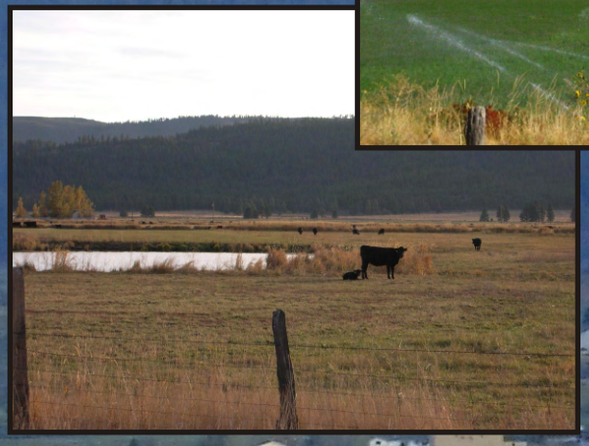
*Final*

# Lassen County Groundwater Management Plan



June 2007

BROWN AND CALDWELL

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Prepared for
Lassen County Board of Supervisors

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PROFESSIONAL GEOLOGIST
ROBERT VINCE
NO. 7606
EXPIRES 1/31/09
STATE OF CALIFORNIA

PROFESSIONAL GEOLOGIST
JOHN WALDO AYRES
No. 8291
STATE OF CALIFORNIA

BROWN AND CALDWELL
10540 White Rock Road, Suite 180
Rancho Cordova, California 95670

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**Lassen County Board of Supervisors:**
Bob Pyle – District 1, Chairman
Jim Chapman – District 2
Lloyd Keefer – District 3
Brian Dahle – District 4
Jack Hanson – District 5

**Lassen County GWMP Management and Coordination:**
David Lile - Lassen County Farm Advisor, Director, UC Cooperative Extension
Bob Sorvaag – Director, Lassen County Community Development Department

**Lassen County Community Development Department:**
Maurice Anderson – Senior Planner
Joe Bertotti – Assistant Director
Rick Simon – Chief Planner
Nancy Summers – Administrative Assistant

**Lassen County Groundwater Management Plan Working Group:**
Bob Anton - Honey Lake RCD
Noel Eaves - DWR, Northern District
Tim Garrod - Agricultural groundwater user, Honey Lake Valley
Paul Herman - Long Valley Groundwater Management District
Rob Hill - City of Susanville, Lassen County Fish and Game Commission
Dan McManus - DWR, Northern District
Kevin Mitchell - Agricultural Groundwater User, Big Valley
Todd Swickard - Agricultural Groundwater User, Honey Lake and Willow Creek Valleys

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|---|---|
| AB 3030 | Assembly Bill 3030 |
| BMO | Basin Management Objective |
| BVFCD | Big Valley Flood Control District |
| CWC | California Water Code |
| DAU | Detailed Analysis Unit |
| DHS | California Department of Health Services |
| DWR | California Department of Water Resources |
| F° | degrees Fahrenheight |
| gpm | gallons per minute |
| gpd/ft | gallons per day per foot |
| GPS | Global Positioning Satellite |
| GWMP | Groundwater Management Plan |
| HLRCD | Honey Lake Resource Conservation District |
| IRWMP | Integrated Regional Water Management Plan |
| MO | Management Objective |
| msl | mean sea level |
| PRCD | Pit Resource Conservation District |
| Plan | Groundwater Management Plan |
| PUC | Public Utilities Commission |
| TCE | Trichloroethylene |
| TDS | Total Dissolved Solids |
| SB 1938 | Senate Bill 1938 |
| SWQL | secondary water quality threshold |
| SWRCB | State Water Resources Control Board |
| TAC | Technical Advisory Committee |
| USGS | United States Geological Survey |
| WAC | Water Advisory Committee |
| WHPA | Wellhead Protection Area |

# EXECUTIVE SUMMARY

Groundwater resources have long played an important role in the development, growth, and sustainability of Lassen County and its residents. Local groundwater management continues to increase in complexity and scope, driven by evolving demands for groundwater resources both within and adjacent to Lassen County. The need for the Groundwater Management Plan (GWMP or Plan) is twofold. First, the GWMP must formalize and direct the County's ongoing commitment to pursue sustainable and beneficial groundwater development and use by its residents. Second, the GWMP must clearly articulate the County's expectations for groundwater management by entities beyond the County's jurisdiction that share groundwater resources with the County. Each of these needs will be met through the implementation of Basin Management Objectives (BMOs), as included in the GWMP and described in Appendix C. BMOs represent a locally-driven, proactive method of groundwater management supported by the Board of Supervisors, County staff, and the local groundwater users who participated in the development of this Plan. Development and adoption of a BMO ordinance will be a priority during initial Plan implementation.

The Lassen County GWMP follows the California Water Code (CWC) Sections 107450 et.seq, by using plan components to support groundwater management objectives which in turn meet a countywide groundwater management goal. The GWMP contains the required components from Senate Bill 1938, the voluntary components from Assembly Bill 3030, and contains suggested components from the Department of Water Resources (DWR) Bulletin 118-2003.

The Lassen County GWMP seeks to achieve its goal through the following objectives:

- Maintain and protect historic groundwater uses;
- Minimize the long-term drawdown of groundwater levels;
- Protect groundwater quality;
- Prevent inelastic land surface subsidence from occurring as a result of groundwater pumping;
- Minimize changes to surface water flows and quality that directly affect groundwater levels or quality;
- Minimize the effect of groundwater pumping on surface water flows, quality, seeps and springs, and natural vegetation.
- Facilitate groundwater replenishment and cooperative management projects;
- Maintain springs, seeps and riparian habitat; and
- Provide a mechanism for mutual management of interstate groundwater basins with Washoe County and the State of Nevada.

GWMP development was supported by a Working Group comprised of individuals with extensive knowledge of local groundwater-related issues, objectives, conditions, and needs. The Working Group assisted plan development by serving in an advisory role. The County convened four meetings of the Working Group during GWMP development. The Lassen County Board of Supervisors held a public hearing to adopt the GWMP on March 13, 2007, and unanimously adopted the Plan following the public hearing.

Lassen County is a topographically diverse area in northeastern California. The county has a mountain climate, and much of the county is arid, with less than 15 inches of precipitation annually. Lassen County is at the confluence of four geomorphic provinces and has 24 groundwater basins. Four of the 24 groundwater basins have been identified as priority basins. The four priority basins identified by County staff and the Working Group represent basins where current and future groundwater management will support agricultural and/or municipal needs. Hydrogeology in the four priority groundwater basins is understood on a large scale.

Groundwater levels in the four priority basins indicate that groundwater levels are generally stable, with declines during drought periods, and recovery during wet periods.

Lassen County is already performing many of the groundwater management activities associated with a GWMP. Through plan implementation, the County is formalizing its groundwater management goal, management objectives, and plan components that both elaborate on current actions and detail future actions, and GWMP implementation actions and the associated schedule are included in Table ES-1. The Lassen County GWMP contains the following plan implementation components:

- **Basin Management Objectives.** BMOs are flexible guidelines for the management of groundwater resources that describe specific actions to be taken by stakeholders to meet locally developed objectives at the basin or sub-area scale. A BMO program will be developed and implemented under direction provided by the Board of Supervisors within an anticipated BMO ordinance.
- **Groundwater Monitoring.** Ongoing groundwater monitoring provides information needed to document current conditions, assess long-term trends, and to support development and implementation of GWMP components.
- **Groundwater Resource Protection.** Groundwater resource protection activities prevent degradation of groundwater quantity or quality. Lassen County has taken actions to promote the protection of groundwater resources, including: groundwater well ordinances, groundwater management districts, and adoption of a groundwater conservation ordinance (export ordinance).
- **Groundwater Sustainability.** Lassen County is working to continue groundwater sustainability through representing Lassen County interests in Nevada groundwater exportation projects that include interstate groundwater basins, and collaborating with state and federal agencies on groundwater studies. Lassen County is also planning to develop Basin Management Objectives to support and achieve of groundwater sustainability.
- **Stakeholder Involvement.** Stakeholder involvement is key to the success of the GWMP, and the GWMP was developed under guidance of the Working Group, comprised of individuals with extensive knowledge of local groundwater-related issues, objectives, conditions and needs.
- **Integrated Water Resource Planning.** Integrated water resource planning and management is intended to address multiple issues or objectives concurrently, thereby maximizing limited financial and staff resources. The state has identified 20 different water management strategies that can be combined to form an integrated project (DWR, 2004b). Examples from the list of 20 water management strategies include water supply reliability, flood control, water quality protection and improvement, ecosystem restoration, and groundwater management. Proposition 50, Chapter 8 and Proposition 84, going before voters in the fall 2006 election, contain significant funding for integrated water resources planning and project implementation. Lassen County has not developed and is not signatory to a regional integrated water management plan.
- **GWMP Implementation, Reporting, and Updating.** GWMP implementation actions and the associated schedule are included in Table ES-1. Many of the actions are a continuation of existing County activities. New actions are highlighted by the development of quantitative Basin Management Objectives to further advance proactive local groundwater management that documents local needs and objectives. Appendix C includes a white paper, *Introduction to the BMO Process of Groundwater Management* that describes this process. Annual reporting and periodic updates of the GWMP will report current groundwater conditions and wall document progress in implementing actions to accomplish Plan objectives.

| Table ES-1. Summary of GWMP Actions | | |
|---|---|---|
| | Description of Action | Implementation Schedule |
| **I.** | **Basin Management Objectives** | |
| 1 | Codify groundwater management using the BMO concept through the development of a recommended BMO ordinance for consideration and adoption by the Board of Supervisors. | 2007 |
| 2 | Formalize and proceed with the four phases identified in the *Introduction to the BMO Process of Groundwater Management* summary in Appendix C. | 2007 |
| **II.** | **Groundwater Monitoring`** | |
| 3 | Identify "key" groundwater monitoring well locations utilizing existing groundwater monitoring data. | 2007 |
| 4 | Develop and implement annual summary report of groundwater level, groundwater quality, and inelastic land subsidence at "key" well locations. | 2007 |
| 5 | Secure funding for annual groundwater summary report. | 2007 |
| 6 | Work with local stakeholders and DWR to identify areas that may need additional groundwater level, groundwater quality, or subsidence monitoring based on identified data gaps or negative performance trends. Request that DWR be alert and report anecdotal evidence of land subsidence at monitoring well locations. | Annual |
| 7 | Work with state and federal agencies to secure funding for expansion of the Lassen County monitoring grid. | As needed |
| 8 | Maintain agreements with DWR for groundwater monitoring and database management activities. | Ongoing |
| 9 | Coordinate with DWR and local landowners to ensure that selected wells are maintained as part of a long-term monitoring program. | Ongoing |
| 10 | Support the development and implementation of quantitative BMOs in priority groundwater basins. | 2007 - 2009 |
| 11 | Pursue opportunities for interstate groundwater basin monitoring and reporting with the State of California, State of Nevada, Washoe County, and federal agencies. | Ongoing |
| 11 | Support efforts to map and compile information on riparian habitats and phreatophyte vegetation. | Ongoing |
| **III.** | **Groundwater Resource Protection** | |
| 13 | Support and implement policies contained in the Lassen County General Plan Natural Resources Element (Water Resources chapter). | Ongoing |
| 14 | Support existing Ordinance 488 associated with well construction, repair, modification, and destruction. | Ongoing |
| 15 | Participate in the review and provide recommendation for permit applications submitted under Ordinance 539, Groundwater Extraction and Exportation. | Ongoing |
| 16 | Support County Environmental Health Department submittal of received well completion reports to DWR Northern District. | Ongoing |
| 17 | Evaluate the need for and implement as necessary a wellhead protection, groundwater recharge area protection, well spacing (and other) programs in Lassen County. | 2007-2008 |
| 18 | Continue to participate and support the function of the Long Valley Groundwater Management District pursuant to the Memorandum of Agreement with Sierra County. | Ongoing |
| 19 | Participate in activities of the Honey Lake Groundwater Management District, if enacted and directed by the Board of Supervisors. | As Needed |
| 20 | Participate in activities of the Willow Creek Valley Groundwater Management District when requested. | As Needed |
| 21 | Participate in activities of the Surprise Valley Groundwater Management District when requested. | As Needed |
| 22 | Support activities of the Lassen-Modoc County Flood Control and Water Conservation District. | Ongoing |
| 23 | Coordinate and collaborate with the Washoe County Regional Water Planning Commission and Nevada State Engineer on interstate groundwater management issues. | Ongoing |

| Table ES-1. Summary of GWMP Actions | | |
|---|---|---|
| | Description of Action | Implementation Schedule |
| **IV.** | **Groundwater Sustainability** | |
| 24 | Participate in the evaluation of local projects to improve groundwater sustainability (e.g. groundwater recharge). | As Needed |
| 25 | Provide support associated with development of quantitative BMOs in Lassen County. | 2007-2009 |
| 26 | Pursue funding from state agencies, federal agencies, and partnerships for groundwater sustainability activities. | Ongoing |
| 27 | Coordinate and collaborate with the Washoe County Regional Water Planning Commission, Washoe County Board of Commissioners, Washoe County Planning Commission, and the Nevada State Engineer on interstate groundwater management issues to encourage a groundwater management method consistent with the BMO process detailed in the Lassen County GWMP. | Ongoing |
| 28 | Participate in the development and adoption of agreements, special legislation, or compacts pertaining to sustainable groundwater management between the State of California and the State of Nevada and encourage groundwater management using the BMO method. | Ongoing |
| 29 | Collaborate with state and federal (e.g. USGS) agencies in the completion of groundwater projects and studies. | Ongoing |
| **V.** | **Stakeholder Involvement** | |
| 30 | Assist in coordination and management activities of the Working Group. | Ongoing |
| 31 | Be responsive to the needs and requests of the Board of Supervisors and other Departments. | Ongoing |
| 32 | Continue to work cooperatively with local stakeholders on groundwater management activities. | Ongoing |
| 33 | Continue to work cooperatively with DWR headquarters and DWR Northern District on groundwater management activities. | Ongoing |
| **VI.** | **Integrated Water Resources Planning** | |
| 34 | Establish an effective approach for participation in or development of an Integrated Regional Water Management Plan. | 2007 |
| 35 | Support water resource-related policies, programs, and projects approved by the Board of Supervisors. | Ongoing |
| 36 | Pursue funding sources for implementation of plan policies, programs, and projects. | As Needed |
| **VII.** | **GWMP Implementation, Reporting and Updating** | |
| 37 | Formalize and institute a Working Group to meet quarterly or as needed on GWMP implementation activities. | 2007 |
| 38 | Lassen County to schedule and facilitate Working Group meetings | Quarterly or As Needed |
| 39 | Work cooperatively with local stakeholders, county government, and local advisory committees to assess needed GWMP updates. | Annual |
| 40 | Develop and implement annual summary report of 1) groundwater level, groundwater quality, and inelastic land subsidence at “key” well locations, and 2) status of GWMP implementation in cooperation with DWR. | Annual |
| 41 | Secure funding for annual groundwater summary report. | 2007 |

# 1. INTRODUCTION

Groundwater resources have long played an important role in the development, growth, and sustainability of Lassen County and its residents. It is a source of drinking water, irrigation water for the agricultural community, and supports important environmental needs through its interaction with surface water and related habitat. Local groundwater users and the County work collaboratively to manage and protect groundwater resources for current and future generations. Local groundwater management continues to increase in complexity and scope, driven by evolving demands for groundwater resources both within and adjacent to Lassen County. Specifically, past and current projects to develop and export groundwater in Nevada from interstate basins shared with Lassen County may impact Lassen County residents reliant on these groundwater basins. As a result, the Board of Supervisors is pursing the development of a Groundwater Management Plan (GWMP or Plan).

The need for the GWMP is twofold. First, the GWMP must formalize and direct the County's ongoing commitment to pursue sustainable and beneficial groundwater development and use by its residents. Second, the GWMP must clearly articulate the County's expectations for groundwater management by entities beyond the County's jurisdiction and share groundwater resources with the County. Each of these needs is met by the introduction of Basin Management Objectives (BMOs) in the GWMP. BMOs represent a proactive method of groundwater management that is supported by the Board of Supervisors, staff, and local groundwater users who participated in the development of this Plan. The BMO concept is explained in detail in Appendix C of this Plan.

The purpose of this Groundwater Management Plan is to provide guidance in managing the County's groundwater resources and to document the necessity for proper management within interstate groundwater basins where mismanagement can impact Lassen County residents. The GWMP documents groundwater conditions, management goals and objectives, and plan implementation activities to achieve the Plan purpose. The GWMP serves to improve the understanding and management of the water resources in Lassen County, providing a framework for the County and other water users to implement effective and sustainable groundwater management programs.

## 1.1 Plan Authority and Administration

On March 28, 2006, the Lassen County Board of Supervisors formally approved Resolution 06-018 directing the development of a countywide GWMP. The resolution is included as Appendix A. Lassen County is an authorized groundwater management agency within the meaning of the California Water Code (CWC) § 10753 (a). This GWMP does not conflict with existing groundwater ordinances and groundwater management plans within the County. Lassen County includes three Special Act Districts (Groundwater Management Districts), no other existing Groundwater Management Plans, and no adjudicated groundwater basins (DWR, 2004a).

## 1.2 Groundwater Management Goal

The goal of the Lassen County GWMP is to maintain or enhance groundwater quantity and quality, thereby providing a sustainable, high-quality supply for agricultural, environmental, and urban use into the future that remains protective of the health, welfare, and safety of residents.

## 1.3 Groundwater Management Objectives

The Lassen County GWMP seeks to achieve its goal through the following objectives:

- Maintain and protect historic groundwater uses;
- Minimize the long-term drawdown of groundwater levels;
- Protect groundwater quality;
- Prevent inelastic land surface subsidence from occurring as a result of groundwater pumping;
- Minimize changes to surface water flows and quality that directly affect groundwater levels or quality;
- Minimize the effect of groundwater pumping on surface water flows, quality, seeps and springs, and natural vegetation.
- Facilitate groundwater replenishment and cooperative management projects;
- Maintain springs, seeps and riparian habitat; and
- Provide a mechanism for mutual management of interstate groundwater basins with Washoe County and the State of Nevada.

## 1.4 Plan Components

The California legislature and DWR developed groundwater management plan components over the 11 years from 1992 to 2003. In 1992, the Legislature enacted the California Groundwater management Act, Assembly Bill 3030 (AB 3030) to encourage local public agencies to adopt plans to manage groundwater resources within their jurisdictions. Provisions were created in the CWC Sections 107450 et.seq. with the intent to manage the safe production, quality, and proper storage of groundwater. AB 3030 codified 12 voluntary components of a GWMP. In 2002, Senate Bill 1938 (SB 1938) was signed into law. SB 1938 amended the CWC with seven required components of a GWMP for any public agency seeking State funds administered through the DWR for groundwater projects. In 2003, DWR published *Bulletin 118 – Update 2003, California's Groundwater*. Bulletin 118-2003 contains seven recommended components of a GWMP.

Lassen County's GWMP is a stand-alone document that meets the requirements set by SB 1938, and addresses the voluntary and recommended components codified by AB 3030 and recommended in Bulletin 118-2003. GWMP components and their location in the GWMP are summarized in Table 1-1.

Table 1-1. Groundwater Management Plan Components

| GWMP Components | Lassen County GWMP Section |
|---|---|
| *Required Components: (10753.7.)* | |
| Establish Basin Management Objectives (BMOs) | 3.4, 3.5, 3.7 |
| Include components relating to the monitoring and management of: groundwater levels, groundwater quality, inelastic land subsidence | 3.5 |
| Prepare a plan that enables the County to work cooperatively with other public entities whose service area falls within the plan area and overlies the groundwater basin | 1.5, 3.8 |
| Prepare a map that details the area of the groundwater basin, the area subject to the GWMP, and the boundaries of other local agencies that overlie the basin | 1.5 |
| Adopt monitoring protocols that detect changes in: groundwater levels, groundwater quality, inelastic land subsidence, and surface water flow or quality that affects groundwater or groundwater pumping that affects surface water flow or quality | 3.5 |

| Table 1-1. Groundwater Management Plan Components | |
|---|---|
| GWMP Components | Lassen County GWMP Section |
| If the GWMP area includes areas outside a groundwater basin as defined in Bulletin 118, the County will use the required components, and geologic and hydrologic principles appropriate for the area | Not applicable |
| *Voluntary Components (10753.8.)* | |
| Control of saline intrusion | 3.5.2 |
| Identification and management of wellhead protection areas and recharge areas | 3.6.5 |
| Regulation of the migration of contaminated groundwater | 3.5.2 |
| Administration of a well abandonment and well destruction program | 3.6.1 |
| Mitigation of conditions of overdraft | 3.7 |
| Replenishment of groundwater extracted by water producers | 3.7 |
| Monitoring of groundwater levels and storage | 3.5 |
| Facilitating conjunctive use operations | 3.7 |
| Identification of well construction policies | 3.6.1 |
| Construction and operation by the County of groundwater contamination cleanup, recharge, storage, conservation, water recycling, and extraction projects | 3.7 |
| Development of relationships with state and federal regulatory agencies | 3.8.1 |
| Review of land use plans and coordination with land use planning agencies to assess activities that create a reasonable risk of groundwater contamination | 3.8.1 |
| *Recommended Components (From bulletin 118-2003 Appendix C)* | |
| Document public involvement and ability of the public to participate in development of the GWMP, this may include a Technical Advisory Committee (TAC) | 1.6, 1.7, Appendix B |
| Establish an advisory committee of stakeholders within the plan area that will help guide the development and implementation of the plan and provide a forum for the resolution of controversial issues | 1.6, 3.8.2 |
| Describe the area to be managed under the GWMP including<br>The physical structure of the aquifer system<br>A summary of available historical data and issues of concern related to groundwater levels, groundwater quality, inelastic land subsidence, and surface water flow or quality that effects groundwater or groundwater pumping that effects surface water flow or quality<br>A general discussion of historical and projected water demands and supplies | Section 2 |
| Establish management objectives (MOs) for the groundwater basin subject to the GWMP | 1.3, 3.3 |
| Describe the GWMP's monitoring program | 3.5 |
| Describe efforts to coordinate with land use, zoning, or water management planning agencies or activities | 3.6, 3.8.1 |

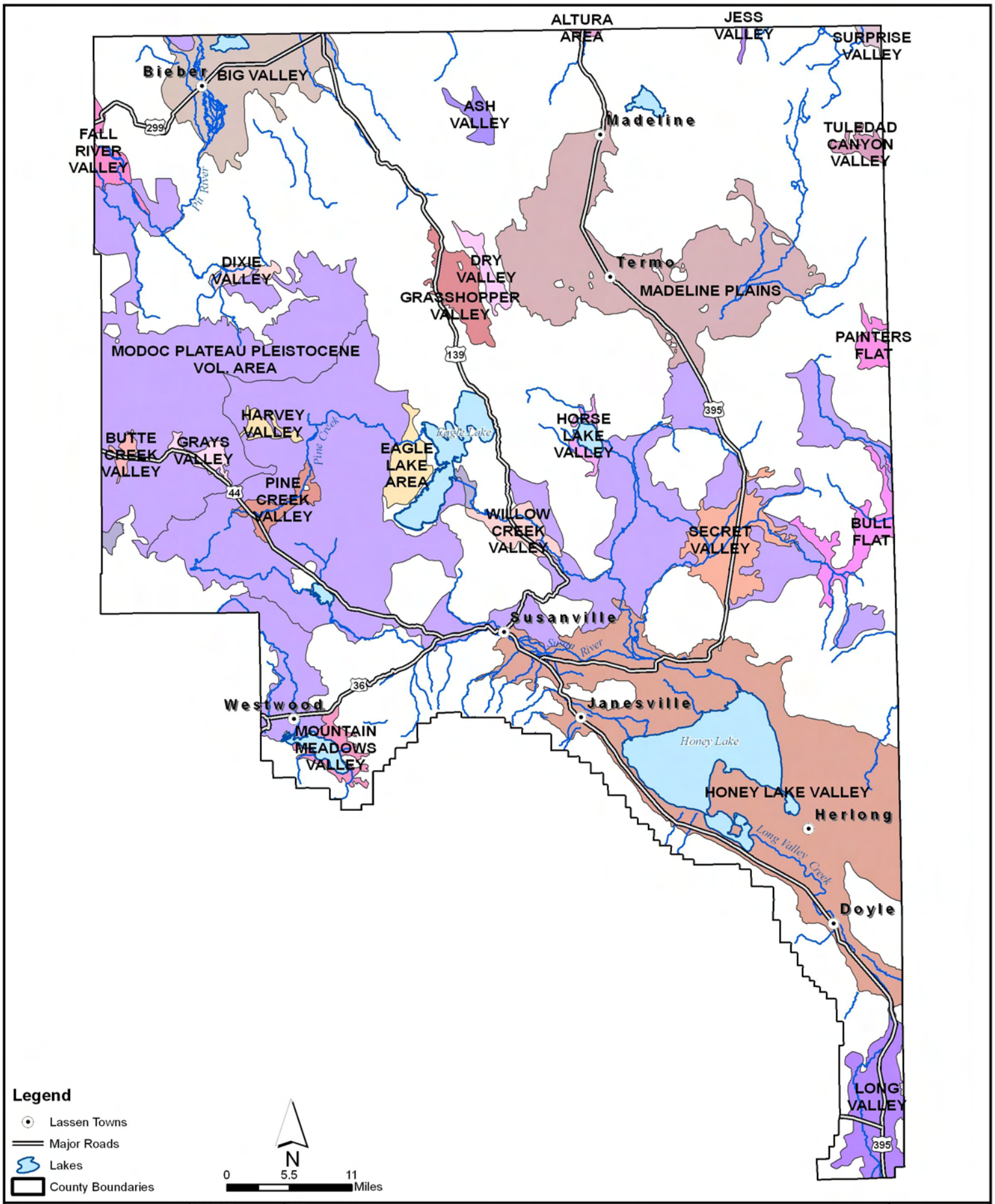
| Table 1-1. Groundwater Management Plan Components | |
|---|---|
| GWMP Components | Lassen County GWMP Section |
| Create a summary of monitoring locations with frequency of wells monitored | 3.5 |
| Provide periodic reports summarizing groundwater conditions and management activities including:<br><br>A summary of monitoring results, with a discussion of historical trends.<br>A summary of management actions during the period covered by the report.<br>A discussion of whether actions are achieving progress towards meeting MOs.<br>A summary of proposed management actions for the future.<br>A summary of any GWMP changes that occurred during the period covered by the report.<br>A summary of actions taken to coordinate with other water and land agencies and other government agencies. | 3.10 |
| Provide for the periodic re-evaluation of the entire plan by the managing entity | 3.10.3 |

## 1.5 Area Covered by Plan

The Lassen County GWMP includes those areas in Lassen County overlying a groundwater basin not within the service area of another local agency, water corporation regulated by the Public Utilities Commission (PUC), or mutual water company without the agreement of the overlying agency (CWC § 10750.7 (a)). Figure 1-1 shows the Lassen County GWMP plan area. Areas within Lassen County not overlying a groundwater basin as defined in Bulletin 118-2003 are not explicitly included in the GWMP.

Local agencies (e.g. Community Service Districts), PUC-regulated water purveyors, or mutual water companies can select to gain coverage under the Lassen County GWMP through adoption of the Lassen County GWMP. Table 1-2 provides a listing of overlying agencies and the groundwater basins overlain.

| Table 1-2. Overlying Agencies and Agreement to Join GWMP | |
|---|---|
| Agency | Groundwater Basin |
| City of Susanville | Honey Lake |
| Clear Creek Community Services District | Modoc Plateau Pleistocene Volcanic Area |
| County Service Area #2, Johnstonville Water System | Honey Lake |
| Herlong Utilities Inc. | Honey Lake |
| Lake Forest Mutual Water Company | Honey Lake |
| Lassen County Waterworks District Number 1 | Big Valley |
| Leavitt Lake Community Services District | Honey Lake |
| Little Valley Community Services District | None |
| Sierra Army Depot | Honey Lake |
| Susan Hills Mutual Water Company | Honey Lake |
| West Patton Village Community Services District | Honey Lake |
| Westwood Community Services District | Modoc Plateau Pleistocene Volcanic Area |




| | | | |
|---|---|---|---|
| BROWN AND CALDWELL | PROJECT 129506 | SITE Lassen County | Figure 1-1 |
| | DATE 8-15-06 | TITLE Plan Area | |

## 1.6 Plan Development Process

The GWMP development was supported by a Working Group comprised of individuals with extensive knowledge of local groundwater-related issues, objectives, conditions, and needs. The Working Group assisted plan development by serving in an advisory role. The County convened three meetings of the Working Group during GWMP development. Working Group participants and the agency represented or the individual's expertise is presented in Table 1-3.

Table 1-3. Lassen County GWMP Working Group

| Working Group Participant | Representing or Expertise |
|---|---|
| Maurice Anderson | Community Development Department |
| Bob Anton | Honey Lake RCD |
| Joe Bertotti | Community Development Department |
| Noel Eaves | DWR Northern District – Groundwater Section |
| Paul Herman | Long Valley Groundwater Management District |
| Tim Garrod | Agricultural groundwater user – Honey Lake basin |
| Rob Hill | City of Susanville; Lassen County Fish and Game Commission |
| David Lile | Lassen County Farm Advisor; UC Cooperative Extension |
| Dan McManus | DWR Northern District – Groundwater Section |
| Kevin Mitchell | Agricultural groundwater user – Big Valley basin |
| Rick Simon | Community Development Department |
| Bob Sorvaag | Community Development Department |
| Todd Swickard | Agricultural groundwater user – Honey Lake and Willow Creek basin |

The County is following CWC guidance on GWMP development. There are five main steps in the development of a GWMP, as defined under CWC§10753.2 through 10753.6. The five steps and the County's actions to follow the five steps are shown in Figure 1-2 and are summarized below:

**Step 1 –** Provide public notification of a hearing on whether or not to adopt a resolution of intention to draft a GWMP and subsequently complete a hearing on whether or not to adopt a resolution of intention to draft a GWMP. Following the hearing, draft a resolution of intention to draft a GWMP. The County provided public notification and held a hearing on whether or not to adopt a resolution of intention on March 28, 2006.

**Step 2 –** Adopt a resolution of intention to draft a GWMP and publish the resolution of intention in accordance with public notification. The Lassen County Board of Supervisors adopted the resolution of intention to develop a GWMP on March 28, 2006. The resolution is included as Appendix A.

*Figure 1-2. Plan Development Process*

**Step 3 –** Prepare a draft GWMP within two years of resolution of intention adoption. Provide to the public a written statement describing the manner in which interested parties may participate in developing the GWMP. The County provided notification and held three meetings where meeting attendees gave input on management objectives for the GWMP. The public draft of the GWMP was available to public at Susanville library and on compact disk at the County's office, and the University Extension from January 9 through March 13, 2007.

