may be highly confined (no direct connection with overlying aquifer/surface) or semi-confined (partially connected to overlying aquifer/surface). The aquifers in the Lincoln SOI vary from unconfined to semi-confined conditions.

The fresh water bearing deposits of the North American Groundwater Subbasin are divided into two broad aquifer systems based on lithologic and hydrologic differences. The division between the two is inexact due to the lithologic heterogeneity of the subbasin coupled with the lack of comprehensive information about geology and groundwater conditions in the subsurface. The abovementioned field investigations indicate that there is a significant amount of variability in these aquifer systems – their thickness, horizontal and vertical extent of individual geologic layers, presence of confining/semi-confining layers, and hydrologic properties. The hydrogeology of the two aquifer systems are briefly described below.

Upper Unconfined / Semi-Confined Aquifer System

This aquifer system occurs directly below surface and is composed of pre-Miocene age alluvium deposits. It varies in thickness from as much as 300 feet in the western part of the Lincoln SOI area to pinching out in the eastern part. The aquifer system contains generally thin sands and gravels that are laterally discontinuous, separated by low permeability clay and silt. Aquifer conditions appear to be unconfined based on the direct response of groundwater levels to imposed stresses. However, throughout much of the Lincoln area, except near creeks and ravines, a low permeability clay soil or "hardpan" layer exists near surface that likely restricts vertical flow and deep percolation into the aquifer. This horizon may act as an upper semi-confining layer to the aquifer in places.

Well production in the upper aquifer system is dependent on how much course grained aquifer material (sand or gravel) is intersected by the well, and has been reported as high as 1,800 gpm (Montgomery Watson, 1995). Aquifer pumping tests performed in one of the geologic formations of this aquifer system, the Riverbank Formation (see below for description), indicated a hydraulic conductivity of 5,600 gallons per day per square foot (gpd/ft^2) and a specific yield of 10% (LSCE, 1997). However, hydraulic conductivity values of 75 to 750 gpd/ft^2 were assigned to the corresponding aquifer system in the calibrated groundwater model used in the same study, while values ranging from 100 to 150 gpd/ft^2 were used in the calibrated IGSM model for the Northern American River Service Area (Montgomery Watson, 1995).

Lower Semi-Confined Aquifer System

This aquifer system occurs below the upper aquifer system, separated by a semi-confining layer, and is composed of Miocene/Pliocene age clastic deposits of volcanic origin, that varies in thickness from greater than 200 feet in the western part of the area to less than 10 feet in the eastern part. This aquifer also contains significant amounts of low permeability clay and silt, but the coarse zones, although laterally discontinuous, appear to be somewhat thicker than those of the upper aquifer system. Aquifer conditions appear to be at least partially confined based on the limited response of groundwater levels to imposed stresses at shallow depths. The semi-confining layer dividing the two aquifer systems consists of a clay layer and/or a hard, consolidated volcanic tuff-breccia layer; both have varying thickness and spatial extent. The base of the lower aquifer system is defined by the base of the fresh water-bearing zone or the top of the regional geologic basement complex of the Sierra Nevada foothills, the former in the western part of the Lincoln area and the latter in the eastern part.

The lower aquifer system is capable of large well yields – two wells near Coon Creek are reported to produce approximately 3,000 gpm each (DWR, 1995) – but well yield is dependent on the combined thickness of sand or gravel intersected by the well. Aquifer pumping tests performed in two wells screened across this aquifer system indicated a hydraulic conductivity of 205 and 390 gpd/ft^2 (assuming the screened interval in the wells was equivalent to the total thickness of the aquifer); the storage coefficient was estimated to be 1.1×10^{-3} and 9.6×10^{-4} (Boyle, 1990). Hydraulic conductivity values of 100 to 150 gpd/ft^2 were used for the corresponding aquifer in the calibrated IGSM for the Northern American River service area (Montgomery Watson, 1995). Wells located near Moore Road and Fiddyment Road southwest of downtown Lincoln have historically produced significant quantities of groundwater.

Geology

The two aquifer systems consist of a number of different geologic formations, classified by their age and how they were formed. In drill holes it is often difficult to distinguish between different geologic formations in subsurface, although there are marker beds that are readily recognized. The geologic formations making up the aquifer systems underlying the Lincoln area are described below.

Upper Unconfined/Semi-Confined Aquifer System

From youngest to oldest, the three geologic units that comprise the upper aquifer system include Holocene alluvium, the Pleistocene Riverbank Formation, and the Pliocene-Pleistocene Laguna Formation.

Alluvium

The youngest alluvium consists of unweathered gravel, sand and silt deposited by present-day creeks and drainages. These deposits are primarily located along the surface streams in the area. Their depositional thickness and areal coverage is not significant and they do not yield appreciable quantities of groundwater.

Riverbank Formation

The Riverbank Formation contains a heterogeneous mixture of silt, sand, gravel, and clay – exhibiting extreme grain size variability over short lateral and vertical distances (DWR, 1995). The formation often is differentiated into two members:

> Upper Member – an unconsolidated, dark brown to reddish-colored alluvium deposit composed of gravels, sands and silt with minor amounts of clay.
>
> Lower Member – a semi-consolidated, red-colored alluvium deposit composed of gravels, sands and siltstone that represent remnants of dissected alluvial fans.

The deposits are widespread throughout western Placer and northern Sacramento counties along the gently rolling foothills and often considered an important aggregate resource. Their thickness varies, with a maximum thickness of 50 to 75 ft. The formation is moderately permeable overall, with highly permeable coarse-grained zones. Where saturated, these deposits can yield appreciable quantities of groundwater.

Laguna Formation

This geologic unit is composed of a heterogeneous mixture of tan/brown interbedded alluvial sand, silt, and clay, with some gravel lenses – deposited by ancestral rivers and streams that drained the Sierra Nevada. The formation generally increases in thickness toward the west and has a maximum thickness of about 200 ft. In certain portions of Placer and Sacramento Counties, the Laguna Formation is similar in depth, thickness and composition to the overlying Riverbank Formation – but generally it is more fine-grained than overlying formations (DWR, 1995). Where this unit is saturated, appreciable quantities of groundwater can be produced, although most wells within the unit have low to moderate yields.

Lower Semi-Confined Aquifer System

The shallow aquifer system is underlain by Miocene-Pliocene clastic deposits of volcanic origin, known as the Mehrten Formation, that comprise the deeper semi-confined aquifer. The City of Lincoln municipal wells No. 2 and No. 4 appear to be constructed such that groundwater is produced from below the Laguna Formation, within this aquifer. Underlying the Mehrten Formation is the Ione Formation, an

Eocene marine deposit that in parts of the Lincoln SOI, where it is shallow, contains fresh water, but otherwise contains brackish or saline water.

Mehrten Formation

The Mehrten Formation is composed of a sequence of fragmental volcanic rocks of late Miocene through middle Pliocene age that unconformably overlies marine and brackish water sediments of Eocene age. The formation consists of two distinct units:

- A sedimentary unit containing fluvial deposits composed of gray to black well-sorted sands with associated lenses of stream gravels containing cobbles and boulders, interbedded with blue to brown silts and clays.
- A dense, hard gray andesitic tuff-breccia formed by the solidification of ash mudflows emanating from volcanic eruptions to the east.

The sand and gravel beds within the sedimentary unit, which are individually 5 to over 20 feet thick, are highly permeable and saturated with primarily fresh water. Consequently, the sedimentary unit of the Mehrten is recognized as an important aquifer in much of the Sacramento Valley, producing significant fresh groundwater supplies throughout much of the Placer and Sacramento County regions. In contrast, the tuff-breccia, which ranges from a few feet to 30 feet thick, generally is impervious and acts as a confining layer where it occurs. DWR investigators indicate that, on a regional scale, the upper surface of the Mehrten Formation trends deeper from north to south (DWR, 1995). The Spectrum-Gasch investigation (1999) shows the Mehrten Formation, in the localized Lincoln SOI area, to be gently dipping westward (the dip estimated to be about one degree), and increasing in overall thickness with depth below surface.

