INYO COUNTY WATER DEPARTMENT

2016-2017 ANNUAL REPORT

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SECTION 1: EXECUTIVE SUMMARY

To protect the County's environment, citizens, and economy from adverse effects caused by activities relating to the extraction and use of water resources and to seek mitigation of any existing or future adverse effects resulting from such activities.

The Water Department's efforts during 2016-2017 were directed toward our core mission of assisting in the implementation of the County's water resources policies through the Inyo/Los Angeles Long-Term Water Agreement. Our work consists of four main activities: joint management with LADWP of LADWP water-related activities through the Inyo/Los Angeles Technical Group and Standing Committee; environmental monitoring to assess impacts of LADWP activities and compliance with Water Agreement goals; planning, monitoring, implementation, and enhancement of mitigation measures associated with the Water Agreement; and disseminating information and fostering public knowledge and involvement in County water policy. In addition to the core mission of implementing the Water Agreement provisions, the Water Department has been instrumental in the County's efforts to comply with the State Groundwater Management Act (SGMA).

The 1997 MOU between LADWP, Inyo County, California Department of Wildlife, California State Lands Commission, the Sierra Club, and the Owens Valley Committee requires that "*DWP and the County will prepare an annual report describing environmental conditions in the Owens Valley and studies, projects, and activities conducted under the Los Angeles Agreement and this MOU.*" This requirement has customarily been fulfilled by two reports, one issued by LADWP and one issued by the Water Department. In addition to fulfilling this MOU requirement, the Water Department's Annual Report is a vehicle for disseminating information to the public about conditions and activities related to the Inyo/Los Angeles Long-Term Water Agreement. The Water Agreement contains a number of provisions for collecting and sharing data, analyzing data, managing groundwater pumping, and mitigating negative effects of LADWP water management. We strive to make this report informative broadly for those wishing an overview of conditions and trends, and also to provide detailed data and analysis for those desiring to look more closely at conditions in Owens Valley. In general, this report covers the 2016-17 runoff year (April 1, 2016 through March 31, 2017), but also contains material pertaining to LADWP's planned pumping for the 2017-18 runoff year.

Central to the Water Department efforts each year is analysis of LADWP's pumping plan prepared each April. Runoff conditions following the winter of 2016-17 was greater than the preceding four years of drought but still below average. Forecasted Owens Valley runoff was 293,800 ac-ft, but because of the exceptional winter of 2017, the actual runoff was of 336,982 ac-ft. Total pumping within the Owens Valley for 2016-17 was 75,411 ac-ft which was slightly less than the planned pumping 76,348 ac-ft. The Water Agreement and Green Book include procedures to calculate a pumping limit to prevent groundwater mining to ensure no long term decline in aquifer storage. The mining calculation is a comparison of pumping and recharge for each wellfield on a water year basis (October 1st through September 31st) for a 20 water year period. No wellfield was in violation of the groundwater mining provision. The Big Pine wellfield was the only wellfield close to its mining limit and the County requested that pumping in this wellfield be curtailed to include only sole source in-valley uses.

Conditions in the Bishop Cone well field continued to require special attention in 2016-17. The Water Department continued to monitor and groundwater levels after declines impacting private domestic wells were followed by high water tables causing saturated soil conditions negatively affecting homes, landscaping, and roads. The County brought in hydrogeologists from California Department of Water Resources to examine and prepare a report on the situation. Subsequently, the Water Department presented its assessment to the Inyo County Water Commission. Surface water flows play an integral role in recharging shallow groundwater levels in west Bishop, and disruptions in equilibrium conditions by reducing flows at certain times or altering recharge rates can result in unintended and complicated groundwater responses.

Water levels in most wellfields in the valley stayed approximately the same or rose slightly in 2016-17. Levels rose more 3 feet in Laws, Bishop, and parts of Big Pine. Water levels also increased substantially in the Thibaut Sawmill area near the Blackrock Waterfowl project. Water levels declined in the southern Independence-Oak wellfield near one pumping well that continued to operate through the winter for stockwater. Water levels declined during the most recent drought and as of April 2017 remained below baseline in most wellfields. Wellfields where water levels are at or above baseline include Bishop, north Big Pine, near the Blackrock fish hatchery in Thibaut-Sawmill, and southern Bairs-George.

The Water Agreement's ON/OFF method of managing LADWP pumping wells is based on monitoring sites where vegetation cover, soil water, and depth to the water table are measured, and the vegetation's water needs are compared to the available soil water. Pumping wells are linked to a monitoring site, and if sufficient soil water is present for vegetation at a site, then wells linked to that site may be pumped. As part of the monitoring effort, each month the Water Department measures depth to groundwater and soil water at 25 monitoring sites in wellfields and 8 sites in control areas (areas unaffected by pumping). At the beginning of the 2016-17 runoff year, six sites of 25 were in On-status; one site went into Off-status on October 1. Large winter storms in 2016-17 brought ample rain and snow to the valley floor and prompted Los Angeles to begin water spreading in February and March. Twelve sites went into On-status during the winter due to infiltration of rain and snow and/or water table recovery. At the beginning of the 2017 growing season, the water table was shallow enough to supply water to the root zone at 15 wellfield monitoring sites.

Each year the Water Department monitors selected vegetation parcels within the valley to ensure that the Water Agreement's vegetation goals are met. The primary goal of this monitoring, according to the Green Book are to detect any *"significant decreases and changes in Owens Valley vegetation from conditions documented in 1984 to 1987"*. Vegetation live cover and species composition documented during the 1984-87 mapping effort were adopted as the baseline for comparison with each annual reinventory according to the Water Agreement. From September 1984 to Nov 1987, LADWP inventoried and mapped vegetation on 223,168 acres of the Owens Valley floor. In the summer of 2016, the Water Department and LADWP sampled 141 parcels using the line-point procedures described in the Green Book. For each parcel, we evaluated the change in perennial vegetation cover since baseline and assessed whether the relative proportion of shrubs, grass, and herbaceous vegetation was different from baseline or has changed over. The effects of pumping are examined by comparing cover and composition of groups of parcels classified as either control or wellfield based on criteria derived from groundwater drawdown during the period of maximum pumping rate that occurred between 1987 and 1993.

Vegetation cover in 2016 increased slightly from 2015. The control parcel group reached the baseline mean while the wellfield parcel group has remained below baseline since 2008. Total cover and grass cover has decreased in both wellfield and control parcel groups over the past 30 years. Shrub cover, however, has increased marginally in the wellfield group. For individual parcels, 45 out of 91 wellfield parcels were statistically below baseline perennial cover, and 53 were below baseline grass cover (66%). For control parcels, cover was below baseline in 20 out of 50 parcels, and grass cover was below baseline in 26 out of 50 parcels

The primary vegetation change in both pumped and unpumped areas as of 2016 was a decline in grass cover, typically accompanied by an increase in woody shrub cover for individual parcels. Aggregated to the wellfield and control group, these relationships are noisy owing to the non-linear nature of water table fluctuations, wet/dry climate cycles, and within group variance in temporal trend. The individual parcel trends in shrub and grass cover over time, however, are evidence of long-term transitions to plant communities increasingly dominated by shrubs in many wellfield and control parcels. Higher rainfall and shallower water tables after the wet winter of 2016-2017, will likely promote increased grass cover, but reversing a shift from grass dominated to shrub dominated vegetation may require water table recovery in some wellfield areas as well as additional management intervention such as prescribed burns or mechanical shrub removal.

Following the resolution of a dispute over vegetation conditions in one vegetation parcel called Blackrock 94, Inyo County and Los Angeles agreed in 2014 to consult with scientists selected by the Ecological Society of America to review our vegetation monitoring methods. Their report was completed in February 2016, and on February 9, 2017 the Standing Committee adopted new Green Book language revising the monitoring program.

One of the roles of the Water Department is to monitor and report on the status of environmental mitigation projects in the Owens Valley. In May 2016, the Inyo/Los Angeles Standing Committee directed staff to identify and evaluate all mitigation commitments arising from the Water Agreement. LADWP and ICWD also were directed to report where the agencies differed in their assessments on the status of these projects. That effort was completed in February 2017.

Sixty-four projects, spread throughout the valley, mitigate for a range of environmental impacts due to abandonment of irrigated agriculture and groundwater pumping in the Owens Valley. These improvements range in size from single-acre spring restoration projects to the 78,000-acre Lower Owens River Project (LORP). The majority of these projects are described in the Water Agreement and associated 1991 Environmental Impact Report and in the 1997 MOU which resolved conflicts and concern over the 1991 EIR. Inyo and LADWP staff assessed each and placed them into one of five categories: Complete, Ongoing as necessary, Implemented and ongoing , Implemented but not meeting goals, or Not fully implemented. In nearly all cases, Inyo and Los Angeles agreed on the project status. Inyo concluded that 16 projects were not meeting their goals or not fully implemented. This will aid future efforts by focusing on projects where Inyo and Los Angeles agree that improvement is needed.

Implementing and monitoring the numerous provisions of the Water Agreement occupies most of the Water Department efforts. In addition, the Water Department undertakes a number of activities unrelated or indirectly related to the Water Agreement, including participation in the Inyo-Mono Integrated Regional Water Management Group, assistance to other County departments needing hydrologic analysis on projects they are working on (e.g., environmental analysis for permitting of solar, industrial, or residential developments), or monitoring and management of projects permitted under Inyo County's groundwater ordinance. In 2014 California enacted the Sustainable Groundwater Management Act. The Owens Valley was a deemed a medium priority basin requiring selection of a responsible local agency to develop a plan to manage groundwater in the Valley. The Water Department has been involved in efforts to form a Groundwater Sustainability Agency (GSA) comprised of several local agencies with groundwater, water supply or land management responsibilities. These activities are also covered in this Annual Report, but information on their status may be found on our web site http://www.inyowater.org.

Finally, the Water Department's Salt Cedar Coordinator, Rick Puskar, retired in April. Rick was instrumental in overseeing a successful program that cleared salt cedar from the entire Lower Owens River channel as well as hundreds of acres within mitigation projects and spreading areas. Rick was the longest tenured member of the present staff, and his hard work and jovial nature will be missed.

SECTION 2: THE CALIFORNIA SUSTAINABLE GROUNDWATER MANAGEMENT ACT IN OWENS VALLEY

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Introduction

In September 2014, Governor Brown signed into law what is probably the most significant water-related legislation in the past fifty years - the Sustainable Groundwater Management Act of 2014 (SGMA). SGMA provides a statewide framework for sustainable groundwater management where local agencies manage groundwater within their local jurisdictions by forming groundwater sustainability agencies (GSAs) which will then develop and implement groundwater sustainability plans (GSPs). If local agencies do not fulfill these responsibilities, the State Water Resources Control Board will undertake groundwater management at the expense of groundwater users in the basin. Prior to SGMA, absent a statewide groundwater management policy, groundwater management occurred locally through an ad hoc array of adjudications, court orders, special act districts, and unenforceable voluntary plans. Because SGMA puts the responsibility for implementation on local agencies such as counties, the Water Department has been involved in efforts to form a GSA in the Owens Valley Groundwater Basin.

SGMA Components

Goals

Under SGMA, sustainability is defined as management and use of groundwater in a manner that does not cause undesirable results, where undesirable results are (California Water Code (CWC) §10721):

1. Chronic lowering of groundwater levels indicating a significant and unreasonable depletion of supply. Overdraft during a period of drought is not sufficient to establish a chronic lowering of groundwater levels if extractions and groundwater recharge are managed to ensure that reductions in groundwater levels or storage during a period of drought are offset by increases in groundwater levels or storage during other periods.

2. Significant and unreasonable reduction of groundwater storage. Significant and

3. unreasonable seawater intrusion.

4. Significant and unreasonable degraded water quality.

5. Significant and unreasonable land subsidence that substantially interferes with surface land uses.

6. Depletions of interconnected surface water that have significant and unreasonable adverse impacts on beneficial uses of surface water.

7. When forming GSAs and developing GSPs, GSAs must consider the interests of all beneficial uses and users of groundwater.

Groundwater Basins

Groundwater management under SGMA is implemented within individual groundwater basins. California's groundwater basins are defined in the Department of Water Resources' (DWR) recently updated publication "Bulletin 118 - California's Groundwater Bulletin 118 – Interim Update 2016." SGMA's deadline for GSA formation is June 30, 2017, and a GSP (or multiple GSPs) must be implemented for each medium and high priority basin (Figure 2.1) by January 31, 2022, unless the basin is in a condition of critical overdraft, in which case the GSP(s) must be implemented by January 31, 2020. There are 515 groundwater basins in California, 127 of which are medium or high priority (Figure 2.1). DWR prioritized groundwater basins on the basis of overlying population; projected growth of overlying population; public supply wells; total wells; overlying irrigated acreage; reliance on groundwater as the primary source of water; impacts on the groundwater (including overdraft, subsidence, saline intrusion, and other water quality degradation); and any other information determined to be relevant by DWR (CWC §10933). Future basin prioritizations will additionally consider adverse impacts to local habitat and local stream flows. If there is not a GSA or GSAs established that entirely covers a basin by June 30, 2017, or a GSP is not in place by January 31, 2020 or 2022, the State Water Resources Control Board may intervene in the basin and develop and implement an interim GSP at the expense of the groundwater users.

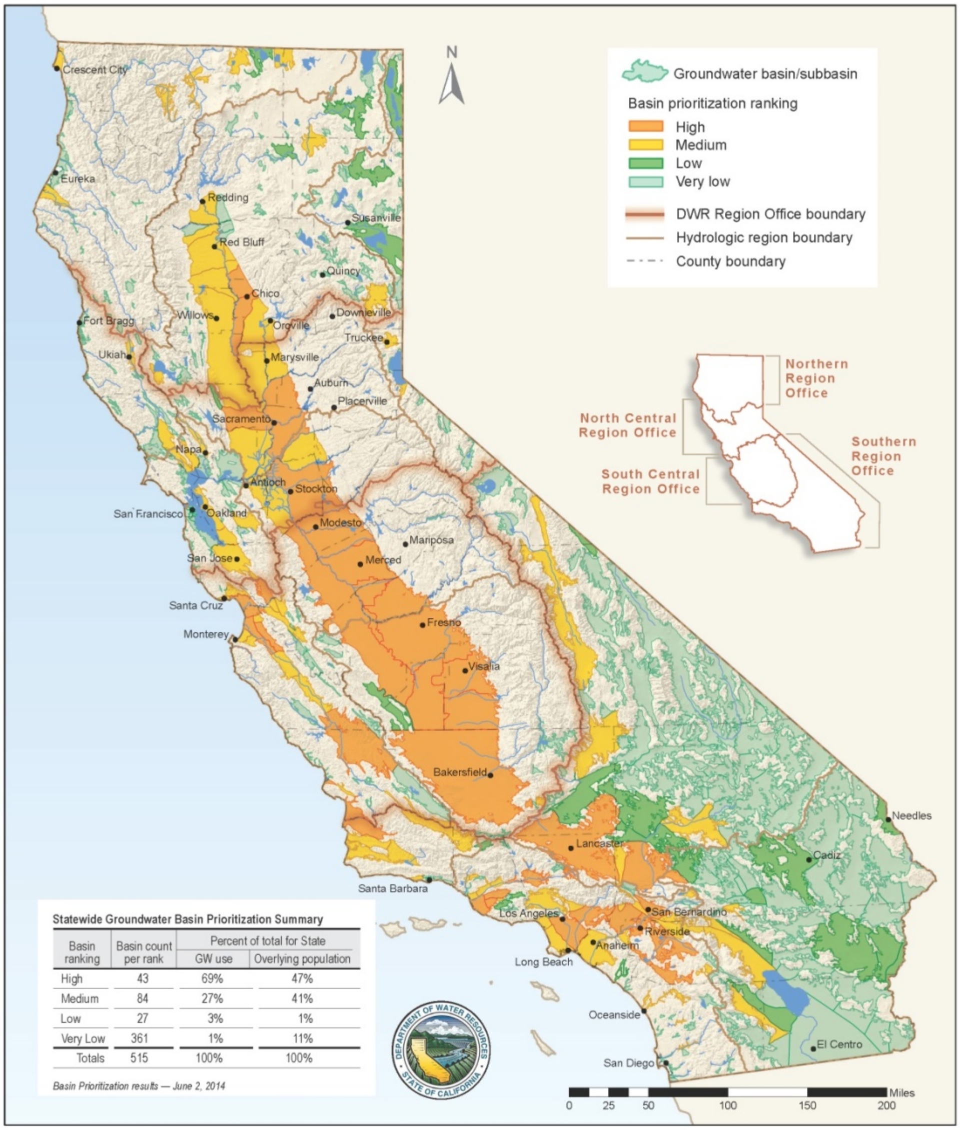
Owens Valley Groundwater Basin Boundaries

The Owens Valley Groundwater Basin (Basin) is a medium priority basin; therefore, local agencies in the Basin must form a GSA or multiple GSAs such that the entire basin is covered by a GSA. The Basin includes Chalfant, Hammil, and Benton valleys and extends to the Nevada-California border in Benton Valley (Figure 2.2). Inyo County submitted a request to DWR to subdivide the Basin into a Mono subbasin that consists of Chalfant, Hammil, and Benton valleys, and an Inyo subbasin consisting of Owens Valley and Round Valley. The basis of this request was that there is a bedrock barrier to groundwater flow from Chalfant Valley to Owens Valley. DWR has denied Inyo County's request, and instead, at the request of the California Department of Fish and Wildlife, is adding a Fish Slough subbasin to the Basin.

Local Eligible Agencies

GSAs are formed by a local agency or group of local agencies notifying DWR of the local agency's decision to become a GSA. A local agency is defined in SGMA as a "local public agency that has water supply, water management, or land use responsibilities within a groundwater basin" (CWC §10721).

CASGEM Groundwater Basin Prioritization



Statewide Groundwater Basin Prioritization Summary

Basin ranking	Basin count per rank	Percent of total for State	
		GW use	Overlying population
High	43	69%	47%
Medium	84	27%	41%
Low	27	3%	1%
Very Low	361	1%	11%
Totals	515	100%	100%

Figure 2.1. DWR's priorities for California's groundwater basins (CASGEM is the California Statewide Groundwater Monitoring Program).

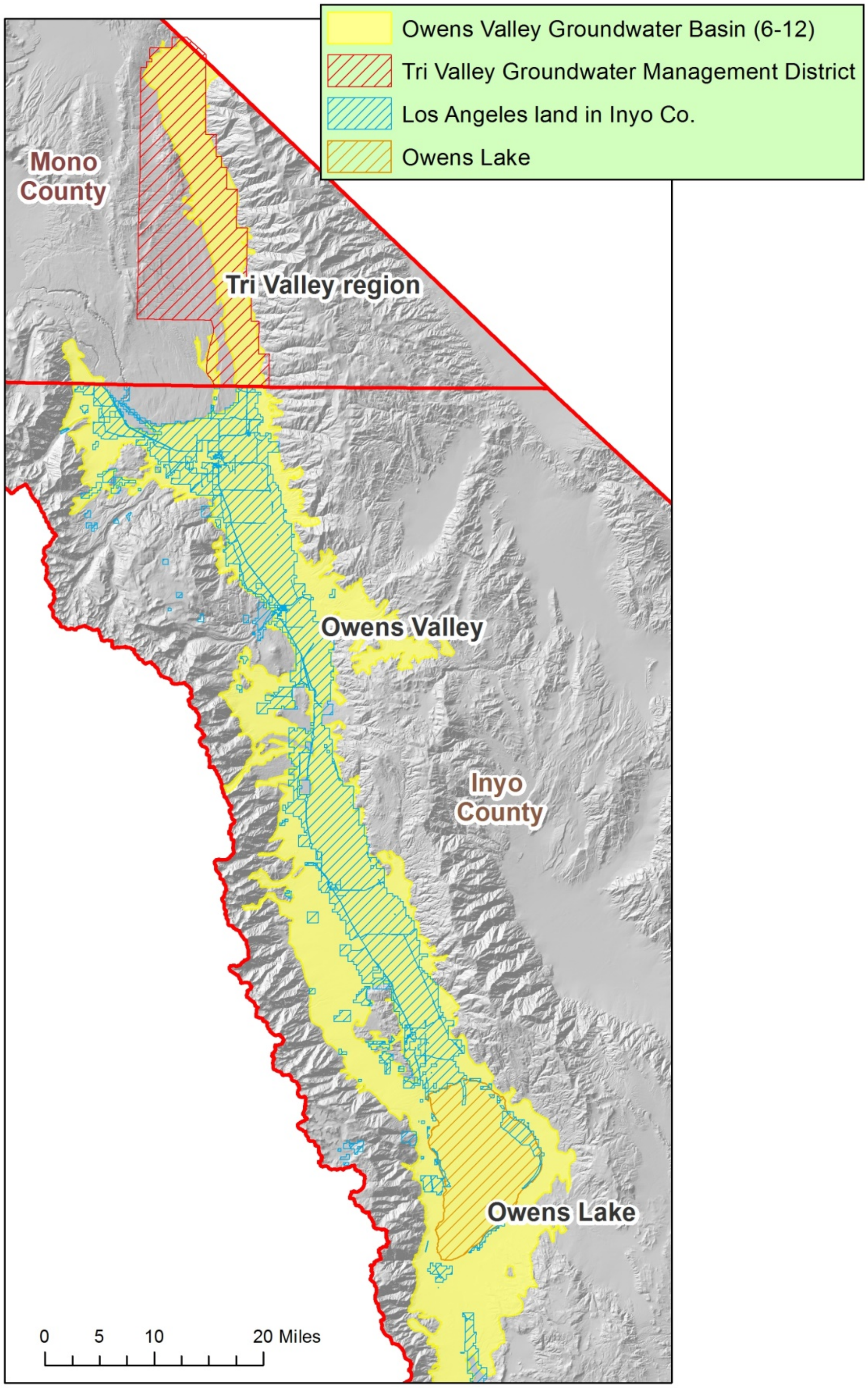


Figure 2.2. The Owens Valley Groundwater Basin.

Local agencies include cities, counties, water districts, irrigation districts, water replenishment districts, and other such California public agencies. A single local agency can decide to become a GSA, or a combination of local agencies can decide to form a GSA by using either a joint powers agreement (JPA), a memorandum of agreement (MOA), or other legal agreement. Within the Basin, local agencies that are eligible to form a GSA are Inyo and Mono counties, the Tri Valley Groundwater Management District, City of Bishop, and nine community service districts.

LADWP Groundwater Pumping

SGMA exempts adjudicated areas from the requirement to form GSAs and develop GSPs, and provides that any groundwater basin or portion of a groundwater basin managed under the Inyo/Los Angeles Long Term Water Agreement (LTWA) is considered adjudicated (CWC §10720.8(c)). As long as Los Angeles's groundwater pumping is conducted pursuant to the LTWA, it is exempt from SGMA's requirement for a GSA and GSP, but must meet certain annual reporting requirements that SGMA imposes on adjudicated areas. Figure 2.2 shows Los Angeles-owned land in Inyo County.

Mutual Water Company, Federal, and Tribal Participation

Mutual water companies may participate in GSAs. Mutual water companies are private not-for-profit organizations that are organized under California Corporations Code §14300, regulated under the US EPA Safe Drinking Water Act, and report to Local Agency Formation Commissions (LAFCO's). SGMA provides (CWC § 10723.6(b)):

> *A water corporation regulated by the Public Utilities Commission or a mutual water company may participate in a groundwater sustainability agency if the local agencies approve through a memorandum of agreement or other legal agreement. The authority provided by this subdivision does not confer any additional powers to a nongovernmental entity.*

SGMA provides for federal, tribal, and private participation in the preparation of GSPs. Concerning federal and tribal participation, CWC §10720.3 provides:

> *The federal government or any federally recognized Indian tribe, appreciating the shared interest in assuring the sustainability of groundwater resources, may voluntarily agree to participate in the preparation or administration of a groundwater sustainability plan or groundwater management plan under this part through a joint powers authority or other agreement with local agencies in the basin. A participating tribe shall be eligible to participate fully in planning, financing, and management under this part, including eligibility for grants and technical assistance, if any exercise of regulatory authority, enforcement, or imposition and collection of fees is pursuant to the tribe's independent authority and not pursuant to authority granted to a groundwater sustainability agency under this part.*

Groundwater Sustainability Agency Powers

SGMA provides GSAs with significant powers and authorities, including the ability to conduct investigations for various purposes; require registration of groundwater extraction facilities; require installation of meters on wells at the owner/operator's expense; require annual reporting of groundwater extraction; require reporting of surface water used for groundwater recharge; acquire property (including water rights); import, store, or treat water; provide a program for fallowing agricultural land; impose spacing requirements on new wells; regulate, limit, or suspend groundwater extraction; limit construction, enlargement, or reactivation of groundwater wells; transfer groundwater pumping allocations; impose fees on groundwater permits, extraction, or other regulated activity to fund a GSP; and impose fees to fund the preparation of a GSP.

SGMA and the Owens Valley Groundwater Basin

The Basin is large – 1,030 square miles - with a number of jurisdictional, legal, and water management considerations specific to the Basin. Considerations relevant to GSA formation in the Basin are:

- SGMA exempts lands managed under the Inyo/Los Angeles Long Term Water Agreement from the requirement for a GSA and GSP, but because of LADWP's extensive land and water rights holdings in the basin, the GSA formed to satisfy SGMA in the non-LADWP portions of the basin needs a meaningful mechanism for interacting with LADWP and groundwater management under the LTWA. SGMA does not have clear requirements or guidance for how GSAs for non-adjudicated areas interact with adjudicated areas in basins that are partially adjudicated. In order to integrate water management throughout the basin, it may be desirable to have LADWP participate in a GSA in some capacity.

- The Tri Valley Groundwater Management District is deemed the exclusive local agency for GSA formation within their jurisdiction, which includes nearly the entire Mono County portion of the basin, including most of the new Fish Slough subbasin (Figure 2.2). Small portions of the basin along the base of the White Mountains are outside of Tri Valley GMD's boundaries, and a small portion of the proposed Fish Slough subbasin is in Inyo County.

- The Swall Meadow portion of the basin is in Mono County and not within TVGMD's boundaries.

- Groundwater management issues are different in the Tri Valley and Owens Valley portion of the basin. In Owens Valley, LADWP is the largest groundwater pumper, using groundwater for both export to Los Angeles and for use in Owens Valley. Other entities in Owens Valley use groundwater for domestic and municipal use, habitat development, water bottling, and agriculture. In Owens Valley, most agriculture groundwater use is for LADWP leases and such pumping is regulated by the LTWA. In the Tri Valley area, the majority of groundwater use is for agriculture on private land, with a small amount of additional domestic use.