*Photo 1-1. Groundwater management plan meeting attendees.*

**Step 4 –** Provide public notification of a hearing on whether or not to adopt the GWMP, followed by holding a hearing on whether or not to adopt the GWMP. The County provided public notice of the hearing to adopt the GWMP in the Lassen County Times newspaper on February 27 and March 6, 2007.

**Step 5 –** The plan may be adopted within 35 days after the completion of Step 4 above if protests are received for less than 50 percent of the assessed value of property in the plan area. If protests are received for greater than 50 percent of the assessed value of the property in the plan area, the plan will not be adopted. The County held a public hearing to adopt the GWMP on March 13, 1997. During the hearing the Board received public comment, which was incorporated into the GWMP following the hearing. Public comment was supportive of the GWMP, and no protests against the GWMP were received. The Board of Supervisors unanimously adopted the GWMP following public comment. Board meeting minutes reflecting GWMP adoption and public comment with responses are provided in Appendix D.

## 1.7 Public Outreach and Education

The County developed a Public Outreach Plan to guide development of the GWMP. Public outreach included the formation of a Working Group to provide input on GWMP development and noticed public hearings on the intent to draft and adopt the GWMP. The Public Outreach Plan is included in Appendix B.

## 1.8 Document Organization

The Lassen County GWMP is organized into the following sections:

- Section 1 Introduction: discusses GWMP goals, objectives, plan area, and development process
- Section 2 Physical Setting: describes the physical setting of Lassen County including items such as geologic setting, land use, water sources, and physical hydrogeologic infrastructure
- Section 3 Plan Implementation: discusses the individual components of the Lassen County GWMP as listed in Table 1-1.
- Section 4 References
- Appendices

- **Hills South of Doyle (042504)**: The Doyle station is in the hills south of Doyle, west of Long Valley Creek, at an elevation of 4,390 feet above mean sea level (msl), with records extending 75 years from 1931 through 2006.
- **Susanville (048702)**: The Susanville station is in the southwestern area of Susanville, south of the Susan River, at an elevation of 4,184 feet above msl, with records extending 60 years from 1946 through 2006.
- **Termo (048873)**: The Termo station is in Termo, east of Highway 395, at an elevation of 5,300 feet above msl, with records extending 51 years from 1948 through 1999.

These stations were chosen because they have long periods of record. The stations also represent the climate in two parts of the Honey Lake valley, and an upland area in Madeline Plains. The following sections use data from these stations to describe Lassen County climate. Additional weather stations were considered, but not selected to characterize weather patterns in Lassen County. Weather stations considered include:

- **Bieber (040731)**, with a period of record of 48 years from 1948 to 2006,
- **Blacks Mountain Ranch (040870)**, with a period of record of 12 years from 1948 to 1960,
- **Doyle 4 SSE (042506)**, with a period of record of 50 years from 1956 to 2006,
- **Eagle Lake Stone Ranch (042595)**, with a period of record of 2 years from 1959 to 1961,
- **Fleming Fish and Game (043087),** with a period of record of 18 years from 1959 to 1977,
- **Little Valley (044988)**, with a period of record of 15 years from 1960 to 1975,
- **Madeline (045231)**, with a period of record of 41 years from 1931 to 1972,
- **Milford Laufman Rs (045623)**, with a period of record of 58 years from 1948 to 2006,
- **Secret Valley (048074)**, with a period of record of 15 years from 1962 to 1977,
- **Standish 1 E (048487)**, with a period of record of 12 years from 1961 to 1973,
- **Susanville 1 WNW (048703)**, with a period of record of 54 years from 1946 to 2006,
- **Termo Brin Marr (048875)**, with a period of record of 3 years from 1960 to 1963,
- **Wendel 10 SE (049526)**, with a period of record of 18 years from 1959 to 1977, and
- **Westwood (049599)**, with a period of record of 24 years from 1929 to 1953.

### 2.2.1 Temperature

Table 2-1 includes the average, maximum, and minimum monthly mean air temperatures at the three stations. Daily temperature measurements show similar trends at each station, with the Termo station usually averaging five or more degrees cooler. The temperatures in Table 2-1 indicate a wide seasonal variability at each station. Average monthly temperatures range from about 27 °F to 33 °F during December through January to about 63 °F to 71 °F during July through August.

Table 2-1. Monthly Air Temperatures in Degrees Fahrenheit at Lassen County Weather Stations

| Month | Hills South of Doyle (042504) | | | Susanville (048702) | | | Termo (048873) | | |
|---|---|---|---|---|---|---|---|---|---|
| | Avg | Max | Min | Avg | Max | Min | Avg | Max | Min |
| January | 30.4 | 40.7 | 20.1 | 30.4 | 40.5 | 20.3 | 26.7 | 38.8 | 14.5 |
| February | 35.7 | 47.6 | 23.7 | 35.0 | 45.9 | 24.0 | 31.4 | 43.3 | 19.5 |
| March | 41.1 | 54.9 | 27.2 | 41.1 | 53.7 | 28.5 | 36.3 | 48.7 | 23.9 |
| April | 49.3 | 65.7 | 32.8 | 47.2 | 61.7 | 32.7 | 41.1 | 56.0 | 26.2 |
| May | 55.7 | 73.2 | 38.1 | 55.0 | 70.9 | 39.0 | 49.2 | 65.8 | 32.6 |
| June | 63.2 | 82.9 | 43.4 | 62.6 | 79.9 | 45.3 | 56.5 | 74.6 | 38.4 |
| July | 71.4 | 93.8 | 48.9 | 69.9 | 89.4 | 50.3 | 63.9 | 84.9 | 42.8 |
| August | 69.0 | 91.7 | 46.2 | 67.9 | 87.7 | 48.1 | 62.3 | 83.9 | 40.7 |
| September | 63.7 | 84.7 | 42.7 | 60.7 | 79.5 | 41.9 | 55.2 | 75.8 | 34.6 |
| October | 52.7 | 71.2 | 34.1 | 50.7 | 66.9 | 34.5 | 45.4 | 63.9 | 26.9 |
| November | 41.7 | 55.3 | 28.1 | 39.4 | 51.8 | 27.0 | 34.7 | 48.0 | 21.3 |
| December | 33.1 | 43.3 | 22.9 | 32.2 | 42.2 | 22.2 | 27.3 | 39.3 | 15.2 |

*Source: Western Regional Climate Center, www.wrcc.dri.edu*

Average monthly low temperatures are below freezing in November, December, January, February, and March at all three stations. Average monthly high temperatures range from 75 °F to 92 °F during the summer months of June, July, and August.

### 2.2.2 Precipitation

Precipitation is influenced by the mountains within Lassen County; greater precipitation typically occurs in the western portion of the county at higher elevations, as shown in Figure 2-3. Precipitation amounts presented in Figure 2-3 are estimated based on data from precipitation stations, topography, and other factors. Precipitation is caused by orographic uplift, as air temperatures cool as the air mass rises over the mountains, resulting in condensation that falls as precipitation. Table 2-2 presents average annual precipitation and snowfall for the three stations, illustrating the significant variability in precipitation between different water years.

Table 2-2. Average Annual Precipitation and Snowfall at Lassen County Weather Stations

| | Average Precipitation (in) | Average Snowfall (in) |
|---|---|---|
| Hills South of Doyle | 17.2 | 20.0 |
| Susanville | 13.3 | 19.2 |
| Termo | 11.0 | 36.0 |

*Source: University of California Statewide Integrated Pest Management Program (UP IPM), www.ipm.ucdavis.edu, Western Regional Climate Center, www.wrcc.dri.edu*

Figure 2-4 depicts the average monthly precipitation, including snowfall over the period of record for the three stations, reported in inches of water. In summer months, areas of high pressure are commonly established over northern California, effectively blocking the inland movement of moist marine air, causing extended periods of little precipitation. Because of this, precipitation is strongly

seasonal, occurring mostly in November through March. Most precipitation in winter at Termo occurs as snowfall, as indicated in Table 2-2. On average, little rain occurs in the months of July, August, and September.

Annual precipitation totals in the Honey Lake valley reflect wet periods and drought periods. Figure 2-5 shows annual precipitation by year at the hills south of Doyle and Susanville weather stations. Both stations show less than 10 inches of precipitation during the 1976 drought, and rainfall totals less than 20 inches during the 1987 through 1994 drought period.

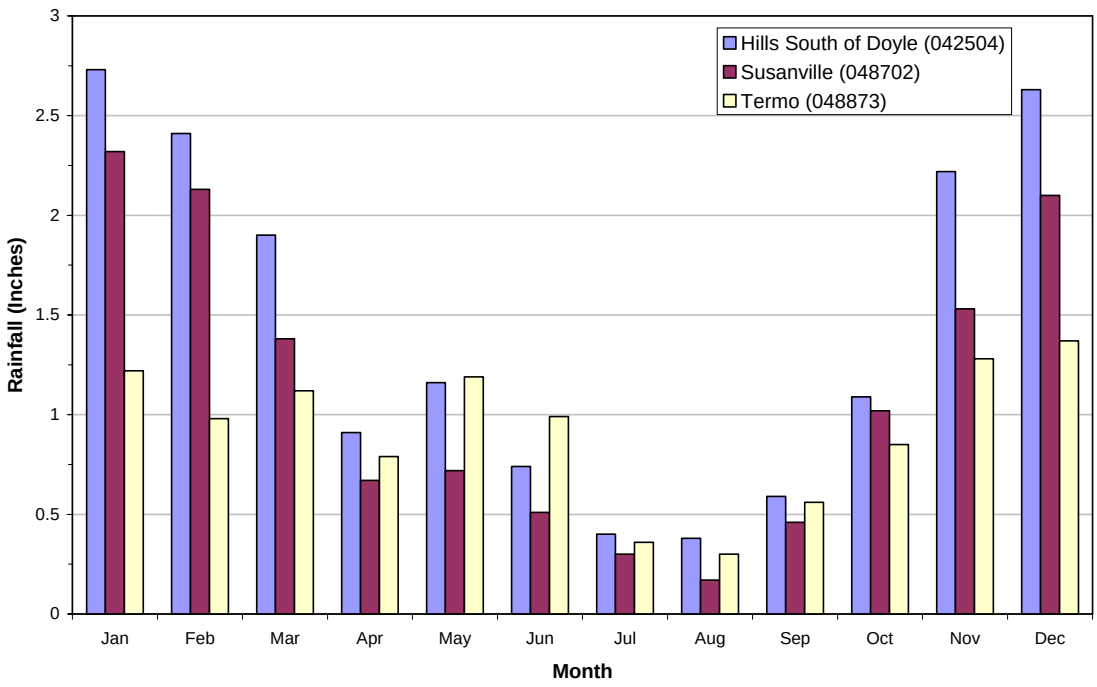
## 2.3 Surface Water Hydrology

The hydrologic characteristics of Lassen County's rivers and streams vary depending on the watershed of origin, area-elevation relationships, and snowfall accumulation patterns. This section describes flows on three of Lassen County's rivers and creeks: the Pit River, the Susan River, and Long Valley Creek. Figure 2-2 shows surface water bodies and representative gauge locations within Lassen County.

There are seven watersheds in Lassen County, including Duck Flat, Feather River, Madeline Plains, Pit River, Smoke Creek, Surprise Valley, and Susan River, as shown in Figure 2-6. The Pit River flows through the northwestern portion of the County, draining to the west. The Susan River flows easterly to Honey Lake in the central portion of the County. Long Valley Creek flows from Upper Long Valley north into Honey Lake. Honey Lake, the largest lake in Lassen County, receives water from the Susan River, Long Valley Creek, Baxter Creek, and Willow Creek.

Several streams in Lassen County are adjudicated. Adjudication is the process by which the amount of water that may be diverted by users of the stream is prescribed, and usually enforced by a water master. Adjudicated streams in Lassen County include: Ash Creek, Baxter Creek, Hallett Creek, Long Valley Creek, Mill Creek, Parker Creek, Pit River in Big Valley, and the Susan River (DWR, 1992).

Figures 2-7 through 2-9 show data from stream gauges on three streams and rivers in Lassen County. The average monthly flow is indicated by the bars in Figures 2-7 through 2-9.




*Source: University of California Statewide Integrated Pest Management Program (UP IPM), www.ipm.ucdavis.edu*

*Figure 2-4. Average Precipitation at Lassen County Weather Stations*

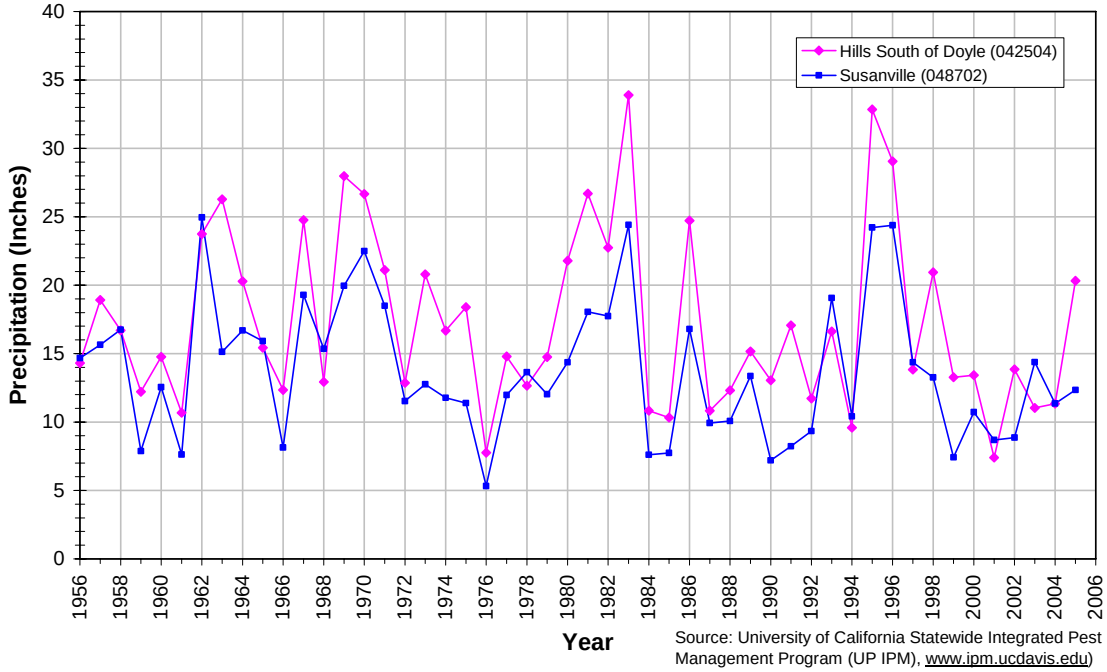
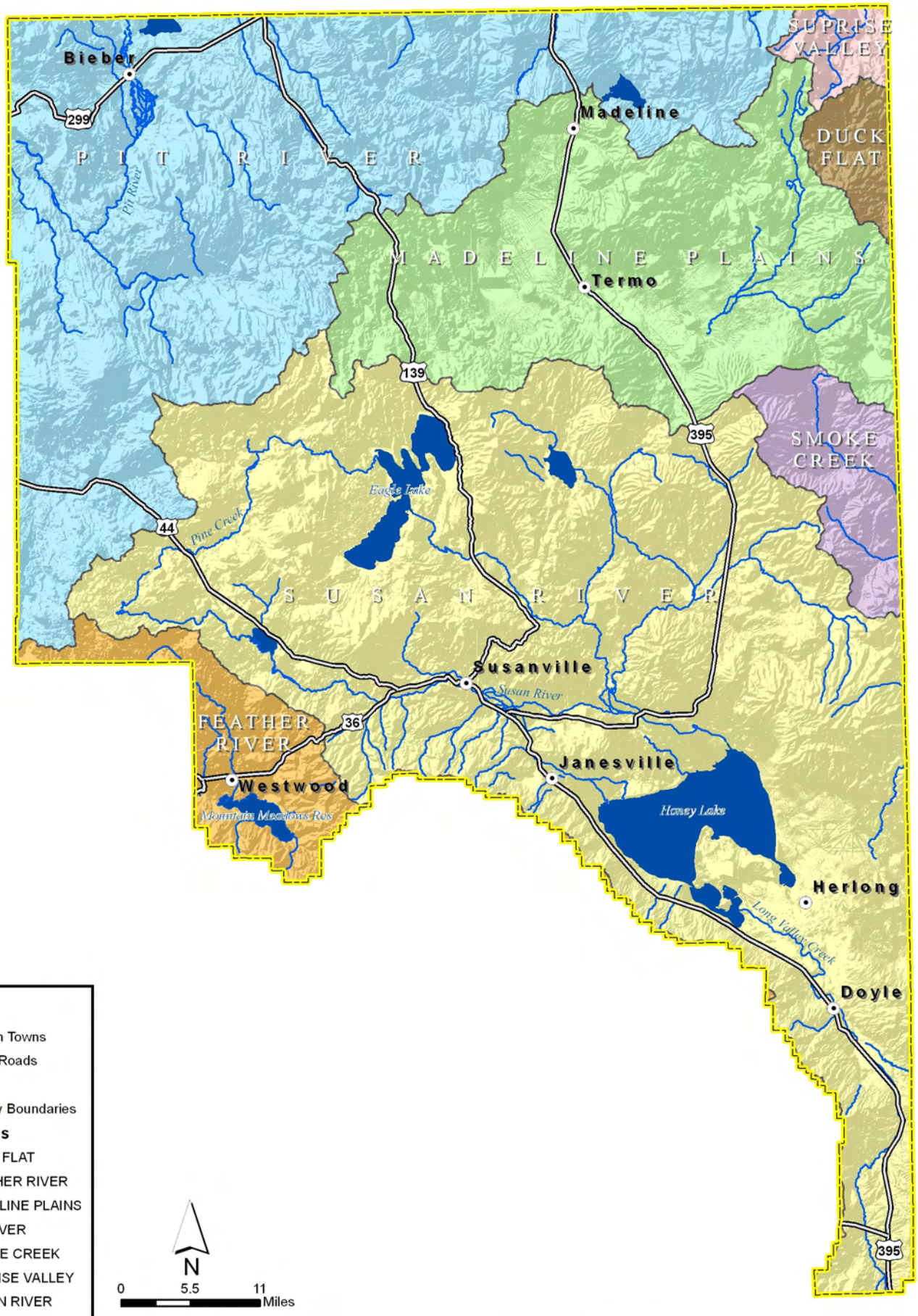



*Figure 2-5. Annual Rainfall at Two Lassen County Weather Stations*




BROWN AND CALDWELL

| PROJECT | SITE | |
|---|---|---|
| 129506 | Lassen County | Figure |
| DATE | TITLE | |
| 8/15/06 | Watersheds | 2-6 |

## The Pit River

Flows on the Pit River are high in the spring and low in the summer and fall. Figure 2-7 shows average stream flows on the Pit River. Average monthly flows are over 400 cubic feet per second (cfs) in January through May, and below 200 cfs in July through December. Average monthly flows are lower in April than in May, which correlates with the amount of rainfall received at the three Lassen County weather stations shown in Figure 2-4. The Pit River stream gauge has a period of record from 1994 through 2005. This short period of record may account for the low reported average flows on the Pit River in April.

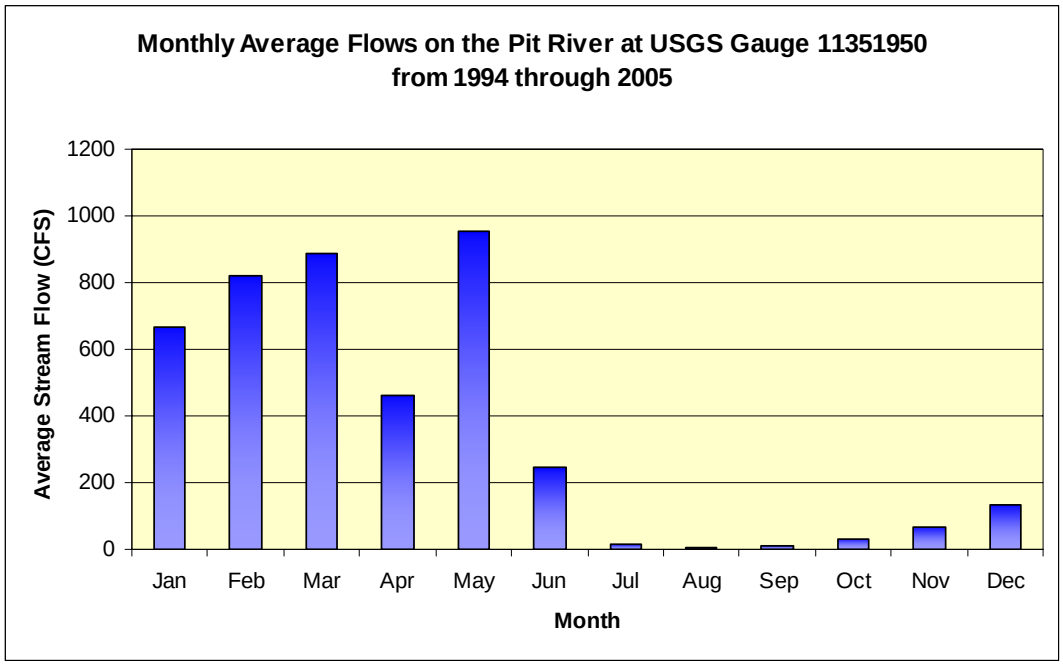



*Figure 2-7. Stream Flows on the Pit River*

## The Susan River

Flows on the Susan River are high in the spring and lower in the summer and fall. Figure 2-8 shows average stream flows on the Susan River. Average monthly flows are over 100 cfs in February through May, and below 50 cfs in August through November. Rainfall increases at the three weather stations in November and December without a corresponding increase in Susan River flows over the same period, likely due to accumulation of the precipitation as snowpack. In April and May, the snowpack melts, increasing flow volumes on the Susan River.

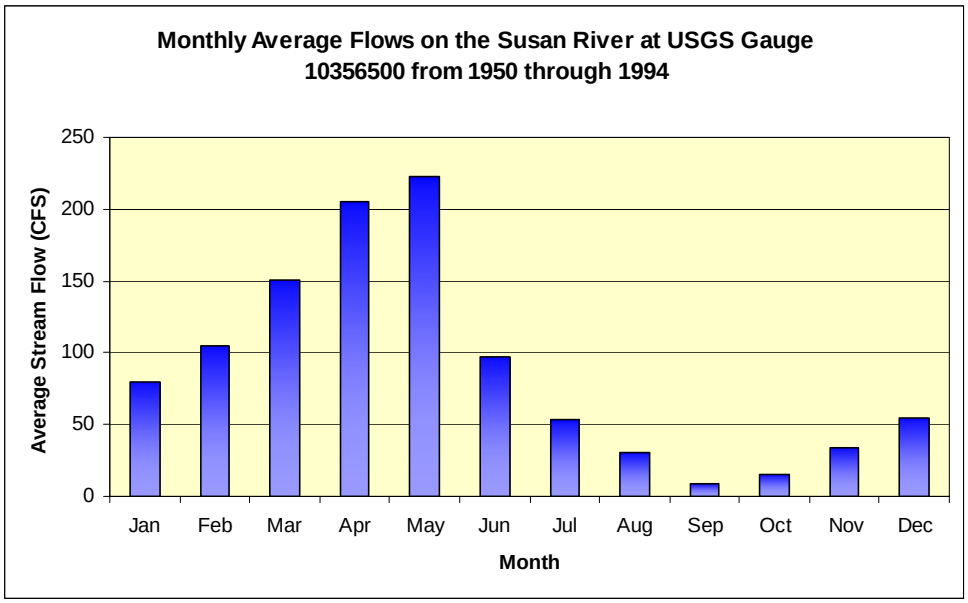



*Figure 2-8. Stream Flows on the Susan River*

## Long Valley Creek

Long Valley Creek flows from the south to the north into Honey Lake. Long Valley Creek flows year round in Upper Long Valley, and is intermittent in stretches in Honey Lake Valley. Flows on Long Valley Creek were measured for five years from 1989 through 1994. Average flows over this period are high in March and lower in the rest of the year, and could be affected by one high flow event in March. Figure 2-9 shows average stream flows on Long Valley Creek over the five year period. Average monthly flows are over 35 cfs in March, and below 15 cfs the rest of the year. Rainfall increases at the three weather stations in winter and spring without a corresponding increase in Long Valley Creek flow measurements, likely due to the short period of record of the stream gauge.

*Photo 2-2. Long Valley Creek flowing in the Long Valley Groundwater Basin*

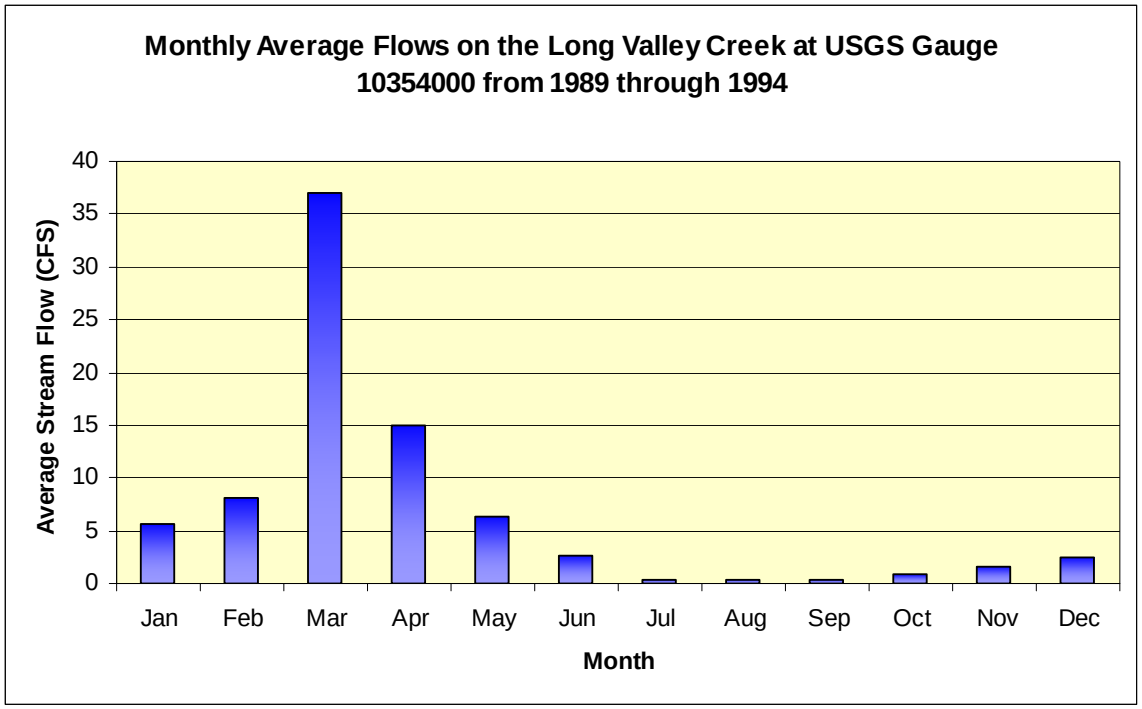



*Figure 2-9. Stream Flows on Long Valley Creek*

## 2.4 Geology

Lassen County is at the confluence of four geomorphic provinces, the Sierra Nevada, the Basin and Range, the Cascade Range, and the Modoc Plateau. Geology in the County consists of volcanic rock that forms many ridges and mountains and sedimentary rocks that form groundwater basins in valleys. The Sierra Nevada geomorphic province is present in the southwestern portion of the county, and is primarily composed of granite. The Basin and Range province is present in the southeastern portion of the County, and includes the Honey Lake Valley. The Cascade Range and Modoc Plateau geomorphic provinces are in the central, northern, and western portions of the County and are primarily composed of volcanic rock.

The Sierra Nevada is composed of mainly igneous and metamorphic rocks of diverse composition and age. Plutonic igneous rocks form the base of the Sierras, and metamorphic rocks overlie the plutons of granitic rock. Metamorphic rock is present in the southwestern edge of Lassen County, and the Honey Lake Valley is bounded on the west by granitic rocks of the Sierra Nevada province.

The Basin and Range province is present in Lassen County primarily in the Honey Lake area. Though underlain by rocks of the Modoc Plateau in this area, the Basin and Range province is characterized by high north-south trending mountains and long narrow valleys filled with sediments. The valley areas of the Basin and Range have interior drainage, often draining to a terminal lake, like Honey Lake.

The Cascade Range in Lassen County is the southern end of a range of volcanic mountains. The Cascade Range includes Mount Lassen and Mount Shasta. In Lassen County, the range includes a number of volcanic features. Volcanic rocks in the Cascade Range consist primarily of andesite and explosive lavas. The Modoc Plateau is an undulating platform composed of assorted volcanic materials, principally basaltic lava flows. The Modoc Plateau grades west into the Cascade Range and

south into the Sierra Nevada. Much of the plateau itself is broken by faults. The Modoc Plateau is drained by the Pit River.