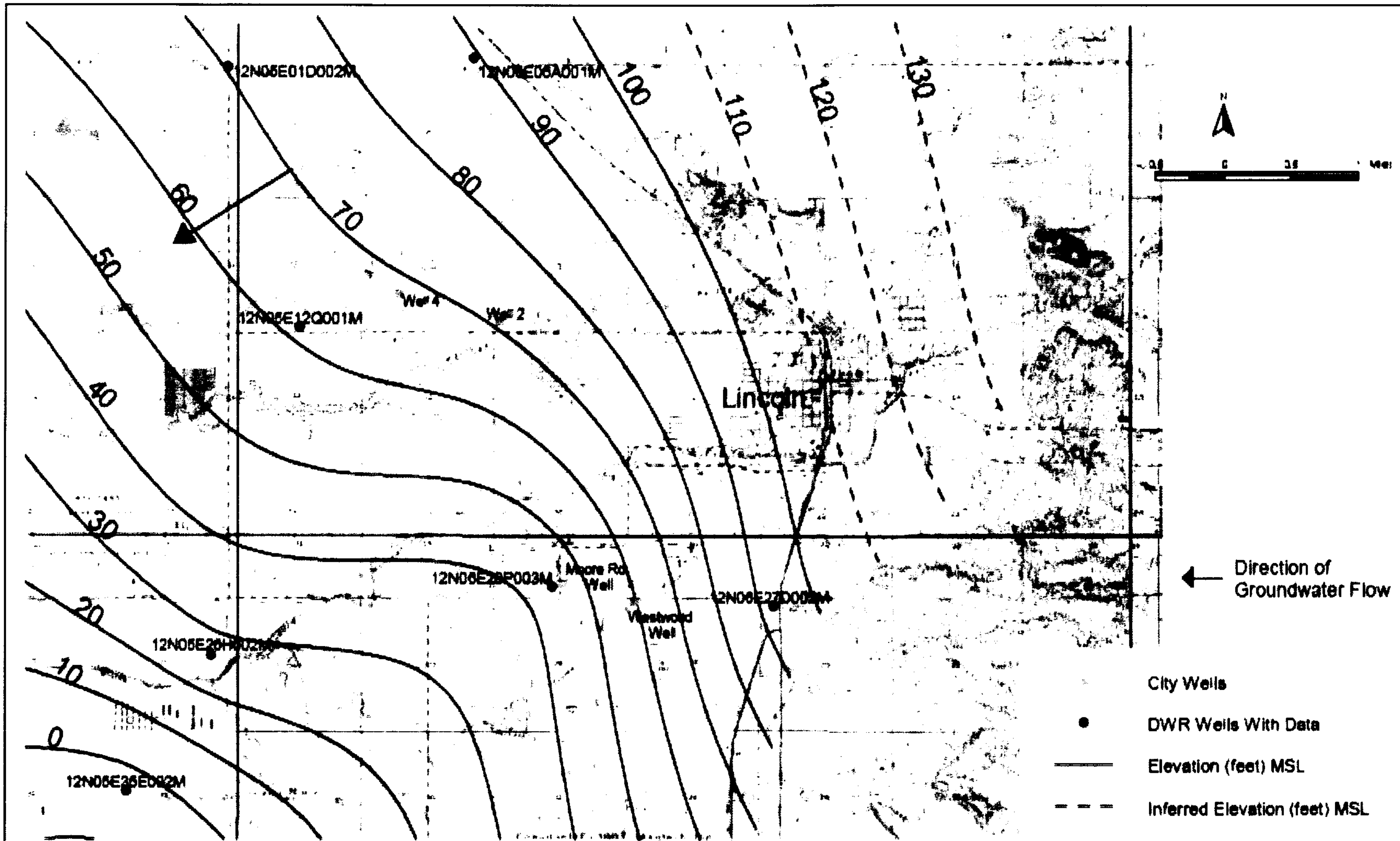
Ione Formation

The Eocene Ione Formation lies below the Mehrten Formation, except in parts of the Lincoln GMP it unconformably underlies the Riverbank Formation and the Mehrten formation is absent. This unit contains marine deposits consisting of white to light yellow colored conglomerate, sandstone, and claystone. The Ione is recognized as the light colored clay visible in the Gladding-McBean quarry north of Lincoln. As the depth of the Ione Formation increases it has been recognized that water quality in this formation becomes poor, or more saline. The Boyle Engineering Corporation investigation of 1990 that was conducted for the City of Lincoln identified the contact between the Mehrten and the Ione Formations as the base of fresh water in the vicinity of Lincoln Airport. The Ione Formation has not been used extensively for groundwater production due to its generally low water yield and mostly poor water quality.

Groundwater Movement

Groundwater levels and flow direction in the Lincoln area have remained relatively stable through the historical record of monitoring well data (approximately 1950 to present). The regional groundwater flow direction is west-southwest, approximately parallel to Coon Creek in the northern part of the Lincoln area and southwesterly through most of the Lincoln SOI approximately parallel to Auburn Ravine. The sedimentary section comprising the aquifer systems dips to the west-southwest as well, at about five degrees or less – suggesting the unstressed groundwater flow direction is parallel to the slope of geologic bedding (Spectrum-Gasch, 1999). There is not enough monitoring well data to define the groundwater elevation contour map and, correspondingly, groundwater flow direction at a more localized scale throughout the Lincoln area. The City of Lincoln has been installing a monitoring well network across the Lincoln SOI. Five dedicated monitoring wells were installed in 2004 through a cooperative project with DWR.

In order to determine groundwater velocity it is necessary to know the groundwater level gradient (change in level over distance) and the hydraulic conductivity and porosity of the aquifer material. The ongoing groundwater level monitoring program is helping provide this information. While these parameters are not well defined across the Lincoln SOI, an estimate of representative groundwater velocity can be calculated for the area in the vicinity of the City of Lincoln Well 2 and Well 4, near the airport. Figure 4 shows groundwater elevation contours across this area computed from measurements in DWR monitored wells. Due to lack of data in the eastern portion of the SOI, groundwater elevations were inferred and are represented as dashed lines. The groundwater level gradient is approximately 300 feet horizontal distance per foot change in groundwater level. Boyle (1990) measured a hydraulic conductivity of 205 and 390 gpd/ft^2 in two wells in the airport vicinity that were apparently completed in the lower aquifer system (the Mehrten Formation). Taking the average of the two (298 gpd/ft^2) and assuming an average total porosity of 20%, the average



Groundwater Elevation Contours and General Flow Direction

City of Lincoln 2005 Urban Water Management Plan

Figure 4
Date: November 2005
Prepared by: HP

groundwater velocity is about 0.6 feet per day. Using the same inputs for representative groundwater gradient and porosity applied for the range of reported hydraulic conductivities from abovementioned studies, the corresponding range in average groundwater velocity for the two aquifer systems is:

Upper aquifer system: 0.15 to 1.5 feet per day
Lower aquifer system: 0.2 to 0.8 feet per day

These values are within velocity ranges expected in alluvial aquifers.

Hydrographs from DWR monitored wells in the Lincoln area show no systemic decrease in groundwater levels since 1960 (a description of individual DWR monitoring well hydrographs is provided in the next section).

Further evidence that groundwater levels are stable in the Lincoln area at recent levels of pumping for a variety of climatic conditions is provided by the Integrated Groundwater and Surface Water Model (IGSM) simulation study performed for the American River Water Resources Investigation (DWR, 1995). The Northern American River Service Area IGSM model was used to simulate groundwater levels on a monthly time-step over the period 1922 to 1992, with water demands at 1992 level of development and crop acreage at 1990 level. Simulated groundwater level, averaged for the two aquifer systems, at a model node just north of Lincoln indicates no systematic change over the period, only seasonal variations.

Furthermore, another IGSM study performed as part of the American River Water Resources Investigation (USBR, 1994) indicates that even under projected 2030 water use demand, wherein unrestricted groundwater use is permitted to meet demand unmet by full delivery of surface water entitlements, simulated groundwater levels in the Lincoln area do not decline, on average, during 1922 to 1991 hydrologic conditions.

Other areas of the North American River Groundwater Subbasin have experienced significant declines in groundwater levels due to pumping extraction from the subbasin's aquifer systems. In particular, there is a deep cone of depression centered in northern Sacramento County near McClellan Air Force Base that extends into southwestern Placer County – as far north as about Pleasant Grove and as far east as about Roseville. This deepening cone of depression and the implications on the areas affected are discussed in the West Placer Groundwater Management Plan (PCWA, 1998). The cone of depression does not extend to or impact groundwater in the Lincoln SOI.

An aggregate mine has been proposed four miles north of Lincoln that will eventually excavate pits covering approximately 1,000 acres over the 85 year expected life of the mining operation. The mine would excavate and process sand, gravel, and granitic rock, creating a 45 ft. deep pit for the alluvial material and a 150 ft. pit for the granite. The pits will require dewatering and will be mined in phases for 35-40 yrs. (alluvium) and 85 yrs. (granite). The plan is to reclaim land as lakes, agriculture land, open space, and habitat areas. One of the primary concerns is the impact the dewatering will have on groundwater conditions in the area. The project plan proposes to help keep the impact on groundwater levels small by placing a low permeability overburden (e.g. clay) around the sides of pits as mining proceeds. The groundwater modeling study of the proposed project impact concludes that there will be lowered groundwater levels in the immediate vicinity of each mining pit, but groundwater levels south of Wise Road and east of Highway 65 will not be affected, according to a report prepared by Luhdorff and Scalmanini (1997). The study also shows that minor reductions in streamflow from lowering of the groundwater level will mostly be compensated for by the addition of water from the dewatering. These conclusions have not been substantiated.

The City of Lincoln is planning to install additional pumping wells within the Lincoln SOI to be able to meet 20 million gallons per day (MGD) demand with groundwater on a short-term basis. The increase in pumping will likely have minor effects on groundwater levels and flow direction, at least localized to the wells themselves (e.g. cones of depression around individual wells when they are in operation). The overall impact of the additional wells will depend on the well placement and depths, and the well pumping rates and schedules. In order to better manage local groundwater, the City developed and adopted a Groundwater Management Plan that contains Basin Management Objectives (BMOs) related to groundwater elevations, groundwater quality and direction of groundwater flow. The groundwater elevation BMO states that the City will not cause an adverse impact on groundwater elevations by pumping. The City, in a cooperation with DWR, installed five new monitoring wells and monitors these and other wells for groundwater elevations (see Figure 6) in order to meet this BMO.