- There are diverse interests and perspectives on water issues in the Basin, including irrigators, tribes, state and federal land management agencies, LADWP, domestic well owners, community water providers, environmental organizations, city and county governments, and industrial groundwater users. SGMA requires that the interests of all beneficial users be considered. The Water Department worked with facilitators provided to the County by DWR to develop an assessment of the Basin's stakeholders to assist the County in conducting an open and inclusive GSA formation process.

- DWR added Fish Slough as a subbasin in the Owens Valley Basin when DWR revised groundwater basin boundaries in 2016. Fish Slough was identified as a separate groundwater basin in the 1975 and 1980 editions of DWR Bulletin 118, but was dropped from the 2003 edition. The boundary of the new Fish Slough subbasin is located such that the new subbasin is mostly in Mono County within the TVGMD's boundaries, but the southern-most portion of the subbasin is in Inyo County. Considering that groundwater development is negligible in the Fish Slough subbasin, no SGMA regulatory activities are likely to be enforced within the subbasin; however, effects on Fish Slough from groundwater extraction in the Bishop/Laws area and the Tri Valley area will need to be evaluated as part of the planning process.

- LADWP is actively planning to supply dust control efforts on the Owens Lake playa by pumping groundwater from California State Lands Commission (CSLC) land. LADWP conducts their Owens Lake dust control activities on CSLC land through lease agreements between LADWP and CSLC, and any future groundwater pumping by LADWP would occur through a lease agreement. Inyo County and LADWP currently have a dispute over whether LADWP pumping on Owens Lake would be subject to the LTWA, with the County arguing that the LTWA regulates such pumping and LADWP arguing that such pumping is not part of the LTWA. It appears that if such pumping is not subject to the LTWA, it would be subject to SGMA. Because the proposed pumping is from state land, the authority of a GSA to regulate activities on state land must be considered in the CSLC's lease agreements. State agencies are required to "*consider the policies of* [SGMA], *and any groundwater sustainability plans adopted pursuant to* [SGMA], *when revising or adopting policies, regulations, or criteria, or when issuing orders or determinations, where pertinent"* (CWC §10720.9), "*a state or local agency that extracts groundwater shall be subject to a fee imposed under* [SGMA] *to the same extent as any nongovernmental entity*" (CWC §10726.8(d)), and SGMA "…*does not authorize a local agency to impose any requirement on the state or any agency, department, or officer of the state. State agencies and departments shall work cooperatively with a local agency on a voluntary basis*" (CWC §10726.8(d)). It appears probable that any future pumping by LADWP at Owens Lake that is not regulated by the LTWA would be subject to regulation through a GSP, and that the CSLC could make compliance with an adopted GSP part of their lease requirements.

GSA Formation in the Owens Valley Groundwater Basin

In order to bring the OVGB into compliance with SGMA's GSA formation requirements, Inyo County pursued two general strategies this year for GSA formation. First, to meet SGMA's GSA formation timeline, the County sought to have all areas of the basin are covered by a GSA by June 30, 2017. This entailed working with other local eligible agencies to ensure that the entire basin was covered with no overlap. Inyo County, Mono County, City of Bishop, and Tri Valley Groundwater Management District each submitted a GSA notification for their respective portions of the basin to DWR, DWR accepted these notices, and the basin was in compliance by the June 30 deadline. At present (August, 2017), these are the four GSAs established in the Basin.

Second, Inyo County developed a Joint Powers Agreement (JPA) titled "Joint Exercise of Powers Agreement Creating the Owens Valley Groundwater Authority" whereby a single GSA for the basin would be formed through local eligible agencies membership in the JPA, with opportunities for other entities such as tribes, LADWP, mutual water companies, federal agencies, and other interested parties to participate by agreement with the JPA board. Development of the JPA was guided by the principles that the GSA would be consistent with SGMA, to be fair to and inclusive of the variety of entities interested in groundwater management, and balance disparities size, stake, and resources among the parties that could potentially participate. The JPA consists of these six articles:

Article I addresses membership. It provides that "Members" of the JPA are local agencies that, under SGMA, are eligible to form GSAs, and that join the JPA by August 1. New "Members" may join after August 1 with the concurrence of the boards of all of the Members that signed by August 1. There are thirteen eligible local agencies, consisting of Inyo and Mono counties, Tri Valley GWD, Bishop, and nine community service districts (listed in Exhibit A). 11 of the 13 eligible local agencies acted before August 1 to become Members of the JPA.

Article II addresses powers, purpose, and duties. This section contains the powers that SGMA and JPA law provides, such as the authority to form a GSA, charge fees, require installation of meters on wells, reporting of pumping amounts, collect data, contract for services, regulate pumping, and a number of other activities. This article also provides that SGMA does not alter water rights and that Member's police powers are preserved. It also addresses a sequence of events for rescinding existing GSA notifications to replace them with the JPA. It provides that within six months, the County will produce a budget for the next few years of groundwater sustainability plan development, and that the initial budget will be adopted by the JPA Members. This budget will be used by Members to decide on their funding level. Article II also describes the use of management areas to segment the basin into management units based on hydrology and managerial considerations. Management areas could have area-specific requirements and costs, which would be borne by entities within a management area. Management areas requirements and goals cannot conflict with the overall goals and requirements for the whole basin.

Article III addresses Officers and staff. There would be a Chair and Vice-Chair chosen from the Board of Directors; Inyo County will be the treasurer, and there will be an executive manager.

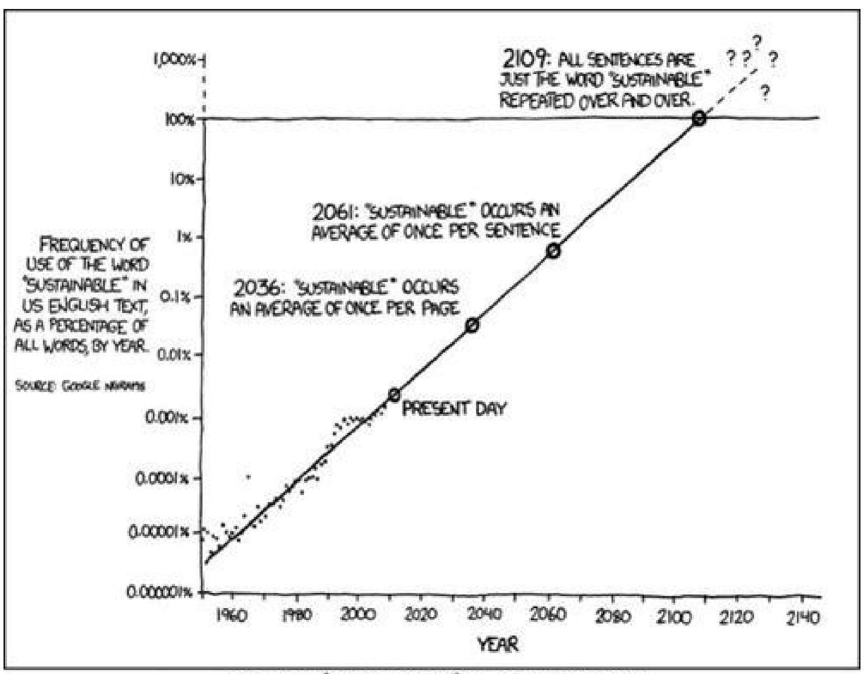
Article IV addresses funding and voting. The initial assumption is that each Member will fund an equal share of the costs, and would be allocated four votes. After the initial budget is produced, Members may choose to be full funders with four votes, non-funders with two votes, partial funders with between two and four votes, or extra funders with more than four votes. The extra funders would assume the votes that the non-funders and partial funders did not assume. The Members of the JPA board, both initiating and new members, would in any case account for 70% of the voting shares.

Article V provides for participation by Associates and Interested Parties. This section provides for voting participation in the GSA by entities not eligible to form a GSA themselves. Entities joining under this section area required to subject areas under their jurisdiction to the GSA's authority, including GSP implementation and costs associated with implementing the GSP in their area. Tribes, the federal government, LADWP, and mutual water companies are eligible to join as associates, with various levels of voting. Others may also join as Interested Parties. Associates and Interested Parties join the GSA by agreement with and at the discretion of the JPA Board. Article VI addresses a number of miscellaneous concerns, such as withdrawal of Members, liability, dissolution of the GSA, and amendments.

Next Steps

At the time of this writing, staff is preparing for the Owens Valley Groundwater Authority's first meeting sometime in September. Upcoming tasks are to replace the current four GSAs within the basin with a single JPA-based GSA, to develop a budget and timeline for preparation of the GSP, and to seek grant funding to prepare the GSP.

With the advent of the Sustainable Groundwater Management Act and its ongoing requirements for sustainability plans and sustainability agencies all aimed at achieving sustainability within a twenty-year time frame and maintaining sustainability in perpetuity, our linguistic future is quantified in the following graphic (courtesy https://xkcd.com):



THE WORD "SUSTAINABLE" IS UNSUSTAINABLE.

SECTION 3: PUMPING MANAGEMENT AND GROUNDWATER CONDITIONS

LADWP prepares an operations plan each April in accordance with the Water Agreement. The plan describes runoff conditions, wellfield pumping, water uses in the Valley, and export to Los Angeles.

ICWD and LADWP each monitor groundwater levels throughout the Valley.

2016-17 Pumping Plan and Groundwater Conditions

In accordance with the Water Agreement, Los Angeles Department of Water and Power prepares an Operations Plan each April for the ensuing 12-month runoff year spanning April 1 to March 31. The 2017-2018 plan included projected amounts for runoff, pumping, water used in the Owens Valley, water exported to Los Angeles, and an update of the groundwater mining calculations. Also, the plan must comply with the pumping well On/Off provisions of the Agreement based on soil water and vegetation measurements. The Inyo County Water Department (ICWD) reviews LADWP's proposed operations plan, performing an analysis of the effects of LADWP operations on groundwater levels in the Owens Valley. Following a Technical Group meeting to resolve concerns raised by the County, LADWP finalizes the plan.

Predicted runoff from the Owens River watershed during the 2017-18 runoff-year is forecast to be 801,900 acre-feet (ac-ft) or 197% of the 50-year (1966-2015) average. The actual runoff value will be available in 2018 when the all the surface water measurements that constitute the sum have been verified and tabulated. Figure 3.1 compares LADWP's forecasted runoff with the ensuing, actual runoff for each year. Planned pumping for 2017-18 is in a range of 47,000-57,000 ac-ft. LADWP is predicting 104,600 ac-ft of water will be used in the Owens Valley, 55,000 of which is planned for irrigation. The 2017-18 water exports from the Eastern Sierra (Inyo and Mono Counties) is planned to be 460,200 ac-ft. A more detailed discussion of the 2017-18 Operations Plan is presented in the "2017-18 Pumping" subsection that follows.

Looking at actual totals from 2016-17, runoff was 336,982 ac-ft, approximately 82% of the 1966-2015 long-term average. Total pumping within the Owens Valley from Laws to Lone Pine for 2016-17 was 75,411 ac-ft, which was slightly less than LADWP's planned pumping amount of 76,348 ac-ft. Actual pumping was within 10% of the planned amount in all wellfields (Table 3.1). Owens Valley water uses for 2016-17 were 99,000 ac-ft, and Eastern Sierra water exports were 141,000 ac-ft.

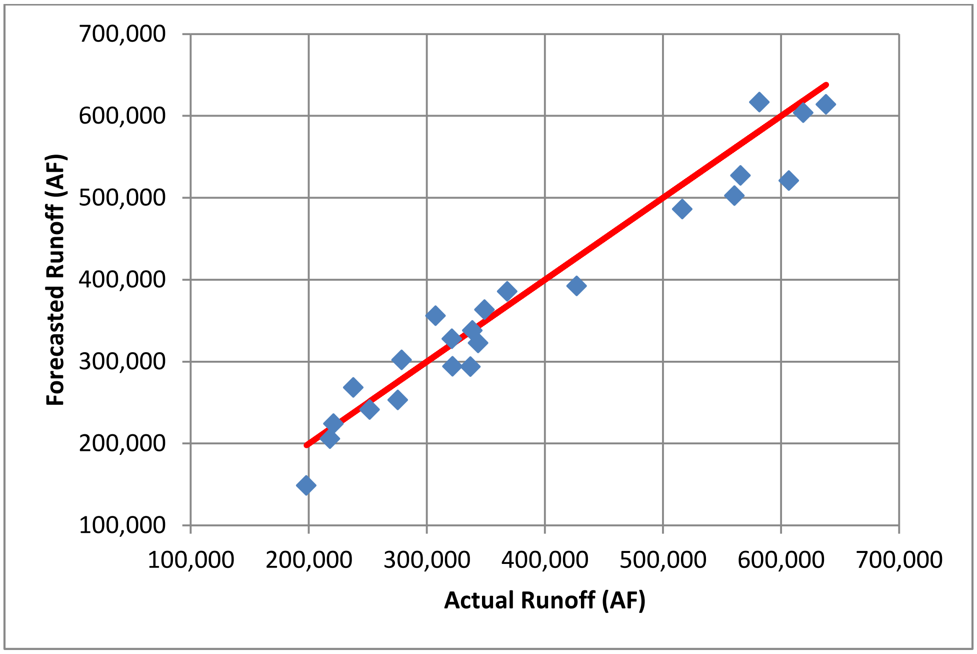


Figure 3.1. Comparison of actual and forecasted runoff 1994-2016 runoff years with the one-to-one correspondence (100% accuracy between forecast and actual runoff) in red. The 2016 actual runoff was 336,982 ac-ft; forecasted runoff was 293,800 ac-ft.

Table 3.1. Planned and LADWP actual pumping by wellfield for the 2016-17 runoff-year. Estimated minimum pumping prepared by Inyo County for sole source uses is included for reference although in an extremely dry year minimum pumping would be insufficient to supply all uses.

Wellfield	Estimated Minimum Pumping (ac-ft)	Planned Pumping (ac-ft)	Actual Pumping (ac-ft)	Percent Actual vs. Planned
Laws	6,300	6,740	6,019	89%
Bishop	10,400	10,850	9,988	92%
Big Pine	20,550	22,810	23,597	103%
Taboose-Aberdeen	300	11,740	11,131	95%
Thibaut-Sawmill	8,160	8,413	8,425	100%
Ind.-Oak	5,990	8,910	9,520	107%
Symmes-Shepherd	1,200	4,575	4,816	105%
Bairs-Georges	500	1,320	915	69%
Lone Pine	1,035	990	1,000	101%
Total	**54,435**	**76,348**	**75,411**	**99%**

Table 3.2. Depth to Water (DTW) at Indicator wells, April 2017. All data are in feet. Negative values denote a decline in water level. Depths are from reference point on the test well. Baseline elevation at monitoring sites is the April average of water levels from years 1985-87. Baseline was predicted from monitoring site/indicator wells regression models if the test well was not present from 1985-87.

Station ID, Monitoring site	DTW April 2017	Change from April 2016	Deviation from Baseline in 2017
Laws			
107T	Dry	NA	NA
434T	8.32	1.45	-0.72
436T	11.98	1.97	-3.88
438T	12.90	4.09	-3.33
490T	17.59	0.49	-4.52
492T	35.29	1.88	-2.49
795T, LW1	14.51	NA	0.05
V001G, LW2	Dry	NA	NA
574T, LW3†	15.91	1.53	-2.70
Big Pine			
425T	21.72	0.15	-6.82
426T	16.88	0.40	-5.31
469T	25.91	0.01	-4.24
572T	10.58	7.55	1.32
798T, BP1	14.72	7.78	1.44
799T, BP2	20.95	1.37	-2.53
567T, BP3	19.30	1.83	-5.34
800T, BP4	19.67	0.59	-6.12
Taboose Aberdeen			
417T	27.97	0.83	-1.00
418T	9.34	0.82	-1.11
419T, TA1	9.36	-0.04	-2.73
421T	40.05	-0.60	-5.70
502T	12.47	0.10	-4.98
504T	13.18	0.18	-2.41
505T	19.92	0.75	-1.32
586T, TA4	10.02	0.66	-1.72
801T, TA5	14.70	1.57	-1.23
803T, TA6	9.55	0.75	-1.08
Thibaut Sawmill			
415T	12.31	1.39	6.19
507T	3.42	2.27	1.25
806T, TS2	11.41	2.44	1.75
Independence Oak			
406T	5.67	0.71	-4.10
407T	12.27	3.93	-4.97
408T	5.87	2.30	-2.74
409T	16.87	0.55	-15.27

Station ID, Monitoring site	DTW April 2017	Change from April 2016	Deviation from Baseline in 2017
546T	11.67	-0.05	-8.24
809T, IO1	16.66	0.21	-10.44
Symmes Shepherd			
402T	10.47	0.53	-2.44
403T	9.59	-0.54	-4.26
404T	5.85	0.32	-2.28
447T	49.49	-1.68	-27.62
510T	6.30	1.11	-1.30
511T	7.10	1.89	-2.47
V009G, SS1	29.84	-1.79	-23.01
646T, SS2	Dry	NA	NA
Bairs George			
398T	5.87	0.08	0.48
400T	5.69	1.06	0.61
812T, BG2	18.87	-0.19	-5.62

ICWD uses groundwater levels from a suite of key test wells (Indicator Wells) located throughout the Owens Valley near LADWP wellfields to both track and predict (using regression models) the effects of groundwater pumping on water tables. The effect of pumping and runoff in 2016-17 on water levels in the Indicator Wells is shown in Table 3.2. Water levels in a larger set of monitoring wells are discussed below.

Groundwater levels rose in 36 of the 43 non-dry test wells (Figure 3.2); the average change in DTW in the 43 wells was a rise of 1.18 feet, with a median rise of 0.75 feet. However, groundwater levels remain below levels of the mid-1980's vegetation baseline period in most wells. A more detailed discussion of groundwater levels in Indicator wells and other monitoring wells at well-field locations across the Owens Valley in presented in the "Summary of Hydrologic Conditions" subsection that follows.

The Water Agreement and Green Book include procedures to calculate a pumping limit to prevent groundwater mining to ensure that there is no long-term decline in aquifer storage; these calculations are summarized in the 2017-18 Operations Plan and used to predict the pumping limit through September of 2017. Unlike the annual reporting periods which are based on runoff year (April to March), the annual period for the groundwater mining calculation is based on the water-year (October 1 through September 30). The mining calculation is a comparison of LADWP pumping and recharge for each wellfield on a water-year basis for the most recent 20-year period. The 2015-16 water-year groundwater recharge in the Owens Valley from the mining calculations was approximately 128,524 ac-ft compared to 80,202 ac-ft of pumping, and no wellfield was in violation of the groundwater mining provision in 2015-16. For the 2016-17 water year, the storage of the Owens Valley groundwater system and availability of groundwater to phreatophytic plants is of primary importance.

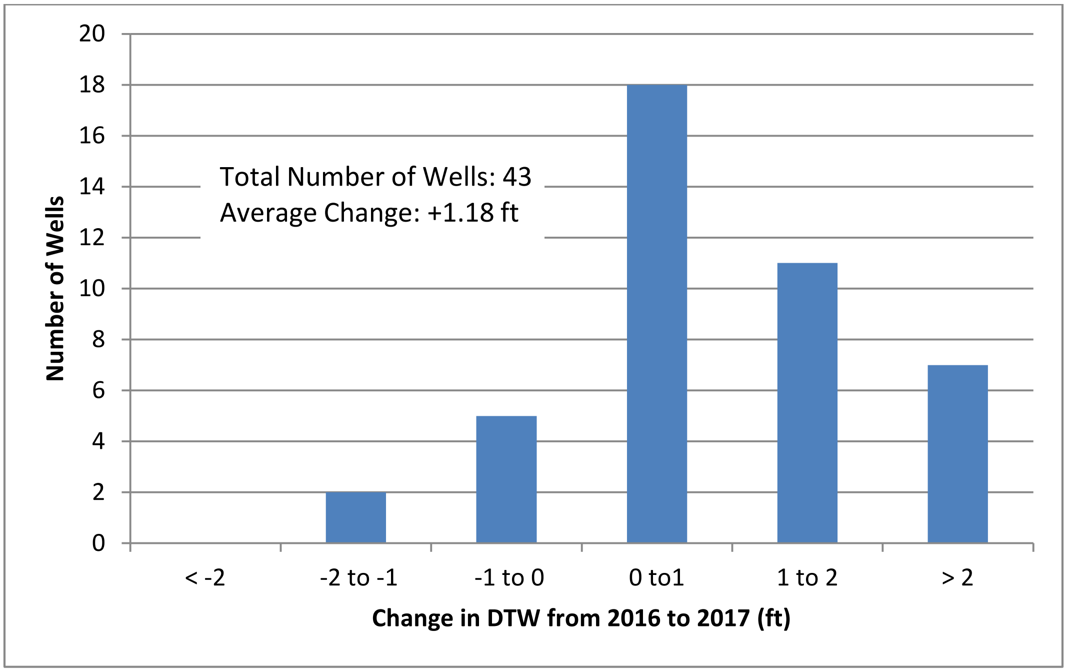


Figure 3.2. Histogram of change in DTW between April 2016 and April 2017 for 43 Indicator test wells. Positive changes indicates rising (shallowing) water tables.

The 19.5-year total of pumping (pumping through April 2017) is subtracted from 20 years of recharge (recharge through September 2017) to arrive at an April to September 2017 pumping limit for each wellfield and the Owens Valley as a whole. The 2016-17 water-year estimate of groundwater recharge in the Owens Valley from the mining calculations was approximately 298,114 ac-ft compared to 24,954 ac-ft of estimated pumping, and no wellfield is projected to be in violation of the groundwater mining provision in 2017.

The Big Pine wellfield is the only wellfield close to its mining provision limit with pumping at 95% of the total recharge thru water-year 2015-16. Pumping exceeded recharge during the five-year period of the recent drought (2012-2016). This does not constitute a violation of the groundwater mining provision, but ICWD has suggested that pumping in this wellfield be curtailed to include only sole source in-valley uses. Additionally, due to the historic winter, LADWP has spread water into the Big Pine Well Field since spring 2017. The narrow difference between recharge and pumping in the Big Pine wellfield is concerning and will continue to be monitored carefully.

For the Owens Valley, the percentage of pumping to recharge through water-year 2015-16 was 46%. Runoff (as an inflow) and pumping (as an outflow) are two of the components of the Owens Valley groundwater budget. It is important to note that evapotranspiration (evaporation and plant transpiration of groundwater primarily by native vegetation along the valley floor) is another primary component (as an outflow) of the groundwater budget; one that is implicitly protected by the Water Agreement. Therefore, looking at groundwater levels which track change in

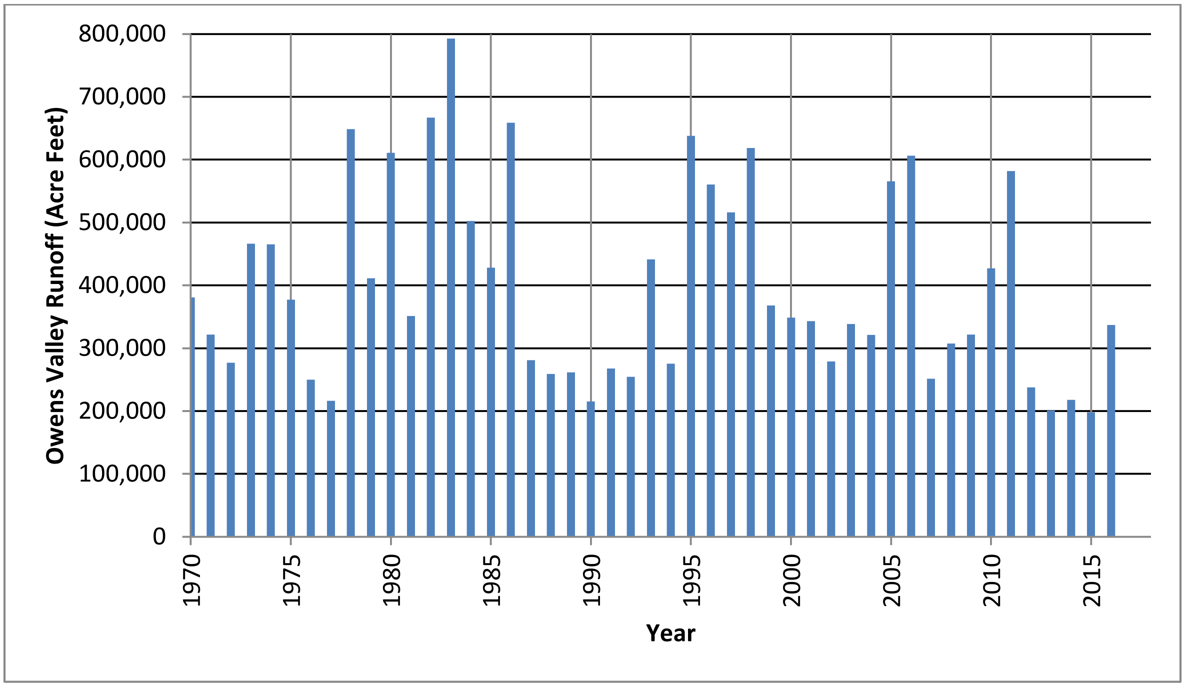


Figure 3.3. Measured Owens Valley runoff since 1970. *Values are for the runoff year (e.g. runoff year 2016 includes April 1, 2016 through March 31, 2017).*

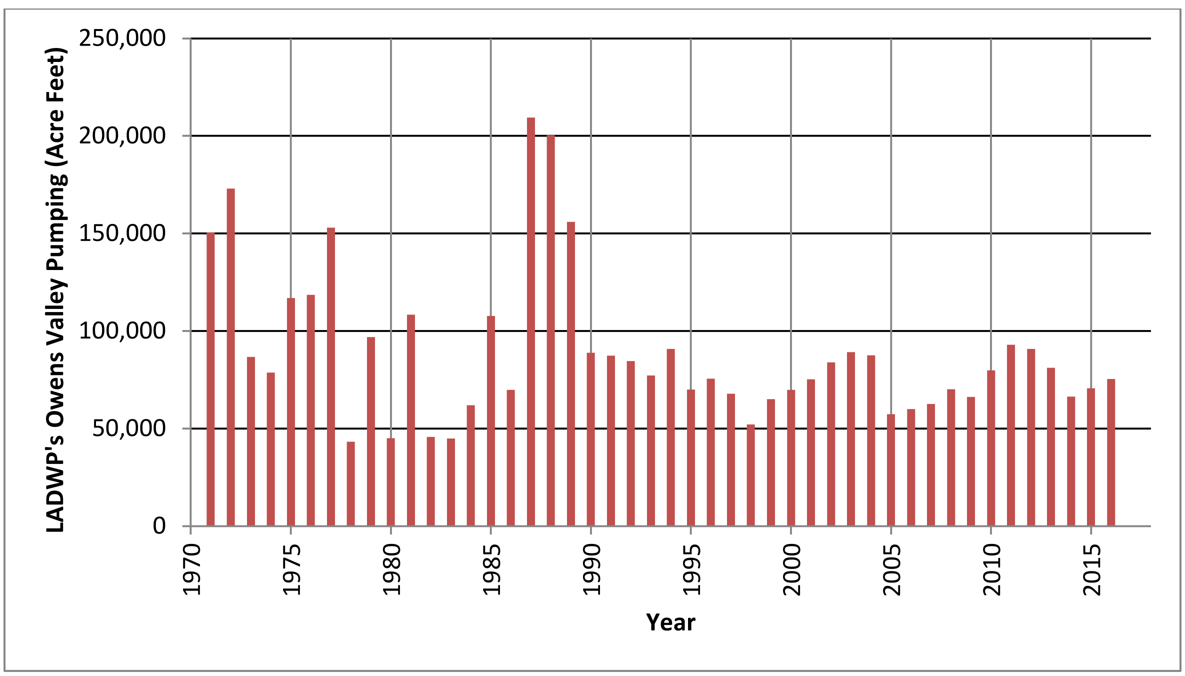


Figure 3.4. Total LADWP pumping in the Owens Valley since 1970 by runoff *year.*

Summary of Hydrologic Conditions

The history of Owens Valley pumping and runoff since 1970 are presented in Figures 3.3 and 3.4. Since the Water Agreement was adopted in late 1991, annual pumping has averaged 73,265 ac-ft and runoff 382,233 ac-ft (the average runoff for 1935-2016 is approximately 410,000 ac-ft).