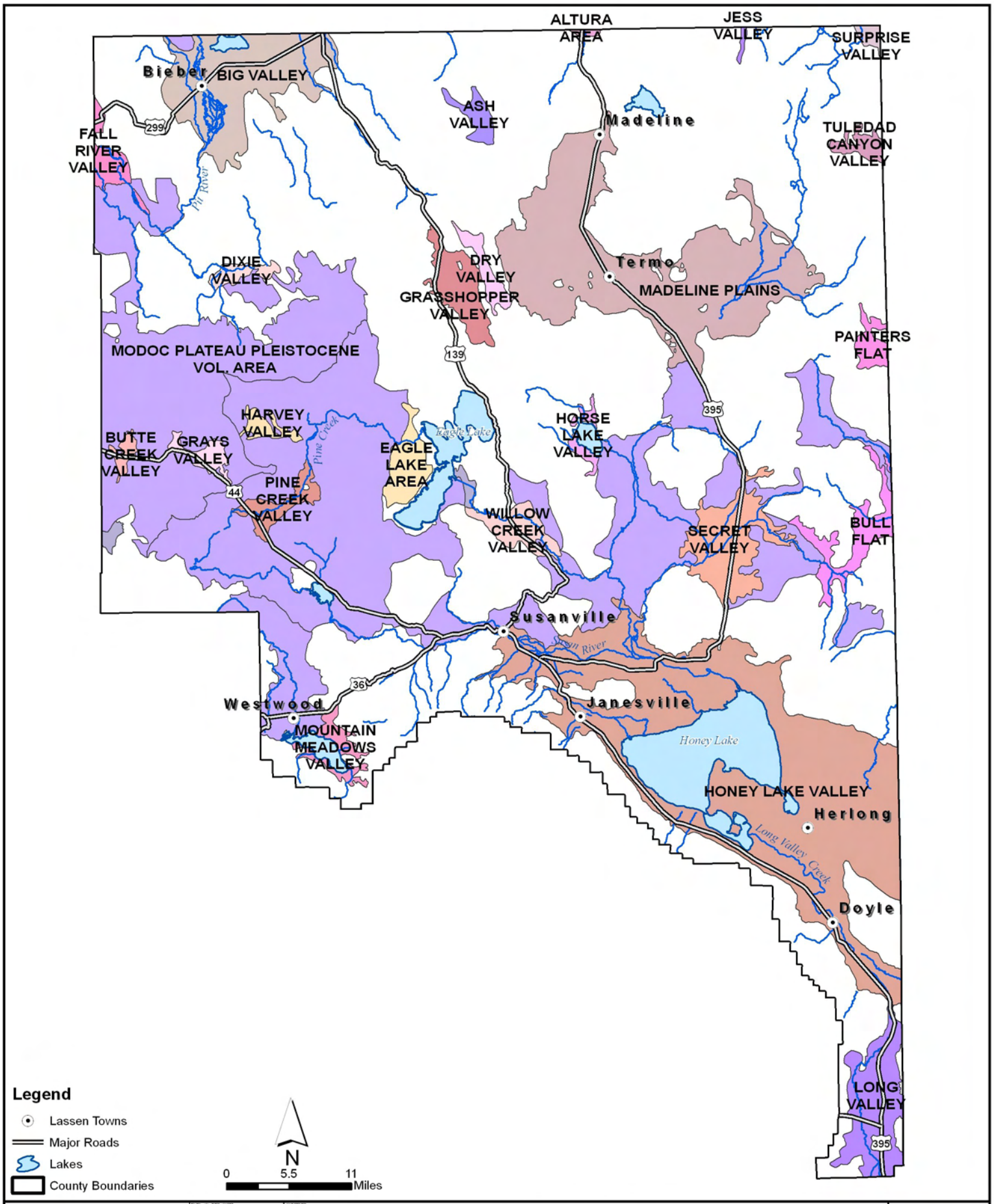
The surficial geology in Lassen County reflects the geologic provinces. At the southern edge of the County, igneous and metamorphic rocks are present, indicating the Sierra Nevada province. The southeastern portion of the county has linear valleys and ridges correlated with the Basin and Range province. In the north and western portions of the County, volcanic rock is present at the surface, corresponding with the Cascade Range and Modoc Plateau provinces. The surficial extents of geologic formations are shown in a composite geologic map of Lassen County (Figure 2-10). The bulk of the mapping shown in Figure 2-10 was conducted in 1958 and 1960. Recent geologic mapping efforts and volcanism studies such as those done by Grose in 2000 are more recent studies but do not provide countywide coverage.

## 2.5 Groundwater Basins

There are 24 groundwater basins in Lassen County. This GWMP identifies four priority groundwater basins; Big Valley, Willow Creek Valley, Long Valley, and Honey Lake Valley. Priority basins were identified from stakeholder input, land use, water source patterns, and existing groundwater well infrastructure. The majority of groundwater monitoring also occurs in the priority basins. Less information is available for the other groundwater basins in Lassen County.

As part of the development of the GWMP, an inventory of available information was conducted for Lassen County groundwater basins. Groundwater basins in Lassen County are shown in Figure 2-11. In general, significant information is available for Big Valley, Willow Creek Valley, Long Valley, and Honey Lake Valley, and less information is available for the other groundwater basins. Newer information is available for Honey Lake Valley and Long Valley. For example, a geophysical study was completed by NGA in 2004 to determine the depth to bedrock of the narrows separating upper and lower Long Valley. Most information about groundwater basins in Lassen County is based on research conducted by DWR in *Bulletin No. 98 Northeastern Counties Ground Water Investigation* in 1963.

*Photo 2-3. Much of Lassen County's Landscape is shaped by past volcanic activity.*




| | | | |
|---|---|---|---|
| BROWN AND CALDWELL | PROJECT 129506 | SITE Lassen County | Figure 2-11 |
| | DATE 8-15-06 | TITLE Groundwater Basins | |

Sections 2.5.1 through 2.5.5 describe water-bearing formations, groundwater hydrogeology, groundwater quality, and existing well infrastructure within the priority and non-priority groundwater basins. The sections include available published information and anecdotal information, where available.

Several terms are typically used when discussing groundwater formations and hydrogeologic properties of groundwater aquifers. The following sections describe Lake County's individual groundwater basins using these terms. These terms include:

- **Specific Capacity -** The specific capacity of a well depends on hydraulic characteristics of the aquifer and on the construction of the well. Specific capacity is determined by dividing the wells production by the drawdown that occurs during pumping. Higher specific capacities in wells tend to be indicative of higher aquifer production. Specific capacity is typically expressed in gallons per minute (gpm) per foot of drawdown.
- **Specific Yield –** The specific yield is the ratio of the volume of water a rock or soil will yield by gravity drainage to the volume of the rock or soil. Specific yield is reported as a percent. Higher specific yields tend to be indicative of higher aquifer production. An example of a good specific yield is 7 percent, which is a typical average specific yield of aquifers in the Sacramento Valley.
- **Transmissivity –** Transmissivity is a term used to define the ability of an aquifer to convey or transport water, similar to the capacity of a pipeline. Transmissivity is related to hydraulic conductivity and saturated thickness of an aquifer or groundwater basin. Hydraulic conductivity is the rate at which groundwater moves through an aquifer. More porous aquifers, such as sand and gravel aquifers, have high hydraulic conductivities. The saturated thickness is the total depth of groundwater in an aquifer or basin. The term transmissivity combines both these terms so it is a good overall indication of the capacity of a groundwater basin to produce water. Higher transmissivity values tend to be indicative of higher aquifer production. An example of a good transmissivity is 100,000 gallons per day per foot (gpd/ft), which is the average transmissivity of a productive aquifer in the Sacramento Valley.
- **Well Production -** Well production is the amount of water that is produced from a well, typically reported in gallons per minute (gpm).

Groundwater quality monitoring is performed by DWR in Lassen County. Groundwater quality is also monitored in conjunction with the California Department of Health Services (DHS). Water quality monitoring data was analyzed in priority basins as part of the GWMP for constituents of concern and compared to secondary water quality limits (SWQLs). The SWQLs are thresholds at which water may begin to have an effected taste or odor.

Sections 2.5.1 through 2.5.5 also contain information about the wells in each groundwater basin. DWR's well completion report database provided well depth and well use data. DWR's database contains information on the majority of wells drilled after 1947, wells drilled prior to 1947 are generally not included and some wells drilled after 1947 may not have been reported to DWR (potentially up to 30%), and therefore are not included in the database. Table 2-3 shows the number of each type of well in each of the priority basins and countywide. Lassen County has approximately 4,446 wells. The wells are classified by use as domestic, irrigation, municipal, monitoring, and other.

Table 2-3 presents the total number of wells by type within the priority basins. Table 2-3 shows that of the 4,446 wells in Lassen County, 3,193 wells are domestic, 407 wells are irrigation, 17 wells are municipal wells, 271 wells are monitoring wells, and 552 wells are listed as "other".

Table 2-3. Number of Wells by Use and Groundwater Basin

| Groundwater Basin | Domestic Wells | Irrigation Wells | Municipal Wells | Monitoring Wells | Other Wells | Totals |
|---|---|---|---|---|---|---|
| Big Valley | 137 | 132 | 2 | 27 | 79 | 377 |
| Willow Creek Valley | 42 | 7 | 0 | 0 | 3 | 52 |
| Long Valley | 33 | 0 | 1 | 0 | 6 | 40 |
| Honey Lake Valley | 2086 | 165 | 8 | 218 | 341 | 2822 |
| Total of 4 Basins | 2,298 | 304 | 11 | 245 | 429 | 3,293 |
| Wells not in the 4 GW Basins | 895 | 103 | 6 | 26 | 123 | 1,153 |
| Total for Lassen County | 3,193 | 407 | 17 | 271 | 552 | 4,446 |

Each priority basin description includes cumulative frequency well depth distribution figures that illustrate the well depth range and cumulative frequency depth distribution for domestic and irrigation wells, if enough wells were present. Figures 2-12 and 2-13 show well depth frequency throughout Lassen County. The cumulative frequency, on the left axis of the figure, shows the percent of all wells that are shallower than the line. For example, on Figures 2-12 and 2-13 respectively, approximately 50 percent of all domestic wells are shallower than 150 feet deep, and approximately 50 percent of all irrigation wells are shallower than 400 feet deep. The steep cumulative frequency curve on Figure 2-12 for domestic wells indicates that adequate domestic supplies are typically found throughout the county with fairly shallow wells. The flat cumulative frequency curve on Figure 2-13 for irrigation wells portrays a flatter slope, indicating that locating groundwater supplies that are adequate for irrigation needs is more difficult. The flatter curve indicates that the location of the well and type of aquifer influence the depth of irrigation wells.

### 2.5.1 Non-Priority Groundwater Basins

Analysis of the 20 non-priority groundwater basins as part of this GWMP was limited to information in Bulletin 118-2003. Table 2-4 lists information for the 24 groundwater basins in Lassen County, and shows that hydrogeologic characteristics of most groundwater basins are not well understood. Bulletin 118 has information for geologic formations for 13 basins, and groundwater level trends for eight basins out of the 24 groundwater basins. There are groundwater monitoring wells in seven of the 24 groundwater basins. Estimated total storage from Bulletin 118 represents the potential water in storage through the entire depth of the groundwater basin, and does not represent usable storage in the groundwater basin. Estimated total storage is generally estimated from average yields and assumed sediment depths, and often overestimates actual storage. Well yields reported in Bulletin 118 are an average of available irrigation wells yields in the groundwater basin. Basins without an adequate number of irrigation wells with production data do not have well production reported.

*Photo 2-4. Intermountain basins, such as Pine Creek Valley have limited groundwater development.*

*Photo 2-5. The groundwater potential in many non-priority basins such as Grays Valley has not been investigated. Groundwater development without adequate characterization and monitoring could have significant impacts to the existing habitat and land uses.*

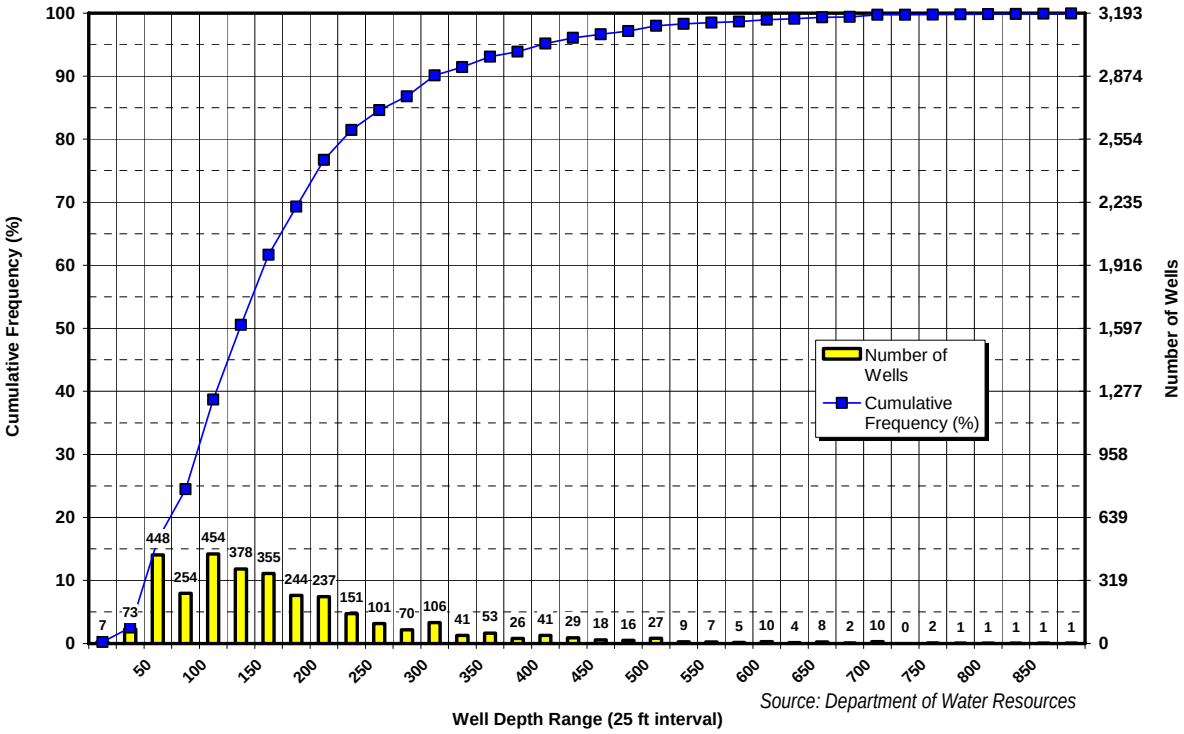



*Figure 2-12. Depth Distribution of Domestic Wells in Lassen County*

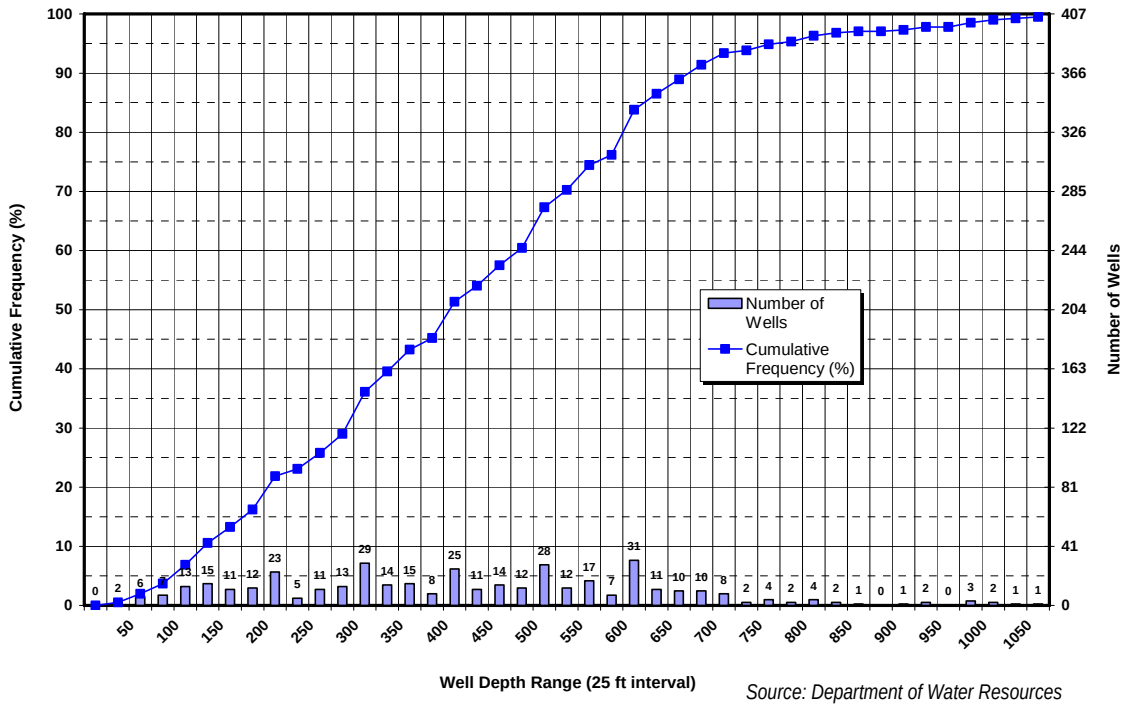



*Figure 2-13. Depth Distribution of Irrigation Wells in Lassen County*

## 2.5.2 Big Valley

Identified as a priority groundwater basin based on stakeholder input, land use, water source patterns, and existing groundwater well infrastructure, Big Valley is in the northwest corner of Lassen County (Figure 2-11). Big Valley is a primary source of water for agriculture and for the town of Bieber. It lies in northwestern Lassen County, and extends into Modoc County. The Modoc County portion of Big Valley ranges from two to five miles long, and 3 to 10 miles wide. Big Swamp, Ash Creek, and the Pit River are major water features in Big Valley. The dominant surface water feature in Big Valley is the Pit River, which meanders through Big Valley with flows exiting the valley to the south.

The ground surface in Big Valley gently slopes towards the south and towards the Pit River. The floor of Big Valley ranges in elevation from 4,110 feet msl at the south end of the valley, to 4,280 feet msl in the northeastern corner of the Lassen County portion of the valley. Big Valley is bounded by extensive bench lands and gently sloping hills. Surrounding mountains include the Big Valley Mountains to the west, and Barber Ridge to the east.

During the Miocene epoch, 25 million years ago, Big Valley was part of an extensive area of lakes bordered by volcanoes. The lakes received ash and other volcanic sediments directly from eruptions. Volcanic sediments were washed into the lakes by rainfall and runoff. During the Pliocene epoch, 13 million years ago, basin and range faulting began, shaping the ridges, mountains, and creating a large prehistoric valley that was the predecessor to Big Valley. The prehistoric lake was restricted more or less to present valley areas. Concurrent with basin and range activity, volcanoes erupted on the southeast end of Big Valley, creating the Big Valley Mountains, and damming the Pit River, creating a large prehistoric lake. By the end of the Pleistocene epoch, 2 million years ago, the Pit River had succeeded in cutting through the mountains and had drained the lake.

Table 2-4. Groundwater Basin Information From Bulletin 118

| Basin # | Basin Name | Area (acres) | Formations | GW Level Trends | Estimated Total Storage (1) (acre-ft) | Water Level Monitoring Wells | Water Quality Monitoring Wells | Well Production (Average GPM) |
|---|---|---|---|---|---|---|---|---|
| 5-44 | Honey Lake Valley | 311,750 | Holocene Sedimentary Deposits<br>Pleistocene Lake and Near-shore Deposits<br>Plio-Pleistocene and Pleistocene Volcanic Rocks | 10 foot decline in early 1990s with recovery since | 10,000,000 | 68 | 21 | 784 |
| 6-104 | Long Valley | 46,840 | Quaternary Sedimentary Deposits<br>Tertiary Hallelujah Formation | Steady | 300,000 | 21 | 7 | Unk |
| 5-53 | Big Valley | 92,000 | Holocene Sedimentary Deposits<br>Pliocene Lava Flows<br>Beiber Formation | 15 foot decline in early 1990s with 12 foot recovery by 1999 | 3,750,000 | 14 | 10 | 880 |
| 5-8 | Willow Creek Valley | 11,700 | Holocene Sedimentary Deposits<br>Holocene Basin Deposits<br>Pleistocene to Holocene Basalt<br>Pliocene Lake Deposits | 2-10 foot decline in early 1990s with recovery since | Unk | 7 | 3 | 382 |
| 5-51 | Surprise Valley | 228,460 | Holocene Alluvial Fans<br>Holocene Alluvium Deposits<br>Pleistocene Near-shore Deposits<br>Pleistocene to Holocene Lake Deposits | Unk | 4,000,000 | 0 | 0 | 1,383 |
| 6-97 | Madeline Plains | 156,150 | Holocene Sedimentary Deposits<br>Pleistocene Near-Shore Deposits<br>Pleistocene Lake Deposits<br>Plio-Pleistocene Basalt | 3-8 foot decline in early 1990s with recovery since | 2,000,000 | 3 | 6 | less than 500 |

*(1) Actual usable storage, based on well infrastructure, is a small percentage of the estimated total storage, typically less than 10 percent of total storage.*

*(2) Unk denotes that the attribute is unknown*

Table 2-4. Groundwater Basin Information From Bulletin 118

| Basin # | Basin Name | Area (acres) | Formations | GW Level Trends | Estimated Total Storage (1) (acre-ft) | Water Level Monitoring Wells | Water Quality Monitoring Wells | Well Production (Average GPM) |
|---|---|---|---|---|---|---|---|---|
| 6-93 | Alturas GW basin, South Fork Pit River Subbasin | 114,000 | Holocene Sedimentary Deposits<br>Pleistocene Near-Shore Deposits<br>Pleistocene Volcanic Rocks<br>Plio-Pleistocene Alturas Formation | 10 foot decline in early 1990s with recovery since | Unk | 0 | 0 | 1,075 |
| 6-98 | Fall River Valley | 54,800 | Holocene Sedimentary Deposits<br>Holocene Volcanic Rocks<br>Pleistocene Near-shore Deposits<br>Pleistocene Volcanic Rocks<br>Pliocene Volcanic Rocks | Shallowest depth to GW in northern portion of basin | 1,000,000 | 2 | 1 | 266 |
| 5-54 | Secret Valley | 33,680 | Holocene Sedimentary Deposits<br>Plio-Pleistocene Basalt<br>Pliocene Lake Deposits | Increased 10-20 feet 1980 to 2000, 10 foot decrease 2000 to 2005 | Unk | 2 | 4 | Unk |
| 6-95 | Grasshopper Valley | 17,670 | Holocene Sedimentary Deposits<br>Pleistocene Near-Shore Deposits<br>Pleistocene Lake Deposits<br>Plio-Pleistocene Basalt | Unk | Unk | 0 | 0 | Unk |
| 6-94 | Dry Valley | 6,500 | Holocene Sedimentary Deposits<br>Pleistocene Near-Shore Deposits<br>Pleistocene Lake Deposits<br>Plio-Pleistocene Basalt | Unk | Unk | 0 | 0 | 328 |
| 6-101 | Painters Flat | 6,400 | Pleistocene Lake Deposits<br>Pleistocene Basalt | Unk | Unk | 0 | 0 | Unk |
| 6-96 | Eagle Lake Area | Unk | Quaternary Lake Deposits<br>Holocene Basalt | Unk | Unk | 0 | 0 | Unk |

*(1) Actual usable storage, based on well infrastructure, is a small percentage of the estimated total storage, typically less than 10 percent of total storage.*

*(2) Unk denotes that the attribute is unknown*

Table 2-4. Groundwater Basin Information From Bulletin 118

| Basin # | Basin Name | Area (acres) | Formations | GW Level Trends | Estimated Total Storage (1) (acre-ft) | Water Level Monitoring Wells | Water Quality Monitoring Wells | Well Production (Average GPM) |
|---|---|---|---|---|---|---|---|---|
| 6-99 | Bull Flat | 18,100 | Unk | Unk | Unk | 0 | 0 | Unk |
| 6-92 | Pine Creek Valley | 9,530 | Unk | Unk | Unk | 0 | 0 | Unk |
| 6-3 | Mountain Meadows Valley | 8,150 | Unk | Unk | Unk | 0 | 0 | Unk |
| 6-100 | Ash Valley | 6,010 | Unk | Unk | Unk | 0 | 0 | 2,200 |
| 6-104 | Grays Valley | 5,440 | Unk | Unk | Unk | 0 | 0 | Unk |
| 5-5 | Tuledad Canyon | 5,200 | Unk | Unk | Unk | 0 | 0 | Unk |
| 5-4 | Dixie Valley | 4,870 | Unk | Unk | Unk | 0 | 0 | Unk |
| 5-2.01 | Harvey Valley | 4,500 | Unk | Unk | Unk | 0 | 0 | Unk |
| 6-2 | Horse Lake | 3,800 | Unk | Unk | Unk | 0 | 0 | Unk |
| 6-1 | Butte Creek Valley | 3,230 | Unk | Unk | Unk | 0 | 0 | Unk |
| 5-44 | Jess Valley | 1,090 | Unk | Unk | Unk | 0 | 0 | Unk |

*(1) Actual usable storage, based on well infrastructure, is a small percentage of the estimated total storage, typically less than 10 percent of total storage.*

*(2) Unk denotes that the attribute is unknown*

During the Pleistocene epoch, 2 million years ago to 500,000 years ago, flows of basalt covered the northern portions of the prehistoric valley, and again dammed the southern end of the valley, forming another large lake. This lake was present possibly into the Recent epoch, 11,000 years ago, until the Pit River cut through the basalt dam and drained the lake, revealing the Big Valley we see today.

### Water-Bearing Formations

There are three major water bearing formations in Big Valley: Holocene Sedimentary Deposits, Pleistocene Volcanic Rocks, and the Beiber Formation. Of these formations, the Pleistocene Volcanic Rocks are most important, providing recharge to much of the valley, and comprising a confined aquifer in the southeastern portion of the valley. The water bearing formations described below are described in order from youngest to oldest, with the youngest formations stratigraphically above the older formations.

### Holocene Sedimentary Deposits

Holocene Sedimentary Deposits include basin deposits, intermediate alluvium, and alluvial fans. Basin deposits occur in the low lying areas in the central portion of the valley, consisting of silt and clay. Basin deposits have very low permeability, and are not usually over 150 feet thick (DWR, 1963). Intermediate alluvium is found along the perimeter of the valley and consists of unconsolidated silt and sand with some clay and gravel. Intermediate alluvium is generally moderately permeable and is up to 150 feet thick. Alluvial fans occur in localized areas on the edge of the valley, and consist of stratified gravel with some clay lenses. Alluvial fans in Big Valley occur only in a few localized areas, and are not considered a significant source of water (DWR, 2003).

### Pliocene and Pleistocene Volcanic rocks

Pliocene volcanic rocks consist of jointed and fractured basalt that occurs north of the basin and end south of Big Valley, with varying thicknesses up to 1,000 feet. The rocks are moderately to highly permeable and act as recharge areas and conduits of groundwater recharge to portions of the valley (DWR, 2003).

Pleistocene volcanic rocks also consist of jointed and fractured basalt flows but deposits range from 50 to 150 feet thick. Pleistocene volcanic rocks serve as recharge areas and yield water to wells in the southern portion of Big Valley (DWR, 2003) The volcanic rocks in the southeastern portion of the basin are confined under lake deposits, and in general yield large quantities of water to deep wells in the area.

### Bieber Formation

The Bieber formation underlies all of Big Valley and consists of diatomite, sand, silt, clay, and some gravel. It ranges in thickness from 1,000 to 2,000 feet. Principal water bearing zones in the Bieber Formation consist of white pumiceous sand and black volcanic sand. These zones yield large amounts of groundwater to irrigation wells.

### Groundwater Hydrogeology/Levels/Movement

The major sources of groundwater recharge in Big Valley is percolated water from the upland recharge areas of Pliocene and Pleistocene Basalt located south and northwest of Big Valley. Precipitation falls on the basalt, infiltrates through fractures and joints, and percolates through the basalt to depth and then laterally beneath the floor of Big Valley (DWR, 1963). A lesser amount of groundwater recharge occurs through direct infiltration of precipitation. DWR estimated the storage capacity of Big Valley to be 3,750,000 acre-feet to a depth of 1,000 feet. Not all of the storage capacity contains economically recoverable or water of acceptable quality for use.

Hydrographs in Figure 2-14, at the end of this section show that groundwater levels in Big Valley follow the same general trends across most parts of the valley. Hydrographs in the north, east, and southeast show increasing seasonal groundwater level fluctuations beginning in the year 2000. Generally, groundwater levels in Big Valley are high in the spring and lower in the fall, after groundwater has been extracted during the summer. Hydrographs in Big Valley indicate 5 to 15 feet of elevation change from spring to fall. Hydrographs in Big Valley also indicate that groundwater levels are impacted during drought periods. During the drought period from 1987 to 1991, spring groundwater levels decrease from 10 to 30 feet, as compared to levels observed before and after drought periods.

Figure 2-14 also shows that agricultural land use is concentrated in the southeastern and eastern portions of the valley. Areas with groundwater or mixed source (surface and groundwater) supplies generally have annual fluctuations in groundwater, which is consistent with summer groundwater withdrawals.

Groundwater in Big Valley occurs in two aquifers, a shallow aquifer, and a deeper, confined aquifer. The shallow aquifer is present throughout Big Valley, and generally is controlled by topography, with groundwater movement from the east towards the Pit River, and then to the south, along with the flow of the Pit River. The Pit River is a gaining river in the southern end of Big Valley.

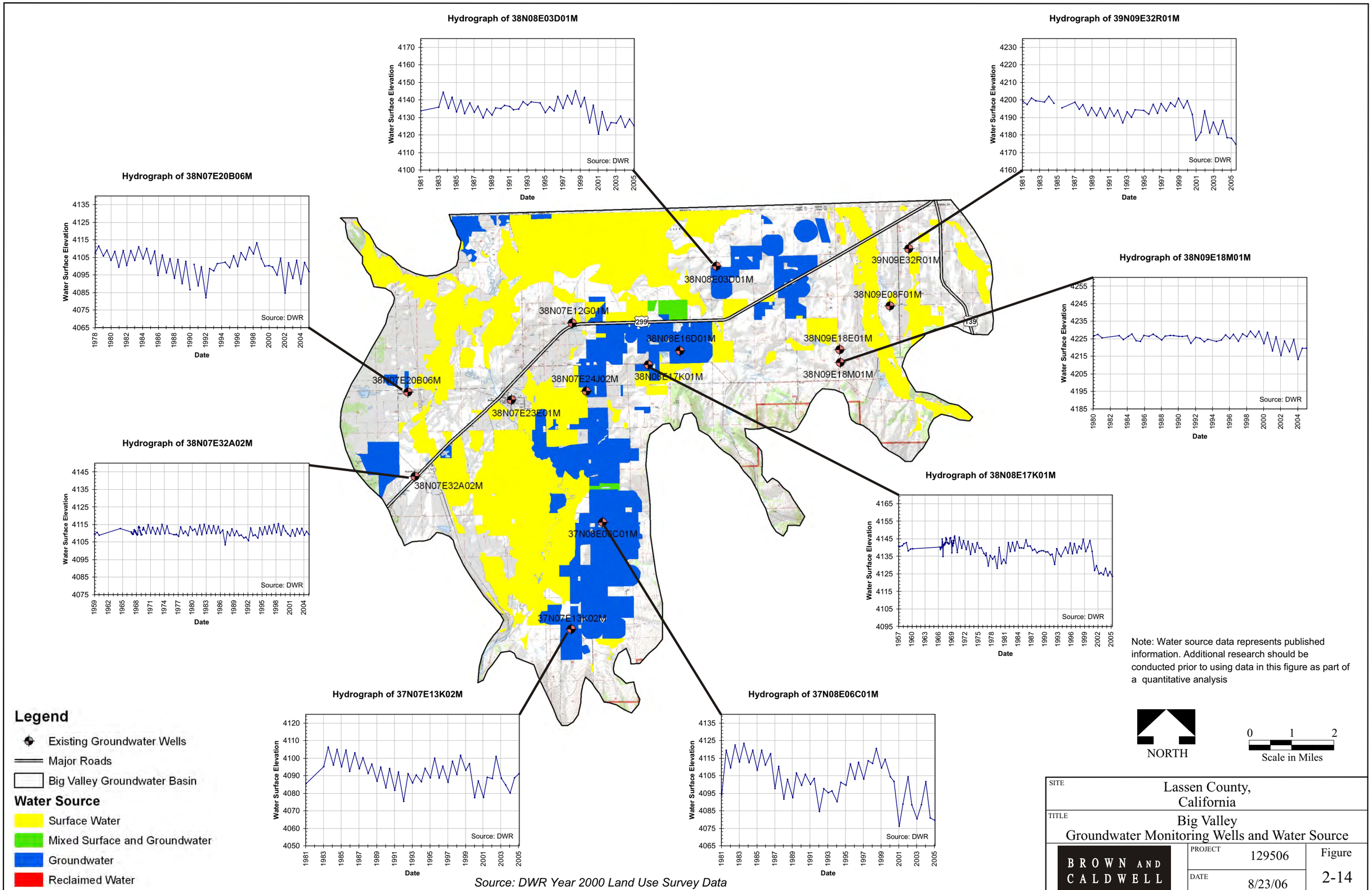
Groundwater movement in Big Valley may also be affected by structural features. Big Valley is bounded by faults on the southwest and faults are present within the groundwater basin. Faults are also present under Big Valley, concealed under Holocene Lake Deposits. Holocene Lake Deposits are not displaced at the surface, likely due to emplacement after fault movement. The main fault trend is to the northwest and the Bieber formation has been deformed into gentle folds apparently associated with faulting (DWR, 1963). The numerous faults may act as partial groundwater barriers, and some faults may act as conduits for upward migration of thermal water, two hot springs in Big Valley are located close to faults.