Recharge

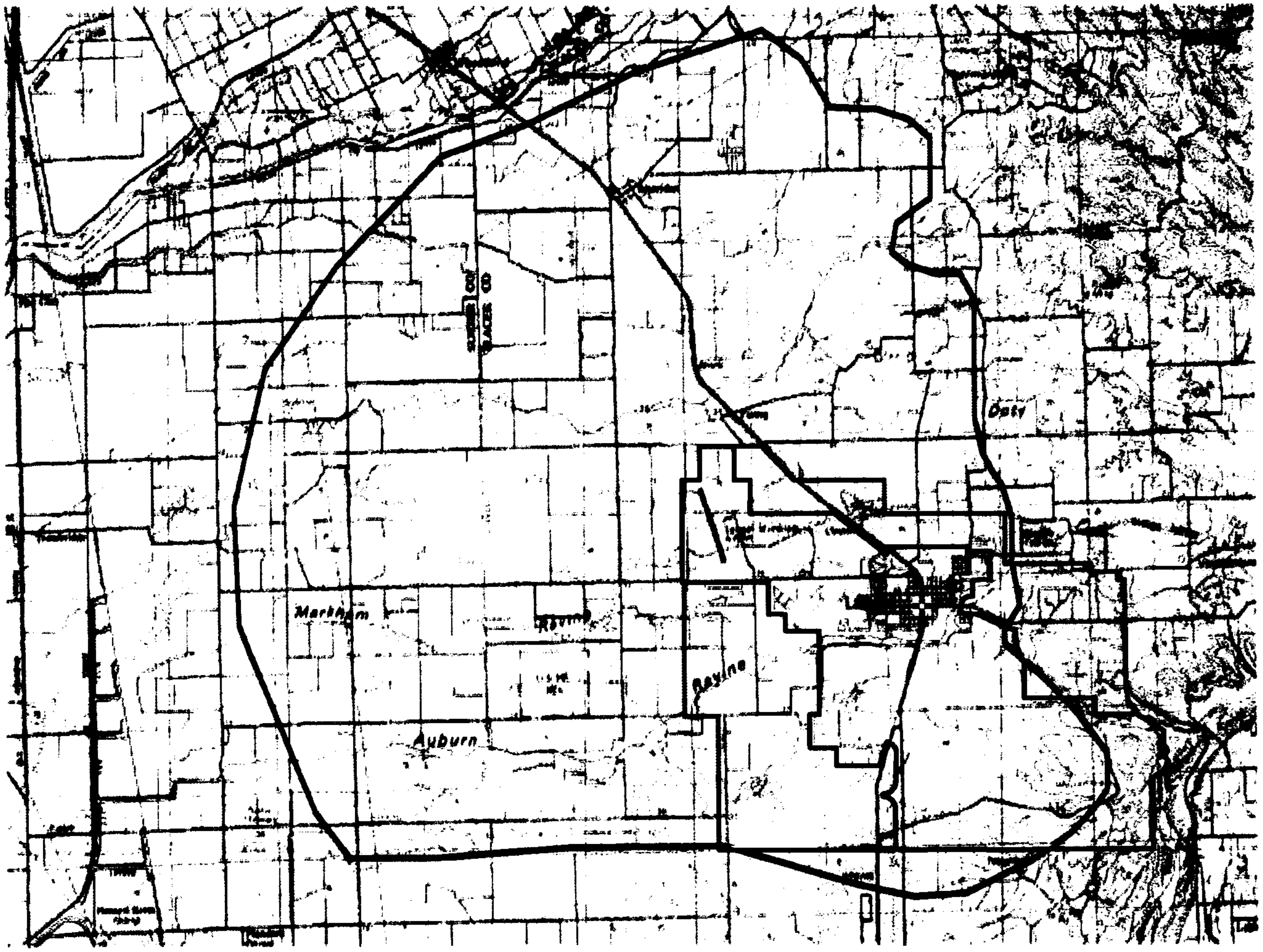
A comprehensive study of groundwater recharge area and rates specific to the Lincoln SOI has not been performed to date. The technical definition of recharge area is where the net saturated groundwater flow is directed away from the water table (Freeze and Cherry, 1979). Thus, to "perfectly" determine where there are recharge areas it is necessary to measure the shallow (just below the water table) groundwater head gradient in three dimensions across the groundwater basin – in essence requiring groundwater level measurements in a densely spaced network of monitoring wells, each containing three nested piezometers at discrete depths. In practice, the direct measurement of a groundwater basin's recharge area is impossible and instead a combination of monitoring well data and indirect methods of inference are employed to delineate probable recharge areas. Currently, there are several indirect indicators of the potential recharge areas within the Lincoln SOI. With the development of the monitoring well network, a more refined delineation of recharge areas will be possible. Through a grant received in 2005, the City will be able to work cooperatively with DWR to characterize recharge from local creeks.

The runoff characteristics and recharge potential of the soil throughout the Lincoln area have been investigated and mapped – providing a qualitative indication of the areal potential for deep percolation of surface water into the aquifer systems. Most of the soil cover across the North American Subbasin has been classified as having high runoff (low infiltration) potential, except in the vicinity of river and stream drainages (Montgomery Watson, 1995). A fairly large area surrounding Auburn Ravine, as well as Coon Creek, has been classified as having soils with moderate to high runoff potential (low to moderate infiltration potential). DWR (1995) characterizes the soil cover across the area as having a dense subsoil that limits deep percolation of water applied at the surface; less dense soils occur in the vicinity of creeks such as Coon Creek and Auburn Ravine, potentially providing better deep percolation and recharge. Boyle (1990) also identified the Markham Ravine drainage as a probable area of groundwater recharge and Spectrum-Gasch (1999) identified the Orchard Creek drainage, along with Auburn Ravine, as probable areas of significant recharge based on the inferred shallow depth to the upper aquifer zone in these areas. As part of Lincoln groundwater investigations, several boreholes were drilled along Auburn Ravine. The thick clay layer encountered may indicate that Auburn Ravine does not contribute significantly to recharge.

Figure 5 displays the recharge area boundary likely encompassing all the surface areas that potentially could contribute recharge water to the aquifer systems within the Lincoln SOI – under existing pumping demands, as well as those that would likely occur with the City of Lincoln's planned additional groundwater extraction.

The eastern boundary of the area marks the geologic contact between the alluvial sediments of the groundwater basin and the non-water bearing basement rocks of the Sierra foothills. The northern boundary is the Bear River drainage that is a probable shallow hydrologic divide, with groundwater flow occurring predominantly parallel to the river and, thus, most of the groundwater to the north of the river never flowing south of the river. The southern boundary of the denoted recharge area was selected to roughly correspond with the southern extent of the Orchard Creek and Auburn Ravine drainages – probable areas of groundwater recharge – and is positioned closer to the City of Lincoln than the northern boundary because flow is in a predominantly southwesterly direction through this area (away from Lincoln). The western boundary was selected at a significant distance down gradient of the SOI; even though the groundwater flow direction is to the west-southwest here, it is possible there could be a localized change in the flow direction as a result of the proposed additional City of Lincoln pumping. Most of the recharge within the boundary is likely occurring in the vicinity of the stream drainages, as discussed above. The recharge areas will be better mapped by looking at the pattern of monitoring well groundwater levels versus well depth throughout the area in the City of Lincoln groundwater resources investigation and through the 2006 Lincoln DWR recharge study.

Quantitative estimates of groundwater recharge rates, by type (e.g. stream inflow, deep percolation), for subregions of the North American River Subbasin were calculated using the IGSM model developed for the Northern American River Service Area – as part of the baseline study (Montgomery Watson, 1995). The modeling study itemizes the groundwater budget for the twenty year period from 1970 to 1990, including all major types of recharge into and discharge from the aquifer systems, but the accounting is not provided for the specific area incorporated in the Lincoln SOI. Table 4 shows the 1970 to 1990 average simulated groundwater budget for the two subregions in the model that include the Lincoln SOI: Subregion 5, located just north of downtown Lincoln (3962 acres), and Subregion 6, encompassing the southern and western portions of the Lincoln SOI, as well as the 24,508 acre area to the west of the SOI (Montgomery Watson, 1995).



City of Lincoln

Approximate Groundwater Recharge Area

City of Lincoln 2005 Urban Water Management Plan

Figure 5
Date: November 2005
Prepared by: HP

Table 4: Average Simulated Groundwater Budget 1970–1990

Groundwater Inflow/Outflow Component	Subregion 5 (acre-feet per year)	Subregion 6 (acre-feet per year)
Deep Percolation	3,194	20,154
Gain from Streams	0	3,903
Boundary Inflow	832	-52
Other Recharge	0	1,930
Pumping Extraction (Outflow)	3,877	28,393
Change in Storage	149	-273
Max. Decrease in Storage for Period	-1,668 in 1977	-20,012 in 1977
Max. Increase in Storage for Period	2,041 in 1983	15,171 in 1982
1990 Storage (1000 acre-feet)	15.7	559.9

The IGSM model predicts that most of the groundwater recharge into the two combined model subregions is due to deep percolation (78%), followed by gain from streams (13%). The areal distribution of the simulated deep percolation is not reported and, thus, the contribution from the Auburn Ravine, Coon Creek, and other stream drainage areas versus outlying areas cannot be determined. The IGSM groundwater budget results suggest that deep percolation is the major contributor to groundwater recharge, which is in contradiction to the soil mapping results, described above, which show a predominance of high runoff / low infiltration soil cover and, consequently, low potential for deep percolation recharge. The reason for this discrepancy is not clear and highlights the need for a more comprehensive investigation of groundwater recharge in the area. Studies currently being planned by the City will better characterize the nature of recharge to the basin. A simple approximation of the simulated groundwater recharge into the actual Lincoln SOI for each subregion can be made by multiplying the recharge component by the fraction of the subregion area in the Lincoln SOI. Using this approach, the approximate total simulated groundwater recharge into the aquifer systems underlying the Lincoln SOI, averaged over the period 1970-1990, is 17,153 acre-ft./yr., of which 11,664 acre-ft./yr. occurs as deep percolation and 3,697 acre-ft./yr. as inflow from streams or canals.