Groundwater data is collected from several hundred monitoring wells located throughout the Owens Valley each spring and fall. Most wells are also visited on more frequent (weekly-monthly schedules). Data presented in this section are depth to water (DTW) below ground surface (bgs) measured in feet.

Water levels in most wellfields in the valley stayed approximately the same or rose slightly in 2016-17 (Figure 3.5). Increases larger than 3ft. occurred in Laws, Bishop, and parts of Big Pine. Water levels also increased substantially in the Thibaut Sawmill area near the Blackrock Waterfowl project. In many wells, water levels responded to water spreading begun in February and March in anticipation of high runoff in 2017-18. Water levels declined in the southern Independence-Oak wellfield near one well that continued to operate through the winter for stockwater.

Water levels declined during the most recent drought and as of April 2017 remained below baseline in most wellfields (Figure 3.6). Wellfields where water levels are at or above baseline include Bishop, north Big Pine, near the Blackrock fish hatchery in Thibaut-Sawmill, and southern Bairs-George. Baseline DTW is the average of water level measured in the spring during 1985-87. It roughly coincides with the period of baseline vegetation mapping, and April is when DTW is typically shallowest each year. Unlike the vegetation baseline, maintaining baseline DTW is not a requirement of the Water Agreement. Baseline water DTW usually is an adequate indicator of better soil water and vegetation conditions, but should be considered a guide rather than a specific threshold that determines whether vegetation conditions are above or below baseline in the immediate vicinity of a monitoring well.

Hydrographs plotting DTW for selected wells are provided in the following discussions of conditions for each wellfield. The hydrographs presented below were selected to provide insight on water level changes over time.

Laws Wellfield

In the 1970's and 80's, pumping and irrigation and spreading from the Owens River via the McNally canals in Laws varied greatly year to year causing large fluctuations in the water table (Figures 3.7, 3.8, and 3.9). This was especially true for T107 and T492 because of their proximity to the McNally canals and LADWP pumping wells. Heavy pumping and low recharge in the late 1980's caused severe declines in the water table in Laws. Under the Water Agreement pumping has remained considerably below the maximum wellfield capacity. As a result, water levels rose, and beginning in 2000, water table fluctuations have been largely driven by pumping for uses in the area and by water spreading following heavy snow winters (2005, 2006, 2011, 2017). In 2016-17, DTW rose in all test holes, but all test holes were below baseline water levels in April 2017 (Table 3.2). It is predicted that the large amount of water spreading during summer 2017 combined with lower amounts of pumping will contribute to a rise in Laws groundwater levels in 2017-18.

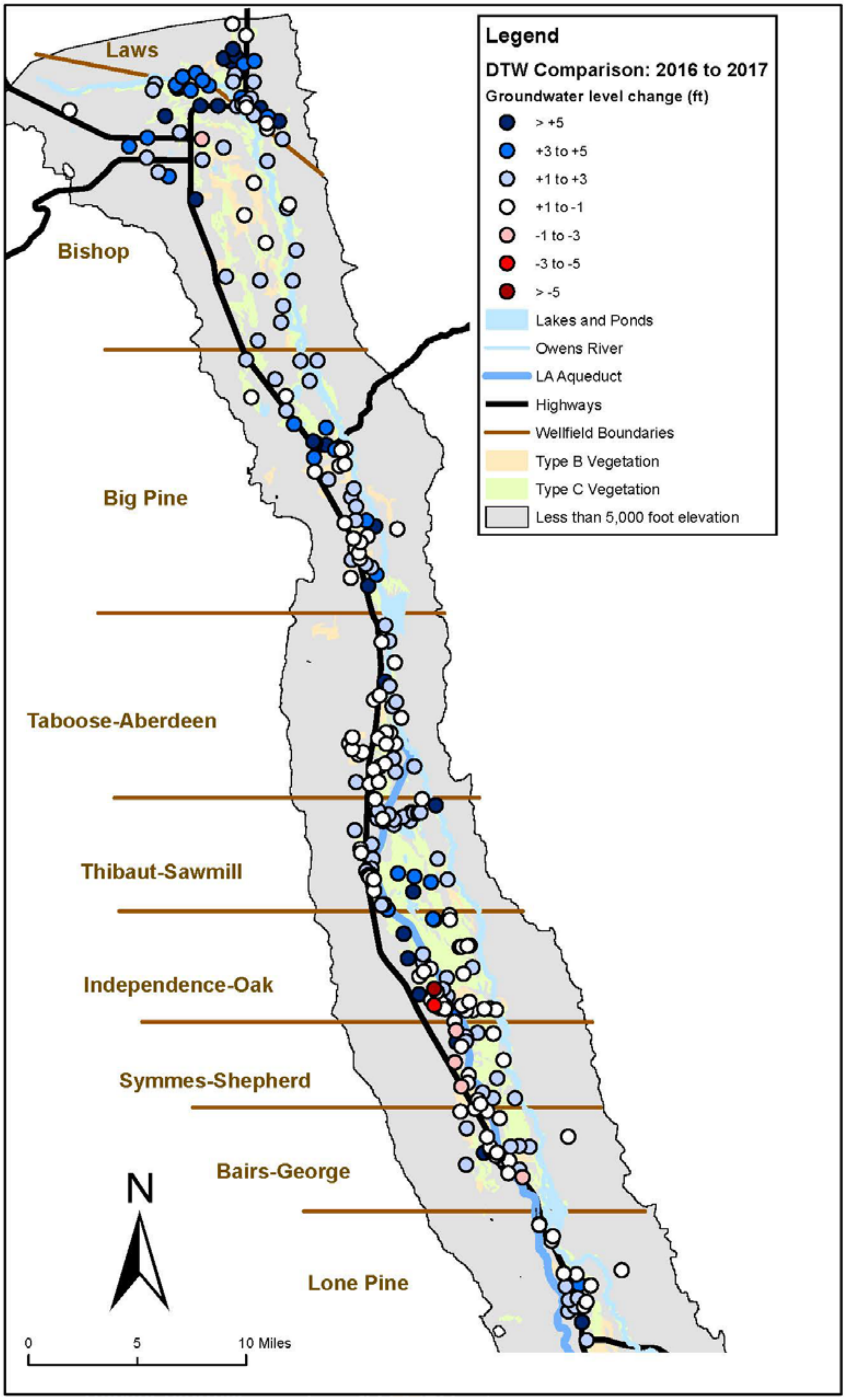


Figure 3.5. Change in water levels in Owens Valley monitoring wells in 2016-17.

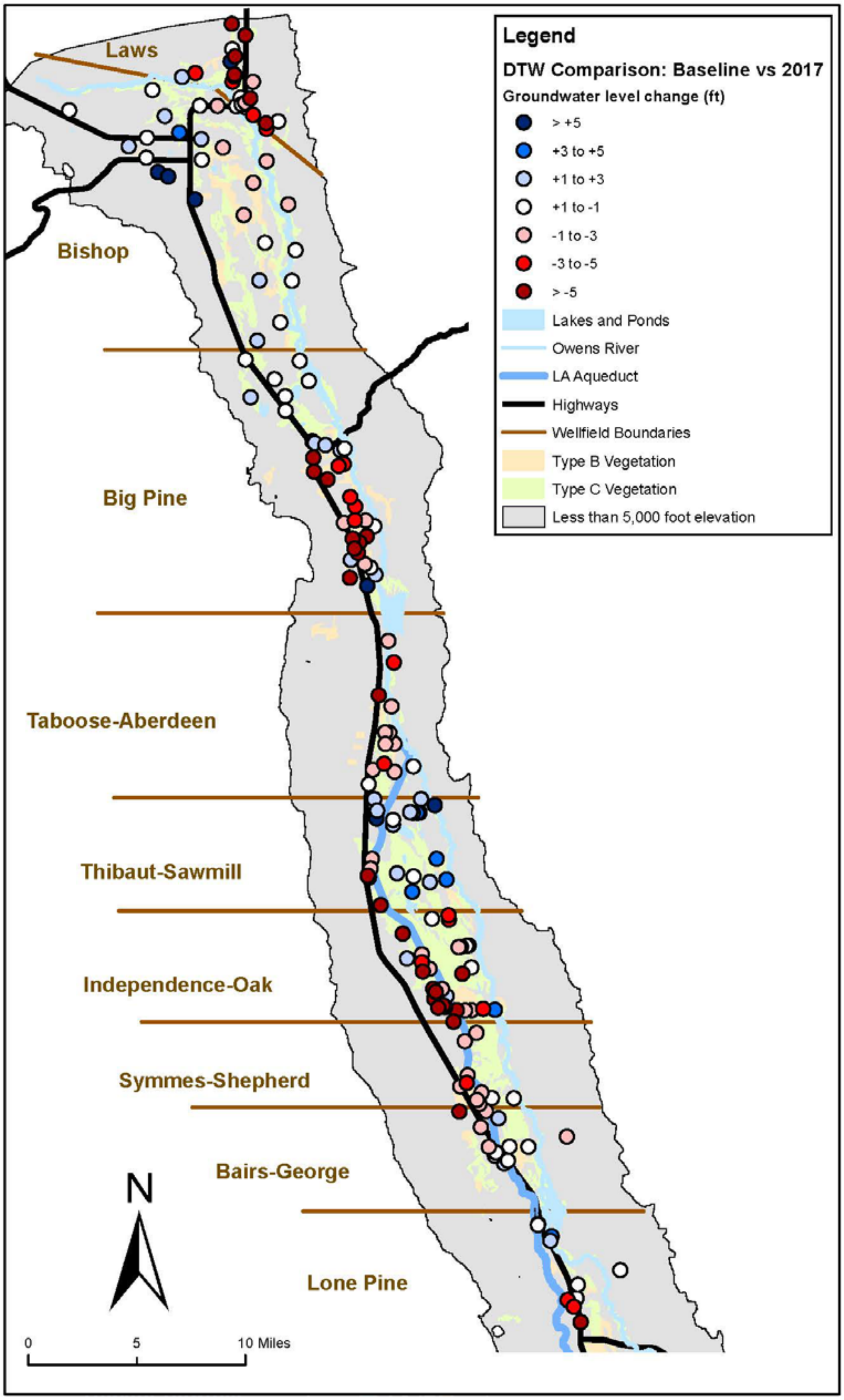


Figure 3.6. Water levels in Owens Valley monitoring wells compared with average water level in 1985-87.

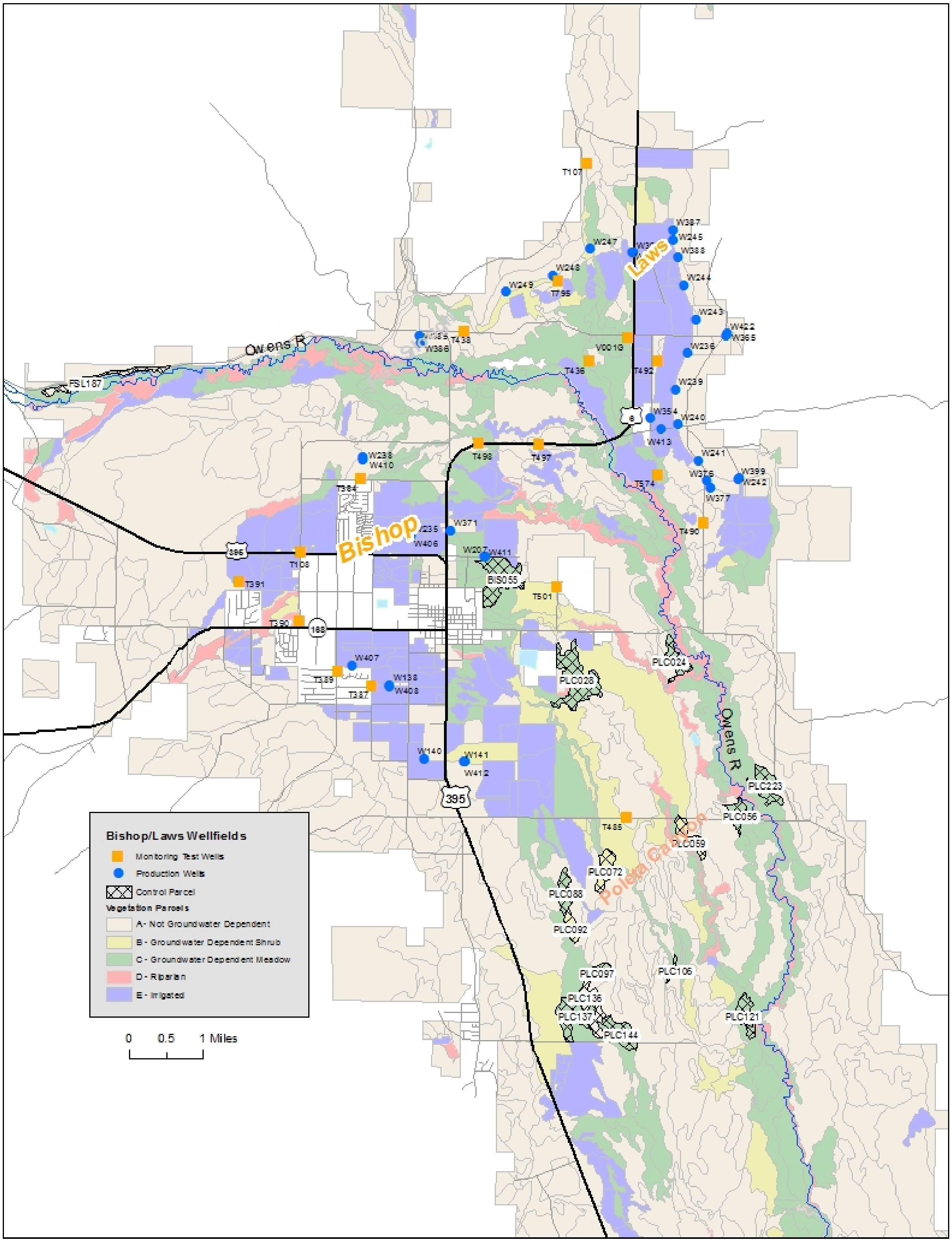


Figure 3.7. Map of monitoring wells and LADWP production wells in Laws and Bishop wellfields.

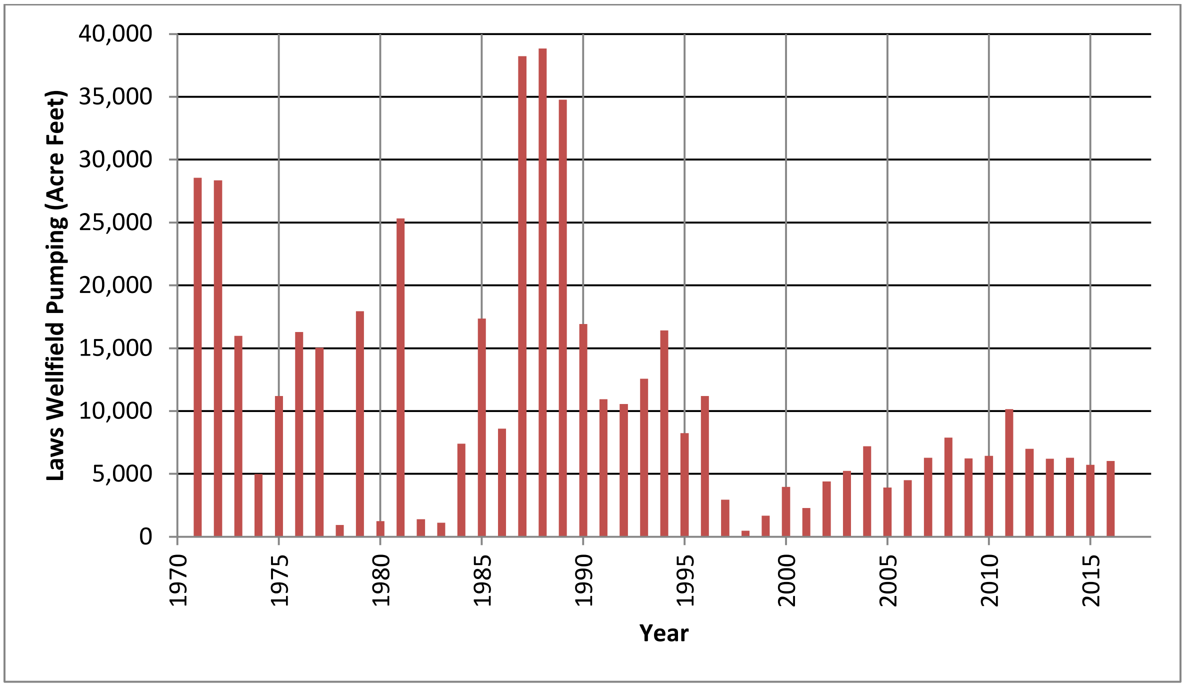


Figure 3.8. Pumping totals for the Laws wellfield.

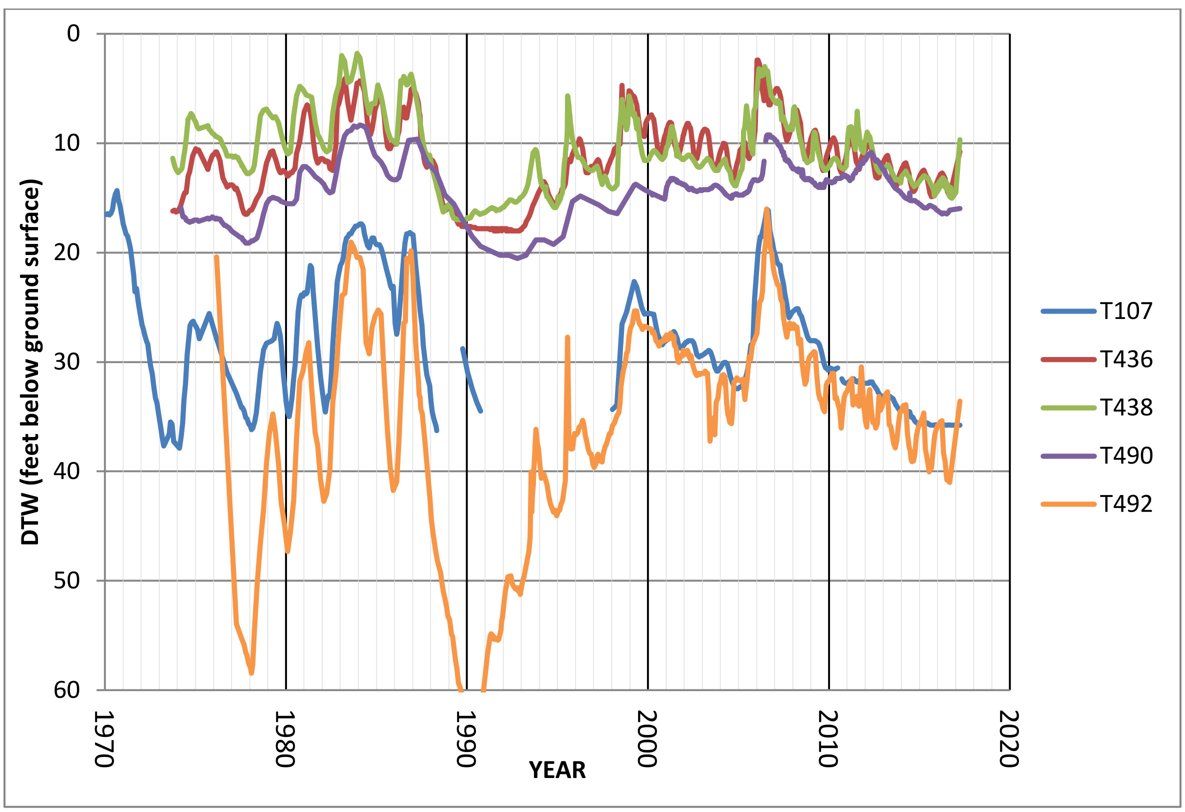


Figure 3.9. Hydrographs of indicator wells in the Laws wellfield. Well T492 is dry if DTW is below 60 ft, and well T107 is dry if DTW is below 37 feet.

Bishop Wellfield

Groundwater pumping in the Bishop Wellfield is managed differently than other wellfields due to additional legal requirements governing LADWP operations. The environmental protections and goals of the Water Agreement still apply, however. The Water Agreement requires Inyo and Los Angeles to prepare an annual audit of pumping and uses on the Bishop Cone to demonstrate compliance with the Hillside Decree (the Decree itself does not contain audit procedures). The Hillside Decree is a 1940 Inyo County Superior Court stipulation and order under which LADWP groundwater extractions from pumped and uncapped flowing wells cannot exceed the annual amount of water used on LADWP owned land on the Bishop Cone.

It is important to understand that the Bishop Cone Audit is not an accounting of the water balance for the groundwater aquifer. Rather, it is an accounting based on the surface water applications (for irrigation and stockwater) to the Bishop Cone compared to the groundwater pumping and flowing wells. Water supplied for irrigation in west Bishop upstream of LADWP pumping wells consists of surface water diverted primarily out of Bishop Creek and the Owens River. Pumped water from the center of the cone is also conveyed for irrigation using the same ditches and canals as the surface water, and most lands are supplied with combined pumped and surface water. Because it is impossible to separate surface and groundwater once they are combined in a canal or ditch, the most reliable method to assess compliance with the Hillside Decree is to compare the sum of pumping and flowing water against the sum of water uses applied on the cone. Uses in the Bishop Cone Audit are calculated as the amount of water applied to a parcel minus the amount of water flowing off the parcel back into the canal or ditch system. In some cases several parcels are grouped into a single account and several monitoring stations are used to measure the water delivered to and exiting from the account. The accounts as well as the individual deliveries/uses are only included in the Bishop Cone Audit following a field inspection and Technical Group approval to ensure that appropriate monitoring is in place. Not all lands supplied with water or all water uses are included in the Audit.

The most recent Bishop Cone Audit examined conditions for the 2015-16 runoff year. Total groundwater extraction (pumping and flowing wells) on the Bishop Cone was 14,988 ac-ft compared with 27,745 ac-ft of recorded uses. Therefore, uses on the Bishop Cone exceeded extractions by approximately 12,757 ac-ft. If extractions had exceeded the amount of recorded uses, all groundwater could not have been used on the Bishop Cone and LADWP would be out of compliance with the Hillside Decree. That situation has not occurred since the audit procedures were implemented as part of the Water Agreement.

Pumping in the Bishop Wellfield has been relatively constant for the past 25 years except in above-normal runoff years when pumping decreased, for example 1998, 2006 and likely 2017 (Figure 3.10). Because of the Hillside Decree and relatively constant pumping, ICWD does not routinely use indicator wells to analyze the annual operations plan for this wellfield. Water levels in west Bishop typically peak after the summer irrigation season. Groundwater levels from 1980 to 2016 at several test wells located west, north, and east of the city of Bishop are presented in Figures 3.11.a -c. Constant pumping and consistent recharge from irrigation has historically resulted in relatively stable water levels in the Bishop Cone Wellfield. However, the effects of the 2012 to

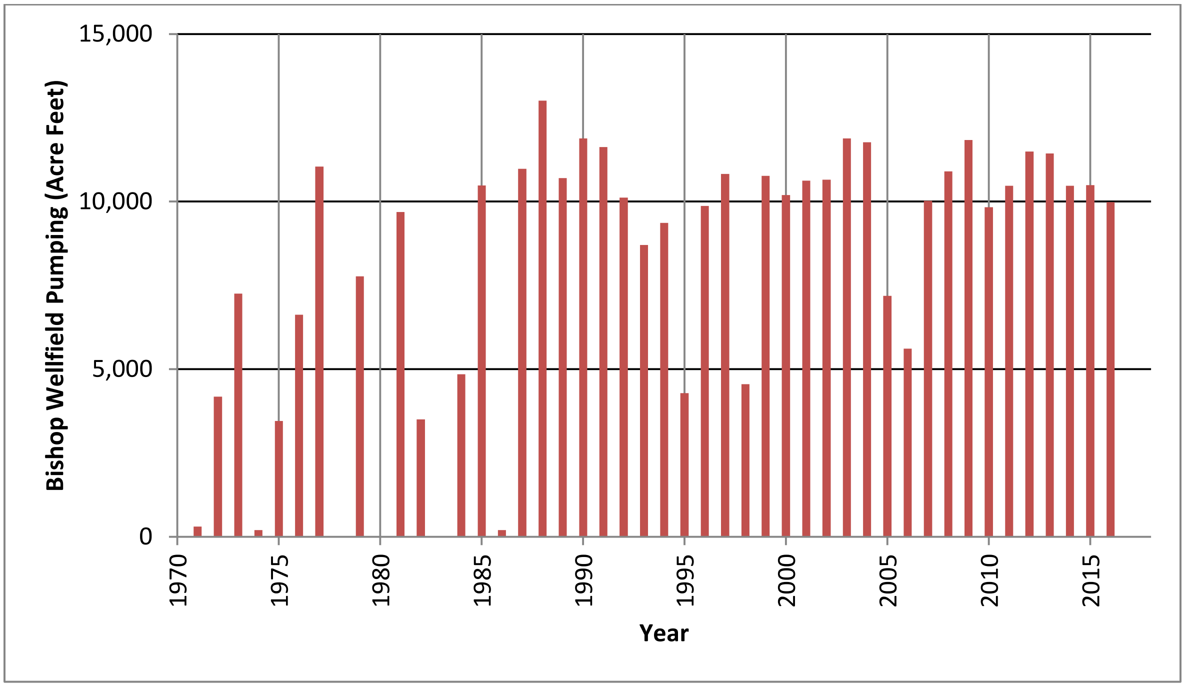


Figure 3.10. Pumping totals for the Bishop wellfield.