### Groundwater Quality/Inelastic Land Subsidence

Current published information regarding groundwater quality and inelastic land surface subsidence in Big Valley is unavailable. Anecdotal evidence indicates that groundwater quality is generally good and that inelastic land surface subsidence is not occurring.

### Groundwater Wells

There are 137 domestic wells and 132 irrigation well records on file for Big Valley. Figures 2-15 and 2-16 present the well depth range and cumulative frequency depth distribution for domestic and irrigation wells in Big Valley, respectively. Approximately 50 percent of domestic wells are shallower than 150 feet deep, and approximately 50 percent of irrigation wells are shallower than 450 feet deep. The steepness of the curve on Figure 2-15 for domestic wells shows that the majority of domestic wells are drilled to similar depth indicated that adequate domestic supplies are readily available in Big Valley at depths between 100 and 200 feet. The gentler slope in Figure 2-16 for irrigation wells shows that irrigation well depths are not concentrated at one general depth, and instead irrigation wells are completed at many different depths. Since irrigation wells require higher yields than domestic wells, the gentle slope indicates that well yields vary throughout the valley, and irrigation wells are drilled deeper to secure an adequate yield in areas that are less productive.




Source: DWR Year 2000 Land Use Survey Data

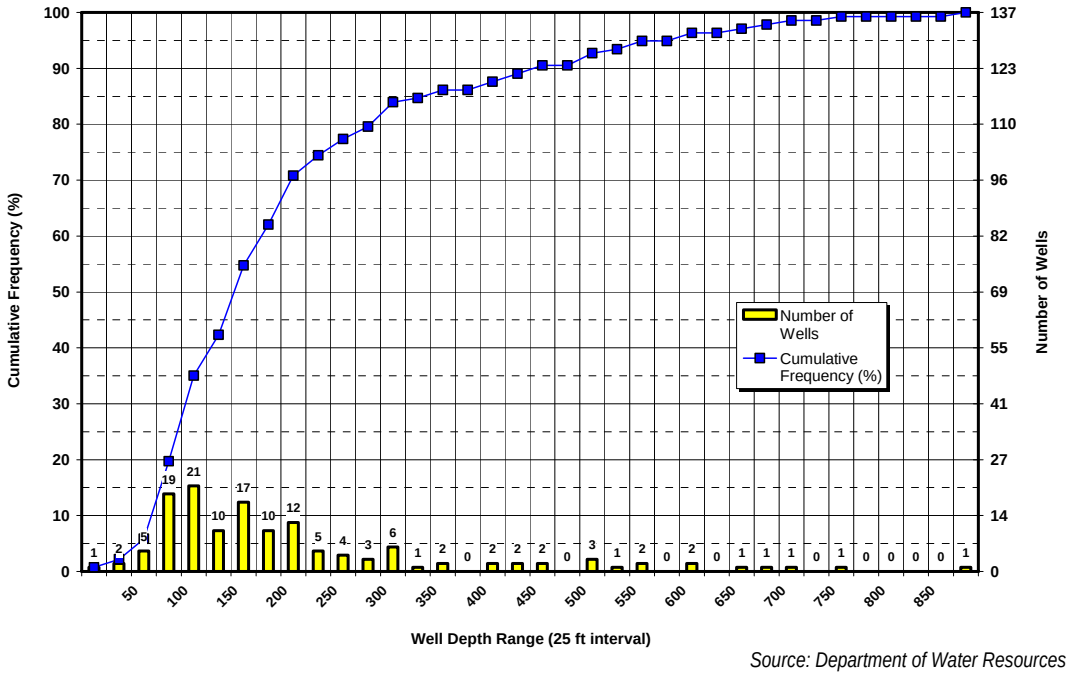



*Figure 2-15. Depth Distribution of Domestic Wells in Big Valley*

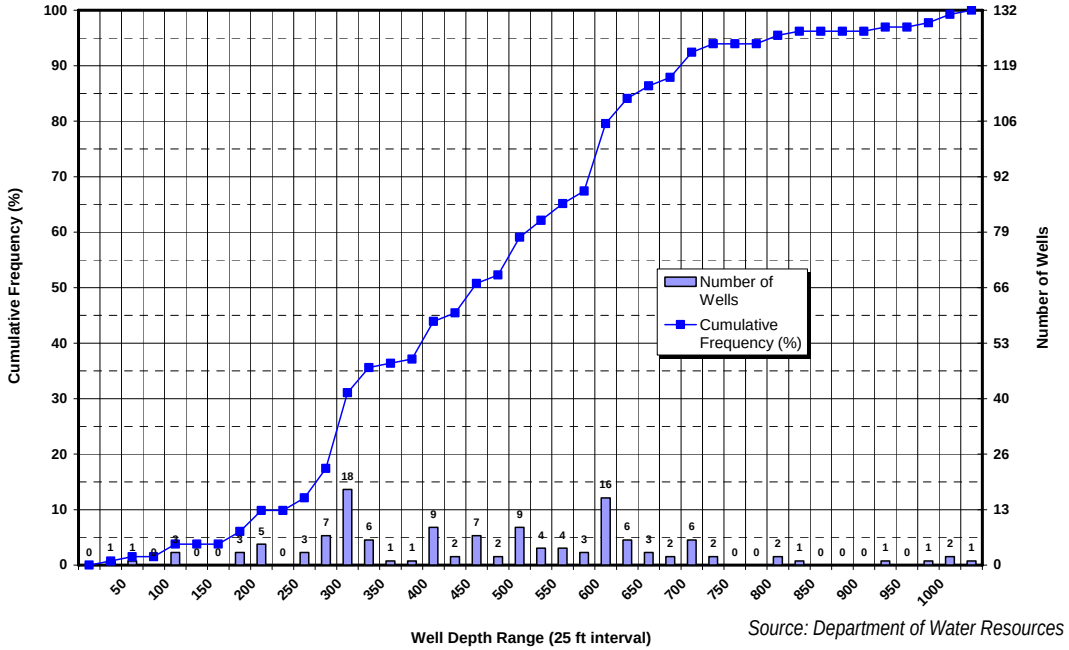



*Figure 2-16. Depth Distribution of Irrigation Wells in Big Valley*

### 2.5.3 Willow Creek Valley

Identified as a priority groundwater basin based on stakeholder input, land use, water source patterns, and existing groundwater well infrastructure, Willow Creek Valley is in the central portion of Lassen County (Figure 2-11). Willow Creek Valley is an agricultural area southeast of Eagle Lake, and is approximately 7 miles long and 4 miles wide. The valley is bounded on the west by Black Mountain and Deans Ridge, on the north by Horse Lake Mountain, on the south by Antelope Mountain, and on the east by Tunnison Mountain. Willow Creek flows originate from springs on the northeast edge of the valley and flows southeast through the valley.

*Photo 2-6. Willow Creek Valley has extensive agricultural use.*

The ground surface in Willow Creek Valley gently slopes towards the southeast and locally toward Willow Creek. The floor of Willow Creek Valley ranges in elevation from 4,900 feet msl at the northwest end of the valley, to 4,880 feet msl in the southeastern corner, where Willow Creek flows out of the basin.

At the beginning of the Pleistocene epoch, 2 million years ago, Willow Creek Valley had formed and sediments were being deposited in it. The northern portion of the valley was covered by volcanic rock. Later eruptions occurred in the vicinity of Black Mountain, covering the western portion of the valley in volcanic rock. Subsequent faulting, erosion and deposition continued into recent times, forming the Willow Creek Valley we see today.

#### Water-Bearing Formations

Water-bearing formations are composed of Holocene sedimentary deposits, Pleistocene to Holocene basalt, and Pliocene lake deposits. The water bearing formations described below are described in order from youngest to oldest, with the youngest formations stratigraphically above the older formations.

#### Holocene Sedimentary Deposits

Holocene Sedimentary Deposits include basin deposits, intermediate alluvium, and alluvial fans. Basin deposits occur in the low lying areas in the northeastern portion of the valley, consisting of silt and clay. Basin deposits have very low permeability (DWR, 1963). Intermediate alluvium is found along the perimeter of the valley and consists of unconsolidated silt and sand with some clay and gravel. Intermediate alluvium exhibits moderate permeability and is up to 150 feet thick. Alluvial fans deposits consist of unconsolidated gravel, sand and clay, and are moderate to high in permeability (DWR, 2003).

#### Pleistocene to Holocene Volcanic Rocks

Pleistocene to Holocene volcanic rocks consist of jointed and fractured basalt containing zone soft scoria that occurs to the east and north Willow Creek Valley, with varying thicknesses. The rocks are moderately to highly permeable and act as recharge areas and conduits of groundwater recharge to portions of the valley (DWR, 2003). Volcanic rocks in the southeastern portion of the valley may contain water under confined conditions (DWR, 1963).

### Pliocene Lake Deposits

These deposits consist of beds of consolidated shale, sandstone, diatomite, and lenses of gravel and underlie younger sediments and volcanic rock in the valley. Permeability of lake deposits is generally low, with yields only adequate for domestic purposes.

### Groundwater Hydrogeology/Levels/Movement

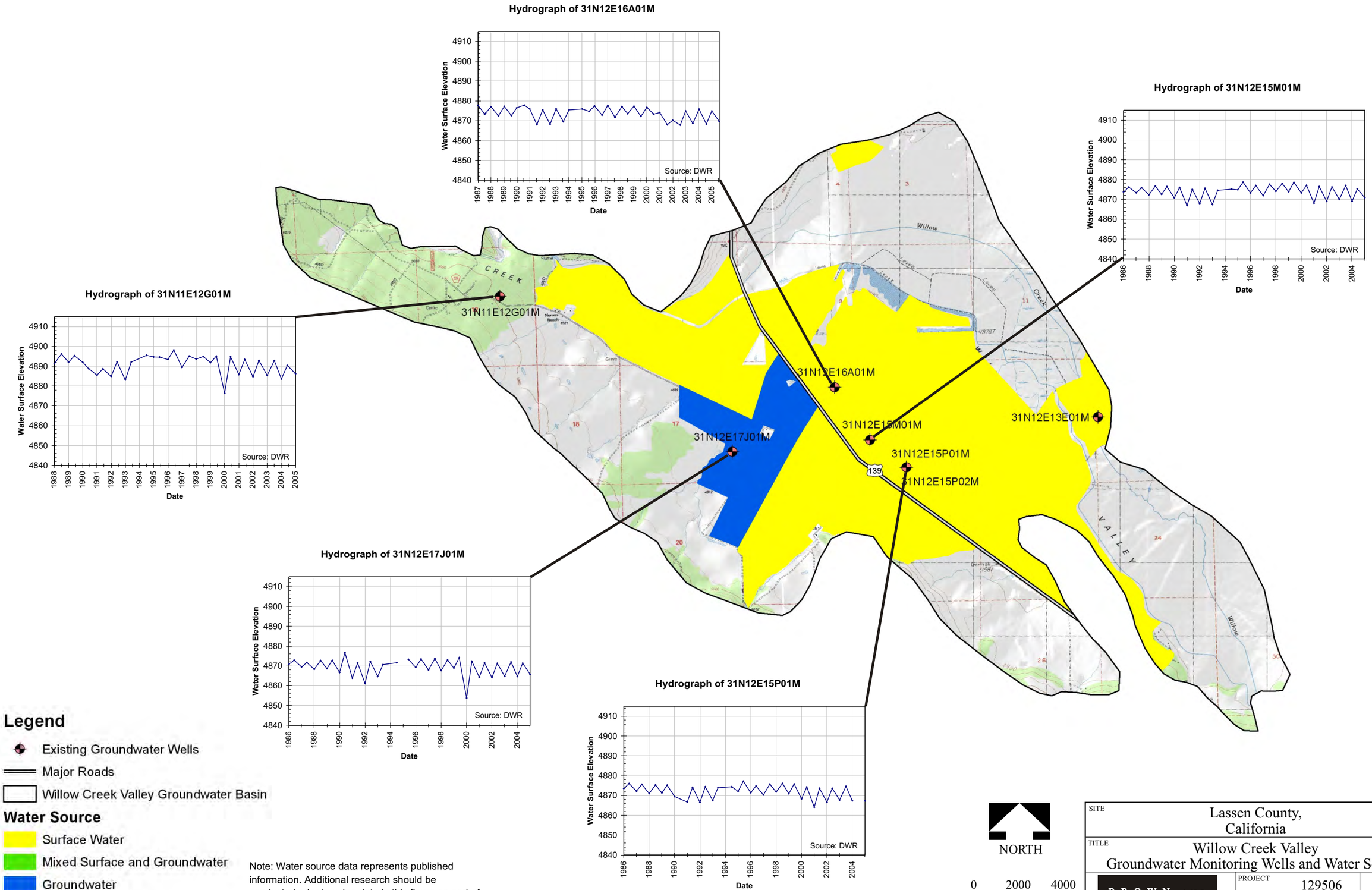
The major sources of groundwater recharge in Willow Creek Valley is water percolated from the upland recharge areas of Pleistocene to Holocene Basalt located north and east of Willow Creek Valley. Precipitation infiltrates through fractures and joints, and percolates through the basalt to depth and then laterally beneath the floor of Willow Creek Valley (DWR, 1963). A lesser amount of groundwater recharge occurs through direct infiltration of precipitation. The amount of groundwater in storage in Willow Creek Valley has not been estimated.

Agricultural lands in Willow Creek Valley are primarily irrigated with surface water, which avoids groundwater level declines during drought periods that are evident in areas irrigated exclusively with groundwater. Hydrographs in Figure 2-17 show that groundwater levels in Willow Creek Valley follow the same general trends in most parts of the valley. Generally, groundwater levels in Willow Creek Valley are high in the spring and lower in the fall, after water has been used during the summer. Hydrographs in Willow Creek Valley show between 5 to 10 feet of seasonal elevation change from spring to fall. Hydrographs in Willow Creek Valley also indicate that groundwater levels in Willow Creek Valley have not declined during drought periods. During the drought period from 1987 to 1991, spring groundwater levels were constant and did not decrease in elevation. Figure 2-17 also shows that most agricultural land in Willow Creek Valley is irrigated with surface water, and a small portion is irrigated with groundwater. Infiltration of irrigation water and the correlated low levels of groundwater pumping combine to protect the groundwater basin from declines during drought periods.

Groundwater movement in Willow Creek Valley is controlled by topography, flowing from west to east, and eventually to the southeast, where Willow Creek leaves the basin (DWR, 1963). Groundwater movement in Willow Creek Valley may also be affected by structural features. Willow Creek Valley is bounded by faults on the southwest and sediments in Willow Creek Valley have been moved by tectonic activity. Faults are also present under Willow Creek Valley, concealed under Holocene Sedimentary Deposits. Holocene Sedimentary Deposits are not displaced at the surface, likely due to emplacement after fault movement. The main fault trend is to the northwest (DWR, 1963). The numerous faults may act as partial groundwater flow barriers or conduits.

### Groundwater Quality/Inelastic Land Subsidence

Current published information regarding groundwater quality and inelastic land surface subsidence in Willow Creek Valley is unavailable. Anecdotal evidence indicates that groundwater quality is generally good and that inelastic land surface subsidence is not occurring.




Note: Water source data represents published information. Additional research should be conducted prior to using data in this figure as part of a quantitative analysis

*Source: DWR Year 2000 Land Use Survey Data*

| | |
|---|---|
| SITE | Lassen County, California |
| TITLE | Willow Creek Valley Groundwater Monitoring Wells and Water Source |
| BROWN AND CALDWELL | |
| PROJECT | 129506 |
| DATE | 8/23/06 |
| Figure | 2-17 |

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### Groundwater Wells

There are 42 domestic well records and 8 irrigation well records on file for Willow Creek Valley. Figure 2-18 presents the well depth range and cumulative frequency depth distribution for domestic wells in Willow Creek Valley. Approximately 50 percent of domestic wells are shallower than 175 feet deep. The steepness of the curve on Figure 2-18 for domestic wells shows that the majority of domestic wells are drilled to similar depth indicated that adequate domestic supplies are readily available in Willow Creek Valley at depths between 100 and 200 feet.

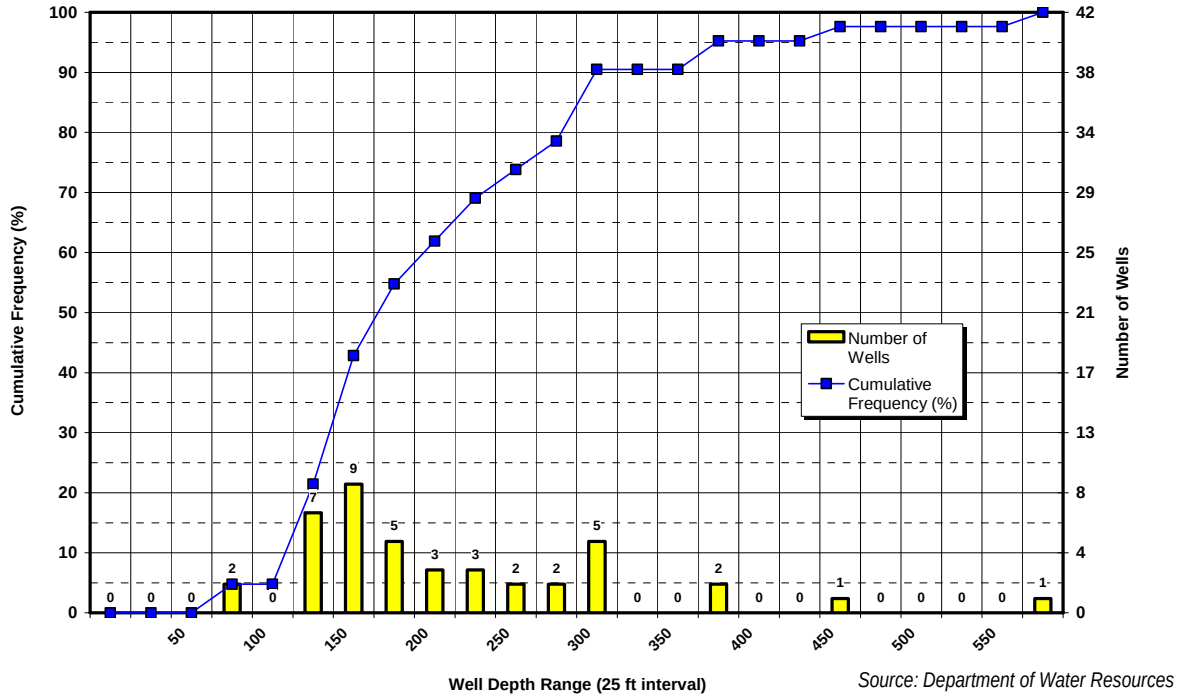



*Figure 2-18. Depth Distribution of Domestic Wells in Willow Creek Valley*

## 2.5.4 Long Valley

Identified as a priority groundwater basin based on stakeholder input, land use, water source patterns, and existing groundwater well infrastructure, the Long Valley Groundwater Basin as identified by DWR in Bulletin 118 underlies Upper Long Valley, which is south of Long Valley, a portion of the Honey Lake Valley Groundwater Basin (Figure 2-11). The boundary between the Long Valley Groundwater Basin and Honey Lake Groundwater Basin occurs at the "narrows", a point on Long Valley Creek where bedrock comes to between 20 and 50 feet below ground surface (NGA, 2004). The majority of Long Valley Groundwater Basin lies in Lassen County, and a small portion of the valley lie in Sierra County. The Lassen County portion of Long Valley is approximately 16 miles long, and 3 miles wide, and the Sierra County portion of Long Valley is approximately 6 miles long, and 2 miles wide. The major water feature in Long Valley is Long Valley Creek, which drains the valley to the north, into Honey Lake Valley, where it is a main source of groundwater recharge.

The Long Valley Groundwater Basin is an elongated north-south trending valley that is bounded by the Diamond Mountains to the west, Peterson Mountains to the east, Peavine Peak to the south, and the Honey

Lake Valley to the north. The valley is bordered by Washoe County to the east. Two east-dipping normal faults are inferred to lie along the western and central parts of the valley. The valley is generally an asymmetric half-graben, with sedimentary sequences that dip westward (DWR, 2003).

The ground surface regionally in Upper Long Valley slopes locally inward Long Valley Creek and towards the north. The floor of Long Valley ranges in elevation from 4,600 feet msl at the north end of the valley, to 5,000 feet msl in the upper end of the valley. Long Valley has extensive bench lands and gently sloping hills. Long Valley Groundwater Basin is near Reno, and has been the subject of proposals of interstate water transfers. It is an interstate basin, sharing a watershed with Washoe County, Nevada.

### Water-Bearing Formations

There are two major water bearing formations in Long Valley: Quaternary sedimentary deposits, and the Hallelujah Formation. The Hallelujah Formation is the primary water-bearing formation in the valley (DWR, 2003). The water bearing formations described below are described in order from youngest to oldest, with the youngest formations stratigraphically above the older formations.

*Photo 2-7. Surface water and groundwater are important resources that support local agriculture and communities in Long Valley.*

### Quaternary Sedimentary Deposits

Quaternary Sedimentary Deposits consist of unconsolidated clay, silt, sand, and gravel deposited by Long Valley creek and its tributaries (DWR, 2003). Quaternary deposits have limited thickness and extent and few wells are completed in it.

### Hallelujah Formation

The Hallelujah Formation consists of a lower member composed of sandstone with interbedded boulder breccias and conglomerates, a middle member consisting of siltstone and shale, and an upper member consisting of sandstone. Thicknesses are reported to be between 3,000 and 8,000 feet (Mergner, 1978). Sediments are fluvial and lacustrine, derived locally from granite and rhyolite tuff in nearby ridges. The lower portion of the formation contains beds of sandy pebble and cobble conglomerate. The conglomerate beds supply most of the groundwater to wells at the southern end of Long Valley.

### Groundwater Hydrogeology/Levels/Movement

The major sources of groundwater recharge in Long Valley are likely to be direct recharge from rainfall, and through percolation of Long Valley Creek and its tributaries. Groundwater outflow from the north end of Long Valley into Honey Lake Valley is restricted by bedrock found 20 to 50 feet below the channel of Long Valley Creek at the "narrows" (NGA, 2004).

Hydrographs in Figure 2-19 at the end of this section show that groundwater levels in Long Valley follow the same general trends throughout most parts of the valley. Hydrographs in the north, and south show that groundwater in the valley is stable and fluctuates 1-3 feet annually. Generally, groundwater levels in Long Valley are high in the spring and lower in the fall. Hydrographs in Long Valley also indicate that groundwater levels in Long Valley have not significantly decreased during drought periods, having maintained constant levels during the 1987 to 1991 drought period. Figure 2-19 also shows that limited irrigation occurs in the valley, and that irrigation primarily utilizes surface water sources.

#### Groundwater Quality/Inelastic Land Subsidence

Current published information regarding groundwater quality and inelastic land surface subsidence in Long Valley is unavailable. Anecdotal evidence indicates that groundwater quality is generally good and that inelastic land surface subsidence is not occurring.

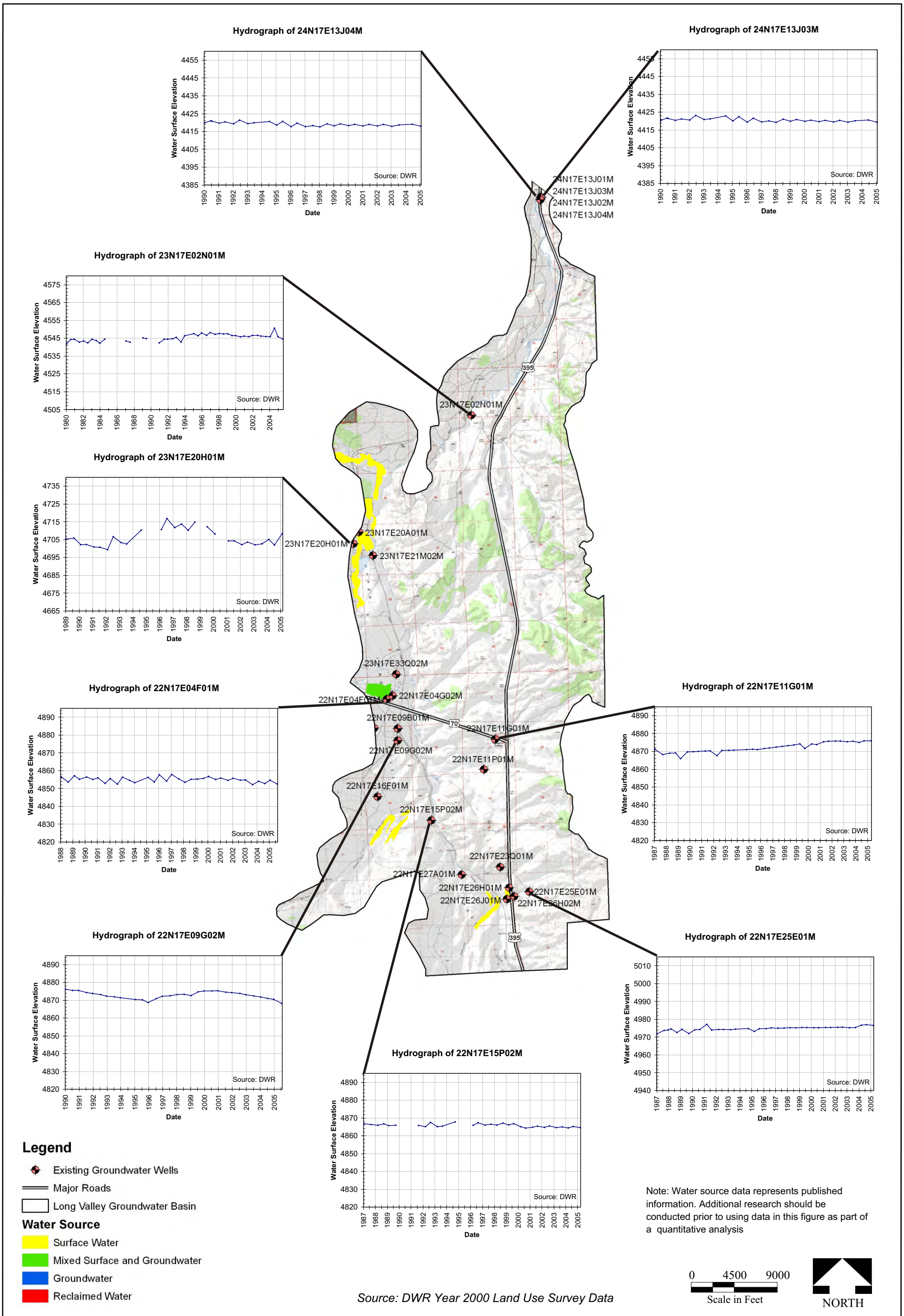
#### Groundwater Wells

There are 33 domestic well records on file, and no irrigation well records on file for Long Valley. Figure 2-20 presents the well depth range and cumulative frequency depth distribution for domestic wells in Long Valley. Approximately 50 percent of domestic wells are shallower than 150 feet deep. The lack of steepness of the curve on Figure 2-20 for domestic wells indicates domestic wells are drilled to different depths to meet domestic demands.

### 2.5.5 Honey Lake Valley

Identified as a priority groundwater basin based on stakeholder input, land use, water source patterns, and existing groundwater well infrastructure, the Honey Lake Valley Groundwater Basin is the source of water for agricultural activities and for the towns of Herlong, Doyle, Litchfield, Janesville, Milford, and Standish. It lies at the eastern edge of Lassen County and the western edge of Washoe County, Nevada. The California portion of the Honey Lake Valley Groundwater Basin is approximately 45 miles long and between 10 to 15 miles wide, and includes Lower Long Valley. The Nevada portion of Honey Lake Valley is approximately 9 miles wide, and between 11 and 5 miles long. Because the valley lies across state lines, it is the subject of water resource discussions between the two states, and groundwater exportation projects have been planned and proposed on the Nevada side of the basin, as described in Section 3.7.

The dominant water feature in Honey Lake Valley is Honey Lake, which covers an area of approximately 90 square miles. More than 40 streams flow into Honey Lake Valley, most of which are intermittent. Major tributaries to Honey Lake are: Long Valley Creek, the Susan River, and Willow Creek. Long Valley Creek drains Long Valley, and receives water from Dry Valley. The Susan River drains the volcanic plateau located to the west of Honey Lake Valley. Willow Creek drains Willow Creek Valley, north of Honey Lake Valley. The ground surface in Honey Lake Valley slopes towards Honey Lake. The floor of Honey Lake Valley ranges in elevation from 4000 feet msl near Honey Lake, to 4,200 feet msl near the edge of the valley.

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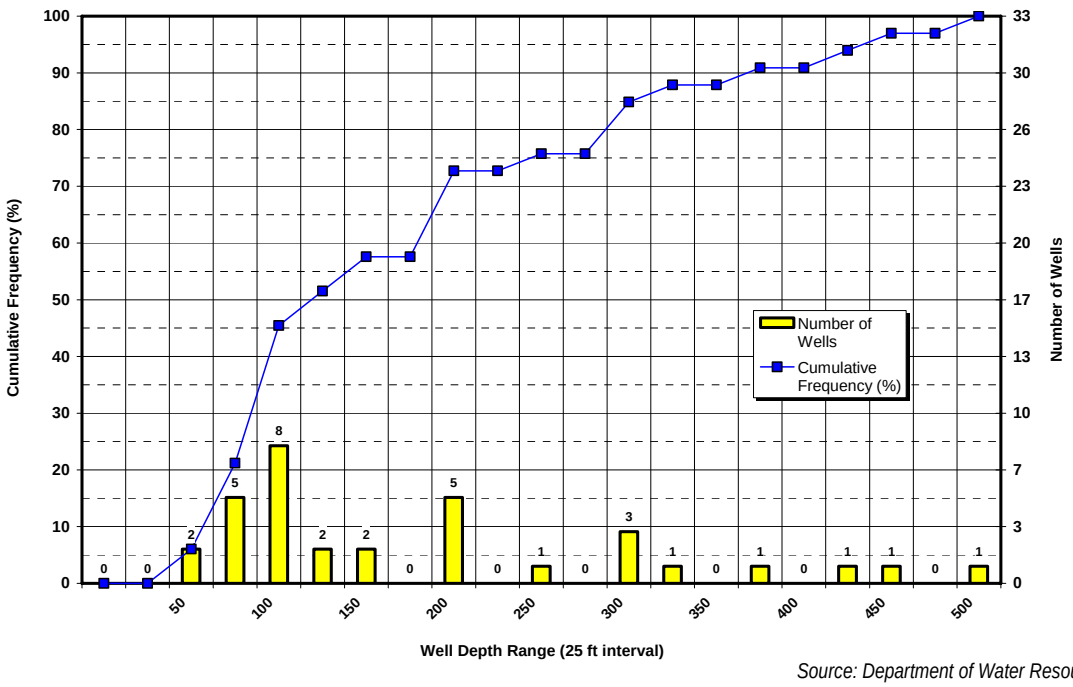



Source: Department of Water Resources

*Figure 2-20. Depth Distribution of Domestic Wells in Long Valley*

Honey Lake Valley is a fault block valley, at the western edge of the Basin and Range Province. The valley is a down faulted basin, called a graben, bounded by up faulted mountains, called horsts, to the northeast and southwest. Honey Lake Valley lies at the junction of three geologic provinces: the Sierra Nevada, which bound the valley to the south, the Cascade Range, which bounds the valley to the north, and the Basin and Range province which the valley lies in. Honey Lake Valley is bounded by the Diamond Mountains to the west and southwest, the Fort Sage and Virginia Mountains to the southwest and southeast, Antelope and Shaffer Mountains to the north, and the Amedee and Skedaddle Mountains to the northeast.