As part of the groundwater management planning process, a useful future study would be to refine and recalibrate the simulation model using updated information about local Lincoln area groundwater conditions, then to perform additional simulation runs using historical precipitation and streamflow records with current applied water demands. As part of this modeling study a sensitivity analysis of input hydrogeologic parameters (e.g. soil and streambed permeability) should be performed to determine the range of values across which they can vary and still produce acceptable model results. Such a study would estimate the groundwater budget (recharge and discharge components, and change in storage) of the aquifer systems directly underlying the Lincoln SOI across a range of realistic conditions. In addition, modeling runs could be made using estimated future demand scenarios to assess the potential impact of additional pumping wells on groundwater conditions. The RWA groundwater model currently being developed for the Sacramento area could be expanded to include the Lincoln area.

Estimated Groundwater Quantity

A recent investigation of groundwater resources in the Lincoln SOI mapped the top and base of the upper aquifer sequence across much of the SOI area using fairly widespread geophysical surveys and drill hole data (Spectrum-Gasch, 1999). This investigation provides the best available spatial coverage of data about the subsurface of the Lincoln SOI, including:

Well logs, geophysical (electric) logs, and/or pumping data from over 200 drill holes, 67,000 feet of seismic reflection data and 12,000 feet of seismic refraction data (geophysical methods performed along survey lines that provide a cross-section image of the subsurface).

The investigators used the processed geophysical surveys and well data to map what they refer to as the upper productive aquifer zone within the Lincoln SOI – the base of the zone defined by the top of the Mehrten Formation tuff/breccia unit or a thick clay layer and the top of the zone defined by the bottom of a surficial clay-rich layer. The results indicate the productive zone pinches out to the east, along a north-south line close to Highway 65. East of this line the only potential aquifer material is the Ione Formation and fractured granitic bedrock. West of this line the productive aquifer zone thickens westward, although there are localized variations in thickness. There are also known variations in the presence and number of clay interbeds and hydrologic properties in the aquifer zone, but these properties cannot be determined from the data. The thickness of the upper aquifer system exceeds 300 feet near the western boundary of the Lincoln SOI, south of Lincoln Airport.

Spectrum-Gasch (1999) used the results of their investigation to calculate a conservative estimate of groundwater reserves underlying the 25,200 acre Lincoln SOI. They inferred that approximately 9,000 acres of the SOI is underlain by the productive aquifer zone, predominantly in the western two miles. They assumed a nominal aquifer thickness of 100 feet across this area, producing 900,000 acre-feet of total aquifer volume. They then assumed an average porosity of 15% and recovery factor of 50% (this is the same as a specific yield of 7.5%), resulting in a yield of 67,500 acre-feet of groundwater. This yield is reduced by 30% to account for discontinuities in the aquifer zone, such as interbedded clay, leaving an estimated total recoverable groundwater yield of 47,250 acre-feet.

The Northern American River Service Area IGSM modeling study (Montgomery Watson, 1995) modeled the aquifer systems as two semi-confined aquifers. Within the Lincoln SOI the two aquifers pinch out east of Lincoln and increase in thickness to the west-southwest, having a maximum thickness of about 140 feet (upper aquifer) and 175 feet (lower aquifer) at the western edge of the SOI. As part of the model calibration for the baseline study the total volume of groundwater stored within the aquifer system at the end of 1990 is reported for specified subregions of the model, two of which include the Lincoln SOI (see Table 4 above). At the end of 1990 total groundwater storage of the aquifer systems underlying the Lincoln SOI was approximately 287,800 acre-ft., based on a simple summation of the approximate fraction of the area in each model subregion that is within the Lincoln SOI multiplied by the storage in that subregion; this approximation assumes the storage is equally distributed across the model subregion. Other important modeling results include:

- The average change in storage across the Lincoln area is small, suggesting the localized groundwater system is stable over the long term (see Table 4 above).
- Year-to-year variations in storage across the Lincoln area are quite large, suggesting the groundwater system is sensitive, and responds quickly, to variations in annual precipitation and the resulting changes in groundwater usage (see Table 4 above).

There is a significant discrepancy between the two estimates of groundwater storage in the Lincoln SOI derived from the geophysics and well data study (Spectrum-Gasch, 1999) and the ground-surface water simulation model study (Montgomery Watson, 1995). The Spectrum-Gasch prediction of recoverable groundwater yield is only 16% of IGSM model estimate of total groundwater storage. The difference is likely due to a number of factors:

- The Spectrum-Gasch study only considers what they call the upper productive aquifer zone, which probably somewhat corresponds with the upper aquifer system as defined for the North American River Subbasin and used in the IGSM model. The IGSM model also includes the lower aquifer system.
- Spectrum-Gasch assumes an average saturated aquifer thickness of 100 ft. across the area where it occurs, even though the thickness in their three-dimensional model varies between zero and over 300 ft.
- Spectrum-Gasch assumes an average specific yield of 7.5% whereas the IGSM model specific yield is between 8% and 12%.
- Spectrum-Gasch considers the aquifer zone to be discontinuous, containing a total of 30% by volume of non-aquifer material, whereas the IGSM model assumes the aquifer is continuous.
- Spectrum-Gasch assumes 50% of the groundwater is recoverable.

A reasonable conclusion is that these two estimates represent approximate lower (47,250 acre-feet) and upper (287,800 acre-feet) limits of the total recoverable groundwater storage; this large range in possible values could be considerably reduced with better estimates of aquifer geometry and aquifer hydrologic properties. The simulation model does not include the new information provided by the Spectrum-Gasch investigation. A refined and calibrated model over the Lincoln area using this and additional future information; could more accurately calculate a groundwater budget to correspond to the boundaries of the Lincoln SOI, and generate much more robust estimates of groundwater storage, as well as recharge and discharge components. The City is planning to develop such a surface water – groundwater model by expanding the RWA model.

DWR Documentation of Non-Overdraft Conditions

> Groundwater elevation data, collected by the California Department of Water Resources, support the conclusion that groundwater elevations are not declining within the vicinity of Lincoln.

The City of Lincoln overlies the North American Subbasin (Basin), which is part of the larger Sacramento Valley Groundwater Basin. DWR documentation was reviewed to determine if DWR has identified the Basin underlying the City to be in a state of overdraft, or if any DWR documentation has projected overdraft within the Basin. The following DWR documents were reviewed for this analysis:

Bulletin 118-80 (DWR, 1980), Bulletin 118-3 (DWR, 1974), Bulletin 118-6 (DWR, 1978), and the draft basin description for the Bulletin 118 Update 2002. Additional historical groundwater elevation data collected by DWR was reviewed for wells within the City of Lincoln's designated sphere of influence. The period of record for each well is plotted and included in this analysis.

Generally, the documents reviewed describe conditions of overdraft in southwestern Placer County and northern Sacramento County, located to the southwest of the City of Lincoln. Groundwater elevations directly underlying the City were not described to be in a long-term state of decline. Groundwater elevation data, Figures 7 - 16, support the conclusion that groundwater elevations are not declining within the vicinity of Lincoln.

Bulletin 118-80

Bulletin 118-80 examined groundwater basins in the state of California and designated basins in a state of critical overdraft. Bulletin 118-80 did not designate the Basin overlying Lincoln as critically overdrafted. The report did find the portion of the Sacramento Valley Basin located in northern Sacramento County as critically overdrafted. This area is located to the southwest of the City of Lincoln.

Bulletin 118 Update 2002

Draft documentation located on the DWR website for the Bulletin 118 Update 2002 was reviewed for the North American Subbasin. The report cited Placer County Water Agency (1999) as finding that "groundwater elevations in southwestern Placer County and northern Sacramento County have generally decreased, with many wells experiencing declines at a rate of about one and one-half feet per year for the last 40 years or more."

Bulletin 118-3

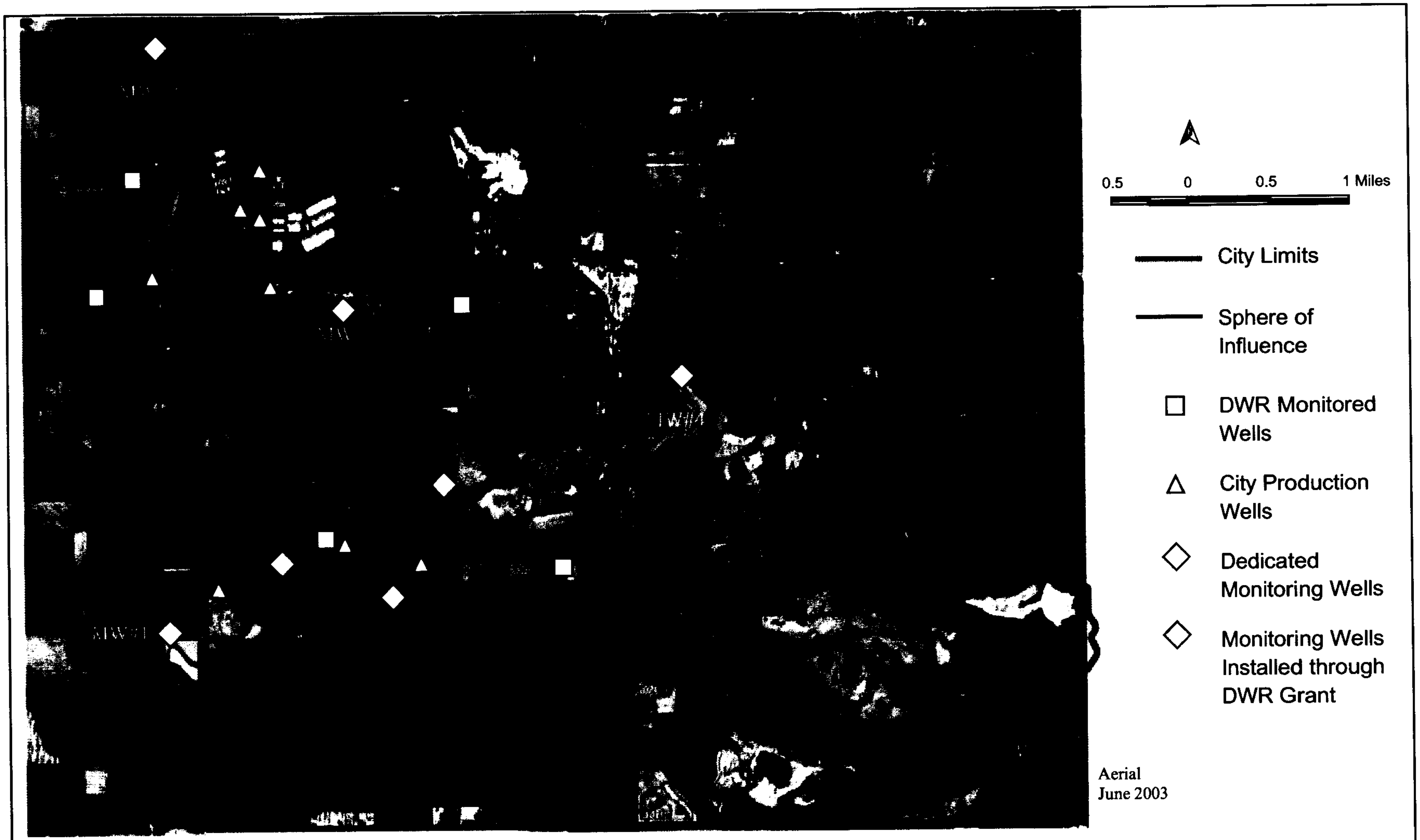
Bulletin 118-3 evaluates groundwater resources in Sacramento County. While the document does not specifically discuss groundwater conditions in Placer County the document does show a cone of depression in groundwater elevation for northern Sacramento County in the spring of 1968.