2016 drought can be seen in the recent water levels from Bishop Cone wells, especially wells in the western and northern portions of the wellfield.

It is likely that a combination of diminished surface water flows caused by the 2012-2016 drought and the change in timing of Bishop Creek surface flows negatively affected shallow groundwater levels in west Bishop from the fall of 2013 through the winter of 2014. Groundwater levels in this area dropped precipitously, in some cases to their lowest recorded levels. Hydrographs of these groundwater levels declines can be seen in Figure 3.12. The declining groundwater levels prompted both ICWD and LADWP to increase the frequency of their monitoring on the western half of the Bishop Cone in order to more fully understand the changes in groundwater levels during the prolonged drought.

From the water table lows in fall and winter of 2013-14, groundwater levels have slowly recovered. For 2017-18, the forecasted flows in Bishop Creek are expected to exceed the Chandler Decree minimums through September 2017 with enough water retained in storage to keep 2017-18 fall and winter flows at or above historic norms.

Important takeaways from recently observed Bishop Cone conditions:

- Surface water flows play an integral role in recharging shallow groundwater levels in west Bishop; and the interaction between surface water and groundwater recharge is very sensitive to changes in equilibrium conditions

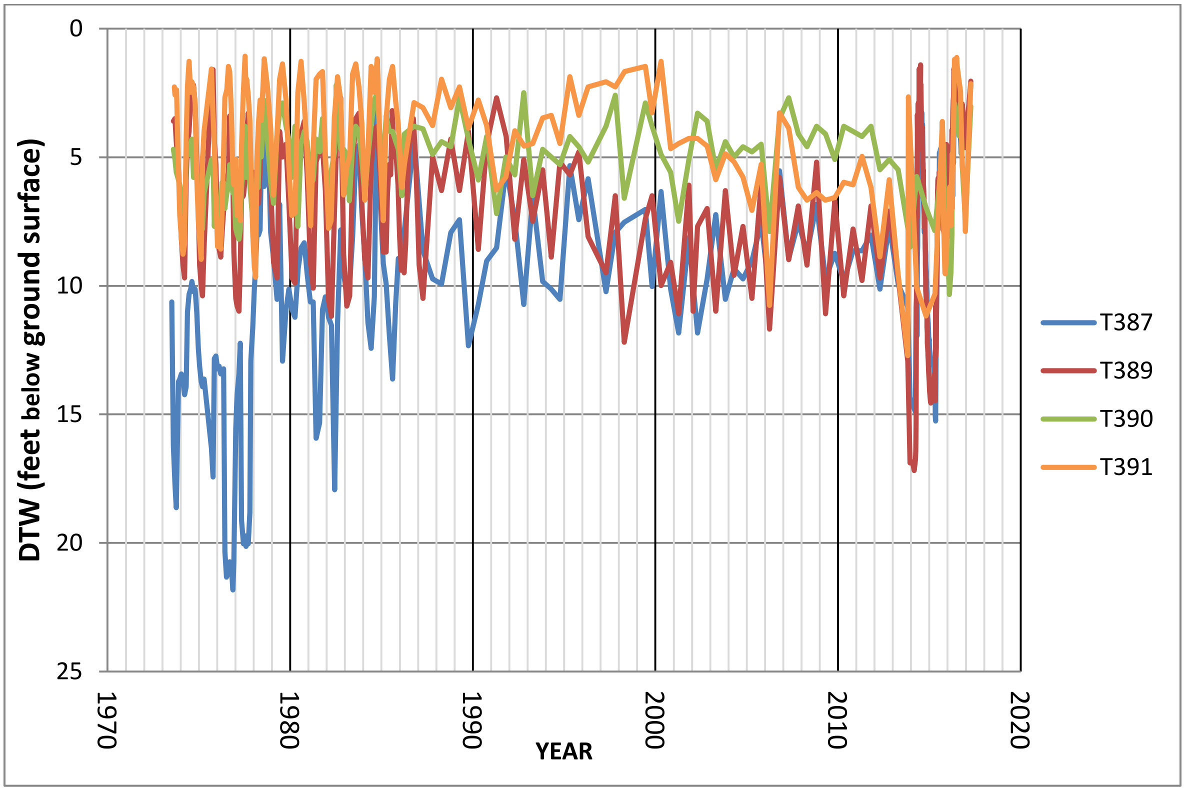


Figure 3.11.a. Hydrographs of selected monitoring wells in the western Bishop wellfield. Locations of the wells are shown in Figure 3.7

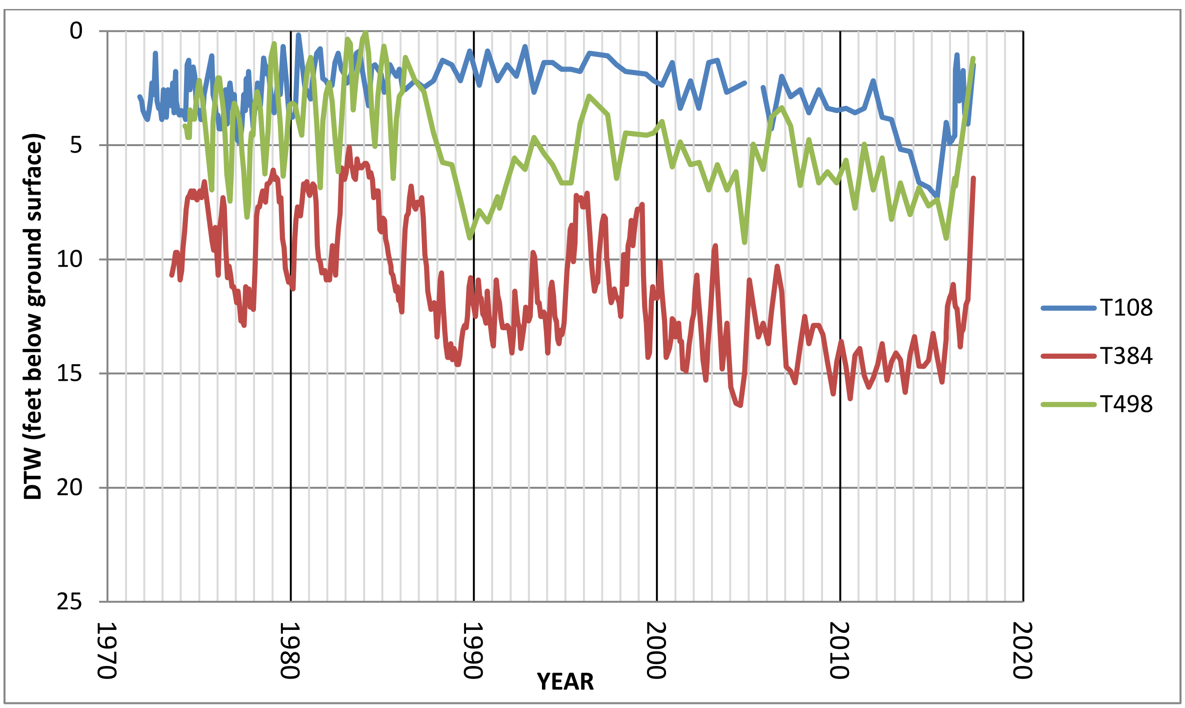


Figure 3.11.b. Hydrographs of selected monitoring wells in the northern Bishop wellfield. Locations of the wells are shown in Figure 3.7

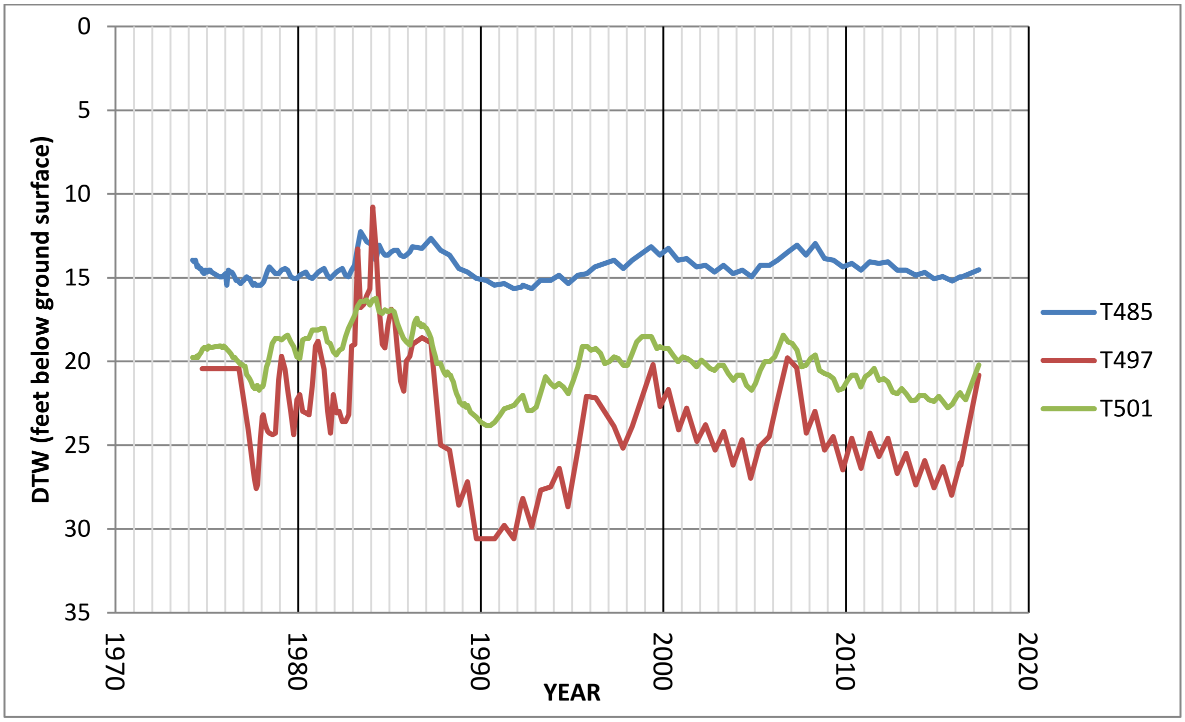


Figure 3.11.c. Hydrographs of selected monitoring wells in the eastern Bishop wellfield. Locations of the wells are shown in Figure 3.7

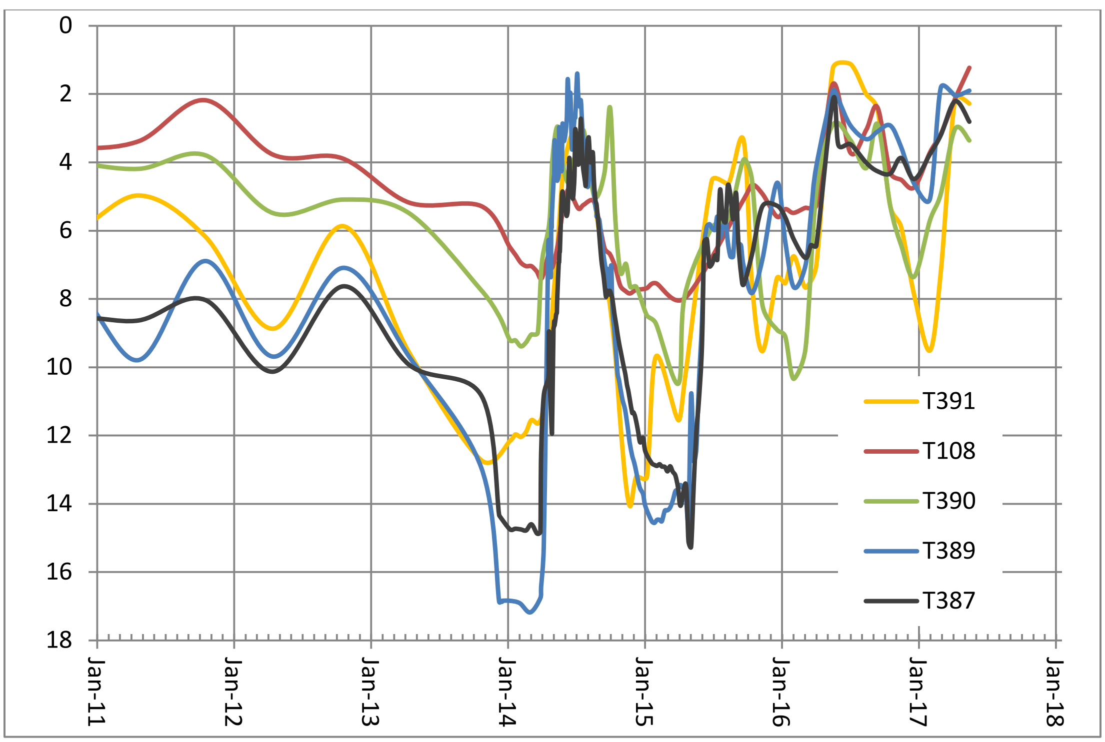


Figure 3.12. Recent hydrographs of selected monitoring wells in western Bishop wellfield. Locations of the wells are shown in Figure 3.7

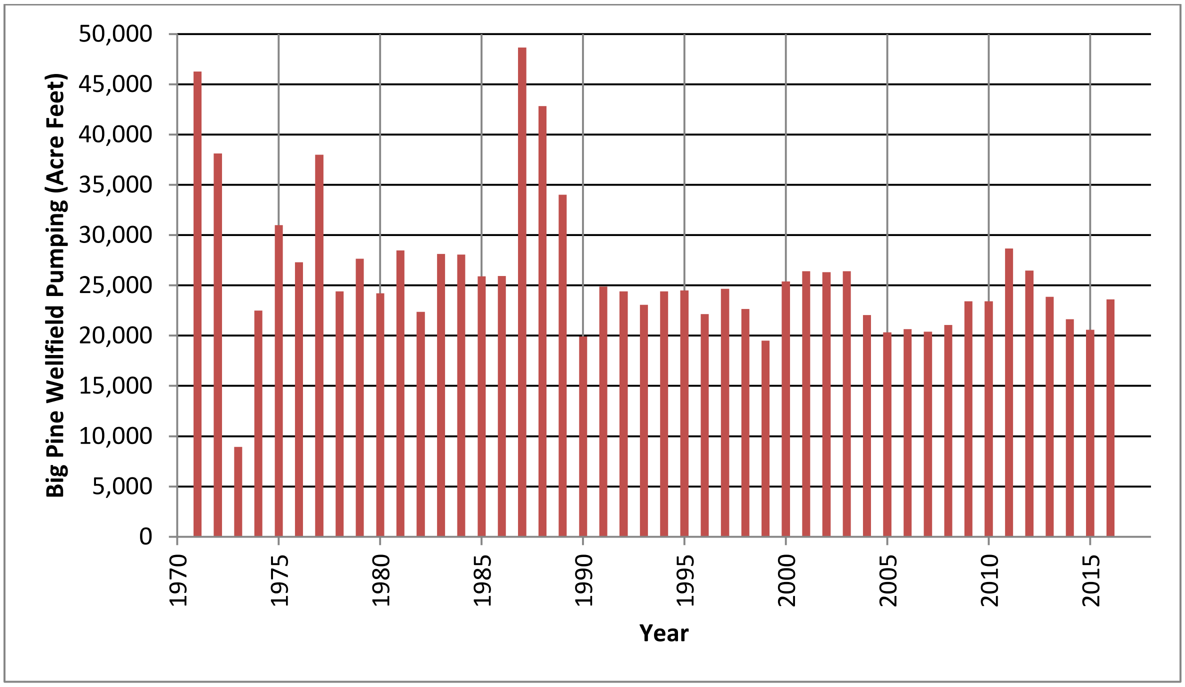


Figure 3.13. Pumping totals for the Big Pine wellfield

- Semiannual monitoring in spring and fall does not capture the full range of groundwater fluctuations in the Bishop area
- Many of the private wells in west Bishop are shallow and, therefore, more vulnerable to impacts associated with deepening groundwater levels
- Thoughtful water management of Bishop Creek flows and the associated diversion and ditch flows should be used during drought and/or low runoff years
- Conservative pumping practices should be used on LADWP wells W407 and W408 during drought and/or low runoff years
- Information gathered in west Bishop during the past several years should be taken into consideration in regards to LADWP's potential new wells B2 and B5

Big Pine Wellfield

Pumping in the Big Pine wellfield (Figure 3.14) since 1974 has been consistently larger than other wellfields (Figure 3.13). Minimum pumping to supply uses in this wellfield include the Fish Springs Hatchery (approximately 19,500 ac-ft per year) and Big Pine town supply (500 ac-ft per year). Pumping under the Water Agreement has largely been to supply these uses. It should be noted that most of the hatchery pumped water also reaches the aqueduct.

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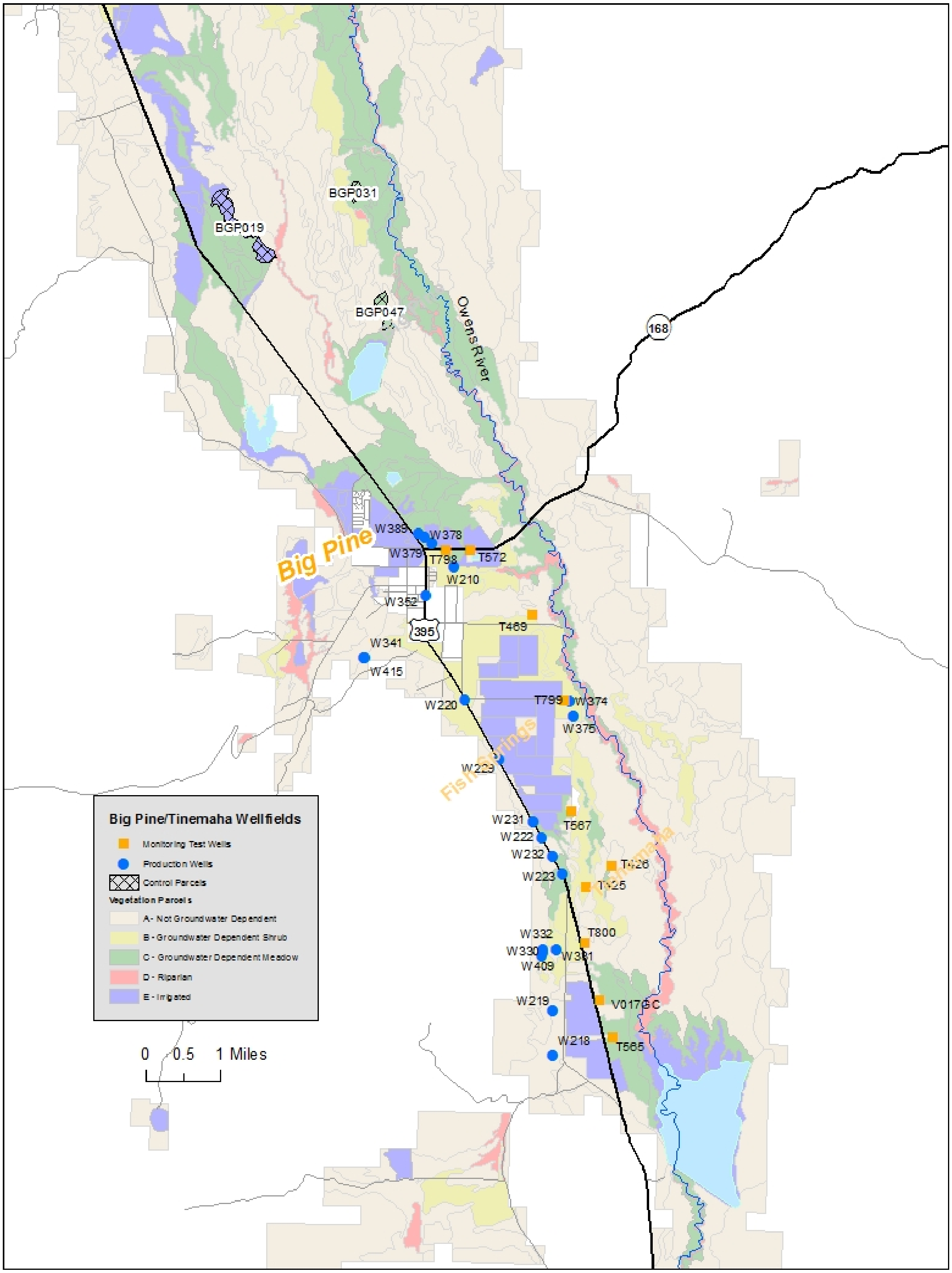

Figure 3.14. Map of monitoring wells and LADWP production wells in Big Pine wellfield.

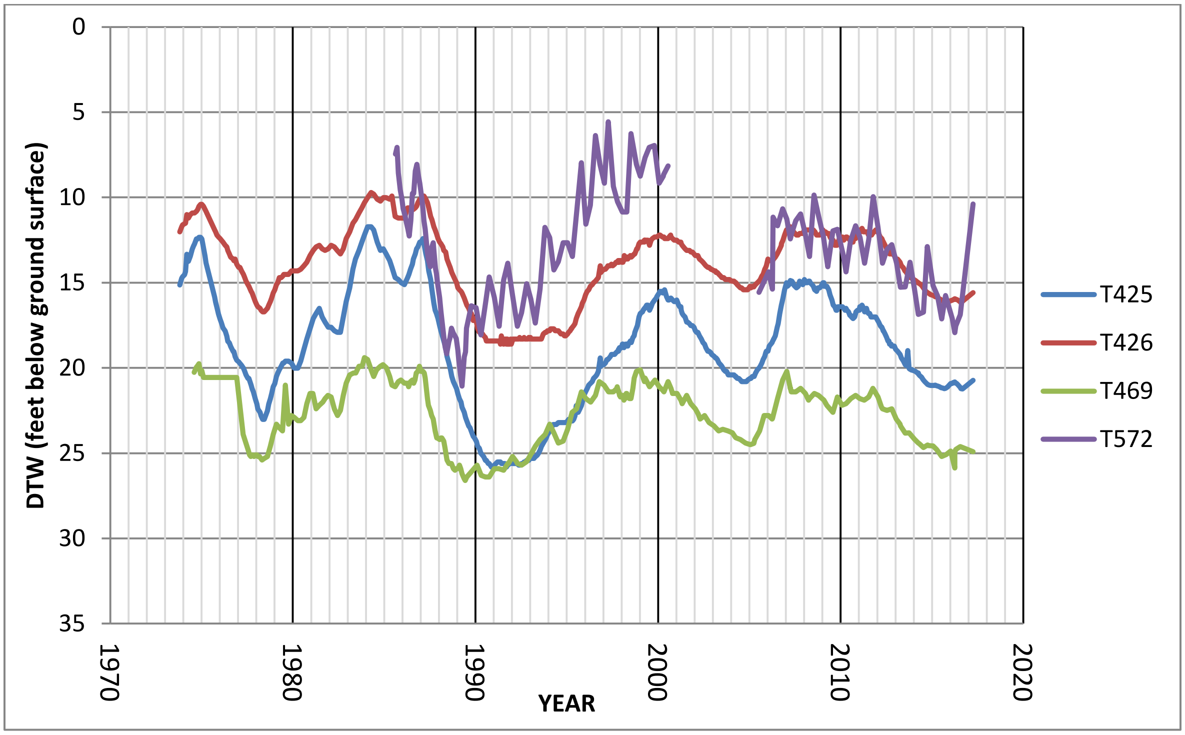

Figure 3.15. Hydrographs of indicator wells in the Big Pine wellfield. Periods of missing data for T572 occurred when the well was plugged and in need of repair T572 shows influence of higher than average flows in the Big Pine Canal in 2017.

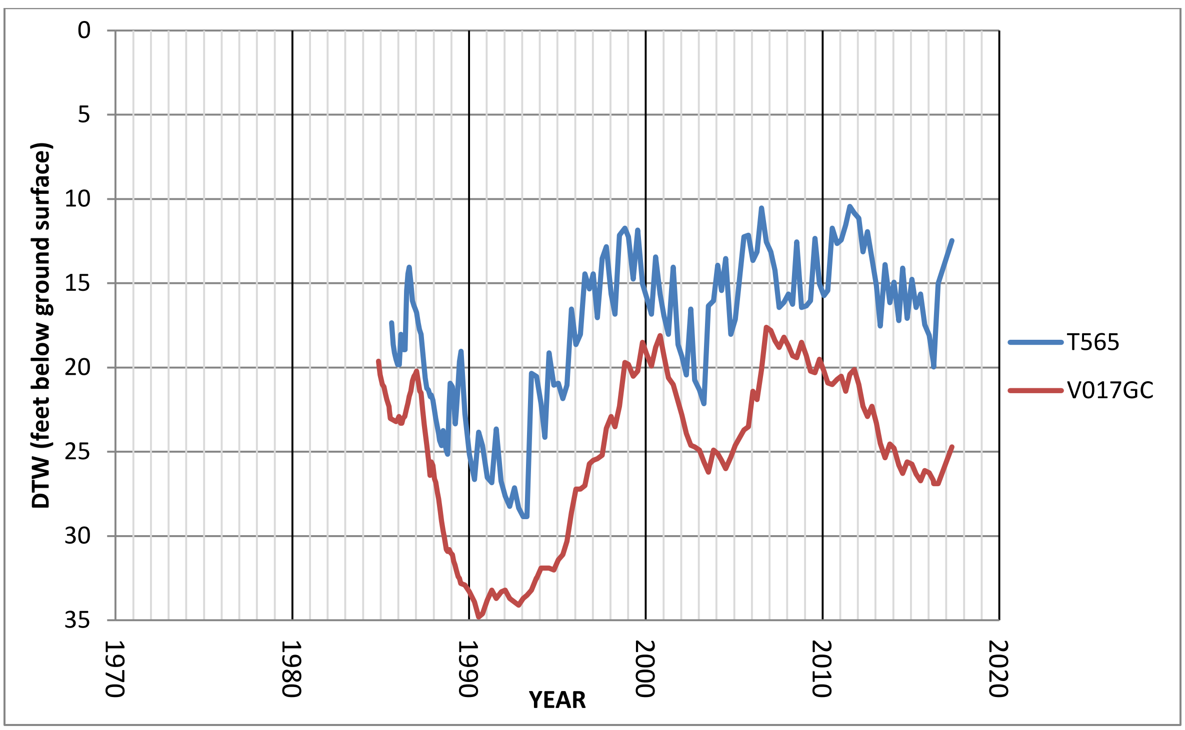

Figure 3.16. Hydrographs of monitoring wells in the southern Big Pine wellfield near pumping wells W218 and W219.