*Photo 2-8. The Honey Lake Valley Groundwater Basin is an important source of agricultural and municipal water.*

Honey Lake Valley contains sediments that are 5,000 to 6,000 feet thick, consisting of unconsolidated and semiconsolidated terrestrial, lakebed, and stream sediments deposited over millions of years (Slosson, 1991). Subsidence due to basin and range faulting started in the Tertiary period, more than 14 million years ago, and as the valley subsided due to faulting, it filled with sediments eroded from nearby mountains. Volcanism occurred on the north end of Honey Lake Valley, creating the Shaffer and Skedaddle Mountains. Lava flows from these two

mountains flowed into the valley and were interbedded with sedimentary deposits. Prehistoric Lake Lahontan covered the Honey Lake Valley during the Pleistocene period, from 14,000 to 12,500 years ago (DWR, 1963). Lake Lahontan covered the Honey Lake Valley and parts of northwestern Nevada, including the Pyramid Lake and Walker Lake areas. Lake Lahontan was up to 400 feet deep, and sediments deposited under Lake Lahontan make up aquifers in Honey Lake Valley today. Very recent and poorly sorted alluvial fan deposits are present at the foot of many of the mountain ranges bounding Honey Lake Valley (Mayo, 1992). Lake Lahontan deposits were covered with recent valley deposits, which were deposited by Honey Lake and its tributaries. The composition of recent valley deposits is dependant on the location of the deposit. Deposits in the center of the valley are fine grained basin deposits, and deposits near the edge of the valley are coarse grained alluvial fan deposits.

### Water-Bearing Formations

There were four major depositional periods in the Honey Lake Valley. Depositional environments influenced the types of sediments deposited in different areas of deposition. Periods of deposition include: Holocene Sedimentary Deposits, Lake Lahontan Deposits, Pleistocene Volcanic rocks, and Pliocene Lake Deposits. The water bearing formations described below are described in order from youngest to oldest, with the youngest formations stratigraphically above the older formations.

### Holocene Sedimentary Deposits

Holocene Sedimentary Deposits include basin deposits and alluvial fans. Basin deposits occur in the flat central portion of the valley, consisting of silt and clay. Basin deposits have very low permeability, interfinger with the alluvial fans, and are not usually over 100 feet thick (DWR, 1963). Alluvial fans occur in localized areas on the edge of the valley, and consist of stratified gravel, sand, and silt. Alluvial fans can be up to 300 feet thick (DWR, 2003), and yield moderate to large amounts of water to irrigation wells. Alluvial fans provide water in the south end of Honey Lake Valley, providing water to Doyle and the area to the south.

### Lake Lahontan Deposits

Lake Lahontan Deposits consist of sediments deposited under prehistoric Lake Lahontan. The coarseness, and subsequent permeability of deposits deposited under Lake Lahontan are influenced by the location of the deposit. Lake Lahontan Deposits can be up to 700 feet thick (DWR, 1963). Sediments from the center of Lake Lahontan, found east of Honey Lake and north of Herlong, are fine grained, consisting of silt and clay, and have low permeability (DWR, 1963).

Sediments deposited at the edge of Lake Lahontan, called near-shore deposits, occur on the edges of Honey Lake Valley. Near-shore deposits are similar to recent valley alluvial fan deposits, and are highly permeable, yielding large amounts of groundwater to irrigation wells (DWR, 1963).

Sediments from other parts of Lake Lahontan, found northwest of Honey Lake and north of Long Valley, are sand deposits, comprising an important aquifer in Honey Lake Valley. Lake Lahontan sand deposits have moderate permeability and yield water to irrigation wells (DWR, 1963).

### Pleistocene Volcanic Rocks

Pleistocene Volcanic rocks lie under the northwestern and northeastern portions of the Honey Lake Valley. The volcanic rocks have moderate to high permeabilities and are an important confined aquifer in the northwestern and northeastern portions of the valley (DWR, 2003). The volcanic rocks are connected to the Shaffer and Skedaddle Mountains north of Honey Lake Valley, and act as a conduit for groundwater recharge from the areas to the north (DWR, 1963).

### Pliocene Lake Deposits

Pliocene Lake Deposits comprise the majority of Honey Lake Valley fill, and can be up to 6,000 feet thick (DWR, 1963). Pliocene Lake Deposits usually have low permeability, and supply only small quantities of water to wells.

### Groundwater Hydrogeology/Levels/Movement

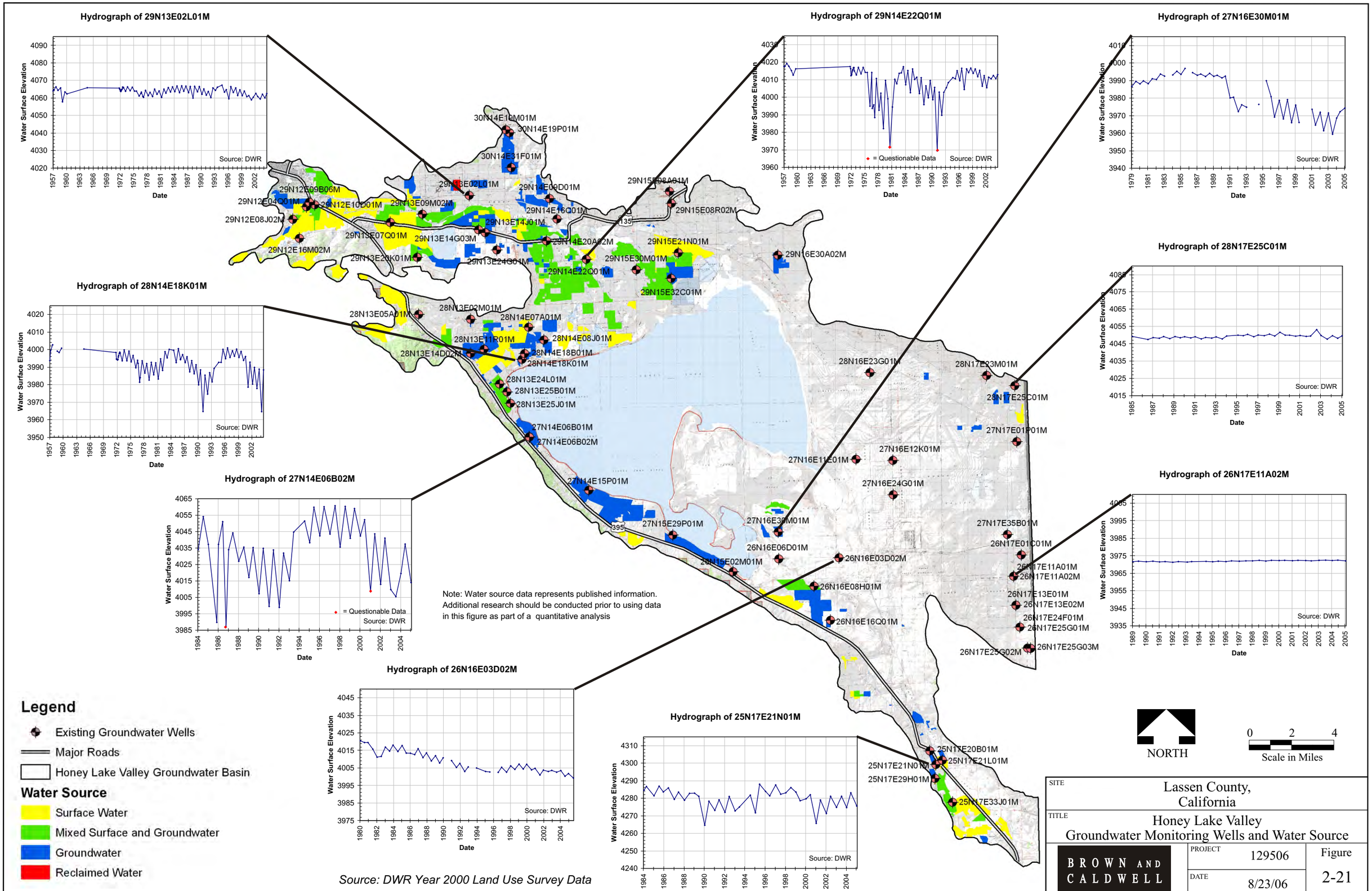
Groundwater recharge in Honey Lake Valley occurs through direct precipitation, infiltration of stream flows, and precipitation that infiltrates basalt north of the valley and then percolates laterally to beneath the valley floor. (DWR 1963). Upland recharge areas consist of Pleistocene Volcanic Rocks, recharge occurs as precipitation infiltrates the volcanic rocks and then percolates laterally beneath the valley floor. Subsurface flow may also enter Honey Lake Valley from Secret Valley through Pliocene Lake Deposits, which may be continuous beneath volcanic rocks separating the valleys (DWR, 1963). Groundwater storage capacity to a depth of 750 feet has been estimated to be about 16,000,000 acre-feet, however much of this storage is not available for use due to water quality impairments (DWR, 1963). Characterization of aquifer properties completed by Berger in 2004 indicate that transmissivity in Dry Valley is 1,200 to 1,500 square feet per day, the hydraulic gradient ranges from 0.003 to 0.005 foot per foot, and subsurface outflow to the Long Valley portion of the Honey Lake Groundwater Basin is estimated to be 50 to 250 acre-feet per year.

Hydrographs in Figure 2-21 at the end of this section show that groundwater levels in Honey Lake Valley exhibit different trends in different areas. Hydrographs for wells along the California/Nevada state line show that groundwater levels do not fluctuate seasonally in that area. Hydrographs for wells in the northwestern portion of the valley show that the groundwater table is influenced by summer pumping and that groundwater fluctuates from five to 30 feet annually. Groundwater in the northwest portion of the valley also is affected by drought periods, showing changes in spring groundwater levels of 20 feet over the period from 1987 to 1991 as compared to preceding and subsequent years. Hydrographs in the area near Herlong do not appear to be affected by drought periods, but instead show a continued decline in groundwater levels of 20 feet during period from 1984 through 2005.

Figure 2-21 also shows that agricultural land use is concentrated in the western and northwestern portions of the valley. The areas with groundwater mixed source (surface and groundwater) supplies are the areas that show annual fluctuations in groundwater, which is consistent with summer groundwater withdrawals.

Groundwater movement is largely controlled by topography in Honey Lake Valley, generally moving towards Honey Lake. Long Valley Creek is a losing stream (surface water moves downward through the streambed and recharges groundwater) as it crosses Honey Lake Valley. The Susan River, Gold Run Creek, and Baxter creek are gaining streams (groundwater moves upward through the streambed and contributes to stream flow) within Honey Lake Valley. Unconfined groundwater in the vicinity of Herlong appears to be recharged by Long Valley Creek (USGS, 1963). Phreatophyte evapotranspiration accounts for a significant amount of groundwater use in the basin (Mayo, 1992)

Groundwater movement in Honey Lake Valley may also be affected by structural features. Honey Lake Valley is bounded by faults and faults are also present inside Honey Lake Valley, concealed under Holocene Lake Deposits. Holocene Lake Deposits are not displaced at the surface, likely due to emplacement after fault movement. Some faults may act as conduits for upward migration of thermal water (DWR, 1963). Because the faulting is so extensive, additional research and compilation of existing studies should be undertaken to understand its effects on groundwater flows (Grose, 2004).


Hydrograph of 29N13E02L01M
Hydrograph of 29N14E22Q01M
Hydrograph of 27N16E30M01M
Hydrograph of 28N14E18K01M
Hydrograph of 28N17E25C01M
Hydrograph of 27N14E06B02M
Hydrograph of 26N17E11A02M
Hydrograph of 26N16E03D02M
Hydrograph of 25N17E21N01M
Water Surface Elevation
Date
Source: DWR
= Questionable Data
30N14E10M01M
30N14E19P01M
30N14E31F01M
29N13E02L01M
29N14E09D01M
29N12E09B06M
29N12E04Q01M
29N12E10D01M
29N13E09M02M
29N12E08J02M
29N14E16Q01M
29N13E14J01M
29N13E07Q01M
29N13E14G03M
29N14E20A02M
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27N16E12K01M
27N16E11E01M
27N16E24G01M
27N14E15P01M
27N15E29P01M
27N16E30M01M
27N17E35B01M
26N17E01C01M
26N16E06D01M
26N16E03D02M
28N15E02M01M
26N17E11A01M
26N17E11A02M
26N16E08H01M
26N17E13E01M
26N17E13E02M
26N17E24F01M
26N16E16Q01M
26N17E25G01M
26N17E25G02M
26N17E25G03M
25N17E20B01M
25N17E21L01M
25N17E21N01M
25N17E29H01M
25N17E33J01M
135
395
Legend
Existing Groundwater Wells
Major Roads
Honey Lake Valley Groundwater Basin
Water Source
Surface Water
Mixed Surface and Groundwater
Groundwater
Reclaimed Water
Note: Water source data represents published information. Additional research should be conducted prior to using data in this figure as part of a quantitative analysis
Source: DWR Year 2000 Land Use Survey Data
NORTH
0 2 4
Scale in Miles
SITE
Lassen County, California
TITLE
Honey Lake Valley Groundwater Monitoring Wells and Water Source
BROWN AND CALDWELL
PROJECT 129506
DATE 8/23/06
Figure 2-21
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## Groundwater Quality/Inelastic Land Subsidence

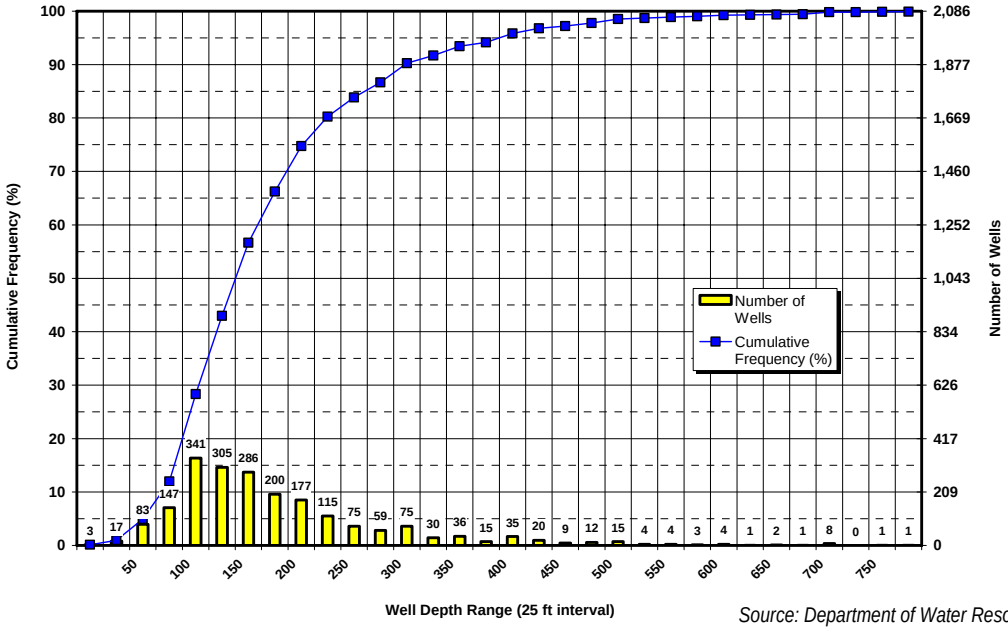
Groundwater quality in Honey Lake Valley is generally good with some areas of concern. DWR's Bulletin 118 reports that poor quality waters, exist east of Honey lake, and North of Herlong, near the ordinance depot and that Total Dissolved Solids (TDS) generally increase west to east, and range from 89 mg/L to 2,500 mg/L (DWR, 2003). In eastern Honey Lake Valley, there are areas where fault-related water is found, which may be of geothermal origin (Moll 2000). Water quality concerns regarding trichloroethylene (TCE) are present and are being remediated in the vicinity of the Sierra Army Depot (Brathode, 2006). Nitrate has been reported as a groundwater quality issue near Herlong, and arsenic has been an issue in the playa areas near Honey Lake. Arsenic has been detected in wells at the Sierra Army Depot (Brathode, 2006).

Residential septic systems located upgradient from water supply sources (Bagwell springs and Cady Springs) for the City of Susanville represent water quality concerns for nitrates and other pathogens for this municipal supply.

Subsidence has been observed in the area surrounding Amedee hot springs, where groundwater extraction for geothermal purposes is ongoing. The County assumes, but no studies have been completed, that the observed subsidence is associated with groundwater extraction.

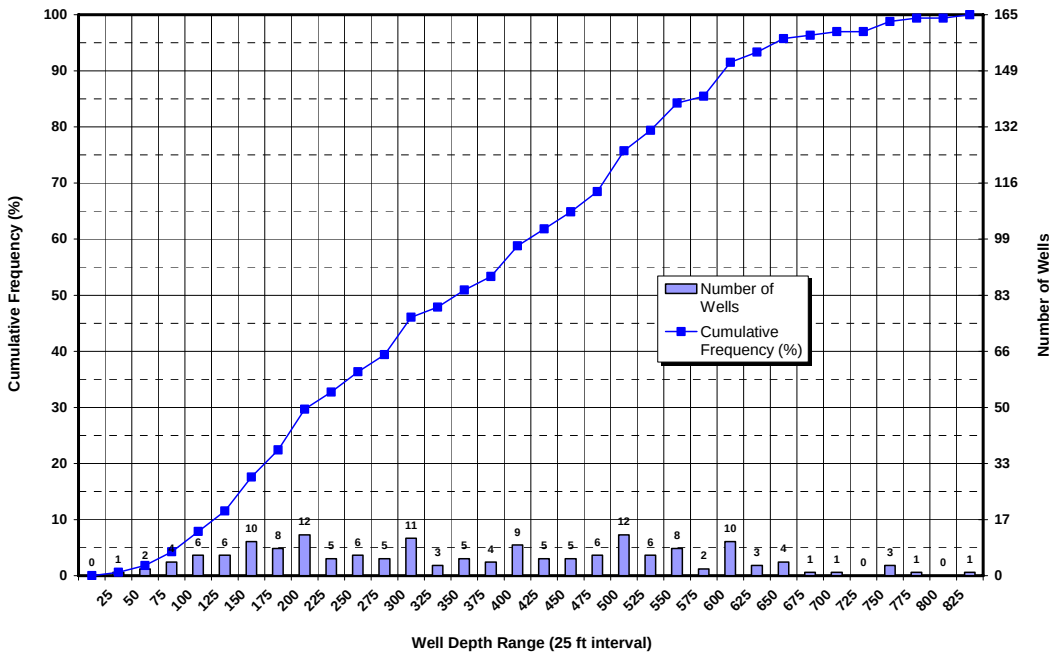
## Groundwater Wells

There are 2,086 domestic well records and 186 irrigation well records on file for Honey Lake Valley. Figures 2-22 and 2-23 present the well depth range and cumulative frequency depth distribution for domestic and irrigation wells in Honey Lake Valley, respectively. Approximately 50 percent of domestic wells are shallower than 150 feet deep, and approximately 50 percent of irrigation wells are shallower than 350 feet deep. The steepness of the curve on Figure 2-22 for domestic wells shows that the majority of domestic wells are drilled to similar depth, indicating that adequate domestic supplies are readily available in Honey Lake Valley at depths between 100 and 200 feet. The gentler slope in Figure 2-23 for irrigation wells shows that irrigation well depths are not concentrated at one general depth, and instead irrigation wells have many different depths. Since irrigation wells require higher yields than domestic wells, the gentle slope indicates that well yields vary throughout the valley, and irrigation wells are drilled deeper to secure an adequate yield in areas that are less productive.




Source: Department of Water Resources

*Figure 2-22. Depth Distribution of Domestic Wells in Honey Lake Valley*




*Source: Department of Water Resources*

*Figure 2-23. Depth Distribution of Irrigation Wells in Honey Lake Valley*

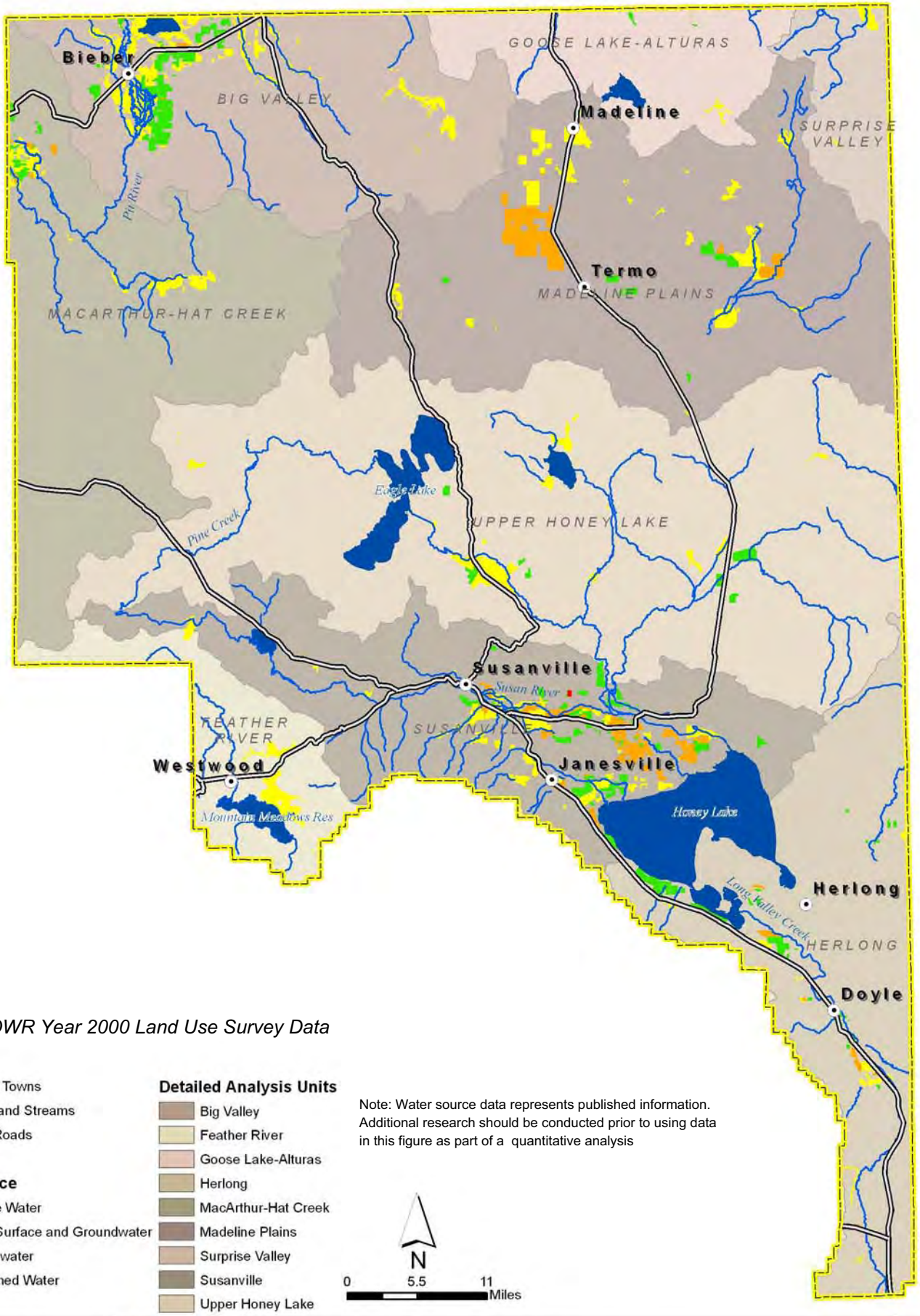
## 2.6 Water Use

DWR calculates water budgets using an applied water methodology. Applied water is defined as the total amount of water that is diverted from any source to meet the demands of water users, without adjusting for system losses. The applied water methodology calculates the managed and measured elements of the water cycle, and therefore, does not account for direct rainfall or streamflows that are not diverted or managed. DWR calculates water budgets by Detailed Analysis Unit (DAU). DAUs roughly correspond with watershed boundaries. Figure 2-24 shows the extent of DAU areas in Lassen County.

DWR performed its most recent analysis in 2000 by using an inflow-outflow analysis that considers supply, depletion, percolation, and outflow. The data created by this analysis was compiled to create a database of applied water for each DAU.

Table 2-5 provides the results of analysis for the year 2000. Analysis indicated that supply was equal to demand in Lassen County. The year 2000 was above average year on the Sacramento River water index. The information in Table 2-5 provides a snapshot of actual water use during the year 2000, but does not indicate future supplies or demands.

Table 2-5 shows supplies and use during the year 2000. In 2000, surface water supplies made up 61 percent of water supplies in Lassen County, while groundwater supplies made up 35 percent of water supplies. The Susanville, Big Valley, and Madeline Plains DAUs comprise seventy percent of water supplies and use in Lassen County.




*Source: DWR Year 2000 Land Use Survey Data*

**Legend**

- Lassen Towns
- Rivers and Streams
- Major Roads
- Lakes

**Water Source**

- Surface Water
- Mixed Surface and Groundwater
- Groundwater
- Reclaimed Water

**Detailed Analysis Units**

- Big Valley
- Feather River
- Goose Lake-Alturas
- Herlong
- MacArthur-Hat Creek
- Madeline Plains
- Surprise Valley
- Susanville
- Upper Honey Lake

Note: Water source data represents published information. Additional research should be conducted prior to using data in this figure as part of a quantitative analysis

N

0 5.5 11 Miles

| BROWN AND CALDWELL | PROJECT 129506 | SITE Lassen County | Figure 2-24 |
|---|---|---|---|
| | DATE 6-23-06 | TITLE Land Use by Water Source and DAUs | |

Table 2-5. Lassen County Year 2000 Water Year Budget (acre-feet)

| | Feather River | Surprise Valley | Madeline Plains | Susanville | Herlong | Upper Honey Lake | Big Valley | Goose Lake - Alturas | Macarthur-Hat Creek | Lassen County Total |
|---|---|---|---|---|---|---|---|---|---|---|
| Supply - Surface Water | 11,800 | 1,900 | 31,500 | 55,600 | 7,600 | 28,200 | 43,000 | 1,300 | 10,900 | 191,800 |
| Supply - Groundwater | 2,000 | 0 | 26,400 | 38,100 | 15,400 | 5,100 | 18,600 | 600 | 3,800 | 110,000 |
| Supply - Reuse | 0 | 0 | 3,100 | 1,500 | 0 | 0 | 4,000 | 0 | 4,100 | 12,700 |
| Use - Depletion | 12,700 | 1,800 | 52,500 | 79,700 | 18,900 | 28,600 | 49,100 | 1,400 | 15,300 | 260,000 |
| Use - Percolation | 800 | 0 | 5,800 | 13,600 | 4,000 | 2,200 | 6,200 | 300 | 1,600 | 34,500 |
| Use - Outflow | 300 | 100 | 0 | 1,900 | 100 | 2,500 | 10,300 | 200 | 1,900 | 17,300 |

*Source: Hillaire 2006 (Department of Water Resources, Northern District)*

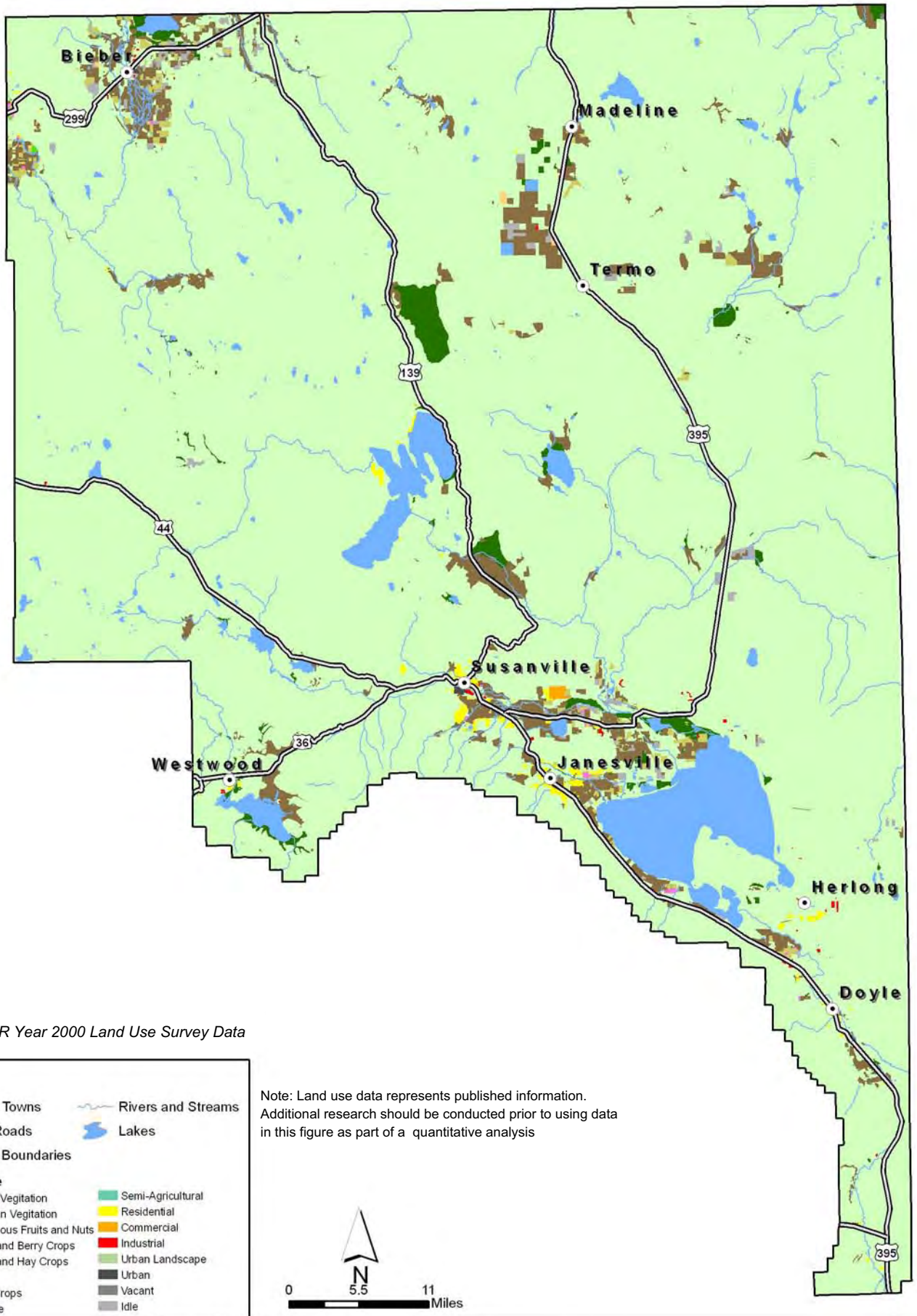
Groundwater extracted from a geothermal source for uses such as power generation is not included in the water budget calculations discussed in this section. Geothermal resources are often available in areas with recent volcanic activity or deep faulting and fracturing allowing contact between circulating groundwater and deep heat sources. The unusually hot material under the earth's surface in these areas heat nearby groundwater and create geothermal waters or steam. The heated water is extracted and used to generate energy (Lassen County 1999). There are three geothermal power plants in Lassen County:

- **Amedee Geothermal Power Plant.** The Amedee plant is located at the northeastern edge of Honey Lake. The plant extracts 3,400 gallons per minute (gpm) of geothermal water when operating at full capacity. Waste water is discharged to three ponds where it cools and percolates into the ground (Lassen County 1999).
- **Honey Lake Power Plant.** The Honey Lake plant is located two miles north of Honey Lake, near the town of Wendel. The plant extracts 550 gpm of geothermal water from a single well. Waste water is disposed of in a 5,100 foot deep re-injection well (Lassen County 1999).
- **Wineagle Power Plant.** The Wineagle plant is located on the shore of Honey Lake, approximately 1.5 miles west of Wendel. The plant extracts 800 gpm of geothermal water from a single well. Waste water is disposed of through surface drainage to Honey Lake (Lassen County 1999).