Bulletin 118-6

Bulletin 118-6 evaluates groundwater resources in the Sacramento Valley. Groundwater contours within this document, and supporting documentation: *Groundwater Conditions in the Sacramento Valley, California, 1912, 1916, and 1971,* show a cone of depression in groundwater elevations located in northern Sacramento County and southwestern Placer County.

Historic Groundwater Elevations

Groundwater level data were downloaded from the DWR Water Data Library (http://well.water.ca.gov) for all wells monitored by DWR within the City of Lincoln's designated sphere of influence (DWR, 2005). Figure 6 displays the location of each well along with the City limits and sphere of influence. Figures 7 - 16 display the historic groundwater elevations for each well. As shown in the figures, over the past 40 years groundwater elevations underlying Lincoln have remained relatively stable.



City of Lincoln

Wells Available for Monitoring

City of Lincoln 2005 Urban Water Management Plan

Figure 6
Date: November 2005
Prepared by: HP

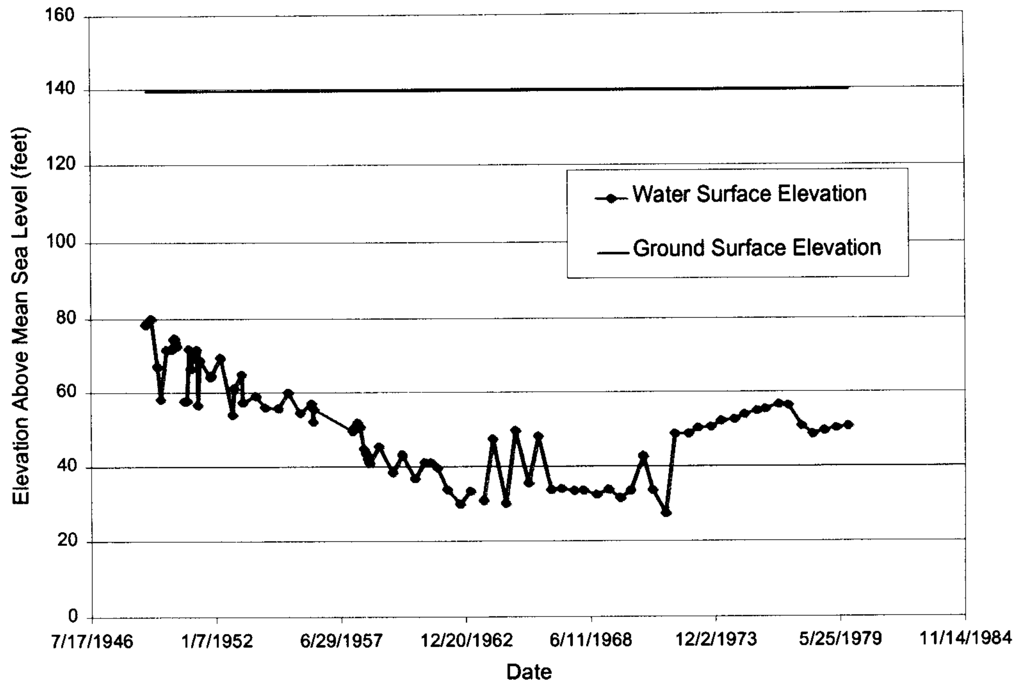


Figure 7: Water Surface Elevation for State Well Number 12N06E27D001M

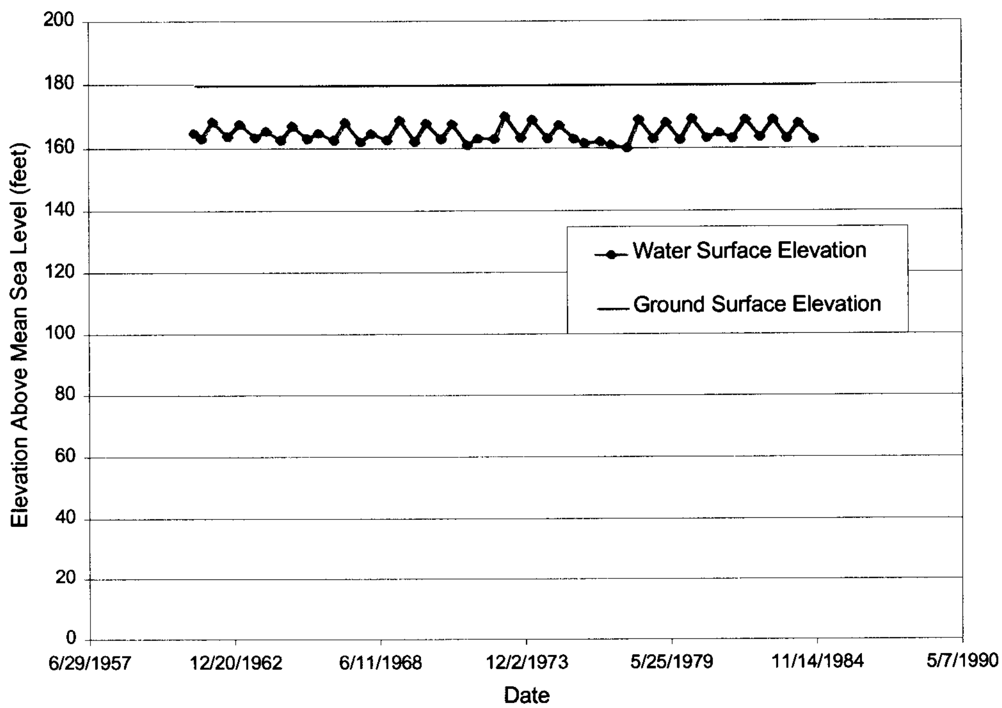


Figure 8: Water Surface Elevation for State Well Number 12N06E14F001M

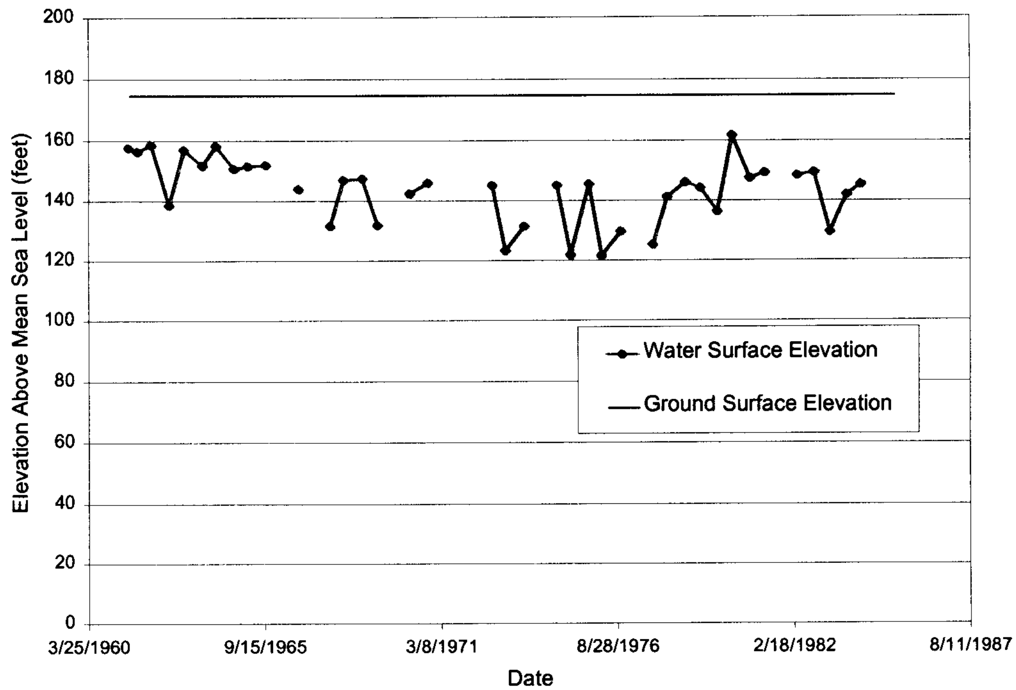


Figure 9: Water Surface Elevation for State Well Number 12N06E11E001M

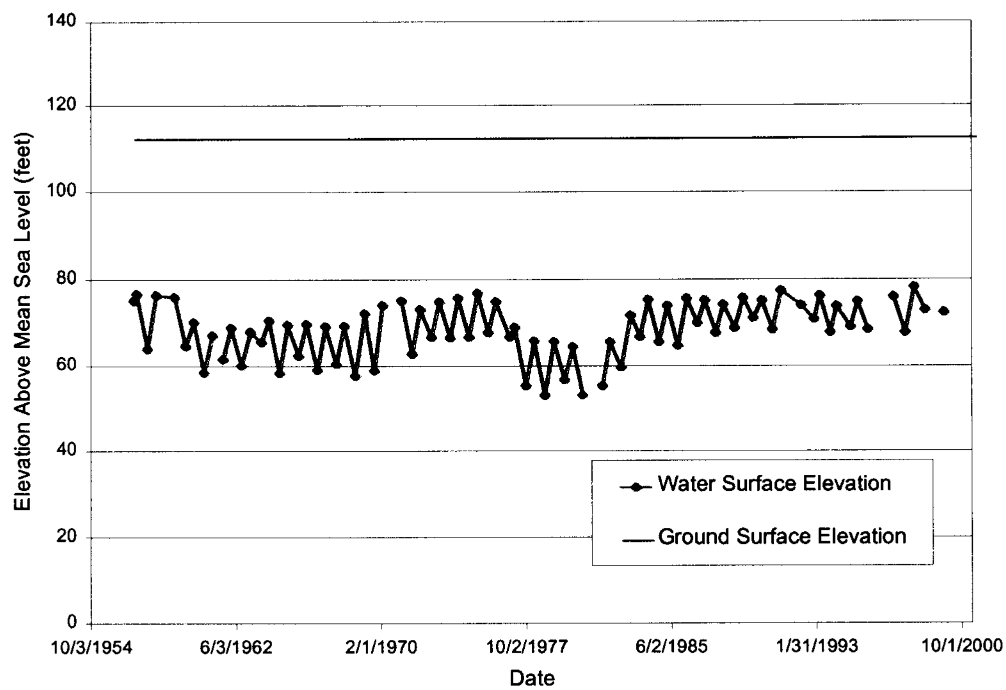


Figure 10: Water Surface Elevation for State Well Number 12N05E01R001M

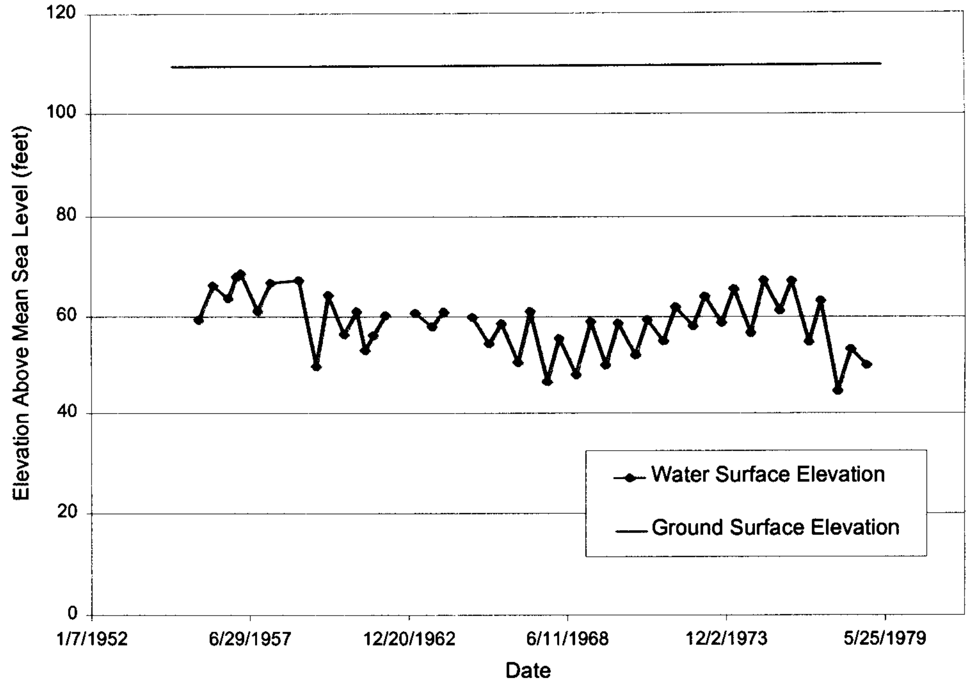


Figure 11: Water Surface Elevation for State Well Number 12N06E07M001M

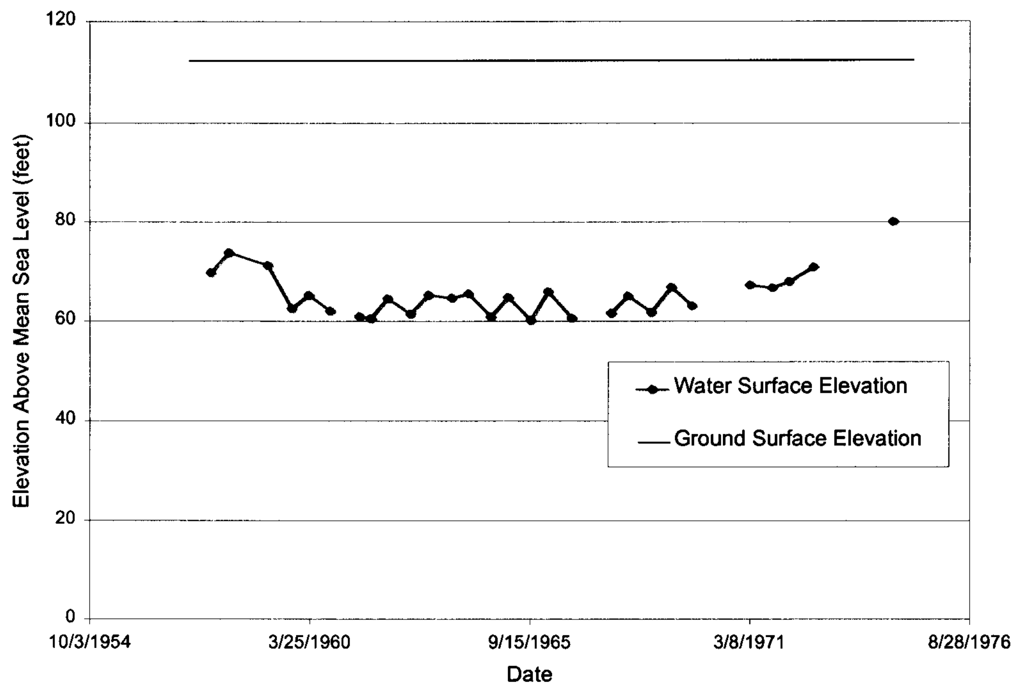


Figure 12: Water Surface Elevation for State Well Number 12N06E18L001M

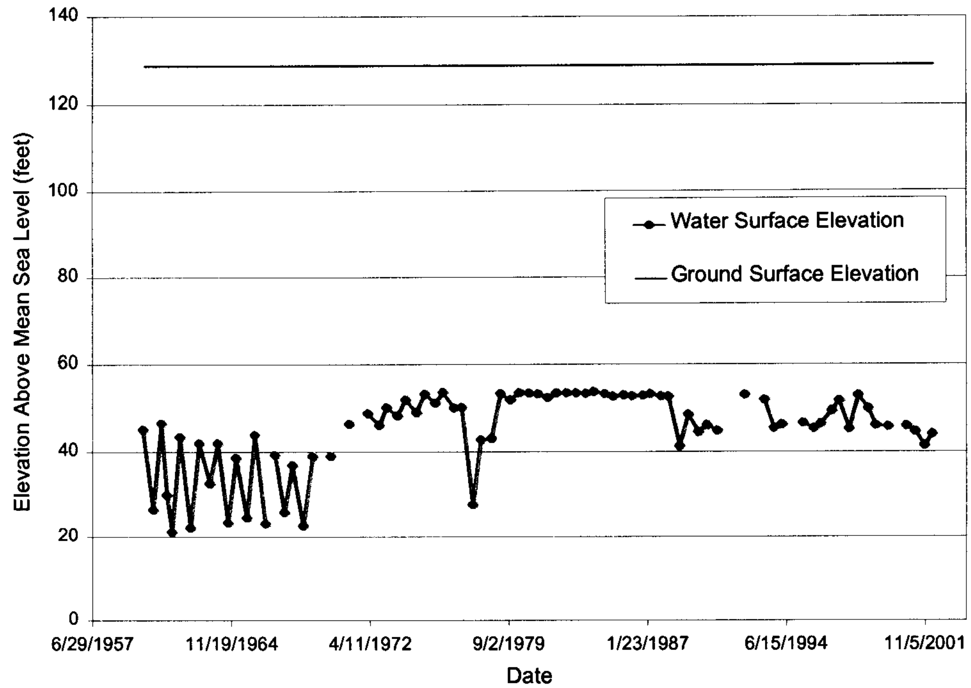


Figure 13: Water Surface Elevation for State Well Number 12N06E20P003M

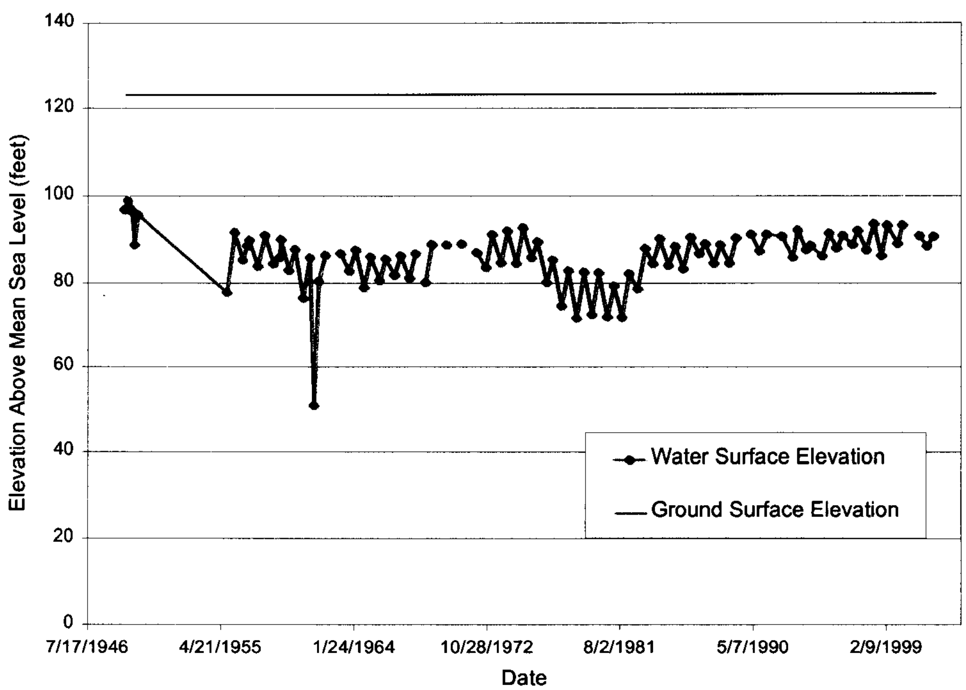


Figure 14: Water Surface Elevation for State Well Number 12N06E06A001M

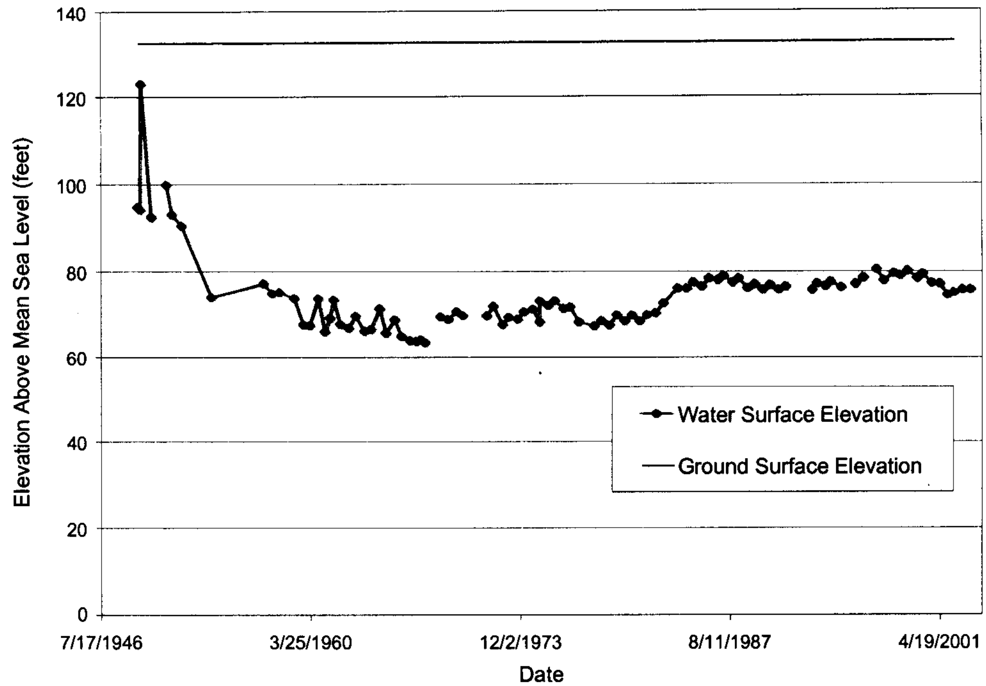