DTW in indicator and monitoring site wells rose in all eight wells in 2017 (Figure 3.15, Table 3.2). However, six of the eight indicator wells remain between 2 to 7 feet below baseline levels in April 2017. The two test wells above baseline (T572 and T798) are in the northern part of the wellfield in close proximity to and strongly influenced by the Big Pine Canal which has received above average flows in 2017 due to the historic winter. ICWD also examined two test wells located just east of U.S. 395 near W218 and W219 to assess possible impacts from the additional export pumping of recent years (Figure 3.16). Both V017GC and T565 are located in or adjacent to groundwater dependent vegetation. Water levels declined in response to drought and pumping from 2012 to 2016. Both of these monitoring wells are below baseline levels. In 2017, LADWP has been actively spreading water into the Big Pine wellfield, notably south of town along the Red Mountain cinder cone.

Taboose-Aberdeen Wellfield

Pumping in the Taboose-Aberdeen Wellfield (Figure 3.17) since 1990 under the Water Agreement has remained much below the wellfield capacity (Figure 3.18). Minimum pumping for this wellfield is approximately 300 ac-ft to supply one mitigation project at Big Seeley Spring, and nearly all of the pumping since 2010 has been for aqueduct supply.

Hydrographs for the indicator wells exhibit similar response to fluctuations in pumping and runoff (Figures 3.19 and 3.20). Most of the recent pumping has been from well W349 and W118 located in the northern portion of the wellfield. Well 118 has been operated consistently from 2011 to 2016, but is currently (June 2017) off. Data from well T587 (a non-indicator well) is included because it is located adjacent to groundwater dependent vegetation near W118 and is used to assess the impacts of recent pumping.

Thibaut-Sawmill Wellfield

Historically, most pumping in the Thibaut-Sawmill Wellfield has been to supply approximately 12,200 ac-ft annually to the Blackrock Fish Hatchery (Figure 3.21). In 2011-12, approximately 1,800 ac-ft was pumped from this wellfield for aqueduct supply; since then, pumping has been for hatchery or local irrigation uses. In 2014, Inyo and Los Angeles agreed to reduce hatchery pumping to approximately 8300 ac-ft.

Groundwater levels in 2016-2017 rose between 0 to 2 feet in eight out of ten indicator or monitoring site wells (Table 3.2). The two test wells with groundwater declines (T419 and T421) are located in the northern part of the wellfield near W349 and W118. Water levels in the southern portion of the wellfield have continued to increase due to a reduction in pumping to supply the Blackrock fish hatchery in 2014. Depth to water in all wells was 1 to 6 feet below baseline in April 2017 (Table 3.2).

Hydrographs of four test wells used to track water levels in Thibaut-Sawmill have exhibited different responses due to local water management within the wellfield (Figure 3.22). Well T415, responding to reduced hatchery pumping, exhibited a substantial water level rise of over 12 ft. Wells T413 and T414 are not used as indicator wells but they are included as examples from the southern portion of the wellfield.

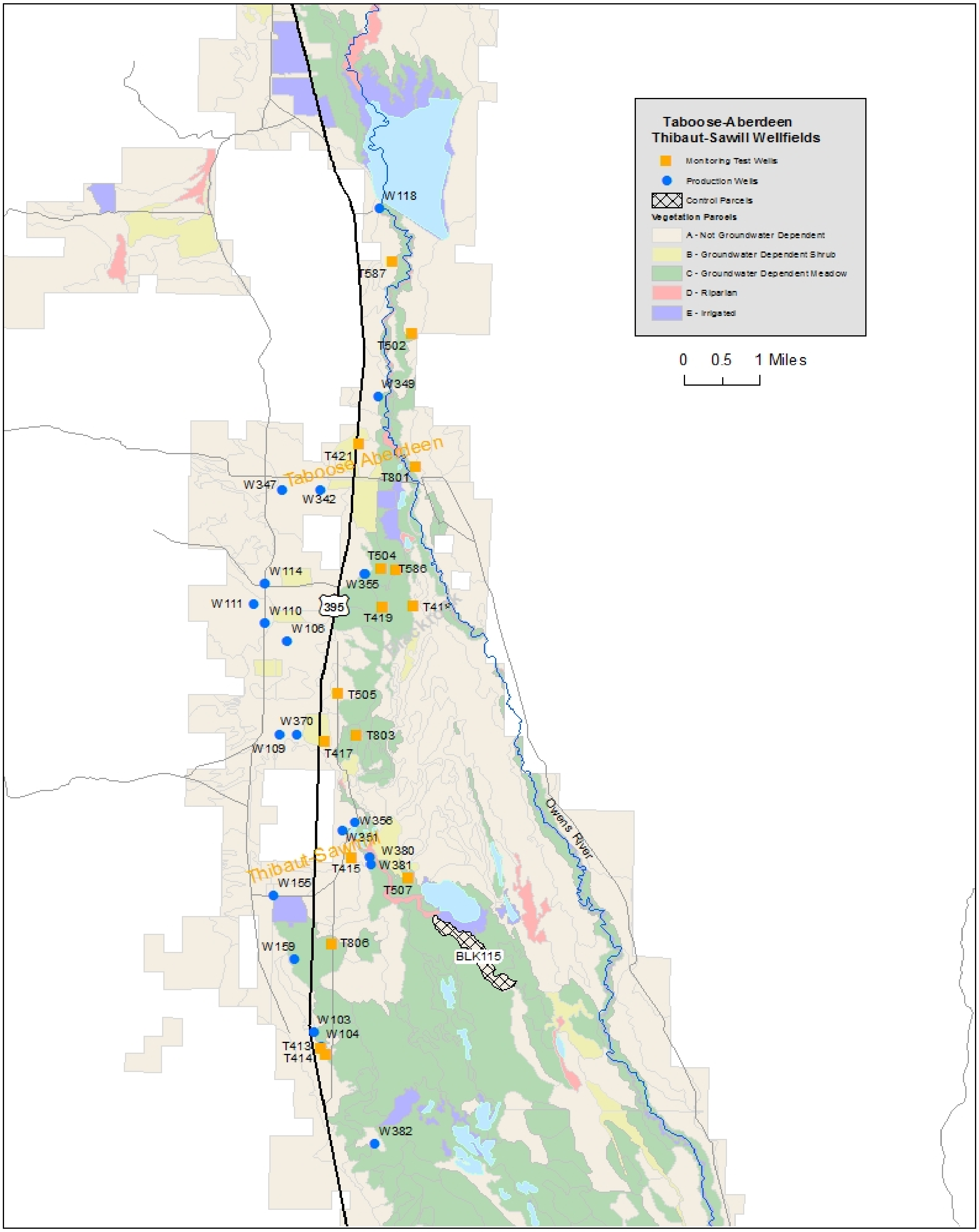

Figure 3.17. Map of monitoring and LADWP production wells in the Taboose-Aberdeen and Thibaut-Sawmill wellfields.

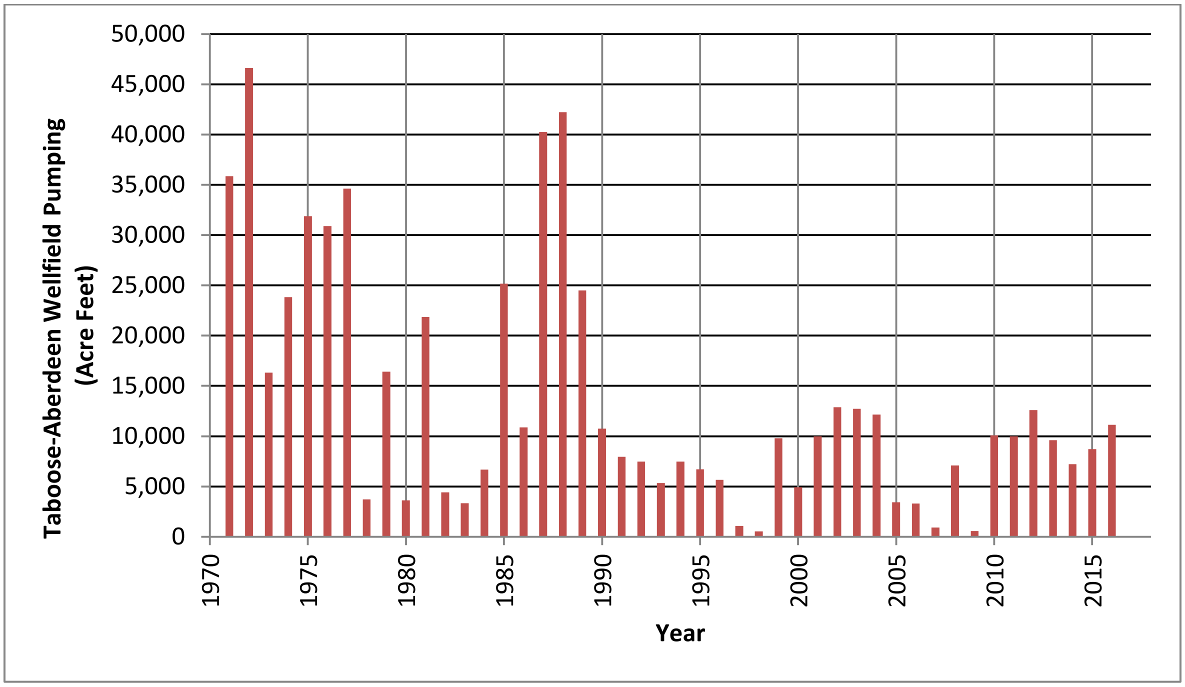

Figure 3.18 Pumping totals for the Taboose-Aberdeen wellfield.

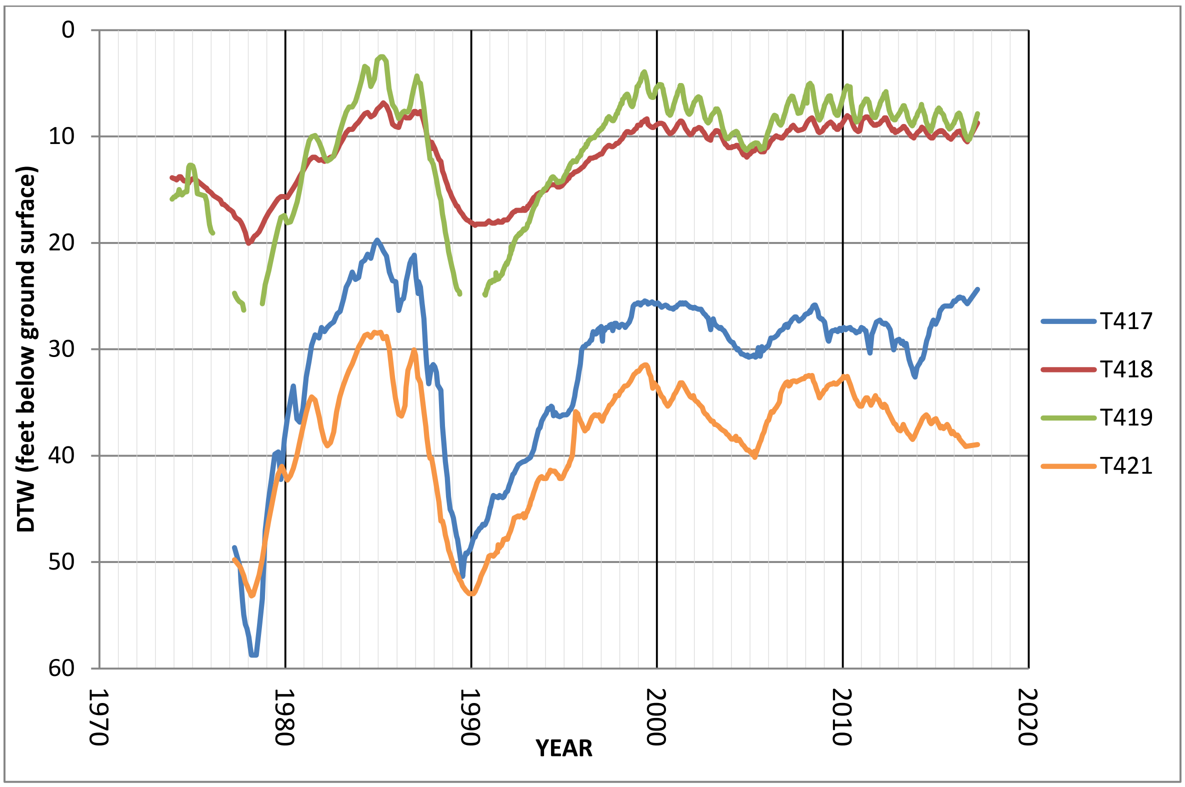

Figure 3.19. Hydrographs of indicator wells in the Taboose-Aberdeen wellfield. Periods of missing data denote when the test well was dry.

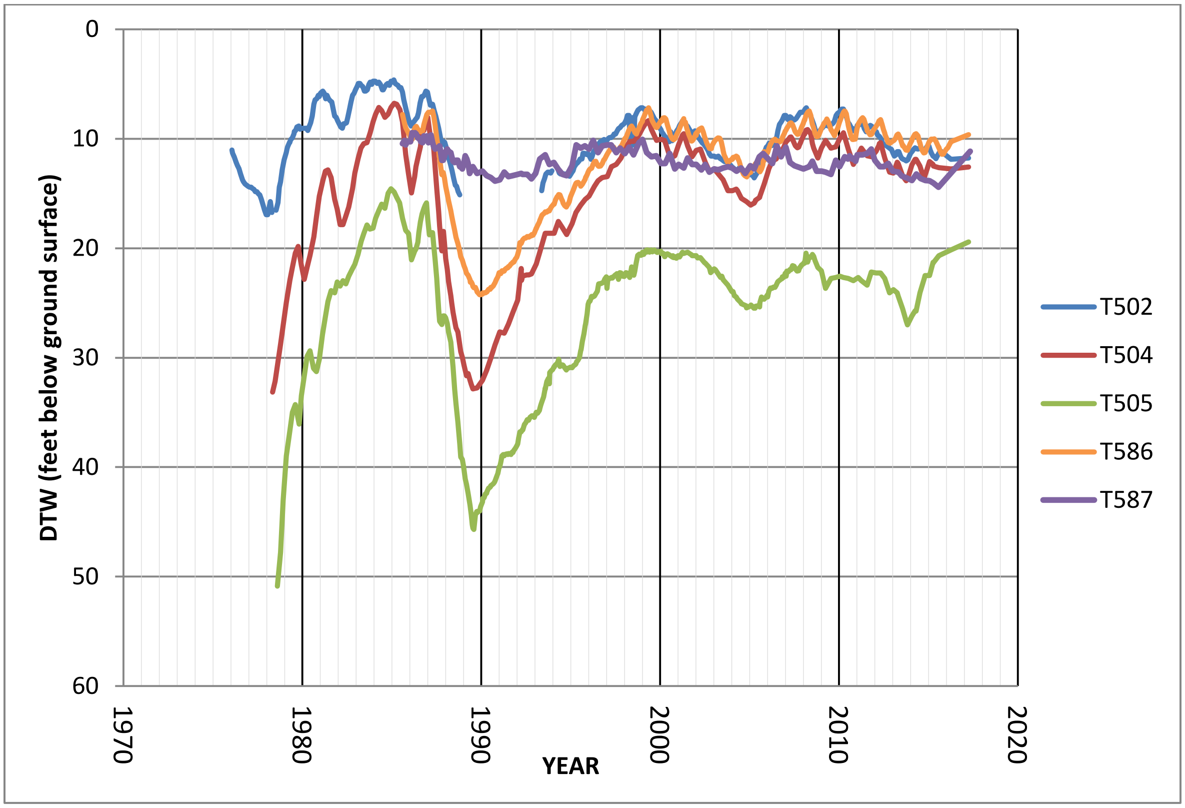

Figure 3.20. Hydrographs of indicator wells in the Taboose-Aberdeen wellfield. Periods of missing data denote when the test well was dry.

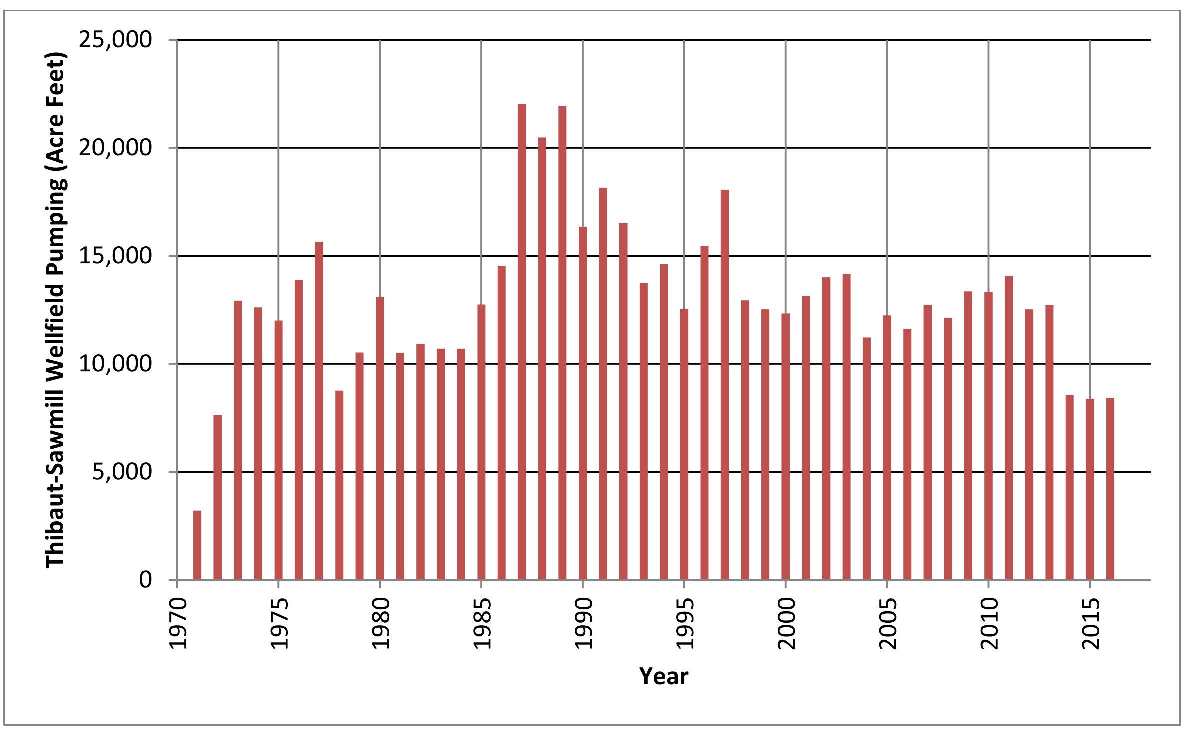

Figure 3.21. Pumping totals for the Thibaut-Sawmill wellfield.

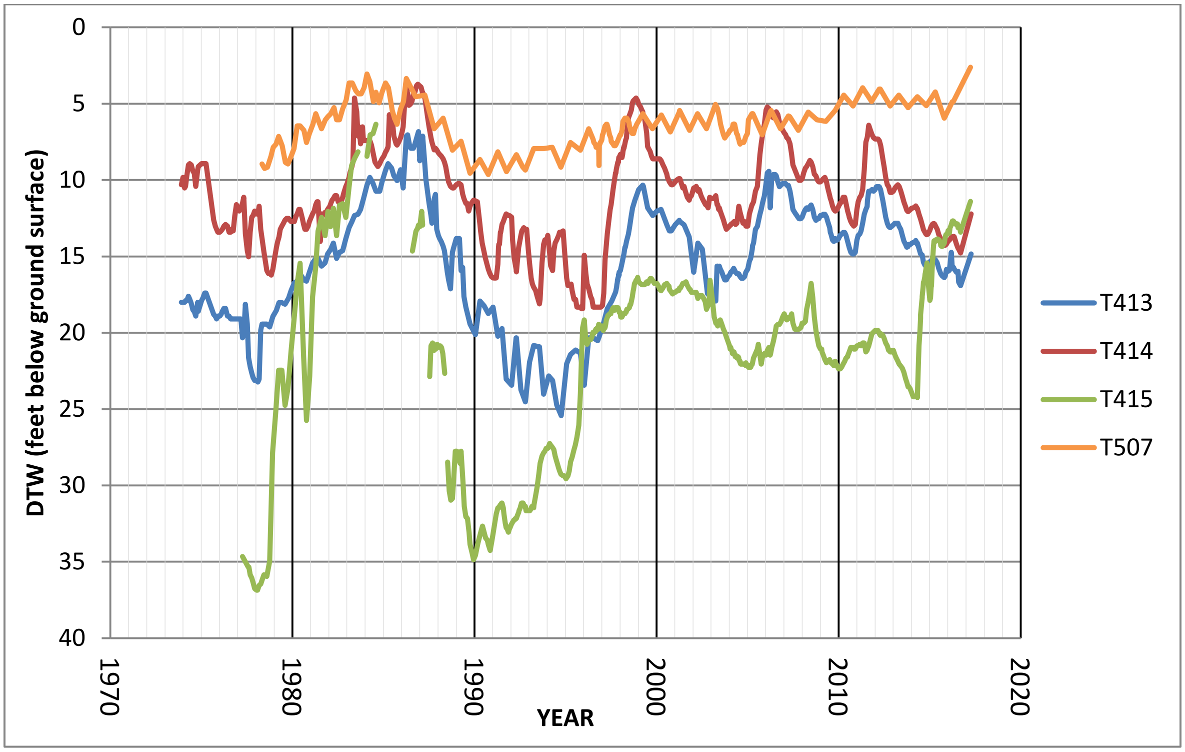

Figure 3.22. Hydrographs of selected test wells in the Thibaut-Sawmill wellfield.

Both wells respond to spreading during high runoff years (e.g. 2006) and then decline gradually in response to pumping and/or reduced runoff. The reduction in the hatchery pumping is not evident in these wells. Following nearly ten years of stable water levels, T507 began to respond in 2009 to the establishment of wetlands in the Blackrock Waterfowl Management Area (BWMA). The rotational flooding of BWMA affects groundwater levels in this well. Groundwater levels in all four wells rose in 2017 compared to 2016.

Independence-Oak Wellfield

Pumping in this wellfield (figure 3.23) is required to supply approximately 6,700 ac-ft annually for irrigation projects surrounding Independence and for town supply (Figure 3.24). LADWP has pumped between 8, 600-9,600 each year since 2011.

Water levels had been stable through the first decade of 2000 in wells located in the center of the wellfield (T406, T407, T408, T409), but have declined in response to the increased pumping of the last five years. Water levels in these wells rose from 0.5 to 4 feet (Table 3.2 and Figure 3.25) in April 2017 compared with the previous year due to increased runoff and surface water availability. The other indicator wells located east and north of Independence exhibited stable (T546) or rising (T809) water levels this past year (Figure 3.26).

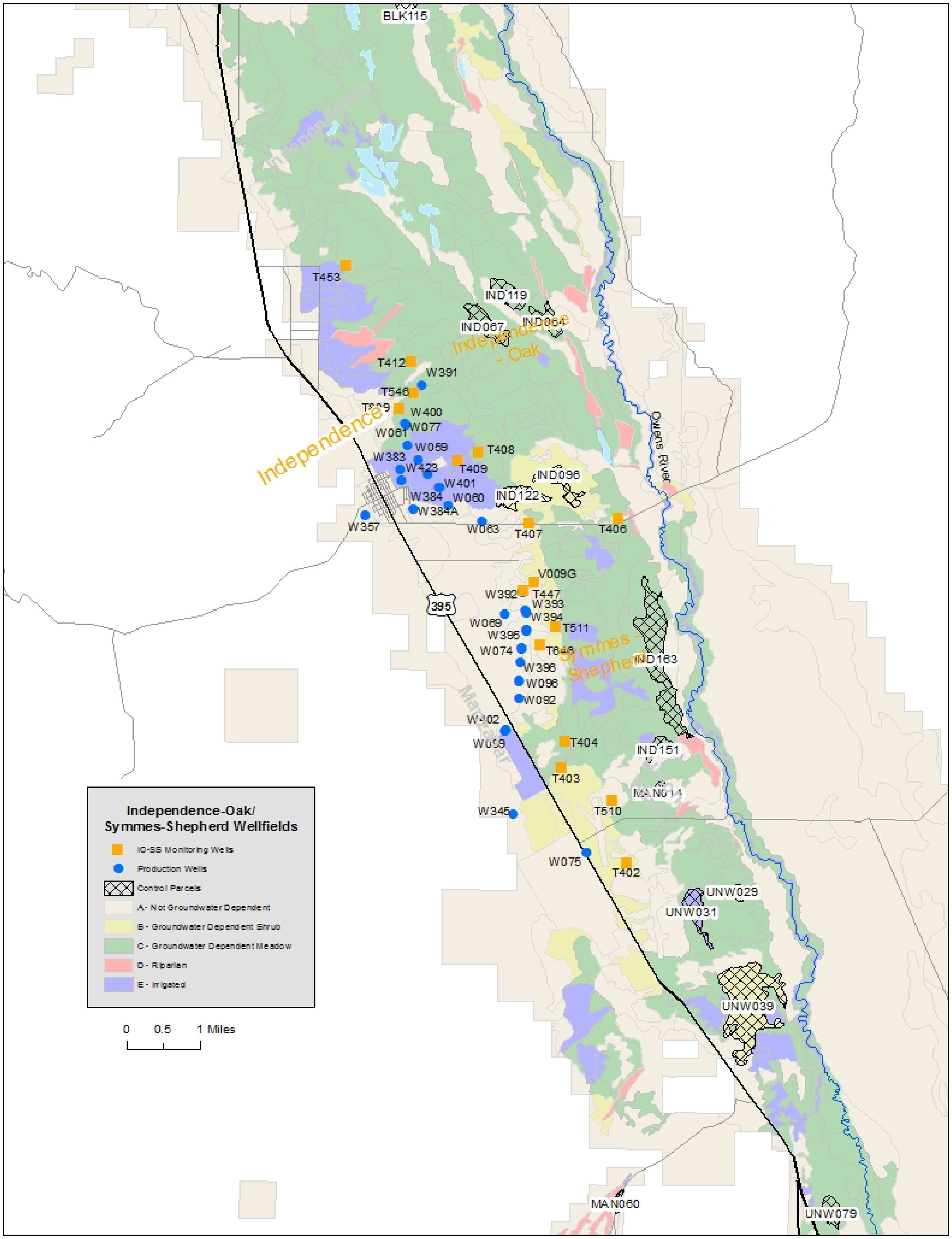

Figure 3.23. Map of monitoring and LADWP production wells in the Independence-Oak and Symmes-Shepherd wellfields.