### 2.6.1 Land Use and Water Source

Figure 2-24 shows water sources for agricultural land within Lassen County during the year 2000. Figure 2-24 illustrates that surface water is the primary source for agriculture, and that groundwater use primarily occurs on the eastern side of Big Valley, and the western and northern end of Honey Lake Valley. A large area of mixed use also occurs in the Madeline Plains.

Agricultural land use in Lassen County generally occurs in valleys and areas that have topography, soils, and water sources conducive to development. As shown in Figure 2-25, pasture, grain, and hay crops were the primary crops in Lassen County in the year 2000. Agricultural land use is focused in the valleys of the County, usually near a surface water body. DWR anticipates a new survey of Lassen County land use during 2006. When land use and water source is resurveyed, a comparison between the two land use surveys should be performed.




*Source: DWR Year 2000 Land Use Survey Data*

**Legend**

- Lassen Towns
- Major Roads
- County Boundaries
- Rivers and Streams
- Lakes

**Land Use**

- Native Vegitation
- Riparian Vegitation
- Deciduous Fruits and Nuts
- Truck and Berry Crops
- Grain and Hay Crops
- Rice
- Field Crops
- Pasture
- Semi-Agricultural
- Residential
- Commercial
- Industrial
- Urban Landscape
- Urban
- Vacant
- Idle

Note: Land use data represents published information. Additional research should be conducted prior to using data in this figure as part of a quantitative analysis

| BROWN AND CALDWELL | PROJECT 129506 | SITE Lassen County | Figure 2-25 |
|---|---|---|---|
| | DATE 10-20-06 | TITLE Land Use | |

# 3. PLAN IMPLEMENTATION

Lassen County is already performing many of the groundwater management activities associated with an AB 3030 Groundwater Management Plan. Through Plan implementation, the County is formalizing its groundwater management goal, management objectives, and plan components that elaborate on both current actions and planned future actions under the GWMP.

## 3.1 Groundwater Management Goal

The goal of the Lassen County GWMP is to maintain or enhance groundwater quantity and quality, thereby providing a sustainable, high quality supply for agricultural, environmental, and urban use into the future that remains protective of the health, welfare, and safety of residents.

## 3.2 Groundwater Management Objectives

The following management objectives are adopted under the Lassen County GWMP:

- Maintain and protect historic groundwater uses;
- Minimize the long-term drawdown of groundwater levels;
- Protect groundwater quality;
- Prevent inelastic land surface subsidence from occurring as a result of groundwater pumping;
- Minimize changes to surface water flows and quality that directly affect groundwater levels or quality;
- Minimize the effect of groundwater pumping on surface water flows, quality, seeps and springs, and natural vegetation.
- Facilitate groundwater replenishment and cooperative management projects;
- Maintain springs, seeps and riparian habitat; and
- Provide a mechanism for mutual management of interstate groundwater basins with Washoe County and the State of Nevada.

## 3.3 GWMP Components

As discussed in section 1.4 and shown on Table 1-1, a number of required, voluntary, and suggested components constitute the GWMP content. These components have been grouped and are discussed, with proposed actions, under the following six headings:

- Basin Management Objectives
- Groundwater Monitoring;
- Groundwater Resource Protection;
- Groundwater Sustainability;
- Stakeholder Involvement;
- Integrated Water Resource Planning; and
- GWMP Implementation, Reporting and Updating

Each of the following sections describes existing activities, new or revised groundwater management activities, and specific activities that will be pursued during Plan implementation.

## 3.4 Basin Management Objectives

Basin Management Objectives (BMOs) are required under the California Water Code (CWC) § 10753.7 (a)(1). BMOs are flexible guidelines for the management of groundwater resources that describe specific actions to be taken by stakeholders to meet locally developed objectives at the basin or sub-area scale. An important feature of the BMO method of groundwater management is that it is intended to provide a flexible approach that can be adapted to changing local conditions and increased understanding of the groundwater resource.

BMOs reflect a proactive method of groundwater management established on a local level by local groundwater users and elected officials working together. BMOs are used to manage groundwater to meet local users' needs instead of working to stop other interests. BMOs include the development of local groundwater management objectives and monitoring of the groundwater basin health to assure water use is consistent with defined local objectives.

Lassen County and the GWMP Working Group recommend pursuit of a BMO program as part of Plan implementation activities. County staff will develop and recommend to the Board of Supervisors an ordinance that articulates the concepts, actions, roles, and responsibilities for groundwater management utilizing the BMO process. To support this effort, the County developed a white paper entitled *Introduction to the BMO Process of Groundwater Management*. The white paper is included as Appendix C of the GWMP and will help guide BMO development as a recommended implementation activity.

### Basin Management Objective Actions

The County will take the following actions:

- Codify groundwater management using the BMO concept through the development of a recommended BMO ordinance for consideration and adoption by the Board of Supervisors.
- Formalize and proceed with the four phases identified in the *Introduction to the BMO Process of Groundwater Management* in Appendix C.

## 3.5 Groundwater Monitoring

Groundwater monitoring is an essential tool to assist Lassen County with implementation of the GWMP. Groundwater level monitoring can identify areas of overdraft, enabling a fast response. Groundwater quality monitoring can help identify areas of degrading water quality, potentially identifying specific water quality issues. Inelastic land subsidence monitoring can indicate the location and rate of subsidence. Ongoing groundwater monitoring provides information needed to document current conditions, assess long-term trends, and to support development and implementation of GWMP components. Riparian vegetation and phreatophyte vegetation (plant life that has roots that reach down to the water table) has not been mapped, and is poorly understood in Lassen County. Protection of environmental resources has been a central theme in the County's efforts to mitigate the potential impacts of groundwater extraction and exportation from projects in Nevada that share groundwater basins with Lassen County.

### 3.5.1 Groundwater Elevation Monitoring

A monitoring well network with a regular monitoring schedule provides data that can be used for analysis of long-term water level trends. Groundwater levels in basins are typically cyclic on an annual basis, higher in the spring and lower in the summer and fall seasons. The cyclic nature of groundwater levels is due to groundwater use and recharge patterns. Groundwater pumping typically peaks during the summer growing season, and slows in the winter. Comparisons of groundwater levels in specific wells from spring, of one year

to spring of other years can indicate groundwater trends, such as lowering of the groundwater table during a drought period.

Groundwater level monitoring in Lassen County is performed by DWR on a semiannual basis, in March and October. DWR currently monitors a network of 121 wells in Lassen County. The distribution of monitoring locations within the groundwater level monitoring network is shown in Figure 3-1. Groundwater level monitoring occurs in seven out of the 24 groundwater basins in Lassen County, including Long Valley, Honey Lake Valley, Willow Creek Valley, Big Valley, Secret Valley, Madeline Plains, and Fall River Valley.

Section 2.5 includes hydrographs detailing changes in water level elevation over time. Hydrographs were developed for monitoring locations that best represent local groundwater conditions. In general, long-term groundwater level elevations have remained consistent, indicating that annual inflow to the groundwater system offsets outflow from the groundwater system, including extraction at production wells.

When Lassen County identifies areas requiring additional groundwater level monitoring, there are several methods available. Methods to increase groundwater level monitoring include:

- Increase in the frequency of monitoring at existing monitoring wells .
- Expand the monitoring grid by increasing the density of monitoring wells through addition of existing production wells or installation of new dedicated monitoring wells to the monitoring grid.
- Expand the monitoring grid into groundwater basins not currently monitored through addition of existing production wells or installation of new dedicated monitoring wells to the monitoring grid.

Increasing the frequency of monitoring in existing monitoring wells can provide additional data for analysis of groundwater level trends. A typical increased schedule includes monitoring four times a year, in March, July, August, and October. The additional measurements in July and August provide information on groundwater levels during the summer, when groundwater use is typically highest.

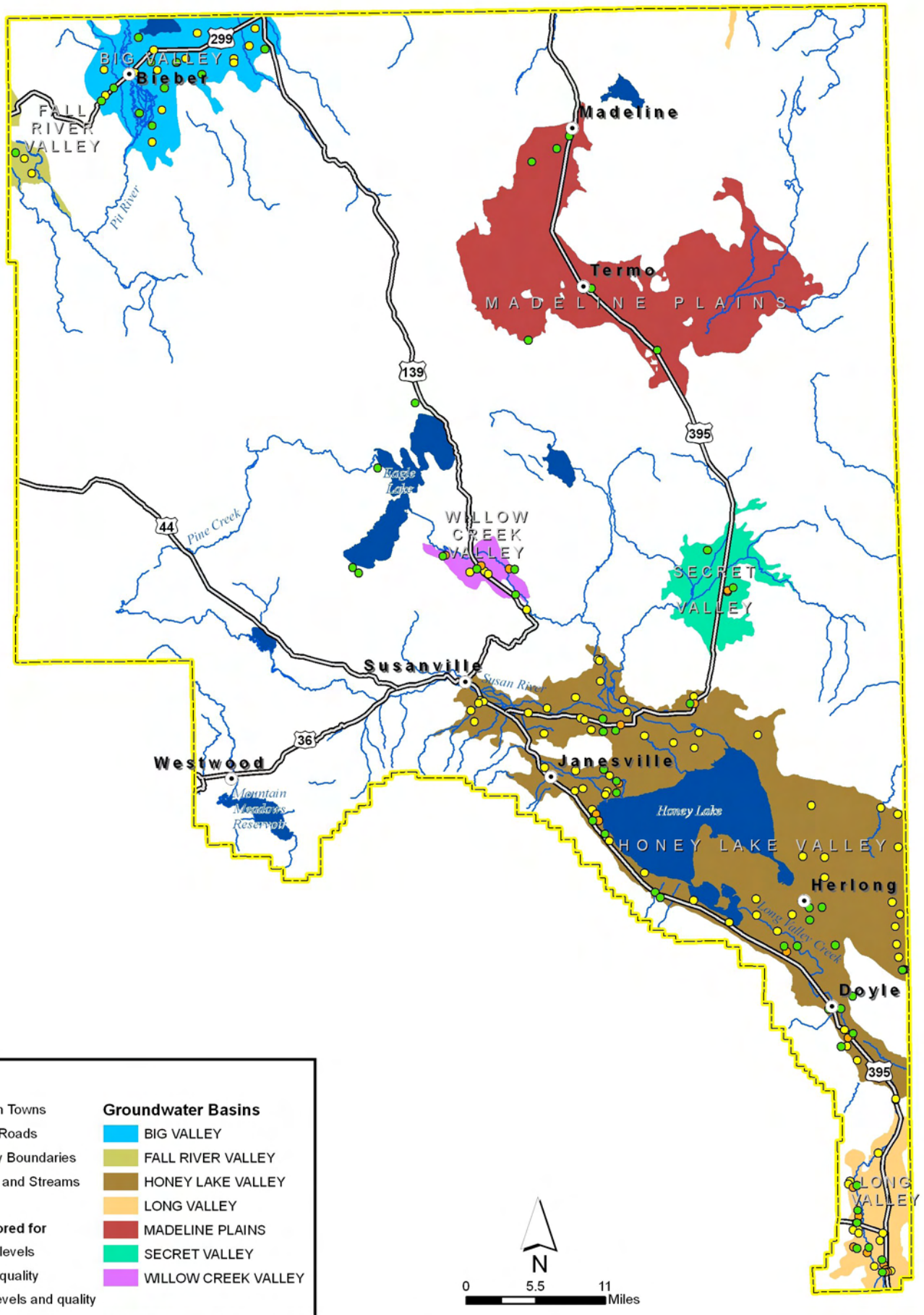
Expansion of the monitoring by increasing the density of monitoring wells through addition of existing wells or installation of new dedicated monitoring wells provides greater detail to areas covered by monitoring. Expansion of the monitoring grid in this fashion adds wells to the monitoring program in new areas to increase coverage, reducing the likelihood that a groundwater level issue will develop unnoticed

Expansion of the monitoring grid into groundwater basins not currently monitored through addition of existing wells or installation of new dedicated monitoring wells. This provides monitoring information for areas that do not have pre-existing groundwater level information. Expansion of the monitoring grid in this fashion develops baseline data on the state of groundwater in those basins.

Installation of new dedicated monitoring wells to expand the coverage of groundwater level monitoring. Installation of new wells provides the most reliable information, because well depth and screen intervals are accurately recorded during installation. Although new wells provide high quality data, installation of new wells is expensive.

### 3.5.2 Groundwater Quality Monitoring

Monitoring of groundwater quality is useful in assessing the state of groundwater basins and identifying saline (high Total Dissolved Solids) groundwater issues. The purpose of water quality monitoring is to assess trends in water quality changes due to changes in groundwater-related activities. For example, groundwater pumping may induce groundwater flow from deeper aquifers or neighboring areas containing water that is less desirable, such as water with a high mineral content. Monitoring groundwater helps identify areas where migration of low quality groundwater may be occurring.




**Legend**

- Lassen Towns
- Major Roads
- County Boundaries
- Rivers and Streams
- Lakes

**Wells monitored for**

- Water levels
- Water quality
- Both levels and quality

**Groundwater Basins**

- BIG VALLEY
- FALL RIVER VALLEY
- HONEY LAKE VALLEY
- LONG VALLEY
- MADELINE PLAINS
- SECRET VALLEY
- WILLOW CREEK VALLEY

BROWN AND CALDWELL

| PROJECT | SITE | |
|---|---|---|
| 129506 | Lassen County | Figure |
| DATE | TITLE | |
| 8-22-06 | Groundwater Monitoring Wells | 3-1 |

FILE: \\Bcsac01\GIS\Lassen County\MXD\Figure 3-1 Groundwater Basins with Wells.mxd

Groundwater quality monitoring in Lassen County is performed by DWR at a number of wells in Lassen County. DWR monitors 23 wells once each four years, and has monitored 24 other wells sporadically for water quality. Figure 3-1 shows the approximate locations of wells that have been monitored for water quality. DWR monitors for a number of constituents, including temperature, pH, total dissolved solids, metals, nitrogen compounds, dissolved potassium, sodium, calcium, magnesium, boron, and hardness. Groundwater quality data has been collected in seven of 24 groundwater basins in Lassen County, including: Long Valley, Honey Lake Valley, Willow Creek Valley, Big Valley, Madeline Plains, and Fall River Valley.

Groundwater quality is also monitored as part of the DHS drinking water program. Monitoring conducted as part of the DHS program is focused on protecting drinking water quality, and is not collected with the frequency or for the variety of constituents necessary to be used to characterize regional groundwater quality.

Should Lassen County implement steps to increase groundwater quality monitoring in the County, there are several methods available. Methods to increase groundwater quality monitoring include increasing the frequency and number of locations of DWR water quality monitoring, or development of a separate countywide water quality monitoring program. With appropriate groundwater quality monitoring data, the County can improve its understanding of the location and extent of groundwater quality issues.

Increasing DWR monitoring could be accomplished by providing funding to DWR to increase the program, through acquisition of grants or other means. Frequency could be increased to annual groundwater quality monitoring, and additional locations could be monitored for water quality, providing groundwater quality information for basins that are not currently monitored.

Establishing a County-led water quality monitoring program would also provide increased groundwater quality monitoring. A monitoring program could be implemented that collects groundwater quality samples once a year. Parameters measured should include, but are not limited to, temperature, pH, electrical conductivity, and total dissolved solids.

### 3.5.3 Inelastic Land Subsidence Monitoring

A major cause of subsidence in California is the overpumping of aquifers. In these aquifers, groundwater is lowered significantly, and is transported through interconnected pore spaces between grains of sand and gravel. If an aquifer has intervals of clay or silt within it, the lowered water pressure in the sand and gravel results in the slow drainage of water from the clay and silt beds. The decreased water pressure reduces the support for the clay and silt beds. Because these beds are compressible, they compact (become thinner), and the effects are seen as a lowering of the land surface. The lowering of the land surface elevation from this process is often permanent (inelastic). Recharge of the aquifer will not result in an appreciable recovery of the land-surface elevation.

Lassen County has not developed a network of extensometers to measure inelastic land subsidence. However, land subsidence monitoring is completed in association with some local projects. Land subsidence has been reported near the Amedee Springs geothermal facility. Groundwater level monitoring indicates that groundwater levels have not been significantly lowered, a condition required for land subsidence due to groundwater extraction to occur. Based on a review of groundwater elevation trends over time, it can reasonably be assumed that significant land subsidence has not occurred on a regional scale due to groundwater extraction. Should the County decide to implement a land subsidence monitoring program, there are several methods available:

- Monitor and analyze groundwater levels, watching for significant declines
- Inspect wells for anecdotal evidence of subsidence during groundwater level monitoring
- Install extensometers to monitor subsidence
- Perform Global Positioning Satellite (GPS) surveys to monitor subsidence

Monitoring groundwater levels with concurrent inspections for anecdotal evidence of subsidence is the least expensive, and least reliable, method to monitor for land subsidence. Declines in groundwater levels can be a precursor to land subsidence. Staff performing water level monitoring can inspect the monitoring well for indicators of subsidence. Anecdotal subsidence indicators include cracks in the well pad, elevation of the well casing in comparison to the ground surface, and cracks in the ground surface.

Extensometers use a pipe inside a well casing to measure subsidence. The pipe extends from the land surface through compressible sediments. A table at the land surface houses instruments that monitor changes in the distance between the top of the pipe and the table. The pipe goes through the entire thickness of the studied sediments and measures subsidence in those sediments. If subsidence occurs, the ground surface (and the table) will sink, but the pipe will not, and the distance between the pipe and the table will change, reflecting the actual amount of subsidence. Figure 3-2 is a diagram of a typical extensometer.

GPS surveys can be used to measure ground surface elevation. A survey is performed, and then repeated over a set schedule. Any change in the ground surface elevation between surveys would be detected in the later surveys.

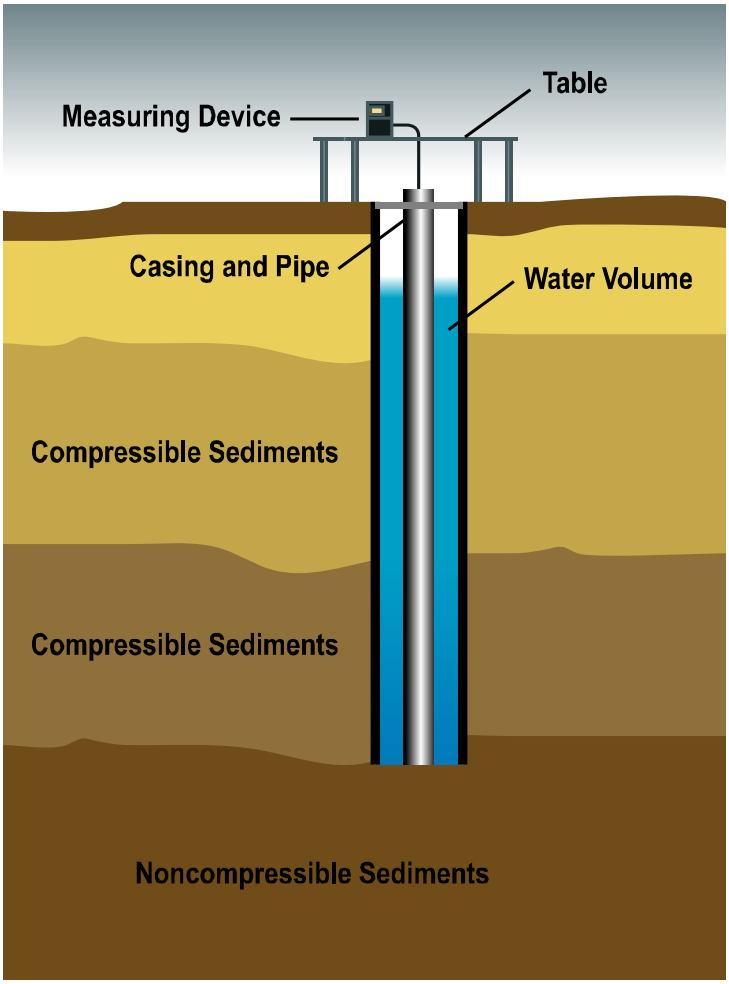



*Figure 3-2. Extensometer Diagram*

## Groundwater Monitoring Actions

The County will take the following actions:

- Identify "key" groundwater monitoring well locations utilizing existing groundwater monitoring data.
- Develop and implement annual summary report of groundwater level, groundwater quality, and inelastic land subsidence at "key" well locations
- Secure funding for annual groundwater summary report.
- Work with local stakeholders and DWR to identify areas that may need additional groundwater level, groundwater quality, or subsidence monitoring based on identified data gaps or negative performance trends. Request that DWR be alert for and report anecdotal evidence of land subsidence at monitoring well locations.
- Work with state and federal agencies to secure funding for expansion of the Lassen County monitoring grid.
- Maintain agreements with DWR for groundwater monitoring and database management activities.

- Coordinate with DWR and local landowners to ensure that selected wells are maintained as part of a long-term monitoring program.
- Support the development and implementation of quantitative BMOs in priority groundwater basins.
- Pursue opportunities for interstate groundwater basin monitoring and reporting with the State of California, State of Nevada, Washoe County, and federal agencies.
- Support efforts to map and compile information on riparian habitats and phreatophyte vegetation.

## 3.6 Groundwater Resource Protection

Lassen County has taken action to promote the protection of groundwater resources, including:

- Groundwater well ordinances;
- Groundwater Management Districts; and
- Groundwater conservation ordinance.

### 3.6.1 Groundwater Well Ordinances

Lassen County had adopted ordinances specific to groundwater and wells. Following is an overview of principal Lassen County ordinances related to groundwater and wells as contained in the Lassen County Code.

- **Chapter 7.28 Water Wells**. It is the purpose of the ordinance codified in this chapter to provide for the construction, repair, modification and destruction of wells in such a manner that the groundwater of Lassen County will not be contaminated or polluted and that water obtained from wells will be suitable for beneficial use and will not jeopardize the health, safety or welfare of the people of Lassen County. (Ord. 488-A § 2 (part), 1988; Ord. 488 § 1 (part), 1988). No person, firm, corporation, governmental agency or any other legal entity shall, within the unincorporated area of Lassen County, construct, repair, modify or destroy any well unless a written permit has first been obtained from the health officer of the county, as provided in Chapter 7.28. For a permit to be valid under Chapter 7.28, the applicant must comply with all other state and county laws.
- **Chapter 7.28.100 Well Standards**. Standards for the construction, repair, reconstruction, deepening, abandonment and destruction of wells in Lassen County are codified in Chapter 7.28.100 which requires standards for the construction, repair, modification or destruction of wells to meet the requirements of Chapter II of California Department of Water Resources Bulletin No. 74-81 "Water Well Standards: State of California" and Chapter II of Bulletin No. 74-1, "Cathodic Protection Well Standards: State of California," with certain exceptions noted in the chapter.
- **Well spacing requirements**. Lassen County does not have an ordinance specific to well spacing requirements specifying a minimum spacing between wells based on the pumping capacity of the well. Existing limitations on well spacing are contained in Title 18, Zoning, within Chapter 18.102.050 which stipulates minimum lot sizes where wells and septic are installed. As an example, a minimum of one acre is required for property utilizing an individual septic system and an individual well.

Additionally, Chapter 12.32.040 of the County Code, which addresses setback limitations associated with building and construction, provides limitations on the well location on a specific property. This section deems it unlawful to dig, excavate or install within any setback zone any well or other excavation for water.

### 3.6.2 Groundwater Management Districts

Water management districts or agencies are formed by special statues enacted by the California Legislature. These districts and agencies may enact ordinances to regulate the amount of groundwater that is extracted and limit its place of use within the district boundaries. Groundwater districts can play an important role in managing groundwater resources and regulating its use. Legislation has been enacted resulting in the formation of four groundwater management districts in Lassen County, including:

- Long Valley Groundwater Management District
- Honey Lake Groundwater Management District
- Willow Creek Groundwater Management District
- Surprise Valley Groundwater Management District

In 1980, the California State legislature adopted the Sierra Valley Groundwater Basin Act. This Act authorizes the formation of two groundwater districts, on of which became the Long Valley Ground Water District comprised on portions of Lassen and Sierra Counties within the Long Valley groundwater basin. The need for this district resulted as a response to the drilling of large wells on the Nevada side of Long Valley near Bordertown and concern that the basin would be overdrafted. The act gives the district the power to curtail or suspend pumping, and to ban exportation out of the basin, in the event of overdrafting or water quality problems (Lassen County, 1999). Lassen and Sierra Counties entered into a joint powers agreement in June 1985 to address their commitment to and management of the district. A permit is required for exportation of water from the district. The Long Valley Ground Water Management District enacted ordinance 89-01 to require a permit for exportation in May 1989.

In 1989, the Honey Lake Valley Ground Water Basin Act, modeled after the Long Valley Act, was authorized by legislation. The impetus for formation of the district and institution of water extraction regulations was largely a response to the intentions of Nevada interests to export groundwater from the Nevada side of the basin. Section 706 of the Act prohibits exportation of water from the district unless the exporter has applied for and obtained a permit from the district.

Lassen County also has supported formation of the Willow Creek Valley Groundwater Management District to give landowners in that area the ability to manage the groundwater resources. Legislation was proposed to form this district in 1993. In 1995, legislation for the Surprise Valley Groundwater Basin Act was enacted, which authorized the creation of the Surprise Valley Groundwater Management District. Although this area is primarily in Modoc County, in includes a portion of Lassen County.

### 3.6.3 Groundwater Conservation Ordinance

Lassen County established groundwater management objectives with the passage of Ordinance 539 in January 1999 detailing requirements for the extraction and exportation of groundwater from Lassen County. Section 1, Title 17, Chapter 17.01 of the Lassen County Code reflects these objectives, which include:

> "The County seeks to foster prudent water management practices to avoid significant adverse overdraft-related environmental, social, and economic impacts."

It is unlawful to extract groundwater underlying county, directly or indirectly, for use of that groundwater, outside county boundaries, without first obtaining a permit. The extraction of groundwater to replace a surface water supply to be transferred for use outside county boundaries is considered an indirect extraction of groundwater and requires a permit.

The permit secured under Chapter 17 does not grant any right or entitlement but rather the permit evidences that the health, welfare, and safety of the residents of the county will not be harmed by the extraction and

exportation of groundwater outside the county boundaries. The permit in no way exempts, supersedes, or replaces any other provisions of federal, state, and district or local laws and regulations including but not limited to:

- Water Code Section 1220;
- Groundwater Management Act;
- Honey Lake Valley Groundwater Basin Act;
- Long Valley Groundwater Basin Act;
- Willow Creek Valley Groundwater Basin Act
- Surprise Valley Groundwater Basin Act; and
- Any actions provided for in California groundwater law, well drilling and maintenance or building permit requirements. (Ord. 539 § 1 (part), 1999).

No permit applications to extract and export water have been submitted to Lassen County since enactment of the ordinance. A permit may only be granted if the Board of Supervisors determines that the extraction will not cause or increase an overdraft of the groundwater underlying the County, will not adversely affect the long-term ability for storage or transmission of groundwater within the aquifer, will not (together with other extractions) exceed the safe yield of the groundwater underlying the County and will not otherwise operate to the injury of the reasonable and beneficial uses of overlying groundwater users, or will not result in an injury to a water replenishment, storage, or restoration project operating in accordance with statutory authorization. Permits are valid for a term, set by the Board of Supervisors, not to exceed three "water years" for the date of issuance. A water year, by definition, begins on March 1 of each year.

### 3.6.4 Natural Resource Element of General Plan

Water resources are addressed in Chapter 3 of the General Plan's natural resource element. Water resource goals, policies, and implementation measures are articulated, including the following goals:

- Water supplies of sufficient quality and quantity to serve the needs of Lassen County, now and in the future.
- Maintain a sensible appropriation and utilization of water for agricultural use in the County.
- Development of new, well-planned reservoirs and other facilities and projects for water supply and/or flood control purposes which will benefit related resources and provide opportunities for multiple public benefits.
- Eliminate the threat of flood events which may result in the loss of lives and major damage to property and resources (Lassen County General Plan, 1999).

The goals and objectives included in this GWMP, included in section 3.1 and section 3.2, are consistent with the water resource goals and policies expressed in the General Plan. GWMP implementation activities will advance the goals and policies of the General Plan.

### 3.6.5 Wellhead and Recharge Area Protection Measures

To date, Lassen County has not formally adopted wellhead or recharge area protection measures. The County may consider in the future a policy recommendation specific to protection of groundwater recharge areas through appropriate zoning and other management measures.