Figure 15: Water Surface Elevation for State Well Number 12N06E16D001M

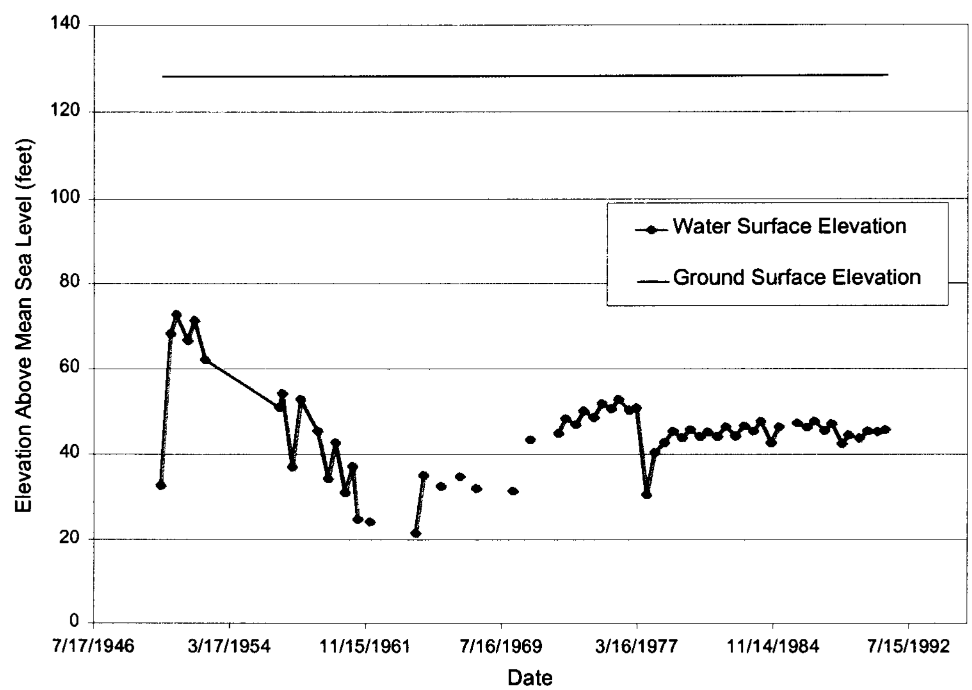


Figure 16: Water Surface Elevation for State Well Number 12N06E28M001M

Groundwater Related Decrees, Local and State Codes

Legal Decrees

There are no legal decrees involving groundwater in the Lincoln sphere of influence.

Groundwater Management Plans

The Groundwater Management Act, also known as Assembly Bill 3030 (AB 3030), encourages local agencies to manage groundwater resources within their jurisdiction. The City, which provides groundwater within its service area, is considered a local agency authorized to adopt a Groundwater Management Plan following the provisions of AB 3030. A copy of the plan is included in Appendix L. Placer County Water Agency, a wholesaler of treated surface water to the City, has developed a groundwater management plan in partnership with the County of Placer and the City of Roseville as described below.

City of Lincoln

Recognizing the importance of effective groundwater management to protect the City's water supply and the health and safety of its customers, the Lincoln City Council passed Resolution No. 98-103 on September 22, 1998, which states the City's intention to draft a Groundwater Management Plan pursuant to the Groundwater Management Act. A second resolution was passed on March 26, 2002 extending the date for Plan completion. The City Director of Public Works directed the development of the Groundwater Management Plan to guide in the effective administration of the groundwater resources within the City sphere of influence. The Plan was adopted in November 2003.

The City continues to participate through the Sacramento Regional Water Authority and other efforts in planning activities in the watershed that may have potential to impact groundwater quality and quantity.

Placer County Water Agency