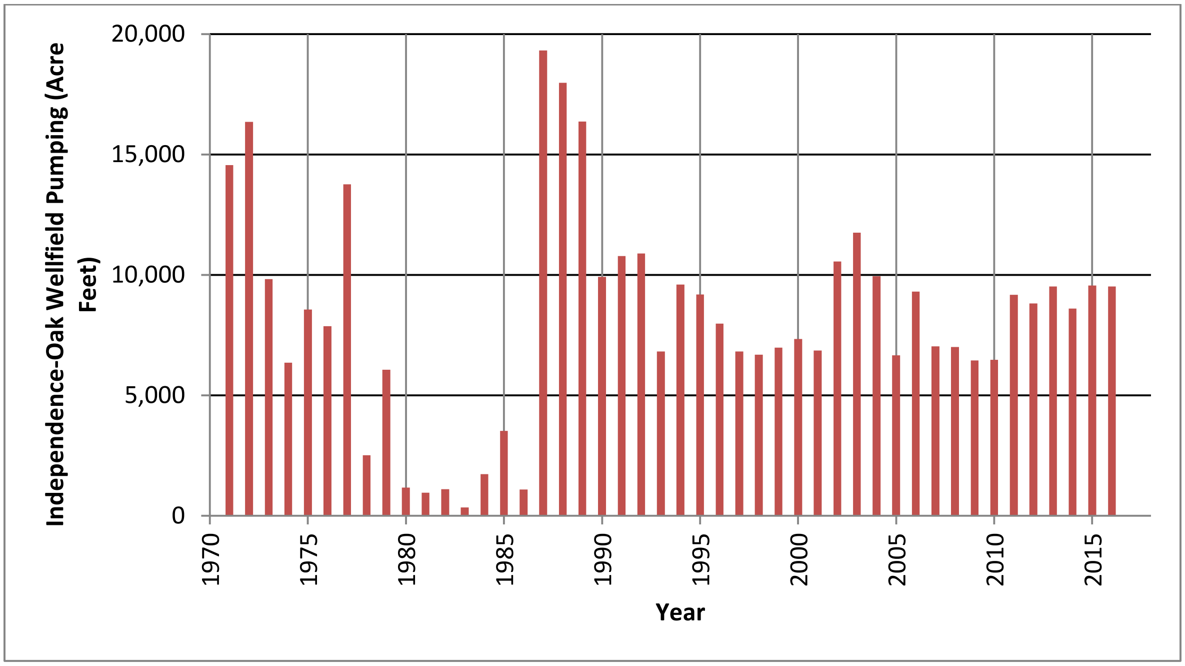

Figure 3.24. Pumping totals for the Independence-Oak wellfield.

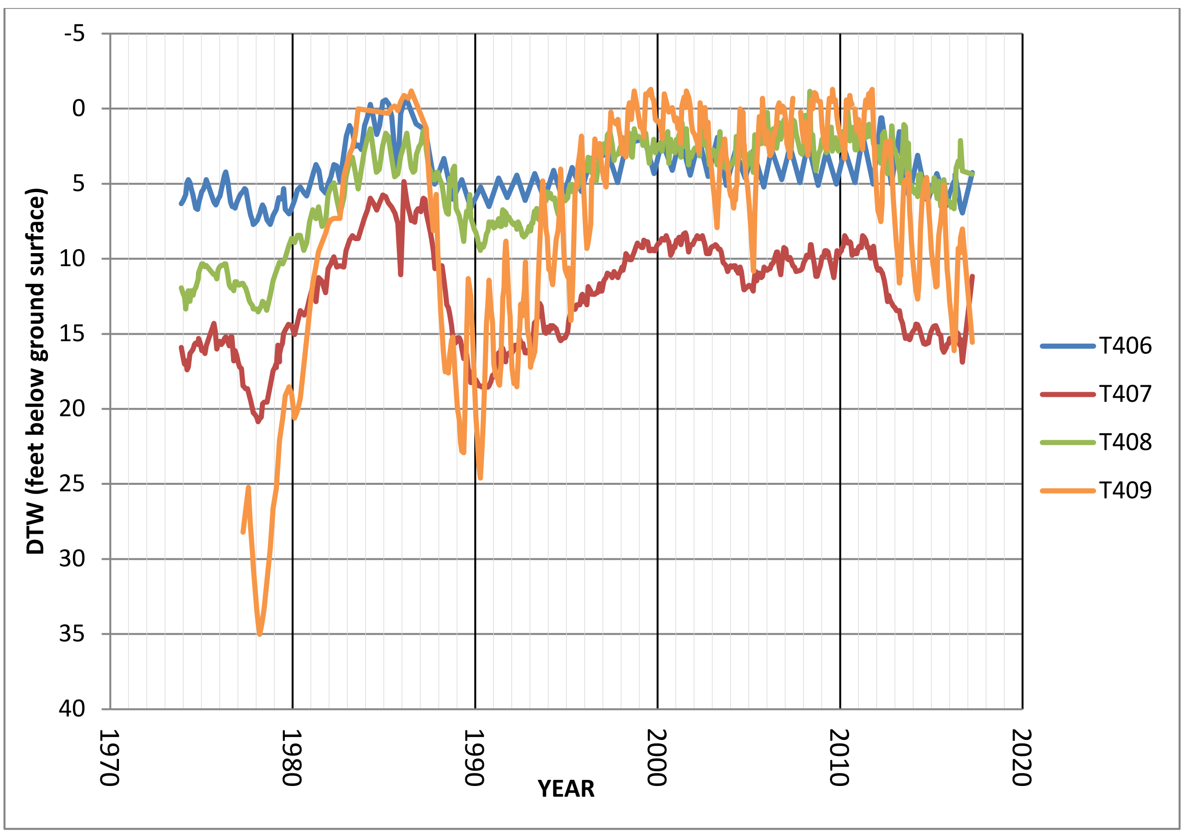

Figure 3.25. Hydrographs of selected test wells in the Independence-Oak wellfield

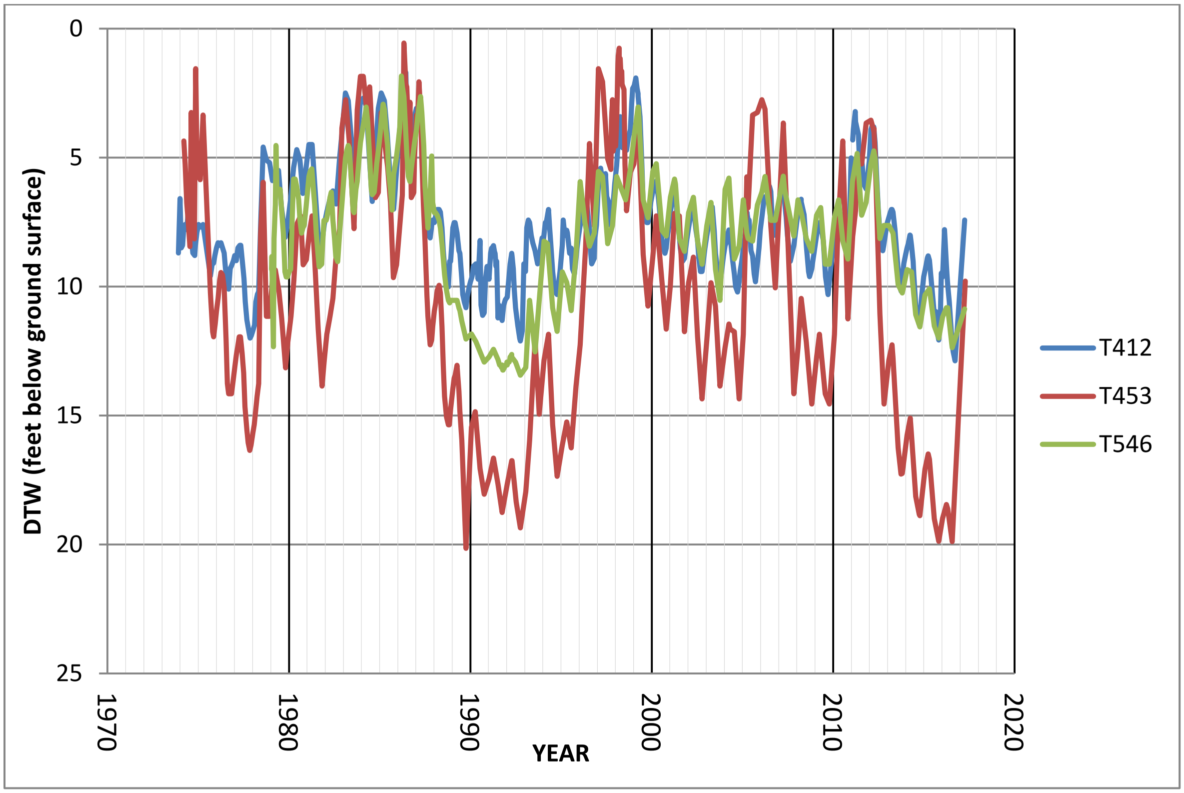

Figure 3.26. Hydrographs of selected test wells in the Independence-Oak wellfield

All of the indicator wells in the Independence-Oak Wellfield were below the baseline in April 2017 by 2 to 16 feet (Table 3.2). Due to the declines in groundwater levels as compared to the baseline period in these wells ICWD staff has recommended to LADWP that pumping and surface water be managed (especially in-light of the large volume of anticipated 2017-18 runoff) to raise the water table in this wellfield.

Symmes-Shepherd Wellfield

In the 1970's and 80's, pumping in the Symmes-Shepherd Wellfield (figure 3.23) varied considerably (Figure 3.27). Under the Water Agreement, pumping was reduced. Approximately 1200 ac-ft of pumpage is required to supply one mitigation project; however, pumping for aqueduct supply has increased since 2010, primarily in the northern part of the wellfield.

In three of the seven indicator wells, groundwater levels in 2016-2017 declined. In the remaining four wells groundwater levels increased from 0.3 to 2 feet (Table 3.2). Some test wells are buffered somewhat by their proximity to the Los Angeles Aqueduct (T402-404 and T510-511), and groundwater levels are relatively stable (Figures 3.28 and 3.29). Test wells T447 and V009G are located near pumping wells in the northwestern portion of the wellfield and responded to the export pumping in 2016-17. Water levels in all monitoring wells were below baseline (Table 3.2).

Due to the declines in groundwater level caused by pumping in this wellfield, Inyo County

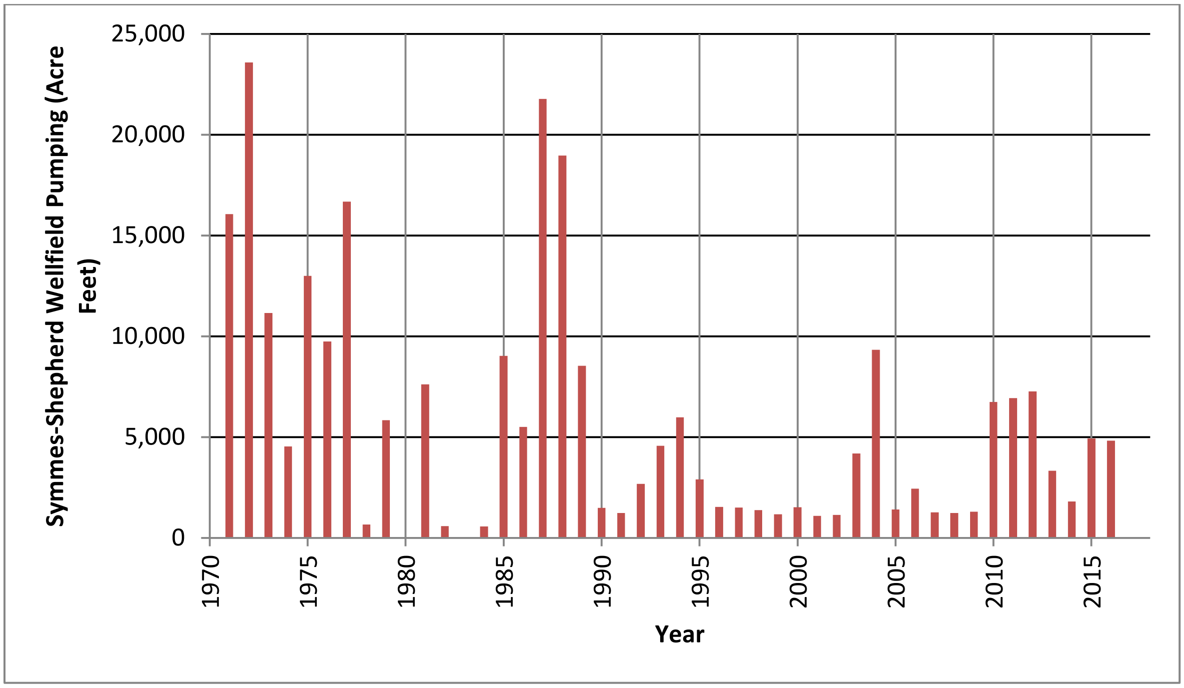

Figure 3.27. Pumping totals for the Symmes-Shepherd wellfield.

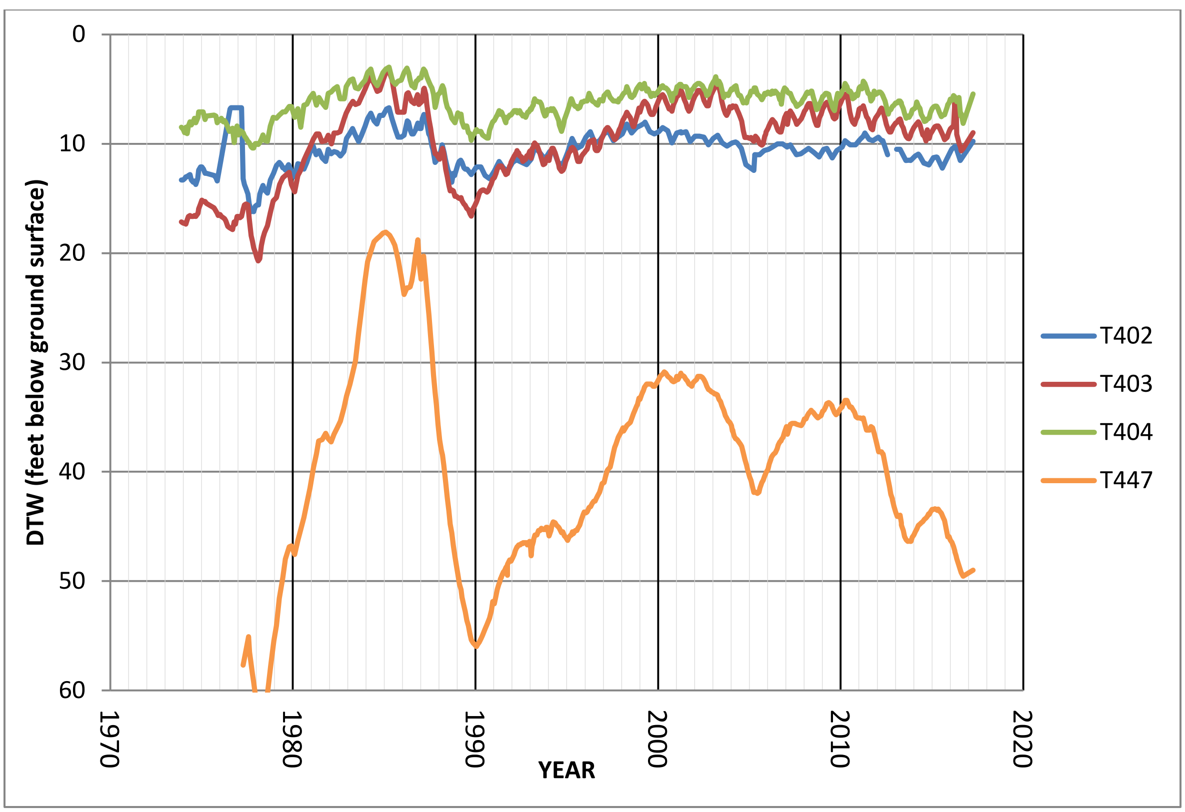

Figure 3.28 Hydrographs of indicator wells in the Symmes-Shepherd wellfield.

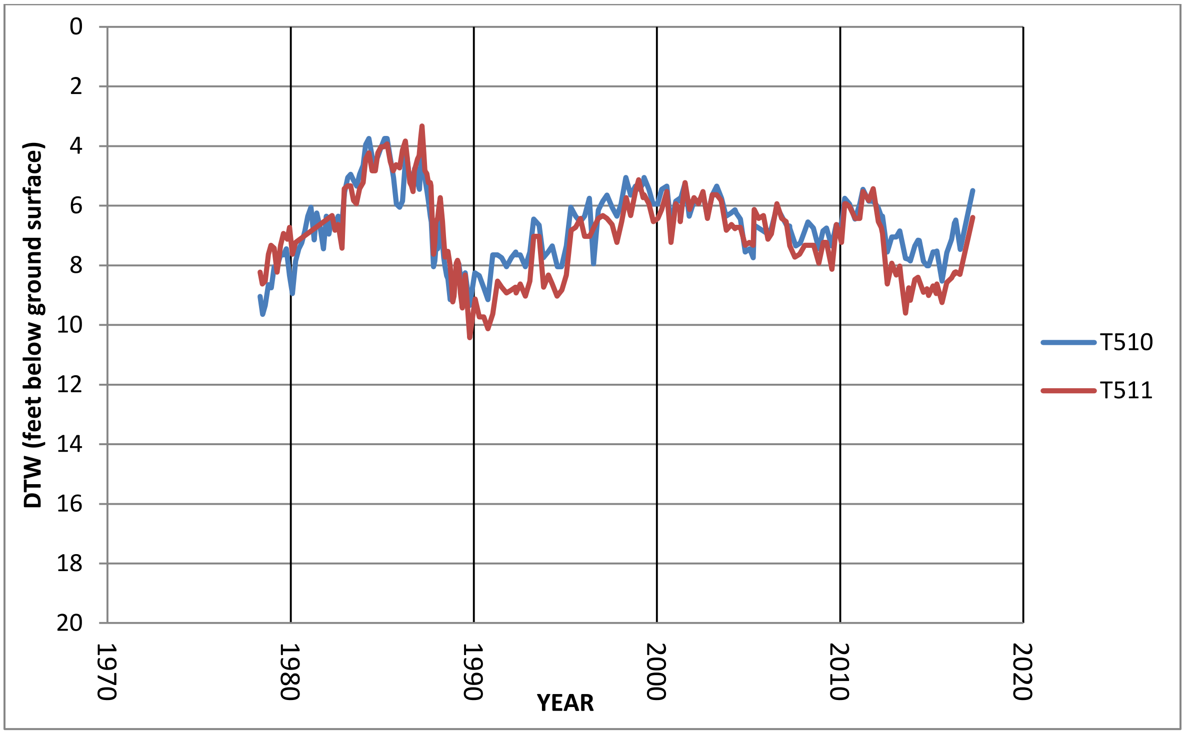

Figure 3.29 Hydrographs of indicator wells in the Symmes-Shepherd wellfield.

monitoring wells at the Independence landfill were dry or within a few feet of becoming dry in spring 2017. If these declines in groundwater continue, these monitoring wells will need to be mitigated by LADWP, either by replacement or deepening, in order for the County to comply with its landfill waste discharge permit

The Bairs-Georges Wellfield

In the 1970's and 80's, pumping and water levels in the Bairs-George wellfield (Figure 3.30) varied considerably, but under the Water Agreement, pumping has been reduced substantially (Figure 3.31. There are no projects supplied by groundwater in this wellfield, but in dry years one well is exempt (W343) and can be operated to supply irrigated pastures. As in other wellfields, pumping for aqueduct supply increased in 2010-2016 compared with the small amounts during the five preceding years. Since the mid 1990's groundwater levels in the two indicator test wells have been relatively stable. Water levels in 2016-2017 rose slightly; both wells are above baseline (Table 3.2).

The pumping wells are located west of the Los Angeles Aqueduct. Monitoring wells T597 and T398 (Figure 3.32) are in the immediate vicinity of the aqueduct and well T400 is east of the aqueduct. Water table fluctuations in these wells are buffered by the infiltration from the aqueduct, though the effect of the increase in pumping since 2010 coupled with the 2012-2016 drought is plainly evident in T398 and T597. Pumping effects are less evident in T400. Wells T598 and T596 are located west of the aqueduct, and they exhibit larger fluctuations due to pumping (Figure 3.33).

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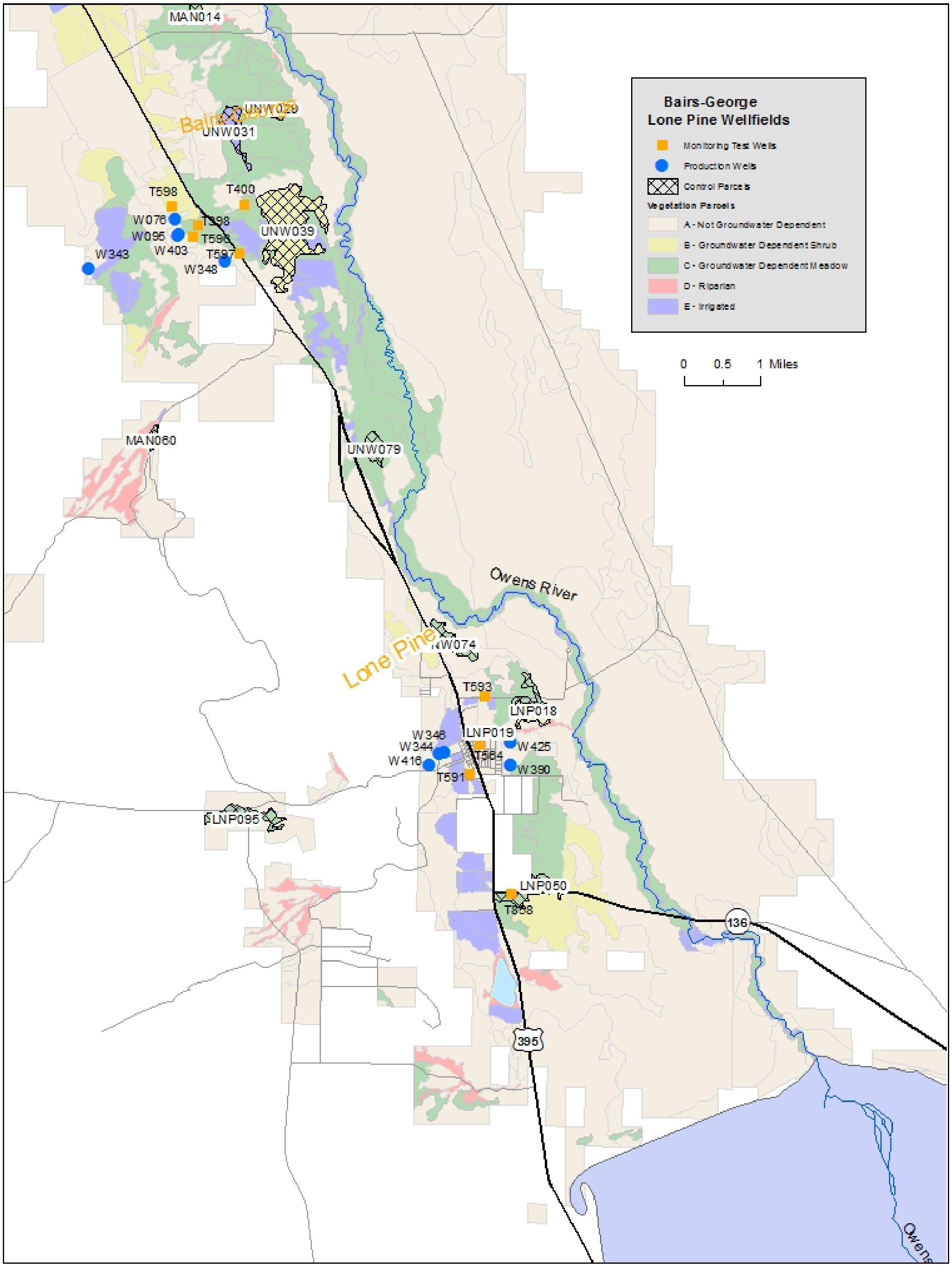

Figure 3.30. Map of monitoring and LADWP production wells in the Bairs-George and Lone Pine wellfields.

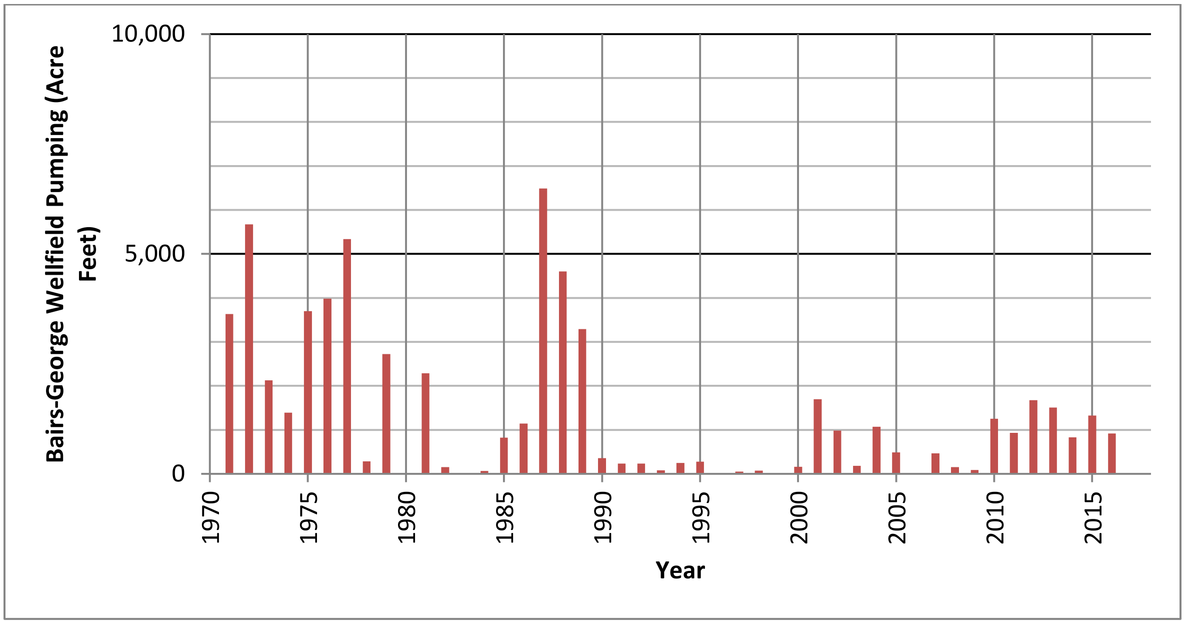

Figure 3.31. Pumping totals for the Bairs-Georges wellfield.