Lassen County has not pursued a wellhead protection plan; however, a federal program is in place to support development of such a plan if the County deems it necessary. The purpose of the federal Wellhead Protection

Program is to protect groundwater sources of public drinking water supplies from contamination, thereby eliminating the need for costly treatment to meet drinking water standards. The program was established by the Safe Drinking Water Act Amendments of 1986 and is based on the concept that the development and application of land-use controls (usually applied at the local level in California) and other preventative measures can protect ground water.

A Wellhead Protection Area (WHPA), as defined by the 1986 Amendments, is "the surface and subsurface area surrounding a water well or wellfield supplying a public water system, through which contaminants are reasonably likely to move toward and reach such water well or wellfield." The WHPA may also be the recharge area that provides the water to a well or wellfield. Unlike surface watersheds that can be easily determined from topography, WHPAs can vary in size and shape depending on geology, pumping rates, and well construction.

Under the Act, states are required to develop an EPA-approved Wellhead Protection Program. To date, California has no formal state-mandated program, but instead relies on local agencies to plan and implement programs. Wellhead Protection Programs are not regulatory by nature, nor do they address specific sources. They are designed to focus on the management of the resource rather than control a limited set of activities or contamination sources.

### Groundwater Resource Protection Actions

The County will take the following actions:

- Support and implement policies contained in the Lassen County General Plan Natural Resources Element (Water Resources chapter).
- Support existing Ordinance 488 associated with well construction, repair, modification, and destruction.
- Participate in the review and provide recommendation for permit applications submitted under Ordinance 539, Groundwater Extraction and Exportation.
- Support County Environmental Health Department submittal of received well completion reports to DWR Northern District.
- Evaluate the need for and implement as necessary a wellhead protection, well spacing (and other) programs in Lassen County.
- Continue to participate and support the function of the Long Valley Groundwater Management District pursuant to the Memorandum of Agreement with Sierra County.
- Participate in activities of the Honey Lake Groundwater Management District, if enacted and directed by the Board of Supervisors.
- Participate in activities of the Willow Creek Valley Groundwater Management District when requested.
- Participate in activities of the Surprise Valley Groundwater Management District when requested.
- Support activities of the Lassen-Modoc County Flood Control and Water Conservation District.
- Coordinate and collaborate with the Washoe County Regional Water Planning Commission and Nevada State Engineer on interstate groundwater management issues.

## 3.7 Groundwater Sustainability

The County is currently engaged in various activities that promote groundwater sustainability. Because groundwater levels in Lassen County are adequate for current uses, the County is not pursuing development of conjunctive use operations, replenishment of groundwater activities, nor mitigation of overdraft. Specific actions currently the County is pursuing or studying include:

- Represent Lassen County interests in Nevada groundwater exportation projects, such as the North Valleys Right-of-Ways Projects, that include interstate groundwater basins; and
- Collaborate with state and federal agencies on regional groundwater studies.

Throughout the development of this GWMP, groundwater sustainability has been a central theme expressed by the GWMP Working Group comprised of local groundwater resource users and experts. Groundwater management objectives included in this Plan support sustainability of the resource.

The North Valleys Right-of-Ways Projects across the Lassen County border in Nevada include groundwater extraction and exportation from interstate groundwater basins. Honey Lake basin and Long Valley basin in Lassen County could be impacted by the projects. Lassen County elected officials and staff continues to represent local interests associated with groundwater sustainability. Development and implementation of an effective Water Resource Monitoring and Management Plan for the exportation projects is central to assuring the sustainability of groundwater resources in these shared interstate basins.

### Groundwater Sustainability Actions

The County will take the following actions:

- Participate in the evaluation of local projects to improve groundwater sustainability (e.g. groundwater recharge).
- Provide support associated with development of quantitative BMOs in Lassen County.
- Pursue funding from state agencies, federal agencies, and partnerships for groundwater sustainability activities.
- Coordinate and collaborate with the Washoe County Regional Water Planning Commission, Washoe County Board of Commissioners, Washoe County Planning Commission, and the Nevada State Engineer on interstate groundwater management issues to encourage a groundwater management method consistent with the BMO process detailed in the Lassen County GWMP.
- Participate in the development and adoption of agreements, special legislation, or compacts pertaining to sustainable groundwater management between the State of California and the State of Nevada and encourage groundwater management using the BMO method.
- Collaborate with state and federal (e.g. USGS) agencies in the completion of groundwater projects and studies.

## 3.8 Stakeholder Involvement

Public outreach and education is a priority for Lassen County. The County encourages two-way dialogue, characterized by information dissemination and requests for suggestions and feedback on County activities. The County has disseminated information on GWMP development as part of its ongoing public outreach effort.

The County also regularly engages in cooperative efforts with other public entities whose service area falls within the plan area and state and federal agencies. Additionally, the County actively encourages the involvement of advisory committees and related stakeholders. The following sections describe the County's involvement with these water resource stakeholders.

### 3.8.1 Interagency and District Cooperation

Effective groundwater management requires coordination and cooperation between numerous local, state, and federal agencies. The County will continue to work proactively with key state and federal regulatory agencies, as well as the local districts and County departments, such as:

- **State Water Resources Control Board (SWRCB).** The SWRCB is the lead state water agency responsible for maintaining water quality standards and providing the framework and direction for groundwater protection efforts. The County has established a working relationship with the SWRCB and the Central Valley and Lahontan Regional Water Quality Control Boards.
- **California Department of Water Resources.** DWR plays in important role in supporting both surface water and groundwater management. DWR continues to support water level and extensometer monitoring in Lassen County. Additionally, DWR is actively participating in the evaluation of proposed groundwater exportation projects, including the Fish Springs and Dry Valley projects, where a portion of the interstate groundwater basin is within Lassen County. DWR staff has participated as Working Group members during development of this GWMP.
- **Big Valley Flood Control District (BVFCD).** The BVFCD was originally established to manage flood control risks on the Pit River, and among other activities, performs groundwater monitoring in portions of Big Valley. The County is has a working relationship with the BVFCD and will continue to support BVFCD efforts.
- **Honey Lake Resource Conservation District (HLRCD).** The HLRCD focuses available technical, financial and educational resources so that they meet the needs of local land managers resulting in the conservation and stewardship of soil, water, and related natural resources. The County has established a working relationship with the HLRCD and will continue to support HLRCD efforts.
- **Pit Resource Conservation District (PRCD).** The PRCD has an ongoing relationship with farmers and ranchers in Big Valley to promote conservation and wise use of resources, including water use efficiency, water quality management, management of rangelands, and Juniper tree management. The County has a working relationship with the PRCD and will continue to support PRCD efforts.
- **United States Geological Survey (USGS).** The USGS has completed groundwater investigations in and around Lassen County to describe geology, hydrogeology, and water quality. The USGS is currently developing a regional groundwater monitoring program in west-central Nevada and adjoining portions of Nevada, including Lassen County. Lassen County will continue to represent local groundwater management needs and issues and encourage USGS collaboration with DWR Northern District during the development and implementation of monitoring activities. In addition to these activities, the USGS is participating as a cooperating agency in the development of the North Valleys Rights-of-Way Projects environmental document and has been identified as a participant in implementation of the Water Resources Monitoring and Mitigation Plan for the same projects.
- **State of Nevada.** The Nevada State Engineer is the lead authority for groundwater rights and management in Nevada. As such, Lassen County engages the State Engineer on interstate groundwater issues where groundwater extraction or management activities in Nevada may impact groundwater users or management in Lassen County. Lassen County elected officials and staff has recently engaged the Nevada State Engineer in an effort to develop an effective Water Resources Monitoring and Mitigation Plan for the North Valleys Rights-of-Way Projects. Groundwater extraction during project implementation may impact groundwater resources in the Lassen County portion of the Honey Lake and Long Valley interstate groundwater basins.
- **Washoe County, Nevada.** Washoe County is to operate and receive water supply from the North Valleys Rights-of-Way Projects. Lassen County elected officials and staff has met with the Director of the Washoe County Department of Water Resource to represent Lassen County concerns associated with the

project. Discussions will continue as the project moves toward implementation and Washoe County assumes responsibility for the project's Water Resources Monitoring and Mitigation Plan.

### 3.8.2 Advisory Committees and Stakeholders

Lassen County recognizes and encourages participation in groundwater management by local groundwater users and technical experts. This GWMP was developed under the guidance and direction of a Working Group. The Working Group members and their representation or expertise are included in Table 1-3. It is the County's intention to continue to solicit input and guidance from the Working Group during GWMP implementation.

#### Stakeholder Involvement Actions

The County will take the following actions:

- Assist in coordination and management activities of the Working Group.
- Be responsive to the needs and requests of the Board of Supervisors and other Departments.
- Continue to work cooperatively with local stakeholders on groundwater management activities.
- Continue to work cooperatively with DWR headquarters and DWR Northern District on groundwater management activities.

## 3.9 Integrated Water Resource Planning

Integrated water resource planning and management is intended to address multiple issues or objectives concurrently, thereby maximizing limited financial and staff resources. The state has identified 20 different water management strategies that can be combined to form an integrated project (DWR, 2004b). Examples from the list of 20 water management strategies include water supply reliability, flood control, water quality protection and improvement, ecosystem restoration, and groundwater management. Proposition 50, Chapter 8 and Proposition 84, passed by voters in the fall 2006 election, contain significant funding for integrated water resources planning and project implementation. Lassen County has not developed and is not signatory to a regional integrated water management plan. State-funding of projects under the Integrated Regional Water Management Program require applicants to have developed, or be signatory, to integrated water resource plans.

#### Integrated Water Resource Planning Actions

The County will take the following actions:

- Establish an effective approach for participation in or development of an Integrated Regional Water Management Plan (IRWMP).
- Support water resource-related policies, programs, and projects approved by the Board of Supervisors.
- Pursue funding sources for implementation of plan policies, programs, and projects.

## 3.10 GWMP Implementation, Reporting and Updating

The following sections discuss Plan implementation, reporting and updating in detail.

### 3.10.1 GWMP Implementation

Plan section 3.3 identifies six GWMP component groups. Individual plan components are described in section 3.5 through section 3.9. Plan implementation actions are identified at the conclusion of each section.

Additionally, this section concludes with actions associated with GWMP implementation, reporting, and updating. Table 3-1 summarizes implementation actions and the associated implementation schedule. Implementation of the first Plan component, Basin Management Objectives, is a high priority for the County. It is anticipated that following Plan adoption, the Board of Supervisors will direct staff to implement BMOs with support of the Working Group and in collaboration with local groundwater users. BMOs will result in quantitative groundwater management objectives that represent local desires and, through monitoring, will document if groundwater exportation from interstate basins impacts Lassen County.

## 3.10.2 GWMP Implementation Report

County staff will prepare an annual summary report detailing GWMP implementation progress during the previous year and anticipated activities during the next year. Table 3-1 of the GWMP will serve as the template for the annual implementation report. Additionally, County staff will communicate with DWR Northern District staff during preparation of the implementation report to discuss and report groundwater monitoring results and associated groundwater conditions that would warrant additional management activities beyond those implementation activities described in Table 3-1 .

## 3.10.3 GWMP Update

The County's increasing knowledge of subsurface conditions and groundwater management techniques will likely result in the need for periodic Plan updates. As further studies of basin geology and groundwater behavior provide new information, the County must consider if this new information should result in a change in groundwater management. Additionally, as the County works with different management techniques, it will likely realize more effective ways to accomplish the objectives within this Plan.

The County will continually consider improvements to its groundwater management techniques. The County will work to incorporate these improvements as they develop. In addition, the County will formalize changes to this Plan once every five years, if changes are warranted.

### GWMP Implementation, Reporting and Updating Actions

The County will take the following actions:

- Formalize and institute a Working Group to meet quarterly or as needed on GWMP implementation activities.
- Lassen County to schedule and facilitate Working Group meetings
- Work cooperatively with local stakeholders, county government, and local advisory committees to assess needed GWMP updates.
- Develop and implement annual summary report of 1) groundwater level, groundwater quality, and inelastic land subsidence at "key" well locations, and 2) status of GWMP implementation in cooperation with DWR.
- Secure funding for annual groundwater summary report.

Table 3-1. Summary of GWMP Actions

| | Description of Action | Implementation Schedule |
|---|---|---|
| **I.** | **Basin Management Objectives** | |
| 1 | Codify groundwater management using the BMO concept through the development of a recommended BMO ordinance for consideration and adoption by the Board of Supervisors. | 2007 |
| 2 | Formalize and proceed with the four phases identified in the *Introduction to the BMO Process of Groundwater Management* summary in Appendix C. | 2007 |

| Table 3-1. Summary of GWMP Actions | | |
|---|---|---|
| | Description of Action | Implementation Schedule |
| **II.** | **Groundwater Monitoring`** | |
| 3 | Identify "key" groundwater monitoring well locations utilizing existing groundwater monitoring data. | 2007 |
| 4 | Develop and implement annual summary report of groundwater level, groundwater quality, and inelastic land subsidence at "key" well locations. | 2007 |
| 5 | Secure funding for annual groundwater summary report. | 2007 |
| 6 | Work with local stakeholders and DWR to identify areas that may need additional groundwater level, groundwater quality, or subsidence monitoring based on identified data gaps or negative performance trends. Request that DWR be alert and report anecdotal evidence of land subsidence at monitoring well locations. | Annual |
| 7 | Work with state and federal agencies to secure funding for expansion of the Lassen County monitoring grid. | As needed |
| 8 | Maintain agreements with DWR for groundwater monitoring and database management activities. | Ongoing |
| 9 | Coordinate with DWR and local landowners to ensure that selected wells are maintained as part of a long-term monitoring program. | Ongoing |
| 10 | Support the development and implementation of quantitative BMOs in priority groundwater basins. | 2007 - 2009 |
| 11 | Pursue opportunities for interstate groundwater basin monitoring and reporting with the State of California, State of Nevada, Washoe County, and federal agencies. | Ongoing |
| 11 | Support efforts to map and compile information on riparian habitats and phreatophyte vegetation. | Ongoing |
| **III.** | **Groundwater Resource Protection** | |
| 13 | Support and implement policies contained in the Lassen County General Plan Natural Resources Element (Water Resources chapter). | Ongoing |
| 14 | Support existing Ordinance 488 associated with well construction, repair, modification, and destruction. | Ongoing |
| 15 | Participate in the review and provide recommendation for permit applications submitted under Ordinance 539, Groundwater Extraction and Exportation. | Ongoing |
| 16 | Support County Environmental Health Department submittal of received well completion reports to DWR Northern District. | Ongoing |
| 17 | Evaluate the need for and implement as necessary a wellhead protection, groundwater recharge area protection, well spacing (and other) programs in Lassen County. | 2007-2008 |
| 18 | Continue to participate and support the function of the Long Valley Groundwater Management District pursuant to the Memorandum of Agreement with Sierra County. | Ongoing |
| 19 | Participate in activities of the Honey Lake Groundwater Management District, if enacted and directed by the Board of Supervisors. | As Needed |
| 20 | Participate in activities of the Willow Creek Valley Groundwater Management District when requested. | As Needed |
| 21 | Participate in activities of the Surprise Valley Groundwater Management District when requested. | As Needed |
| 22 | Support activities of the Lassen-Modoc County Flood Control and Water Conservation District. | Ongoing |
| 23 | Coordinate and collaborate with the Washoe County Regional Water Planning Commission and Nevada State Engineer on interstate groundwater management issues. | Ongoing |
| **IV.** | **Groundwater Sustainability** | |
| 24 | Participate in the evaluation of local projects to improve groundwater sustainability (e.g. groundwater recharge). | As Needed |
| 25 | Provide support associated with development of quantitative BMOs in Lassen County. | 2007-2009 |
| 26 | Pursue funding from state agencies, federal agencies, and partnerships for groundwater sustainability activities. | Ongoing |

| Table 3-1. Summary of GWMP Actions | | |
|---|---|---|
| | Description of Action | Implementation Schedule |
| 27 | Coordinate and collaborate with the Washoe County Regional Water Planning Commission, Washoe County Board of Commissioners, Washoe County Planning Commission, and the Nevada State Engineer on interstate groundwater management issues to encourage a groundwater management method consistent with the BMO process detailed in the Lassen County GWMP. | Ongoing |
| 28 | Participate in the development and adoption of agreements, special legislation, or compacts pertaining to sustainable groundwater management between the State of California and the State of Nevada and encourage groundwater management using the BMO method. | Ongoing |
| 29 | Collaborate with state and federal (e.g. USGS) agencies in the completion of groundwater projects and studies. | Ongoing |
| **V.** | **Stakeholder Involvement** | |
| 30 | Assist in coordination and management activities of the Working Group. | Ongoing |
| 31 | Be responsive to the needs and requests of the Board of Supervisors and other Departments. | Ongoing |
| 32 | Continue to work cooperatively with local stakeholders on groundwater management activities. | Ongoing |
| 33 | Continue to work cooperatively with DWR headquarters and DWR Northern District on groundwater management activities. | Ongoing |
| **VI.** | **Integrated Water Resources Planning** | |
| 34 | Establish an effective approach for participation in or development of an Integrated Regional Water Management Plan. | 2007 |
| 35 | Support water resource-related policies, programs, and projects approved by the Board of Supervisors. | Ongoing |
| 36 | Pursue funding sources for implementation of plan policies, programs, and projects. | As Needed |
| **VII.** | **GWMP Implementation, Reporting and Updating** | |
| 37 | Formalize and institute a Working Group to meet quarterly or as needed on GWMP implementation activities. | 2007 |
| 38 | Lassen County to schedule and facilitate Working Group meetings | Quarterly or As Needed |
| 39 | Work cooperatively with local stakeholders, county government, and local advisory committees to assess needed GWMP updates. | Annual |
| 40 | Develop and implement annual summary report of 1) groundwater level, groundwater quality, and inelastic land subsidence at “key” well locations, and 2) status of GWMP implementation in cooperation with DWR. | Annual |
| 41 | Secure funding for annual groundwater summary report. | 2007 |

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# 5. LIMITATIONS

## Report Limitations

This document was prepared solely for Lassen County in accordance with professional standards at the time the services were performed and in accordance with the contract between Lassen County and Brown and Caldwell. This document is governed by the specific scope of work authorized by Lassen County, it is not intended to be relied upon by any other party except for regulatory authorities contemplated by the scope of work. We have relied on information or instructions provided by Lassen County and other parties and, unless otherwise expressly indicated, have made no independent investigation as to the validity, completeness, or accuracy of such information.

# APPENDIX A

## Resolution of Intent to Draft a Groundwater Management Plan

RESOLUTION NO. 06-018

RESOLUTION OF THE BOARD OF SUPERVISORS, COUNTY OF LASSEN, STATE OF CALIFORNIA, NOTICING ITS INTENT TO PREPARE A GROUNDWATER MANAGEMENT PLAN UNDER WATER CODE §10750 *et seq.* (AB 3030, STATS 1992) FOR THE AREAS OF LASSEN COUNTY NOT COVERED BY ANOTHER GROUNDWATER MANAGEMENT PLAN UNDER THIS AUTHORITY OR ANY OTHER AUTHORITY

WHEREAS, the Legislature finds and declares that groundwater is a valuable natural resource in California and should be managed to ensure both its safe production and its quality; and

WHEREAS, it is the intent of the Legislature through the passage of AB 3030 (Stats 1992) codified as Water Code §10750 *et seq.* to encourage local agencies to work cooperatively to manage groundwater resources within their jurisdictions; and

WHEREAS, the Legislature also finds and declares that the additional study of groundwater resources is necessary to better understand how to manage groundwater effectively to ensure the safe production, quality, and proper storage on groundwater in this state; and

WHEREAS, the adoption of a Groundwater Management Plan is encouraged, but not required by law; and

WHEREAS, any local agency, whose service area includes a groundwater basin, or a portion of a groundwater basin, that is not subject to groundwater management pursuant to other provisions of law or a court order, judgment, or decree, may, by ordinance, or by resolution if the local agency is not authorized to act by ordinance, adopt and implement a groundwater management plan pursuant to this part within all or a portion of its service area not served by a local agency or served by a local agency whose governing body, by a majority vote, declines to exercise the authority to implement a groundwater management plan and enters into an agreement with the local public agency pursuant to Water Code §10750.7 and §10750.8; and

WHEREAS, prior to adopting a resolution of intention to draft a groundwater management plan, Water Code §10753.2 requires a local agency to hold a hearing, after publication of notice pursuant to Government Code §6066, on whether or not to adopt a resolution of intention to draft a Groundwater Management Plan pursuant to this part for the purposes of implementing the plan and establishing a groundwater management program; and

WHEREAS, such hearing was noticed pursuant to Government Code §6066 and held on March 28, 2006, at 10:45 a.m., in the Board of Supervisors Chambers, 707 Nevada Street in Susanville, California.

WHEREAS, at the conclusion of the hearing, the local agency may draft a resolution of intention to adopt a groundwater management plan pursuant to this part for the purposes of implementing the plan and establishing a groundwater management plan.

NOW, THEREFORE, BE IT RESOLVED, that the Board of Supervisors of the County of Lassen hereby agree to:

1. Adopt a Resolution of Intention to Draft a Groundwater Management Plan pursuant to Water Code §10750 *et seq.* for the purposes of implementing the plan and establishing a groundwater management program.

2. Direct the Clerk of the Board to publish the Resolution of Intention under Government Code §6066 pursuant to Water Code §10753.3(a).

3. Direct the Department of Community Development to prepare the groundwater management plan under Water Code §10750 *et seq.*

4. Direct the Department of Community Development to prepare the groundwater management plan within two years of the date of the Resolution of Intention pursuant to Water Code §10753.4.

The foregoing resolution was adopted at a meeting of the Board of Supervisors of the County of Lassen, State of California, held on the 28th day of March, 2006, by the following vote:

AYES: Supervisors Pyle, Chapman, Keefer, Dahle, Hanson

NOES: None

ABSENT: None

APPROVED: _____
Chairman
Lassen County Board of Supervisors

ATTEST: _____
Theresa Nagel, County Clerk,
Lassen County

I, THERESA NAGEL, County Clerk of the County of Lassen, State of California, and ex-officio Clerk of the Board of Supervisors thereof, do hereby certify that the foregoing resolution was duly adopted by said Board of Supervisors at a regular meeting held on the 28th day of March, 2006.

_____.

_____
County Clerk and ex-officio Clerk of the Board of Supervisors

# APPENDIX B

## Public Outreach Plan

**Lassen County Department of Community Development**
**AB 3030 Groundwater Management Plan**

# Public Outreach Plan
**March 2006**

***Technical Memorandum***

## 1.0 Introduction

This technical memorandum describes the Outreach Plan for the development of the Lassen County AB 3030 Groundwater Management Plan (GWMP or Plan). Lassen County (County) seeks to develop the GWMP through an inclusive process that informs, educates, and involves local stakeholders. Stakeholders in Lassen County understand the value of their water resources and have been active in advancing water management through monitoring and evaluation of groundwater resources. Development and implementation of the GWMP will benefit from the active participation of those who have knowledge of – and a stake in – the outcome of the planning process. Locally driven plan development will contribute to plan elements that are appropriate, equitable, and implementable.

### 1.1 Project Description

The Lassen County Department of Community Development (Department) is the County lead for groundwater-related activities. The Lassen County groundwater management ordinance is currently the primary tool for groundwater management in the County. Based on the need for proactive groundwater management and the desire to compete for state grant funding, the Lassen County Board of Supervisors has directed the Department to develop a countywide AB 3030 GWMP. The Plan is being developed under the authority provided in California Government Code § 25210.1 et seq.

This Public Outreach Plan will support the development of other GWMP components. Local stakeholder input will help define current and anticipated groundwater management issues, the GWMP goal and associated objectives, the GWMP area and associated Basin Management Objective (BMO) areas, and GWMP implementation activities. Stakeholders will also assist in identifying existing information used to describe the current hydrogeologic setting.

### 1.2 Public Outreach Objectives

Lassen County has identified the following objectives for public outreach as part of the GWMP:

- Inform the public regarding the process for - and progress of – GWMP development
- Provide meaningful opportunities for stakeholders and the general public to contribute to the Plan
- Incorporate public input regarding planning goals and objectives, and issues of concern
- Document stakeholder recommendations in a clear, complete manner for consideration by the Department
- Develop and demonstrate stakeholder support and understanding regarding the GWMP

To pursue these objectives, Lassen County recognizes the need to match appropriate involvement opportunities and outreach methods with groups targeted for inclusion in the planning process. Some participants may merely wish to remain informed regarding the planning process, while others should be involved directly in GWMP development.

## 2.0 Outreach Implementation

The Lassen County GWMP team will direct outreach with a variety of groups and individuals, including organized stakeholder groups, public agencies, non-profit organizations, and individuals with an interest in the planning process and its results. Outreach to departments and individuals within the DWR and Lassen County will also be necessary. The groups and individuals targeted by this Outreach Plan have a range of potential outreach needs. The three categories below present the range of information needs that this Outreach Plan will seek to address.

- *Notification Group* – This group merely needs to know that GWMP development is proceeding. This group includes County departments monitoring the use of funding, those tracking various water resources planning efforts at the state level, and others. Parties in this group may need to see formal progress reports, be notified that deliverables have been made, and should be notified when the GWMP is complete.

- *Information Group* – This group may want to or need to learn about GWMP goals and approach, and should be informed regarding the general progress of the GWMP development.

- *Input Group/Participatory Group* – This group may wish to provide suggestions regarding GWMP development, and should be given opportunities to learn about - and provide comments on - planning elements, methods, and documents. This group also may contain individuals with specific knowledge or experience related to the development of GWMP elements, and should participate in decisions regarding development of Plan content.

The categories at higher levels of involvement are inclusive of those at more minimal levels of involvement. Those in the input group, for example, would have access to public information received by the notification and information groups.

### 2.1 Key Groups and Needs

Table 2-1 lists key groups that this Outreach Plan targets. The table describes each group's mission and/or interest in the plan and identifies the group's outreach needs, using the categories described above. It is likely that participants will identify other specific groups and individuals to involve – this list may grow with the GWMP. In Table 2-1 groups anticipated to have ongoing decision-making involvement with the planning effort are presented first. Levels of outreach and participation may vary both within each group and over the course of plan development.

Table 2-1
Key Groups and Outreach Needs

| Group | Mission or interest in GWMP | Outreach Needs | Notes |
|---|---|---|---|
| Lassen County | Lassen County is leading the GWMP development effort. | Participation / Input | Some departments (Department of Community Development and Board of Supervisors) will require notification and formal progress reporting.<br>Representatives of other departments may want or need to be informed, provide input, and/or participate. Staff dedicated to the GWMP planning effort will participate. The Department of Community Development and Board of Supervisors may take action only on formal tasks. Other departments should be informed regarding GWMP goals, and should be provided with an internal contact to which they may direct their own (and external) inquiries regarding the GWMP. |
| Groundwater Management Districts | Groundwater Management Districts have direct knowledge and experience related to GWMP elements. | Participation / Input | Development of several GWMP elements will focus on groundwater sustainability and will require involvement from districts that utilize groundwater. |
| Well Owners | Owners and operators of groundwater wells in Lassen County have direct knowledge and experience related to GWMP elements. | Participation / Input | Development of several GWMP elements will focus on groundwater sustainability and will require involvement from individuals that utilize groundwater. |
| Environmental Advocacy Groups | Various interests including protection and enhancement of: habitat; wildlife populations; and water, air, and terrestrial resource quality. Many have education and outreach objectives. | Information | Interest by environmental advocacy groups typically focuses on groundwater / surface water interaction and habitat where groundwater is a primary source of water supply. |
| General Public | Varies | Information/Notification | |

## 2.2 Planned Outreach Methods

Just as public participants in GWMP development have a range of outreach needs, so too is there a range of methods for meeting those needs. The planning team can: make information available to the public; share information in a unidirectional manner; ask for public response; and can interact with public representatives in group settings. The range of outreach methods extends from "one-way" outreach methods to highly interactive decision-making.

Settings that provide interaction with interested parties and groups allow for both one-way and two-way communication, enhanced by discussion. These methods provide opportunities for extensive involvement through focused education and participatory decision-making. A stakeholder workshop, featuring informational presentations and discussion, is an example of an interactive method.

A variety of potential methods are appropriate for GWMP development, and a combination of the methods will help to provide the right information to the right people at the right time. This Outreach Plan identifies methods that are planned; in order for the Outreach Plan to be effective, however, it must be adaptable based upon needs that may be identified during the planning process. Monitoring the effectiveness of the outreach methods will provide the planning team guidance in evaluating and adjusting Outreach Plan implementation to meet the Department's objectives. Table 3-1 describes the outreach methods that may be employed during GWMP development and indicates a potential monitoring method for each.

**Table 3-1 Outreach Methods**

| Method | Description |
|---|---|
| Press Releases | Provide written information to local newspapers for publication; take out ads announcing events, or post public notices of upcoming events in the "calendar" section of local publications. |
| Interviews | Meet with (or call) planning process participants to evaluate outreach and discuss issues of concern. Interviews may be based upon a structured questionnaire or freeform. |
| Public Meetings | Prepare and conduct a meeting that is open to the public and which provides informational presentations on the planning goals, approach, and progress. Include opportunities for the public to ask questions of the planning team and to offer suggestions, either at the meeting or thereafter. |
| Public Hearings | Prepare and conduct a meeting that is open to the public and which provides informational presentations on the planning goals, approach, and progress. Include structured opportunities for attendees to make brief statements. (Hearings are not likely to be used.) |

## 2.3 Outreach Tasks and Materials

Following completion of the Outreach Plan, the County will implement activities described in the Outreach Plan. Outreach efforts will focus on public notification and participation and

interaction with public entities whose service area overlay groundwater basins. Outreach activities will include:

- Public meeting; One public meeting will be held during Plan development to provide the public with an overview of the Plan development process and to receive public comment on identified elements of the Plan. Public comment will be encouraged and will be considered for incorporation in the GWMP as appropriate.
- Formal Notices, Hearings, and Resolutions (CWC 10753.2-10753.6), including:
    - Step 1 - Provide public notification of a hearing on whether or not to adopt a resolution of intention to draft a GWMP and subsequently complete a hearing on whether or not to adopt a resolution of intention to draft a GWMP. Following the hearing, draft a resolution of intention to draft a GWMP.
    - Step 2 - Adopt a resolution of intention to draft a GWMP and publish the resolution of intention in accordance with public notification (6066 gov. code). Upon written request, provide a copy of resolution of intention to interested persons.
    - Step 3 - Prepare draft GWMP within two years of resolution of intention adoption. Provide to the public a written statement describing the manner in which interested parties may participate in developing the GWMP.
    - Step 4 - Provide public notification (6066 gov code) of a hearing on whether or not to adopt the GWMP, followed by a hearing on whether or not to adopt the GWMP.
    - Step 5 - If protests are received for less than 50 percent of the assessed value of property in the county area the plan may be adopted within 35 days after completion of Step 4 above. If protests are received for greater than 50 percent of the assessed value of the property in the county area, the plan will not be adopted.
- Stakeholder Working Group: Lassen County will identify and request participation by a stakeholder working group. The working group is anticipated to include representatives of local groundwater management districts, local water agencies, and other water resource stakeholders with knowledge specific to groundwater conditions and issues in Lassen County. The working group is anticipated to meet up to four times during GWMP formulation and review.