Placer County Water Agency adopted the West Placer Groundwater Management Plan in October 1998. According to the plan, the primary objective is to facilitate studies and activities to restore and maintain groundwater quality and quantity in the basin. The plan consists of the following elements:

1. Monitoring of groundwater levels and groundwater quality.

2. Identifying groundwater recharge opportunities, with particular emphasis on the area adjacent to the Placer/Sacramento county line.
3. Identifying conjunctive use opportunities for non-residential uses in the area north of Pleasant Grove Creek.
4. An evaluation of the safe yield.
5. Maximizing groundwater management coordination with all jurisdictions, landowners, and the general public within west Placer County, with those jurisdictions in north Sacramento County portions of the basin, and with the appropriate State and Federal agencies.

The West Placer Groundwater Management Plan covers an area smaller than the boundaries of the Placer County Water Agency. According to the plan, the plan area includes "the cities of Roseville and Rocklin and the unincorporated portion of west Placer County that is bounded by the following: on the east by the Nevada Irrigation District and the western boundary of the City of Lincoln; on the north by the Bear River; on the west by the South Sutter Water District boundary and the Placer County/Sutter County line; and on the south by the Placer County/Sacramento County line." The City of Lincoln is included in the Placer County Water Agency boundaries but is not included within the boundaries of the West Placer Groundwater Management Plan.

State Codes

Department of Water Resources

Well Construction

The California Department of Water Resources, per the California Water Code, has developed minimum standards for water supply wells, monitoring wells, and cathodic protection wells in an effort to help protect groundwater and wells in California. These standards are contained in Bulletin 74-90 (DWR, 1991) and Bulletin 74-81 (DWR, 1981). All California cities and counties are required to adopt well ordinances that meet or exceed DWR standards.