The Lone Pine Wellfield

Most pumping in the Lone Pine Wellfield (Figure 3.30) has been to supply the town of Lone Pine and one mitigation project (approximately 1,300 ac ft annually). Pumping increased occasionally (e.g. 2000) to offset aqueduct water previously supplied to Diaz Lake (Figure 3.34). In 2015, pumping also increased largely due to the operation of a new well to supply the E/M project Van Norman field. The previous well (W390) degraded and production declined noticeably in 2008. The new well (W425) has capacity to fully supply the project. Because of the relatively constant pumping for sole source uses, we do not routinely use indicator wells to analyze the annual operations plan for this wellfield.

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Hydrographs for test wells T564 and T591 are presented in Figure 3.35 to represent water levels near the town of Lone Pine where the LADWP pumping wells are located. Monitoring wells T593 and T858 are located in groundwater dependent vegetation north and south of Lone Pine, respectively. All wells exhibit seasonal fluctuations as well as water table response to decreased recharge due to drought. Pumping effects are not as evident. In early 2010, LADWP tested a new production well, W416, installed to increase aqueduct supply. This new production well has been modified and initial tests to determine well capacity and performance have been completed. However, details of the operational monitoring have yet to be agreed upon by the Technical Group

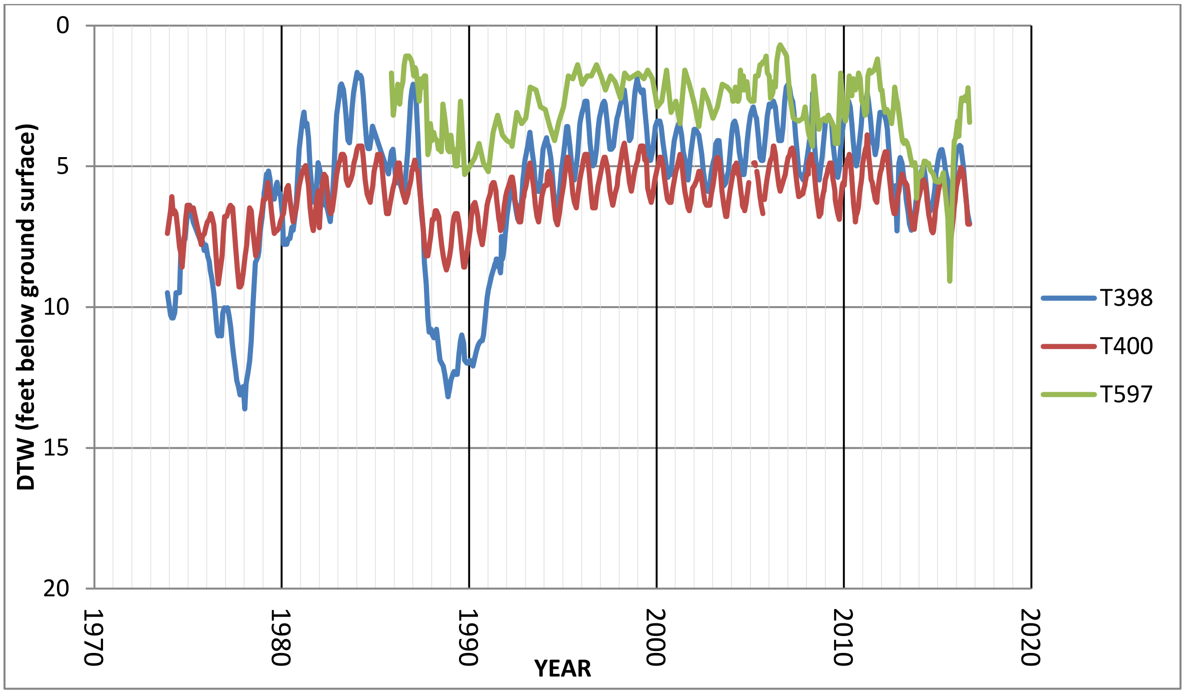

Figure 3.32. Hydrographs of indicator wells and 597T in the Bairs-Georges wellfield.

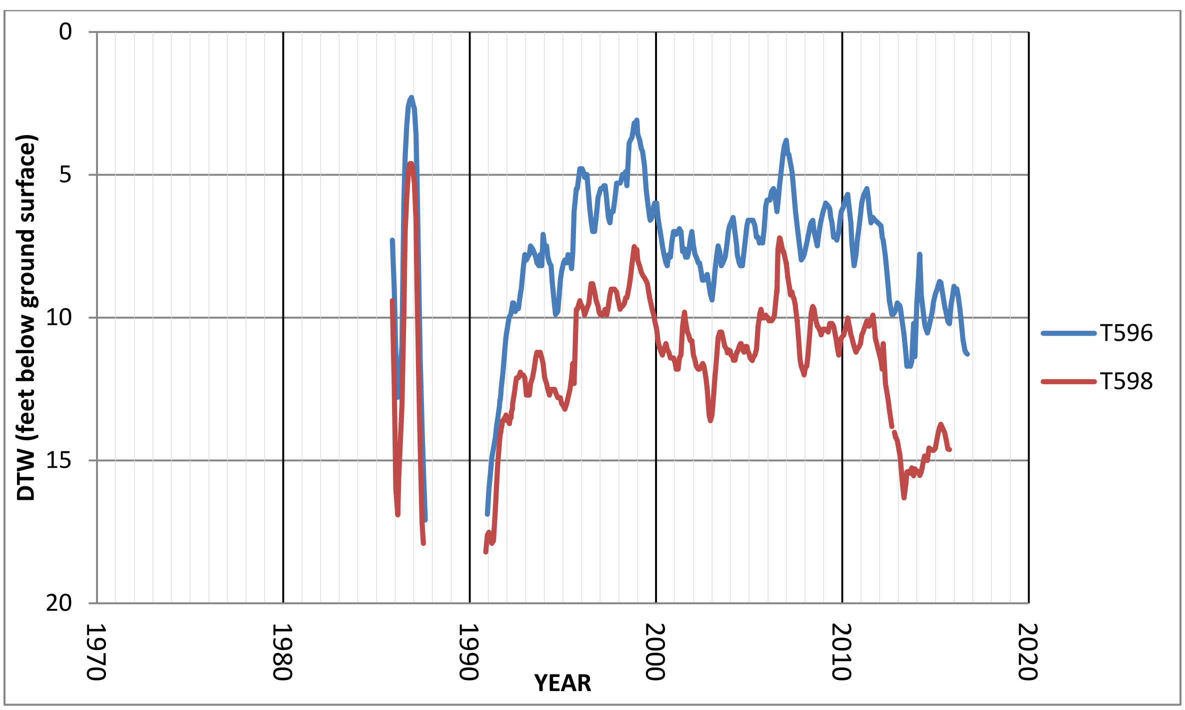

Figure 3.33. Hydrographs of selected wells in the Bairs-Georges wellfield.

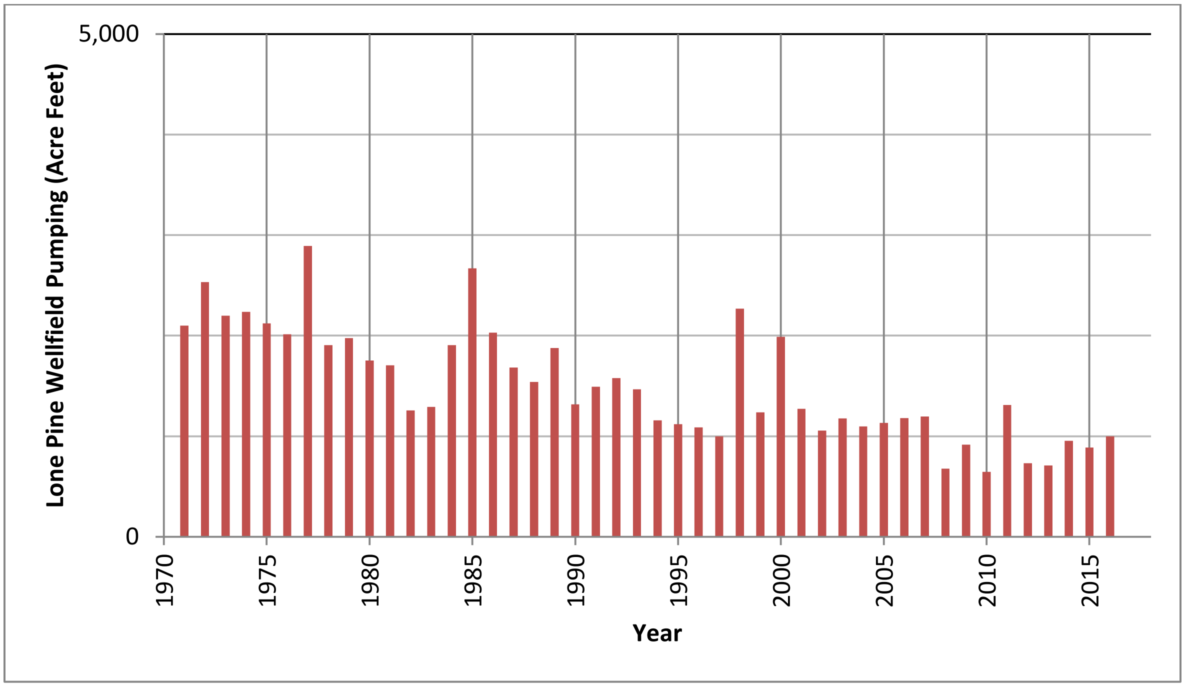

Figure 3.34. Pumping totals for the Lone Pine wellfield.

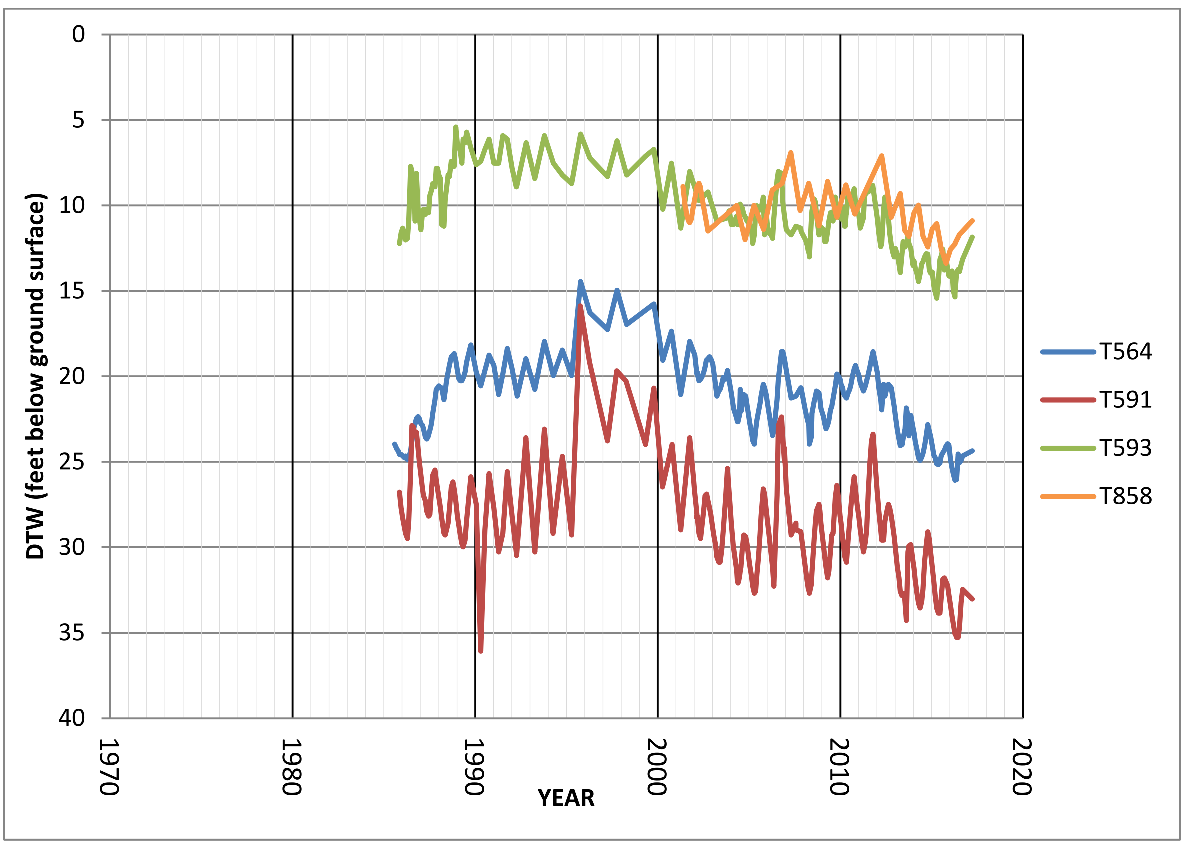

Figure 3.35. Hydrographs of selected test wells in the Lone Pine wellfield.

Table 3.3. Planned LADWP pumping by wellfield for 2017-18 and ICWD recommended pumping.

Wellfield	LADWP proposed 2017	Inyo Recommended
	Ac-ft/year	Ac-ft/year
Laws	5,040	5,040
Bishop	6,120	6,120
Big Pine	21,160	*20,550*
Taboose-Aberdeen	3,270	3,270
Thibaut-Sawmill	8,463	8,463
Independence-Oak	8,880	*7,110*
Symmes-Shepherd	2,400	*1,090*
Bairs-George	250	250
Lone Pine	870	870
Sum	56,453	52,733

2017-18 Pumping Plan

LADWP issued its annual operations plan for the 2017-18 runoff year on April 20, 2017. The forecasted runoff for the Owens River watershed runoff is 801,900 ac-ft (197% of normal), ending the 5-year drought of 2012-16 (the second most severe drought in the past 80 years). LADWP's plan provided a range of planned pumping for the year (Table 3.3). In LADWP's plan, projected total pumping for the entire runoff year of 2017-2018 was estimated to be between 47,450 to 56,453 ac-ft. The majority of this pumping is for sole-source (in valley) uses due to the extremely high runoff year fulfilling the LA aqueduct's carrying capacity.

The Water Department analyzed the effect of the operations plan on groundwater levels in the Owens Valley using regression models for several monitoring wells (Table 3.4). Most models rely on measured depth to water in April 2017, planned wellfield pumping for the entire runoff year and Owens Valley runoff, to predict water levels next April. For several wells, Owens Valley runoff was not a statistically significant variable in the regression model. Water levels in those wells are correlated with pumping, and the models are still useful for evaluating the pumping plan. Models in Laws use the amount of water diverted from the Owens River into the McNally canals as the variable associated with recharge. The quantity of water diverted into the McNally canals was estimated from LADWP's annual estimated spreading in Laws provided in Chapter 2.8 of their 2017-18 annual report

The models used by the Water Department to analyze the annual operations plan predict water levels one year in the future (e.g. April 2017 to 2018) based on annual pumping for each wellfield. Since LADWP began presenting a range of pumping amounts, the final annual pumping total has been just below the proposed upper limit. Therefore, it was deemed unnecessary to evaluate the low range of proposed pumping.

Table 3.4. Predicted water level changes at indicator wells and monitoring sites for LADWP's proposed annual operations plan for 2017 and for pumping recommended by Inyo County. Negative DTW values denote a decline.

Station ID, Monitoring site	LADWP proposed 56,453 ac-ft	Dev. from baseline 2018, LADWP	Inyo Recommended 52,733 ac-ft	Dev from baseline 2018, Inyo
	(ft)	(ft)	(ft)	(ft)
Laws				
107T	NA	NA	Same	Same
434T	3.19	2.47		
436T	7.71	3.83		
438T	7.52	4.22		
490T	6.26	1.74		
492T	14.42	11.93		
574T	7.44	4.74		
Big Pine				
425T	4.31	-2.51	4.41	-2.41
426T	2.86	-2.46	2.92	-2.40
469T	2.69	-1.56	2.75	-1.50
572T	3.60	4.92	3.71	5.03
798T, BP1	2.78	4.25	2.87	4.34
799T, BP2	1.00	-1.53	1.06	-1.47
567T, BP3	4.36	-0.97	4.46	-0.88
800T, BP4	3.16	-2.96	3.28	-2.84
Taboose Aberdeen				
417T	3.14	2.13	Same	Same
418T	1.93	0.82		
419T, TA1	4.19	1.46		
421T	5.68	-0.02		
502T	3.86	-1.12		
504T	4.53	2.12		
505T	3.12	1.80		
586T, TA4	2.29	0.57		
801T, TA5	0.67	-0.56		
803T, TA6	3.21	2.12		
Thibaut Sawmill				
415T	4.98	11.17	Same	Same
507T	0.38	1.63		
806T, TS2	2.93	4.69		
Independence Oak Creek				
406T	1.16	-2.94	1.27	-2.83
407T	-0.43	-5.40	0.14	-4.83

Station ID, Monitoring site	LADWP proposed 56,453 ac-ft	Dev. from baseline 2018, LADWP	Inyo Recommended 52,733 ac-ft	Dev from baseline 2018, Inyo
408T	-0.20	-2.93	0.19	-2.54
409T	4.45	-10.82	5.62	-9.65
546T	3.75	-4.48	4.00	-4.24
809T, IO1	4.78	-5.66	5.37	-5.07
Symmes Shepherd				
402T	1.25	-1.19	1.39	-1.05
403T	2.03	-2.23	2.43	-1.83
404T	0.28	-2.01	0.42	-1.86
510T	0.05	-1.25	0.18	-1.12
511T	0.14	-2.32	0.29	-2.17
447T	8.26	-19.36	9.22	-18.40
V009G, SS1	4.81	-18.21	5.63	-17.38
Bairs George				
398T	0.96	1.44	Same	Same
400T	-0.19	0.42		
812T	5.51	-0.11		
Average	2.76		2.94	

†: *Values in this table are only significant to 0.1 ft. Extra digits are presented for transparency before rounding.*

Inyo typically has included an analysis of minimum pumping as a basis for comparison with LADWP's proposed and Inyo County's recommended pumping amounts. Minimum pumping is not a constant and varies depending on runoff availability to supply irrigation or mitigation projects instead of groundwater where possible. Inyo has used an estimated minimum pumping amount of 54,435 ac-ft to represent expected pumping needs for uses in the Owens Valley in normal or slightly below normal runoff years. Given the similarity of this value to LADWP's 2017-18 proposed pumping, the minimum pumping scenario was not included in this analysis although for Taboose-Aberdeen and Independence-Oak, LADWP proposed pumping exceeds the minimum by 2400-2900 ac-ft. Instead an alternative recommended pumping scenario was developed.

Water levels should be expected to rise in nearly all wells in 2017-18 under LADWP's proposed operations plan (Table 3.4). The average water level rise is predicted to be 2.76 ft. By April 2018, predicted water levels will be at or above baseline in Laws, northern Big Pine, middle-southern Taboose-Aberdeen, Thibaut-Sawmill, and Bairs-George. Water levels will be less than 3 ft. below baseline in the remaining wellfields except for portions of Independence-Oak and Symmes-Shepherd.

Concerns and recommendations to LADWP's proposed 2017-18 pumping plan were made by Inyo County in the Water Department's April 28, 2017 letter to LADWP. A summary of these comments are presented as follows. Due to the extraordinarily high amount of expected runoff in 2017-18, there is an opportunity to recover groundwater levels to levels comparable to those that prevailed during the baseline vegetation mapping period of the mid-1980s. Given that LADWP has ample surface water supplies for export to Los Angeles and for use in Owens Valley this year, ICWD recommended that LADWP groundwater extraction be minimized to take advantage of this opportunity for water table recovery. ICWD has expressed concerns to LADWP about pumping and water level declines in three wellfields during the recent drought: Big Pine, Independence-Oak, and Symmes-Shepherd. Pumping for aqueduct supply has been concentrated from exempt and On-status wells located in these wellfields. Despite the anticipated high-runoff this year, groundwater levels in several wells in Independence-Oak and Symmes-Shepherd wellfields are predicted to remain several feet below baseline. In addition, the groundwater mining limit calculation for the Big Pine wellfield shows a relatively small amount of recharge in excess of pumping over the past 20 year period. ICWD recommended that pumping in these wellfields be limited to sole source uses to allow for maximum water level recovery in this exceptional runoff year.

The Water Department's comment letter can be found on the inyowater.org website.

Evaluation of 2016 DTW predictions

As noted in the previous sub-section, ICWD routinely uses linear regression models to predict the effects of pumping on DTW as part of its analysis of LADWP's annual operations plans. Periodically, we examine the accuracy of these models by comparing the predictions with DTW measurements collected the following year on April 1. The regression models were constructed from historical data for wellfield pumping, Owens Valley runoff, and current water levels. The models in Laws rely on an estimate of the diversions into the McNally canals instead of Owens Valley runoff as the variable related to groundwater recharge. For nine of the permanent monitoring sites, a second model was used that relies on predicted DTW in a nearby indicator well that responds similarly to pumping and runoff. The models were originally developed by Harrington (1998) and Steinwand and Harrington (2003). These reports are available on the Water Department website.

This analysis of the predictions includes uncertainty in the input variables (runoff forecast and planned pumping) as well as uncertainty in the models. Model uncertainty includes all management actions and environmental conditions not captured in the regression model e.g. atypical recharge or pumping operations near one of the test wells. Predictions for 39 indicator wells made in October 2016 were examined for this report.

The predicted DTW values were based on the high pumping amount planned by LADWP in the October 2016-17 pumping plan, Wellfield pumping totals for the year differed by as much 800 acre feet of the planned amounts in the wellfields with indicator wells. The discrepancies in planned and actual pumping decreases the accuracy of predictions. The model predictions also rely on forecasted Owens Valley runoff and unavoidably include the uncertainty in that prediction. The LADWP runoff forecast has tracked actual runoff with accuracy since 1994, and therefore the contribution to model uncertainty is small.

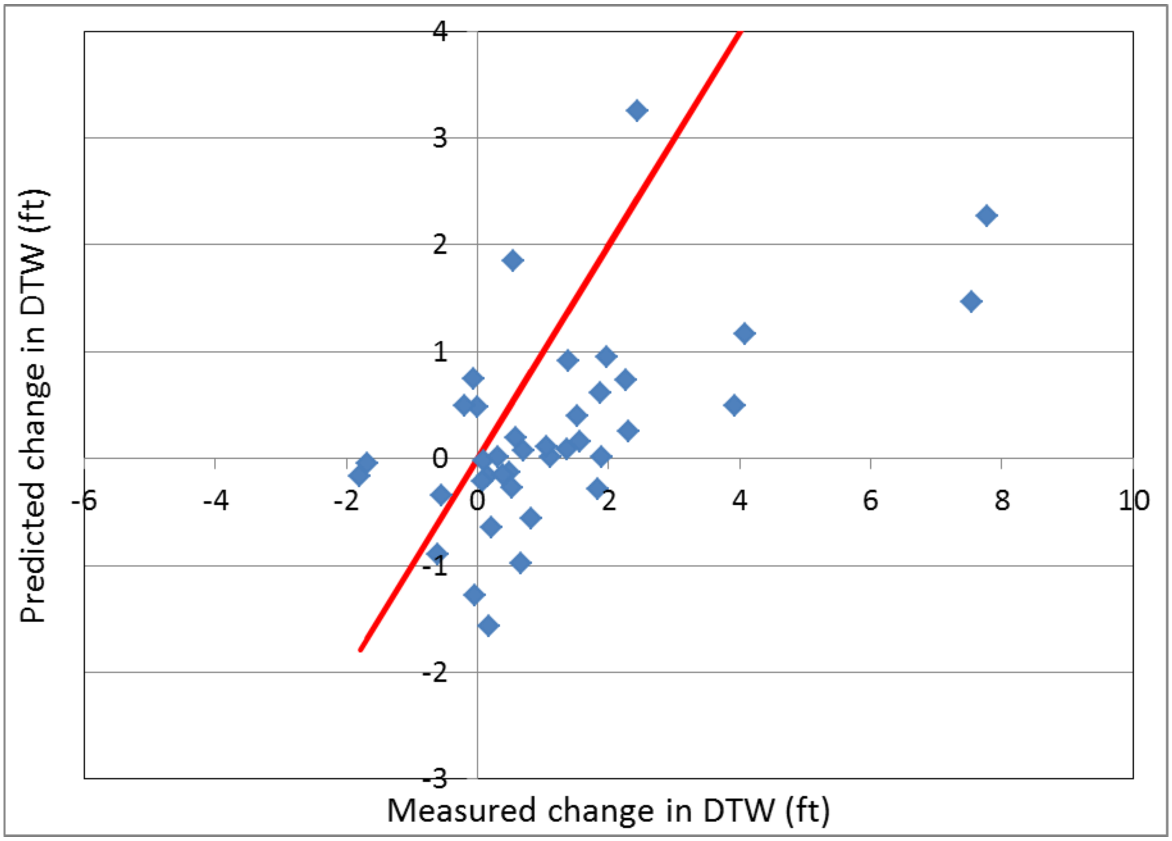

Figure 3.36. Measured and predicted change in DTW from April 2016 to April 2017 for 39 indicator and monitoring site wells. The sold line is the 1:1 line Negative values denote decline in water level.

Model performance in 2016-17 was satisfactory and comparable to previous years. Measured and predicted change in DTW are plotted in Figure 3.36. If the models were perfect predictors, the points would fall on the 1:1 line between the lower left and upper right quadrants. Most points were in the correct quadrant and of the 43 wells, actual and predicted DTW in 19 wells differed by less than 1 ft, and 28 differed by less than 1.5 ft. The average of the actual deviation for all monitoring wells was 1.32 ft, but the value is skewed upward by the few outliers in the Laws wellfield (438T) and Big Pine wellfield (572T, 798T and 567T) due to spreading in March that was not anticipated when the predictions were made in October 2016. Without those unexpected outliers, the average absolute deviation was 0.90 ft which is comparable to previous years. Wells 407T and 408T in the Independence-Oak wellfield were also outliers. The reasons for the poor performance of the predictions for these wells is not known, but possibly is related to the large change in stage of the Los Angeles aqueduct in February and March. For all outliers, the water table rose >2 ft. than predicted.

As mentioned previously, for nine wells, two regression models were used sequentially to predict DTW which introduced an additional source of uncertainty in predictions for those wells. The average absolute deviation for the predictions based on one model and two models were 1.28 ft and 1.45 ft, respectively. Given the similar accuracy of the two sets of ells, relying on the paired regressions was not a large source of additional uncertainty.

References

Harrington, R. F., Multiple regression modeling of water table response to groundwater pumping and runoff, Inyo County Water Department report, 1998.