# APPENDIX C

## Introduction to the BMO Process of Groundwater Management

# APPENDIX C

## Introduction to the BMO Process of Groundwater Management

### Introduction

The Basin Management Objective (BMO) concept was developed to overcome the problems of defining safe yield. Safe yield attempts to define the volume of water that can be extracted without lowering the groundwater table. This requires great volumes of data on groundwater levels along with complete and accurate data on groundwater extraction. In addition to problems estimating groundwater extraction, the concept of safe yield does not correlate with the actual behavior of groundwater. As an example, "the safe yield of a groundwater basin is 10,000 acre feet", which is interpreted to mean that the long-term groundwater levels will not decline if annual groundwater use remains below 10,000 acre-feet. What this really means is that long-term annual groundwater recharge averages 10,000 acre-feet per year.

This is problematic because recharge rates to groundwater basins are highly variable. There are good records of groundwater levels in areas of Honey Lake basin and other priority groundwater basins, but groundwater extraction rates and recharge rates can only be estimated. Recharge to a groundwater basin is affected by numerous factors including the amount of precipitation, interaction between groundwater and surface water, and the overall permeability of the aquifer system. Recharge is less during a year with below average precipitation or can decrease if stream beds that recharge groundwater lose permeability. Since groundwater recharge is variable, the concept of safe yield is less than ideal.

The BMO concept provides an improved alternative to the concept of safe yield. BMOs reflect a proactive method of groundwater management established on a local level by local groundwater users and elected officials working together. BMOs are used to manage groundwater to meet local users' needs instead of working to stop other interests. BMOs include the development of local groundwater management objectives and monitoring of the groundwater basin health to assure the water use is consistent with defined local objectives.

### The Four Phases of the BMO Process

BMOs are developed and implemented through four phases, as depicted in Table C-1. The four phases include:

- Planning;
- Development;
- Implementation; and
- Resolution.

Activities associated with each BMO phase are described in the following sections.

**Table C-1. Basin Management Objective Phases**

| |
|---|
| Planning Phase |
| Establish Working Group |
| Establish Management Sub-Areas |
| Develop Organizational Structure |
| Establish Public Input Process |
| Development Phase |
| Identify Monitoring Elements |
| Identify Monitoring Program |
| Develop Basin Management Objectives |
| Implementation Phase |
| Collect and Evaluate Data |
| Disseminate Data |
| Determine Need For Resolution |
| Reevaluate Management Objectives |
| Reevaluate Monitoring Program |
| Resolution Phase |
| Technical Advisory Committee (TAC) Investigation and Recommendation |
| Water Advisory Committee (WAC) Strives for Mutually Agreeable Solution |
| Potential WAC Recommendation to Board of Supervisors |
| Board of Supervisors Action |

## Planning Phase

The planning phase of the BMO process establishes the institutional structure that will be used during development and implementation of the BMO program. This phase can typically be completed in three to six months, with much of the effort centered on the development of an organizational structure that is acceptable to local groundwater users and will meet the functional needs of the BMO program. The planning phase of the BMO process is expected to culminate in a BMO ordinance that codifies the concepts, actions, roles, and responsibilities for groundwater management under the BMO process. Elements of the BMO planning phase are summarized in the following paragraphs and include:

- Establish Working Group;
- Establish Management sub-areas;
- Develop organizational structure; and
- Establish public input process.

***Establish Working Group.*** The first step in the planning phase is the establishment of a BMO Working Group including representatives from disparate regions of the county with a role in groundwater management. Representation on the Working Group may include agriculture, public water supply, environmental, County staff, and Department of Water Resources (DWR) – Northern District staff. The Working Group performs key roles in the planning, development, and implementation phases of the BMO program. A similar Working Group comprised of local groundwater users and resource specialists guided development of the Lassen County Groundwater Management Plan (GWMP) and could be expanded, if needed, to form the BMO Working Group.

***Establish Management Sub-areas.*** The Working Group will guide the identification of Management sub-areas that represent the portion of the groundwater aquifer where management objectives will be established. Management sub-areas are defined by hydrologically similar regions or groundwater basins. Management sub-areas can be further subdivided to define areas where groundwater users have the same vested interest in maintaining the groundwater resource at mutually agreeable levels. A critical concept to consider during establishment of management areas is that water management practices or activities in one Management sub-area should not negatively impact the water management objectives of another Management sub-area. Draft Management sub-areas were proposed for the Honey Lake basin during an earlier groundwater management project and should be reviewed and revised as needed.

***Develop Organizational Structure.*** The BMO program organizational structure defines how local groundwater users are represented and interact during the implementation and management phases. The Working Group is responsible for developing a recommended organizational structure that meets local groundwater user needs, provides an efficient structure for BMO implementation and management, and reflects the desired level of statutory-based involvement from Lassen County. The organizational structure should be constructed to both promote involvement and reflect the groundwater management needs of local groundwater users from each Management sub-area.

An example BMO organizational structure is provided in Figure C-1. Individual groundwater users within Management sub-areas form the base of the organizational structure and define BMOs that meet their local needs. The next level within the organizational structure is the Water Advisory Committee (WAC). The WAC includes one locally nominated representative from each of the Management sub-areas and may include additional members such as County staff. The Management sub-area representative serving on the WAC acts as a communication path between local groundwater users and the WAC.

The WAC receives input from individual Management sub-areas and provides programmatic consistency and guidance to each of the Management sub-areas. Assisting the WAC is the Technical Advisory Committee (TAC), which is composed of technical experts capable of providing unbiased, scientific-based opinions to the WAC. Some members of the current Lassen County GWMP Working Group may be incorporated into the WAC and TAC, as appropriate. County staff, working collaboratively with the WAC, will consider and develop a recommendation to the Board of Supervisors associated with the need for BMO statutory authority. Statutory authority held by the Board of Supervisors would be consistent with existing police powers to protect public health and safety. The Board of Supervisors will participate in resolution of BMO exceedances that could not be resolved in a voluntary, mutually agreeable manner. The Board of Supervisors would also

support Management sub-areas that experience groundwater management issues that extend beyond County boundaries. It would not be the intent or interest of the Board of Supervisors to engage in day-to-day groundwater management within Management sub-areas, as local groundwater users are expected to manage the resource to meet their needs.

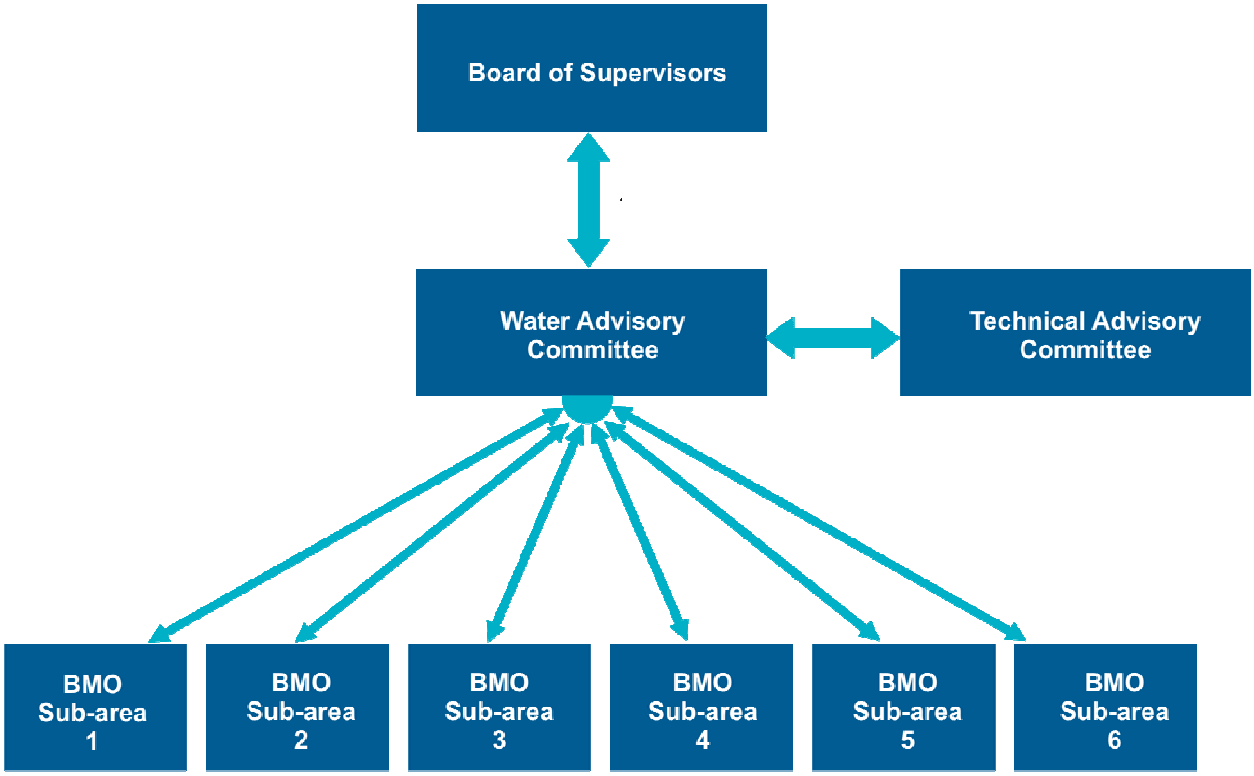



**Figure C-1. Potential Organizational Structure**

***Establish Public Input Process.*** Public input is a critical factor for successful BMO development and implementation. The public input process must be tailored to fit the region where it is applied, and should accommodate, if possible, the needs and wishes of the local groundwater users in the area to be managed. Public input can be through input at Working Group meetings during the development phase or through input at WAC meetings during the implementation and management phases. The Management sub-area representative to the WAC is responsible for conveying public ideas and concerns to the WAC as well as educating the public during Management sub-area meetings.

## Development Phase

The BMO development phase culminates in the identification of quantitative management objectives for each groundwater management element (e.g. water level, water quality, inelastic land subsidence). This phase of the BMO process requires engaged participation by local groundwater users and is typically time consuming. Ample time should be taken to educate local groundwater

users on BMO concepts, allow groundwater users to determine if the proposed method of management meets local needs, and work closely with local groundwater users to define quantitative management objectives. The BMO development phase includes:

- Identification of the monitoring elements;
- Identification of monitoring program; and
- Development of management objectives.

***Identify Monitoring Elements.*** For each Management sub-area, the need and ability to develop quantitative BMOs is considered for key monitoring elements including groundwater level, groundwater quality, and inelastic land subsidence. The need to include a monitoring element is dictated by the importance of the element to overall groundwater management. Typically, water level and water quality are key elements included in a BMO program. Inelastic land subsidence should be included if subsidence has been observed or if a change in groundwater management is proposed that would lower groundwater levels to historic lows, potentially resulting in subsidence.

The ability to develop quantitative BMOs for an element, and as a result to include the monitoring element in the BMO program, is predicated on having an adequate amount of baseline data. Neither the water quality nor inelastic land subsidence element requires extensive background data because quantitative management objectives typically reflect desired water quality or acceptable subsidence. Quantitative management objectives can be established for these elements with minimal baseline data. Establishing management objectives for water levels requires a longer history of groundwater levels, ideally covering periods of drought or extensive groundwater extraction. Lassen County has adequate water level and water quality data to establish quantitative BMOs for these elements. Observed inelastic land subsidence in Lassen County, based on groundwater well cement seals perched above ground level, support the need for inclusion of inelastic land subsidence as a monitoring element.

***Identify Monitoring Program.*** The monitoring program describes the monitoring location, frequency, and BMO elements to be monitored. The monitoring program description should also describe data management and dissemination.

Lassen County has an existing groundwater monitoring network consisting of wells where groundwater levels are monitored at regular intervals, typically in the spring and fall. Groundwater level monitoring and data management is compiled and completed by DWR Northern District – Groundwater Section staff. DWR also periodically monitors water quality at selected wells within the monitoring network. A coordinated, countywide inelastic land subsidence monitoring network does not exist; however, limited monitoring is conducted associated with individual projects. The identification of key wells with water level information representative of local conditions has been initiated during the development of the Lassen County GWMP and would be confirmed by groundwater users within each Management sub-area. Previous results of water quality monitoring by DWR, United States Geological Survey, and others would guide the selection of key water quality monitoring locations.

Monitoring frequency must also be considered during development of the monitoring program. DWR currently monitors water levels in the spring and fall of each year. Monitoring results from

these seasons should be sufficient for the development of water level BMOs. Water quality is monitored by DWR infrequently, typically once each few years. Water quality monitoring and assessment for BMO compliance would likely only be required each two to three years as groundwater quality tends to change slowly. Some areas, specifically near water supply sources, may require more frequent BMO water quality compliance monitoring.

DWR has adopted and follows standard monitoring protocols and maintains a database of water level and water quality information for the Lassen County groundwater monitoring network. The BMO Water Advisory Committee would develop a recommendation to continue to collaborate with DWR for data management activities or would suggest an alternative, such as County management of a database. The WAC would also develop a recommendation associated with dissemination of monitoring results and program status reports. Methods could include the County web site, mailings, Board of Supervisor updates, or other means.

***Develop Basin Management Objectives***. Development of quantitative BMOs for water level, water quality, and inelastic land subsidence is completed for each Management sub-area by local groundwater users, with the assistance of their WAC representative and other resources. The BMOs define minimum desired levels (sometimes referred to as "triggers") for groundwater level and water quality at each key well within a Management sub-area. If a BMO is not achieved, various management activities can be pursued including informing the public, investigating the cause, and pursuing resolution activities. Any needed resolution activities will focus on voluntary, mutually agreeable solutions which may include rescheduling or redistribution of groundwater extractions, reducing groundwater extraction rates, or establishment of alternative BMO levels in the sub-area. The resolution phase is discussed in detail beginning on page C-8. Development of quantitative BMOs is a time consuming process. In both Glenn and Butte Counties, approximately 18 to 24 months was required to complete the development of quantitative BMOs for all of the Management sub-areas (about 20 sub-areas in each county).

BMO Development Packets are a tool that can assist and accelerate the development of quantitative BMOs by providing guidance on BMO concepts, steps to develop BMOs, and graphs of past water level and water quality monitoring results at key well locations within each Management sub-area. Both Butte County and Tehama County have successfully used this approach to assist locals during development of BMOs.

## Implementation Phase

The third phase of the BMO program involves implementation. The implementation phase continues for as long as the BMO process is utilized for groundwater management. This phase includes data collection, evaluation, and dissemination. If management objectives are exceeded, an investigation to determine the cause of the exceedance would be completed and a range of resolution actions would be considered (as described in the resolution phase section below). Changes to the monitoring program may also occur under the implementation phase. The BMO implementation phase includes:

- Collect and evaluate data;
- Disseminate data;
- Determine need for resolution;
- Reevaluate management objectives; and
- Reevaluate monitoring program.

***Collect and Evaluate Data.*** Monitoring is completed consistent with the BMO monitoring plan. The data is then evaluated by the TAC or County staff, with findings and recommendations reported to the WAC. For the BMO process to work properly, the results of monitoring must be the basis for determining whether a Management sub-area is achieving its quantitative objectives. The BMO process cannot work if individual well owners or small groups of well owners promote groundwater management activities or objectives outside of the collaborative process that are not supported by monitoring results.

***Disseminate Data.*** Summarized monitoring results can be disseminated in a number of ways including the County web site, public meetings, annual reports, and other methods. The reported data can then be viewed by interested local stakeholders and other parties. Widespread dissemination of monitoring data is an important factor for success of the BMO program.

***Determine Need for Resolution.*** BMOs should not be exceeded on a regular basis if they are developed in a reasonable manner. This is especially true in Lassen County where groundwater basins are generally in good health. If monitoring results indicate BMOs are not met, then various actions will follow. Actions taken if a BMO objective is exceeded should be based on the magnitude and repetitiveness of the exceedance. The WAC will request assistance from the TAC to help determine the cause of the exceedance based on a scientific-based investigation. If the WAC determines that the exceedance requires resolution, then the resolution phase begins, which runs concurrently with the implementation phase during exceedances. The WAC and TAC will collaborate to develop voluntary, mutually agreeable resolution actions that are responsive to local groundwater user needs and that resolve the exceedance. If the exceedance is determined to not be representative of an actual groundwater issue, the Management sub-area may reevaluate the management objective.

***Reevaluate Management Objectives.*** Management sub-area BMOs can change over time to more accurately reflect groundwater levels required to meet local needs. Management levels may have been initially set too high or too low, and therefore do not match actual levels that need to be maintained for effective groundwater management. Also, objectives for groundwater quality and subsidence may need to be revised as monitoring provides a more extensive baseline of information.

***Reevaluate Monitoring Program.*** The monitoring program should be reviewed and reevaluated periodically to account for changes in groundwater understanding, and to improve monitoring coverage of Management sub-areas. The monitoring program can be augmented, for example, by adding more locations where monitoring occurs, thus increasing the area covered by the monitoring program. The monitoring program can also be augmented by expanding monitoring for groundwater quality and subsidence elements.

**Resolution Phase**

The resolution phase of the BMO process is only activated if monitoring results demonstrate that the established quantitative BMO for a program element has been exceeded. If BMOs are developed consistent with local groundwater management needs, this phase would likely only be activated during drought, a significant local increase in groundwater extraction, or if groundwater quality deteriorates.

The resolution phase is discussed in the following paragraphs and includes:

- TAC investigation and recommendation;
- WAC strives for mutually agreeable solution;
- WAC recommendation to Board of Supervisors; and
- Board of Supervisors action.

***TAC Investigation and Recommendation.*** With an understanding of the regional extent and magnitude of the BMO non-compliance, the TAC performs an investigation to find the cause(s) of the BMO exceedance. The TAC reports its findings to the WAC.

***WAC Strives for Mutually Agreeable Solution.*** After the cause(s) of the exceedance have been identified, the WAC will work toward a mutually agreeable, voluntary solution. The WAC tries to resolve the problem in the effected area by negotiations with local groundwater users. Example voluntary solutions include rescheduling or redistribution of groundwater extractions, reducing groundwater extraction rates, or establishment of alternative BMO levels in the sub-area.

***WAC Recommendation to Board of Supervisors.*** If a mutually agreeable solution is not attainable, the WAC will seek resolution through the Board of Supervisors. The WAC will bring the issue to the Board of Supervisors, and suggest a non-mutually agreeable solution, if necessary, to resolve the BMO exceedance. If a mutually agreeable solution is not reached and the Board of Supervisors does not choose to resolve the dispute, legal solutions could be pursued by the impacted groundwater user(s) against those alleged to have impacted the users.

***Board of Supervisors Action.*** The Board of Supervisors, will take actions related to the cause of the BMO exceedance that allow groundwater management objectives to be achieved. These actions should have the least impact on groundwater users possible and could include the same actions suggested during discussion of mutually agreeable options.

# APPENDIX D

## Lassen County Board of Supervisors Meeting Minutes and Farm Bureau Comments with Response

# APPENDIX D

## Lassen County Board of Supervisors Plan Adoption

## And

## Public Comment with Response

Appendix D includes meeting minutes from the Lassen County Board of Supervisors meeting on March 13, 2007, where the GWMP was unanimously adopted following a public hearing. Public comment on the GWMP was unanimously supportive of the plan.

Appendix D also includes written comment submitted during the public review period. The Lassen County Farm Bureau provided the only written comments. The County appreciates Farm Bureau comment and has developed responses in an effort to provide clarification and additional information. The County appreciates the contribution of local residents who provided significant guidance and input during development of the Groundwater Management Plan.

BOARD OF SUPERVISORS

MARCH 13, 2007

PUBLIC HEARING – COMMUNITY DEVELOPMENT DEPARTMENT
The public hearing for Lassen County Groundwater Management Plan is opened at 10:45 a.m.

Farm Advisor David Lile presents historical information on the Groundwater Management Plan. Brown and Caldwell Consultant Bob Vince presents information from a power point presentation. A report from the City is submitted for the record.

COMMENTS IN FAVOR
Baxter Creek resident Phil Nemir states this plan is a great start; there is a lot of great information. This issue will become more important down the line. He is concerned about the declining groundwater trends in Herlong and would like to know how that would be addressed. The plan has no enforcement teeth. He feels there may be problems with the Honey Lake Groundwater District that should be modified as needed. States having the committee continue is good, but if they have no ability to enforce anything or try to address the issues seriously, asks what are we left with?

Adin resident Dale Albaugh states he has not studied the groundwater plan but feels adopting it is a good start. They are already starting on a groundwater plan in Big Valley, monitoring 83 wells and getting an historical line. He would like to have all water districts in Lassen County kept informed.

Honey Lake Valley rancher and member of the Honey Lake Valley Resource Conservation District (RCD) Tim Garrod requests the Board move forward on the plan. States this is not a finished product; need to find out more about resource in order to manage it. This is a closed basin without any options to get more water, so it needs to be managed well. He urges adoption of the plan.

Vice-Chairman Hanson thanks the working group and everyone who participated in the meetings.

Lassen County Farm Bureau member Luke Garrod explains comments previously written to the Board. The Farm Bureau understands the plan is a broad and open plan and details of management are unknown. Comments were meant to give a little direction in form to the plan so there is a foresight of what the outcomes of the districts will be.

The public hearing is closed at 11:04 a.m.

Supervisor Pyle states that the Farm Bureau amendments were very good.

Supervisor Keefer states the Farm Bureau and City comments need to be looked at a later time; agrees that more needs to be known about resources through monitoring data; grants need to be aggressively pursued. Need to monitor residential wells along the escarpment from Susanville to Hallelujah Junction. He is in support of the plan.

Supervisor Chapman states the amendments suggested by the Farm Bureau are mostly minor. Is pleased with the plan and feels it is one of the best products by consultants he's seen in 30 years.

It is moved by Supervisor Chapman and seconded by Supervisor Pyle to adopt the plan. Supervisor Hanson suggests allowing for some small editorial adjustments to respond to the comments that have been received. The motion is carried unanimously on roll call vote with Supervisor Dahle absent.

## Farm Bureau Comments to 2007 Ground Water Management Plan

**Comment #1:** Comments 2-5 would potentially be added to appendix C as Guide lines for the BMO's to operate within.

**Response:** The concepts presented in Appendix C are intended to serve as a guideline that frames the major elements of a BMO program. County staff and stakeholders developed these guidelines as a "roadmap" for BMO implementation that would be useful to local groundwater users when considering the Public Draft GWMP and during GWMP implementation. Adoption of the GWMP is not intended to formalize the BMO guidelines presented in Appendix C, but rather confirm that the BMO concept will be of value to protect historic groundwater use and should be initiated during GWMP implementation. Comments 2 – 5 following should be addressed early in the BMO development process.

**Comment #2:** The same methodology should be used by all BMO's for all types of data collection (water quality, depth, timing of monitoring)

**Response:** Agreed. The Intro to BMO Process information in Appendix C discusses the monitoring program on page C-5. DWR is currently monitoring water level and water quality using standardized methods for sampling and data management. BMO monitoring would employ the same methodology as that currently used by DWR to establish baseline water level and water quality data. As the County moves forward to implement BMOs, an implementation element will include standard operating procedures for monitoring and data management.

**Comment #3.** BMO's must establish their own individual trigger point at witch no more water extraction from that basin will be permitted.

**Response:** This comment recommends a potential BMO exceedance resolution action, whereby no additional groundwater development would be permitted. BMO resolution is discussed on page C-8. Resolution actions following BMO exceedance center on technical evaluation of the cause of the exceedance followed by the pursuit of a mutually agreeable, voluntary solution. If this cannot be achieved, then the Board of Supervisors would become engaged to prescribe a resolution.

**Comment #4.** Well users, Ag and Domestic, should be allowed to sell their historical water usage during periods of overdraft when water extraction is no longer permitted from a particular basin.

**Response:** The BMO process as defined would not prohibit this activity. The BMO process is intended to quantify management objectives, for water level in this case, that recognizes and protects historic use. A tenet of BMOs is that impacts can be avoided through proactive groundwater management.

**Comment #5:** Housing developments of a certain size (size to be determined by each individual BMO) are to be required to have one well field for all water users within that development and a sewer system that services the entire development. It would be mandatory to monitor these wells.

**Response:** The BMO concept is not intended to set policy on how groundwater is developed. Management objectives are established through a locally-led process that results in the protection of historic use. As such, the BMO program may not be appropriate vehicle to address this recommendation. County land use planning and zoning may be the appropriate vehicle to address the issues raised. Additionally, the suggested requirements would be addressed through the plan review and environmental documentation for new development. Following enactment of SB610 and SB221, new development exceeding 500 dwelling units is also required to demonstrate water supply reliability under normal, single dry year and multiple dry year conditions. As the developer is meeting local and state requirements, the County should require the developer to project if locally-established BMOs would be exceeded under these hydrologic conditions.

**Comment #6 would potentially be added to section 2:** Data from the weather station should be inserted into the plan to represent Big Valley along with the data from the flood control district in Big Valley.

**Response:** Staff understand that this information would enhance the description of existing conditions described in Section 2 of the GWMP. However, due to budget and schedule constraints, staff requests that this information be provided to Big Valley stakeholders during BMO development.

**Comment #7.** BMO board members should be ratified by the Board of Supervisors.

**Response:** Agreed. An initial suggested step in the BMO program will be to develop a County ordinance including a description of the formation, approvals, and function of a Water Advisory Committee and Technical Advisory Committee.

**Comment #8.** A timetable or deadline at witch all BMO's in the county must be established by.

**Response:** Agreed. The BMO ordinance will direct staff on the schedule for BMO development, review, and reporting.

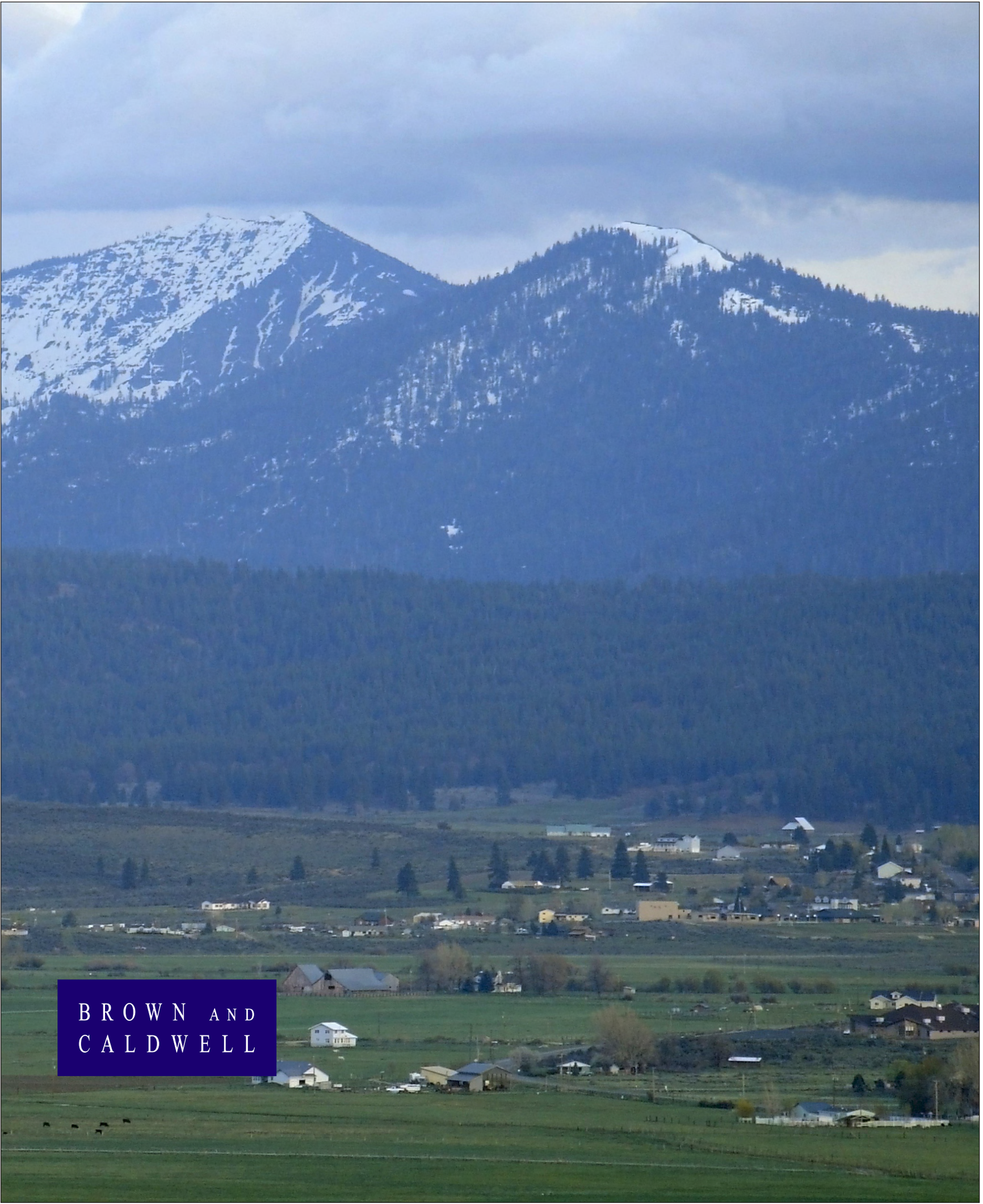
**Comment #9.** A guarantee from the Board of Supervisors that a certain amount of staff time and or funds will be allocated to the implementation of the GWMP.

**Response:** Agreed. Implementation of proactive groundwater management is a tenet of the GWMP and requires a commitment of staff time and energy. Development and adoption of the GWMP will position the County to receive grant funding from DWR to support staff involvement in GWMP implementation.

**Comment #10**: The Ground Water Management Plan (GWMP) as submitted to the Board of Supervisors without the above amendments leaves almost all of the management discretion to the BMOs. Now it is entirely possible that the BMOs, once established, would choose to address these issues without prompting. However the Farm Bureau is asking that these amendments be added to the GWMP so that these particular issues must be addressed by the BMO's and the county instead of leaving the possibility of them being addressed to chance.

**Response:** All comments provided by the Farm Bureau have merit and are appreciated. The preceeding responses are intended provide clarification and staff recommendation, where appropriate. We look forward to continuing work with the agricultural community in our collaborative efforts to manage groundwater resources to reach our goals and objectives.

**Comment #11:** The Farm Bureau supports the current GWMP as it stands without these amendments but with moderate reservations. Our comfort level would rise accordingly with each one of these proposed amendments that you choose to adopt. Lassen County Farm Bureau would be happy to work with its lawyers form the California Farm Bureau, the author of the GWMP and the boards of supervisors until all parties were happy with the language and placement of the proposed amendment into the GWMP.



BROWN AND CALDWELL