Well Completion, Abandonment and Destruction Reports

The California Department of Water Resources requires water well contractors to be licensed by the state. These contractors who construct, modify or destroy wells in California are required to prepare, and submit to DWR, a Well Completion Report.

The California Water Code, beginning with section 13751, describes information that must be contained in Well Completion Reports.

Department of Health Services

The California Department of Health Services, Division of Drinking Water and Environmental Management (DDWEM) has regulatory oversight of public water systems located throughout the state. The DDWEM Field Operation offices are responsible for the enforcement of the federal and State Safe Drinking Water Acts. This involves regulatory oversight of public water systems to assure the delivery of safe drinking water to all Californians. Primacy has been delegated by the Department to 35 county health departments for regulatory oversight of small water systems, i.e. those with less than 200 service connections.

Drinking Water Source Assessment and Protection Program

The Wellhead Protection Program (WHPP) was established in 1986 through amendments to the Safe Drinking Water Act (SDWA). The program was intended to help protect groundwater that supplies drinking water wells of public water systems. Each state was required to prepare a WHPP and submit it to EPA by June 19, 1989. California did not develop a WHPP by the 1989 deadline.

Further amendments to the SDWA in 1996 established the Source Water Assessment Program (SWAP). Central elements of the SWAP—protection area and zone delineation, inventory of possible contaminating activities (PCAs), and vulnerability analysis—are also elements of a Wellhead Protection Program.

In California, the source water assessment program is being called the Drinking Water Source Assessment and Protection (DWSAP) Program, and it will satisfy the mandates of both the 1986 and 1996 SDWA amendments. The DWSAP Program is intended to address assessments and also to facilitate the development of protection programs for both ground and surface waters.

The DWSAP Program submitted by the California Department of Health Services to EPA was formally approved on November 5, 1999.

California originally had until November 2001 to complete the assessment for all drinking water sources, although an 18-month extension was obtained from EPA. California's time line for completion of assessments for its 16,000 active drinking water sources includes the 18-month extension, so assessments must be completed by May 2003.

The City of Lincoln has conducted assessments for all five of its water supply wells.

County Codes

Groundwater Related Ordinances

There are no Placer County ordinances related to groundwater.

General Plan

The Placer County General Plan contains a number of goals and policies related to water resources. These are summarized below.

Goals

- To ensure the availability of an adequate and safe water supply and the maintenance of high quality water in water bodies used as sources of domestic supply.
- To protect and enhance the natural qualities of Placer County's streams, creeks and groundwater.

Policies

- Where the County will approve groundwater as the domestic water source, test wells, appropriate testing, and/or report(s) from qualified professionals will be required substantiating the long-term availability of suitable groundwater.
- The County shall support opportunities for groundwater users in problem areas to convert to surface water supplies.
- The County shall protect the watersheds of all bodies of water associated with the storage and delivery of domestic water by limiting grading, construction of impervious surfaces, application of fertilizers, and development of septic systems within these watersheds.
- In implementation of groundwater policies, the County will recognize the significant differences between groundwaters found in bedrock of "hardrock" formations of the foothill/mountain region and those groundwaters found in the alluvial aquifers of the valley. The County should make distinctions between these water resources in its actions.
- The County shall ensure that solid waste disposal facilities do not contaminate surface or groundwater in violation of state standards.

- The County shall support the management of wetland and riparian plant communities for passive recreation, groundwater recharge, nutrient catchment, and wildlife habitats. Such communities shall be restored or expanded, where possible.
- The County shall protect groundwater resources from contamination and further overdraft by pursuing the following efforts:

  - Identifying and controlling sources of potential contamination
  - Protecting important groundwater recharge areas
  - Encouraging the use of surface water to supply major municipal and industrial consumptive demands
  - Encouraging the use of treated wastewater for groundwater recharge; and
  - Supporting major consumptive use of groundwater aquifer(s) in the western part of the county only where it can be demonstrated that this use does not exceed safe yield and is appropriately balanced with surface water supply in the same area.

Implementation Programs

Placer County provides preventive and corrective public health programs, and monitors the development of land uses to assure long-range and short-term community health. Services related to groundwater include reviewing and inspecting land use applications filed with the County for a wide range of development; monitoring the proper use, storage, and disposal of hazardous materials; inspection of underground storage tanks to prevent leakages; and the permitting of well drilling and septic systems.

The County shall work with local water purveyors and members of the California Groundwater Association, Mother Lode Branch, to adopt and implement a water availability monitoring program that includes the following components:

a. A private well sampling program to evaluate the quality of groundwater supplied to newly constructed private domestic wells; and
b. A program to evaluate the quantity and quality of groundwater in small public water systems; the County shall support state monitoring of larger systems; and
c. A program to monitor and evaluate surface water quality in major reservoirs and rivers; and

d. A geo-based, digitized database which plots groundwater and water well information, and shall become the basis of conclusions about groundwater quality and quantity.

The County should identify precise locations of severe groundwater contamination and overdrafting. The County shall work with water users in these areas to investigate methods for shifting to reliance on surface water supplies or other appropriate solutions.

The County shall prepare, adopt, and implement a comprehensive surface and groundwater management program to ensure the long-term protection and maintenance of surface and groundwater resources. This water management program shall include at least the following elements:

a. County leadership of the process and a commitment to its integrity and inclusiveness;
b. Coordination and cooperation with other public and private agencies, organizations, and groups that have an interest in water resources management in the county or surrounding areas. This should include, but not be limited to the following agencies and organizations:

    1. The cities of Roseville, Rocklin, Loomis, Lincoln Auburn and Colfax
    2. The counties of Nevada, Yuba, Sutter, Sacramento and El Dorado
    3. California Department of Water Resources
    4. State Water Resources Control Board and the affected regional boards
    5. Local irrigation, water supply and public utilities districts
    6. The Placer County Flood Control District, Placer County Water Agency, and other water resource management special districts
    7. The California Farm Bureau and other agricultural water supply and management interest groups
    8. Pacific Gas and Electric and other private hydroelectric and water supply utilities
    9. U.S. Forest Service - Tahoe and El Dorado national Forests
    10. Bureau of Reclamation
    11. Tahoe Regional Planning Agency
    12. California Department of Fish and Game
    13. U.S. Fish and Wildlife Service

14. California Groundwater Association and other private, professional groups interested in water supply protection;
15. Academic and scientific groups; and
16. Any other agencies, organizations, and groups that the County selects to add needed expertise or breadth to the water resource management process.

c. An inventory of water supply and quality information and demand estimates, using as mush available information as possible, with the objective of creating an easily accessible comprehensive, and regularly updates database that can be shared by water management agencies;
d. Identification, documentation, and prioritization of the most significant water supply sources and pressing local water quality management problems;
e. Identification of existing ongoing water management and regulatory policies, programs, and standards by the various agencies and organizations with an interest in water resource management;
f. Recognition and incorporation of ongoing compatible water management efforts into a comprehensive approach to water resources management to implement the goals and policies of this *General Plan*;
g. Identification of any regulatory or policy "gaps" that can and should be addressed by the County;
h. Application of sound water resources management principles, including watershed land use management, wetlands and vegetation management, non-point source pollution control, waste disposal monitoring and controls, groundwater recharge, and aquifer protection;
i. Application of sustainable multiple-use water management principles and incorporation of diverse and potentially compatible land use objectives, including provision of open space and recreation opportunities, watershed and habitat protection, flood control, and water provision to meet future agricultural, ecological, and community development needs; and
j. Utilization of innovative and alternative funding mechanisms from sources outside of the County.

City Codes

Well Construction Permits

In order to construct a well in Lincoln, a permit must first be obtained from the City. Within the City of Lincoln, the Placer County Health Department has relinquished its permitting and approval authority to the City.

Water Quality Testing and Reporting

The City regularly tests the quality of the water from its municipal wells and PCWA regularly tests water from its treatment plants. The results of groundwater and surface water quality testing are published in the annual Consumer Confidence Report. More information on water quality is provided in Chapter 4.

Lincoln General Plan Policies

The Lincoln General Plan contains several policies related to water. These include:

- To identify and protect, in cooperation with Placer County, local aquifers and water recharge areas.
- To encourage the use of City reclaimed water, in place of potable water from the City, by industrial and recreational uses.
- To develop a long-term reliable supply of water that will permit the City to meet the existing and future demands of development.

Lincoln Codes and Ordinances Related to Water

Lincoln has several ordinances and Municipal Codes related to water. Appendix H contains excerpts from the Municipal Code regarding prohibited uses of water. Appendix I contains excerpts from the Municipal Code regarding penalties for violating Codes related to water use.

4

WATER SUPPLY

Sources

The City utilizes surface water and groundwater to meet its water supply needs. Treated surface water is purchased from the Placer County Water Agency (PCWA) and the City owns and operates five municipal water supply wells.

Distribution System

Lincoln provides its customers with potable water through one pressurized distribution system. The system is supplied with treated surface water purchased from PCWA and five groundwater wells and operates in the range of 15 – 125 pounds per square inch of pressure. Three gravity storage tanks (1.5, 3 and 5 million gallons) are utilized.

The City utilizes a computerized Supervisory Control and Data Acquisition (SCADA) system to monitor, change operational setpoints, and acknowledge alarms in the water distribution system.

Water meters utilized to measure water deliveries to the City's customers are equipped with radio frequency transmitters that allow water consumption to be monitored off-site. This allows Public Works staff the ability to read the water meters in a more time and cost effective manner. It will also assist in conducting a system-wide water survey and audit to help determine system losses and to detect and repair leaks.