Steinwand, A.L, and R.F. Harrington. 2003. Simulation of water table fluctuations at permanent monitoring sites to evaluate groundwater pumping. Report to the Inyo/Los Angeles Technical Group, February 25, 2003.

SECTION 4: SOIL WATER CONDITIONS

The purpose for monitoring soil water and the On/Off procedures is to manage pumping to protect plant communities that require periodic access to the water table for long-term survival.

Introduction

The Water Agreement established procedures to determine which LADWP pumping wells can and cannot be operated based on soil water and vegetation measurements (On/Off status). As part of the monitoring effort for the Agreement, the ICWD regularly measures depth to groundwater (DTW) and soil water content at 25 sites in wellfields and eight sites in control areas. Three of the wellfield sites are not used to determine the operational status of nearby pumping wells but are monitored to continue the data record. Each site is equipped with 1 to 6 soil water monitoring locations. Soil water measurements are collected using a neutron gauge calibrated for each site (Dickey, 1990; Steinwand, 1996).

The purpose for the On/Off procedures is to manage pumping to protect plant communities that require periodic access to the water table for long-term survival. Generally, the sites with On-status have wet soil and shallow water tables, and sites in Off-status have dry soil and deep water tables.

To assist the evaluation of LADWP pumping proposals, the Water Department examined the DTW and soil water data to determine whether groundwater is accessible to plants at the permanent monitoring sites at the beginning of the 2017 growing season.

How well plants can access groundwater depends on the vegetation type as well as water table depth. In similar soils, a shallower water table is necessary to supply groundwater to grasses than shrubs because of the shallower roots of the grasses. For management purposes in the Water Agreement, shrub-dominated sites are assigned a root zone of 4 m (13.1 ft.); grass-dominated or mixed grass and shrub assemblages are assigned a root zone of 2 m (6.6 ft.). These approximate values are not the actual rooting depth at a particular monitoring site, but they are useful to compare with the soil depth that received recharge from groundwater.

Soil water in the root zone can be supplied by infiltration from the surface (rain or irrigation) or from contact with the water table. It is usually possible to discriminate deeper soil affected by groundwater from soil near the surface affected by infiltration based on the depth and timing of the measured changes in soil water content. Plant roots can utilize groundwater directly, and if the water table is within the root zone it is reasonable to conclude that groundwater is available. A rising water table can progressively wet the root zone from below and provide water to plants. Plant roots can also tap groundwater that is drawn into the soil above the water table by capillarity where it is held in soil pores or adsorbed to soil particles. Plant uptake during the summer depletes soil water, and when transpiration ceases in the fall,

Table 4.1 June 2016 monitoring site status and July 1, 2016 soil/vegetation water balance calculations according to Green Book, Section III.

Site	June, 2016 Status	July, 2016 Veg. Water Req./ Soil AWC for turn-on	July 2016 soil AWC	July 2016 Status	Soil AWC required for well turn-on
		(cm)	(cm)		(cm)
L1	OFF	5.0/15.6	2.5	OFF	15.6, OFF 7-10
L2	ON	3.3/NA	7.2	ON	NA
L3	OFF	5.5/25.2	9.2	OFF	25.2, OFF 10-11
BP1	OFF	1.7/22.9	1.3	OFF	22.9†, OFF 10-97
BP2	OFF	7.5/28.4	2.2	OFF	28.4, OFF 7-98
BP3	OFF	7.0/10.6	3.7	OFF	10.6. OFF 7-12
BP4	ON	5.4/NA	34.6	ON	NA
TA3	OFF	13.8/26.0	7.5	OFF	26.0, OFF 10-11
TA4	OFF	7.7/23.3	14.2	OFF	23.3, OFF 10-11
TA5	ON	2.1/NA	21.8	ON	NA
TA6	OFF	8.3/17.6	10.8	OFF	17.6, OFF 10-11
TS1	OFF	9.4/20.4	1.9	OFF	20.4†, OFF 10-96
TS2	ON	4.6/NA	8.2	ON	NA
TS3	OFF	8.0/32.9	17.1	OFF	32.9, OFF 10-12
TS4	OFF	23.0/55.9	41.8	OFF	55.9, OFF 10-11
IO1	OFF	26.1/42.2	12.1	OFF	42.2, OFF 10-98
IO2	OFF	1.7/18.9	5.1	OFF	18.9, OFF 7-11
SS1	ON	8.4/NA	9.8	ON	NA
SS2	OFF	1.3/25.6	3.2	OFF	25.6, OFF 7-11
SS3	OFF	11.1/33.8	16.2	OFF	33.8, OFF 10-11
SS4	OFF	6.3/15.9	4.3	OFF	15.9, OFF 7-05
BG2	ON	5.1/NA	21.2	ON	NA

†: These values of soil water required for well turn-on were derived using calculations based on % cover that were routinely performed in the past. The values have not been updated to conform to the Green Book equations in section III.D.2, p. 57-59.

Table 4.2. Monitoring site status and soil/vegetation water balance calculations for Oct. 1, 2016 according to Green Book, Section III.

Site	July 1, 2016 Status	October, 2016 Veg. Water Req./Soil AWC for turn-on	October 2016 soil AWC	+30% annual ppt.	October 1 2016 Status	Soil AWC req. for well turn-on
		(cm)	(cm)	(cm)		(cm)
L1	OFF	8.7/15.6	1.3	NA	OFF	15.6, OFF 7-10
L2	ON	5.8/NA	4.5	4.5 + 4.7 = 9.2	ON	NA
L3	OFF	10.1/25.2	7.0	NA	OFF	25.2, OFF 10-11
BP1	OFF	3.1/22.9	1.0	NA	OFF	22.9†, OFF 10-97
BP2	OFF	13.9/28.4	1.1	NA	OFF	28.4, OFF 7-98
BP3	OFF	12.4/10.6	2.7	NA	OFF	10.6. OFF 7-12
BP4	ON	9.6/NA	33.2	33.2 + 4.9 = 38.1	ON	NA
TA3	OFF	25.9/26.0	6.4	NA	OFF	26.0, OFF 10-11
TA4	OFF	14.4/23.3	12.1	NA	OFF	23.3, OFF 10-11
TA5	ON	3.8/NA	20.4	20.4 + 4.9 = 25.3	ON	NA
TA6	OFF	15.4/17.6	8.7	NA	OFF	17.6, OFF 10-11
TS1	OFF	17.6/20.4	1.5	NA	OFF	20.4†, OFF 10-96
TS2	ON	8.5/NA	6.2	6.2 + 4.4 = 10.6	ON	NA
TS3	OFF	14.8/32.9	15.5	NA	OFF	32.9, OFF 10-12
TS4	OFF	41.8/55.9	38.9	NA	OFF	55.9, OFF 10-11
IO1	OFF	48.3/42.2	9.2	NA	OFF	42.2, OFF 10-98
IO2	OFF	3.2/18.9	3.8	NA	OFF	18.9, OFF 7-11
SS1	ON	15.2/NA	8.9	8.9 + 3.9 = 12.8	OFF	15.2, OFF 10-16
SS2	OFF	2.5/25.6	3.3	NA	OFF	25.6, OFF 7-11
SS3	OFF	20.7/33.8	14.3	NA	OFF	33.8, OFF 10-11
SS4	OFF	11.7/15.9	3.4	NA	OFF	15.9, OFF 7-05
BG2	ON	9.5/NA	18.9	18.9 + 4.0 = 22.9	ON	NA

†: These values of soil water required for well turn-on were derived using calculations based on percent cover that were routinely performed in the past. The values have not been updated to conform with the Green book equations in section III.D.2, p. 57-59.

Table 4.3. Monitoring site status on April 1, 2017 according to Green Book, Section III.

Site	Oct 2016 soil AWC	30% Annual Precip.	Proj. soil AWC	October 2016 Veg Water Req./ Water Req. for well turn-on	Oct 2016 Status	April 2017 soil AWC	April 2017 Status	Soil AWC req. for well turn-on
	(cm)	(cm)	(cm)	(cm)		(cm)		(cm)
L1	1.3	NA	1.3	8.7/15.6	OFF	24.3	ON	NA
L2	4.5	4.7	9.2	5.8/NA	ON	18.7	ON	NA
L3	7.0	NA	7.0	10.1/25.2	OFF	22.7	OFF	25.2, OFF 10-11
BP1	1.0	NA	1.0	3.1/22.9	OFF	24.5	ON	NA
BP2	1.1	NA	1.1	13.9/28.4	OFF	20.1	OFF	28.4, OFF 7-98
BP3	2.7	NA	2.7	12.4/10.6	OFF	25.9	ON	NA
BP4	33.2	4.9	38.1	9.6/NA	ON	55.8	ON	NA
TA3	6.4	NA	6.4	25.9/26.0	OFF	32.8	ON	NA
TA4	12.1	NA	12.1	14.4/23.3	OFF	22.9	ON	NA
TA5	20.4	4.9	25.3	3.8/NA	ON	34.7	ON	NA
TA6	8.7	NA	8.7	15.4/17.6	OFF	37.1	ON	NA
TS1	1.5	NA	1.5	17.6/20.4	OFF	22.7	ON	NA
TS2	6.2	4.4	10.6	8.5/NA	ON	30.4	ON	NA
TS3	15.5	NA	15.5	14.8/32.9	OFF	35.4	ON	NA
TS4	38.9	NA	38.9	41.8/55.9	OFF	66.7	ON	NA
IO1	9.2	NA	9.2	48.3/42.2	OFF	29.3	OFF	42.2, OFF 10-98
IO2	3.8	NA	3.8	3.2/18.9	OFF	17.6	ON	NA
SS1	8.9	3.9	12.8	15.2/15.2	OFF	20.5	ON	NA
SS2	3.3	NA	3.3	2.5/25.6	OFF	19.2	OFF	25.6, OFF 7-11
SS3	14.3	NA	14.3	20.7/33.8	OFF	28.7	OFF	33.8, OFF 10-11
SS4	3.4	NA	3.4	11.7/15.9	OFF	11.6	OFF	15.9, OFF 7-05
BG2	18.9	4.0	22.9	9.5/NA	ON	29.5	ON	NA

Table 4.4. Comparison of DTW preceding the growing seasons in 2016 and 2017. Data compare measurements taken near April 1 of each year except for BP1 and BP3 where the minimum DTW is in the fall. Hydrographs for the sites are provided in Appendix A. Depths are below ground surface.

Wellfield Site	2016 DTW (m)	2017DTW (m)	DTW Change 2016-17† (m and ft)
Laws			
L1	Dry at 8.28	4.39	--
L2	Dry at 7.53	Dry at 7.53	--
L3	5.59	5.18	0.41 (1.34)
Bishop Control			
BC1	3.30	3.03	0.27 (0.90)
BC2	4.56	4.28	0.28 (0.93)
BC3	1.83	1.09	0.76 (2.50)
Big Pine			
BP1	5.77	4.33	1.45 (4.75)
BP2	6.60	6.20	0.40 (1.31)
BP3	5.85	5.63	0.22 (0.72)
BP4	6.02	5.81	1.08 (3.55)
Taboose Aberdeen			
TA1 & 2	2.37	2.49	-0.12 (-0.38)
TA3	5.13	4.95	0.18 (0.59)
TA4	3.20	2.99	0.21 (0.70)
TA5	4.90	4.42	0.48 (1.57)
TA6	3.01	2.71	0.30 (0.99)
TAC	1.56	1.36	0.20 (0.65)
Thibaut Sawmill			
TS1	5.65	5.40	0.25 (0.82)
TS2	4.10	3.33	0.78 (2.55)
TS3	3.02	2.32	0.71 (2.32)
TS4	2.10	1.41	0.70 (2.28)
TS6	6.32	6.62	-0.30 (-0.98)
TSC	1.62	0.78	0.84 (2.76)
Independence Oak			
IO1	5.00	4.94	0.06 (0.18)
IO2	11.27	11.82	-0.55 (-1.80)
IC1	1.21	1.22	-0.00 (-0.01)
IC2	2.55	2.41	0.15 (0.48)
Symmes Shepherd			
SS1	7.60	8.21	-0.61 (-1.99)
SS2	Dry at 8.41	Dry at 8.41	--
SS3	4.44	5.06	-0.63 (-2.06)
SS4	6.65	6.76	-0.11 (-0.36)
Bairs George			
BG2	5.39	5.40	-0.01 (-0.03)
BGC	2.93	2.60	0.33 (1.09)

†: positive values denote a rise in the water table.

water from the moist soil above the water table will replenish the drier soil in the root zone via capillarity or through inactive plant roots even if the water table is stable or declining. This is a slow process and usually provides much less soil water recharge than a rising water table.

Results

Monitoring results for available soil water, vegetation water requirement, water table depth, and the On/Off status for all sites are presented in the figures that are periodically updated and available at Technical Group meetings and on the ICWD website. At the beginning of the 2016-17 runoff year, six sites were in On-status: L2, BP4, TA5, TS2, SS1, and BG2 (Table 4.1). Site SS1 went into Off-status in October, 2016 (Table 4.2). Large winter storms in 2016-17 brought ample rain and snow to the valley floor and prompted Los Angeles to begin water spreading in February and March. Twelve sites went into On-status during the winter due to infiltration of rain and snow and/or water table recovery (Table 4.3).

Hydrographs for the permanent monitoring sites are presented on the ICWD website, and the DTW measured during the fall and winter before the 2016 and 2017 growing seasons are presented in Table 4.4. At most sites, the minimum DTW occurs in the spring, near April 1. At sites BP1 and 3 in Big Pine, usually the water table rises during the summer and reaches a minimum in the fall coinciding with the timing of diversions into the Big Pine canal for irrigation. Spreading activities in Big Pine began in February and March causing the water table to rise earlier than usual. The shallowest water level before April 1, 2017 was used in Table 4.4 for all sites. The water table rose on average 0.76 ft in wellfields and 1.2 in control areas. Because pumping was relatively low, stable or slightly rising water levels were expected despite the ongoing drought. One control site and seven wellfield sites experienced water table declines. See the Groundwater section of this report for an assessment of water level changes using a larger set of monitoring wells.

At most sites it was difficult to discriminate groundwater recharge from surface infiltration because of the wet winter in 2016-17 (Tables 4.5 and 4.6). Infiltration often exceeded 1.2 m resulting in substantial increases in soil water. At approximately 16 out of 99 monitoring locations, rain or melting snow preferentially flowed down the sides of the access tubes to soil depths well below typically wetted by infiltration, further complicating data interpretation. Where possible, the monitoring sites were grouped into simple categories to summarize the connection between soil water in the root zone and the water table. Brief descriptions of the three categories and the results are given below:

1. Connected: Water table fluctuations resulted in soil water recharge in the top half of the root zone at most monitoring locations within a site. One wellfield and four control sites were placed in this category.

2. Partially connected: Water table fluctuations resulted in soil water recharge in the bottom half of the root zone at most monitoring locations within a site. Three control and 15 wellfield sites occur in this category.

3. Disconnected: No recharge from groundwater occurred in the root zone. Nine wellfield sites and one control site occur in this category.

Table 4.5. Soil depth below ground surface replenished by groundwater in 2016-2017 at control sites. Values are provided for each monitoring location within a site. Minimum DTW early in the growing season was measured in the associated test well. N/D designates where infiltration or bypass flow prevented identification of groundwater recharge depth.

Site	Dominant plant species	Root Zone (m)	Minimum DTW (m)	Groundwater recharge depth (m)
BC1	rabbitbrush, saltbush, greasewood, alk. sacaton	4	3.03	<1.7†, <2.9, <2.5
BC2	rabbitbrush, saltgrass	2	4.28	N/D, <1.3, N/D, <1.9
BC3	rabbitbrush, saltgrass, saltbush	2	1.09	N/D all tubes
TAC	saltbush, rye grass, saltgrass, alk. sacaton	2	1.36	N/D all tubes
TSC	alk. sacaton, rabbitbrush, greasewood.	2	0.78	N/D all tubes
IC1	saltbush, saltgrass, rabbitbrush	2	1.22	<1.1, <1.1, <1.3
IC2	rabbitbrush, alk. sacaton	2	2.41	<2.1, N/D, N/D
BGC	saltbush, saltgrass	4	2.60	1.1, 1.1, 1.7

†: Less than symbols (<) denote locations where both infiltration and groundwater recharge contribute to increasing soil water content above the depth indicated

At the beginning of the 2017 growing season, the water table was capable of supplying water to the root zone at 15 wellfield monitoring sites (Figure 4.1). Thirteen sites were placed in a different category in 2017 compared with 2016. All sites were wetter except BGC. Nearly every site had ample retained water in the soil above the water table due to precipitation and/or groundwater.

Monitoring locations at BP4, TA3, TS6, IO1, SS3, SS4, and BG2 exhibited increasing soil water content at certain depths well above the water table while lower depths showed no change. Water can be transported during winter from wetter, deeper soil layers through plant roots to recharge dry soil at shallower depths (Horton and Hart, 1998; Jackson et al., 2000), but without additional information, assigning that cause is speculative. The increase in water content was small and barely detectable, usually about 3%. Regardless of the exact mechanism causing the increase in soil water, the monitoring and On/Off management was able to measure and account for that source of water.

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Table 4.6. Soil depth below ground surface replenished by groundwater in 2016-2017 at wellfield sites. Values are provided for each monitoring location within a site unless the identification of a specific depth was uncertain. Minimum DTW before the 2017 growing season was measured in the associated test well. N/D (Not determined) designates where infiltration or bypass flow prevented identification of groundwater recharge depth.

Site	Dominant plant species	Root Zone (m)	Minimum DTW (m)	Groundwater recharge depth (m)
L1	greasewood	4	4.39	2.3, 2.9, 2.1
L2	alk. sacaton, greasewood, saltbush	2	Dry at 7.53	>3.9 at all five locations
L3	alk. sacaton, saltgrass	2	5.18	<1.3††, <1.3,< 0.9, <1.1, 1.3, <1.3
BP1	saltbush, greasewood	3	4.33	3.1, 1.9, <1.7,N/D, 2.3
BP2	saltbush, rabbitbrush	4	6.20	4.7, >3.9, 3.7
BP3	greasewood, rabbitbrush	4	5.63	3.5, 3.3, >3.9
BP4	saltbush, greasewood	4	5.81	1.9†, 1.7†, 2.1†
TA1	alk. sacaton, saltbush	2	2.49	1.5
TA2	alk. sacaton, saltbush, greasewood, rabbitbrush	2	2.49	1.1
TA3	saltbush, alk. sacaton, sagebrush	2	4.95	N/D, 2.1†, 2.1†
TA4	rabbitbrush, alk. sacaton	2	2.99	2.7, 1.7, 1.7
TA5	greasewood, alk. sacaton	2	4.42	1.7. 1.5, 1.7
TA6	saltbush, rabbitbrush	2	2.71	1.5, 1.7, 1.7
TS1	weeds, alk. sacaton	2	5.40	>3.9 at tubes 1-4, 3.3 at tube 5
TS2	sagebrush, saltbush, alk. sacaton	2	3.33	N/D, all tubes
TS3	saltgrass, alk. sacaton	2	2.32	N/D, all tubes
TS4	greasewood, alk. sacaton, saltbush, saltgrass	2	1.41	N/D, all tubes
TS6	alk. sacaton, saltbush, saltgrass	2	6.62	1.9†
IO1	rabbitbrush, alk. sacaton, saltbush	2	4.94	2.1†, 2.1†, 1.9†
IO2	saltbush	4	11.82	4.9, >3.9. >3.9
SS1	saltbush, greasewood	4	8.21	>5.5, >3.9, >3.9
SS2	saltbush	4	Dry at 8.41	>5.5, >3.9, >3.9
SS3	saltbush	4	5.06	N/D, 2.7†, 2.7†
SS4	saltbush	4	6.76	2.3†, 2.7†, 2.9†
BG2	inkweed, saltbush	4	5.40	3.1†, 2.1†, 2.3†

†: Soil water content at these depths increases slightly during winter well above the limit of capillarity above the water table suggesting that another recharge mechanism is operating.

††: Less than symbols (<) denote locations where both infiltration and groundwater recharge contribute to increasing soil water content above the depth indicated.

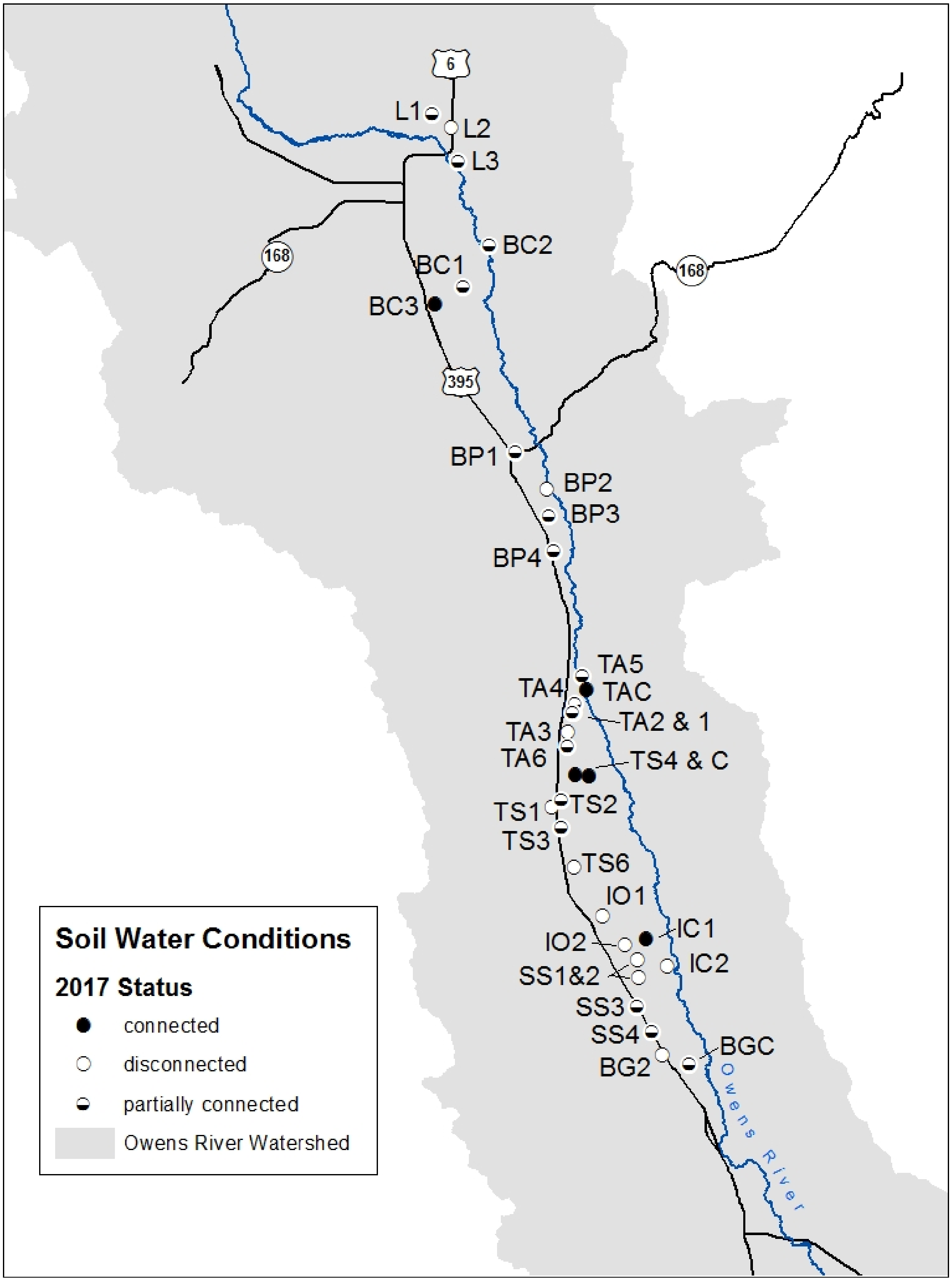


Figure 4.1. Owens Valley permanent monitoring sites and groundwater recharge classes. It is difficult to distinguish TA1 and TA2 on this map because of their proximity to one another. TA1 and TA2 are partially connected.

SECTION 5: VEGETATION CONDITIONS

A primary goal of the Water Agreement is to manage groundwater and surface water while maintaining healthy groundwater-dependent plant communities in the Owens Valley.

This section presents an analysis of the 2016 vegetation conditions

Introduction

Inyo County Water Department monitors trends in vegetation cover and species composition in groundwater-dependent vegetation parcels following protocols described in the Technical appendix to the Water Agreement (Green Book Box I.C.1.a.ii, revised 2017). The primary purpose of this monitoring is to detect any *"SIGNIFICANT DECREASES AND CHANGES IN OWENS VALLEY VEGETATION FROM CONDITIONS DOCUMENTED IN 1984 TO 1987"*. Vegetation management goals of the Agreement are based on canopy cover and species composition recorded during LADWP's 1984-87 parcel mapping and vegetation sampling effort. To evaluate the condition of the vegetation, field crews of ICWD and LADWP monitor vegetation at permanent locations within a subset of the groundwater-dependent parcels potentially affected by pumping.

Methods

From September 1984 to Nov 1987, LADWP inventoried and mapped vegetation on 2126 vegetation parcels (223,168 acres). Most of these lands were characterized as nonphreatophytic plant communities (Green Book management type A). The Green Book vegetation monitoring program is focused on groundwater-dependent parcels (GB types B, C, D and some E) and primarily those potentially affected by groundwater pumping.

In the 2016 growing season, ICWD and LADWP jointly monitored 141 parcels using the line-point-intercept protocol described in the Green Book. Parcels were initially selected based on meeting one or more of the following criteria: (1) the parcel contained a permanent monitoring site; (2) baseline data was collected for the parcel; (3) the parcel was in close proximity to a pumping well; (4) information of past and current land use for the parcel was available. Additional parcels have been added to the list over the years.

Parcels were classified as either belonging to a wellfield group or control group based on criteria derived from groundwater drawdown during the period of maximum pumping rate that occurred between 1987 and 1993. Parcels were assigned to the wellfield group if (1) kriged DTW estimates exceeded 1-m water-table drawdown during 1987-1993 or (2) they were located at sites corresponding to modeled drawdown contours greater than 10 ft. Parcels were assigned to the control group if (1) kriged DTW estimates were less than 1 m and (2) they were located at sites corresponding to modeled drawdown contours less than 10 ft. If the kriged DTW estimates were not reliable owing to inadequate test well coverage near vegetation parcels, then the groundwater-flow model estimate of the 10-ft drawdown contour was used as the sole criteria to designate parcels as either wellfield or control. An exception to the above criteria was applied to parcels associated with drawdown contours greater than 10-ft yet located near a surface water source (specifically, a canal, sewer pond, creek, river, or a ground water seepage source) that would lessen local drawdown effects—these parcels were classified as control. Some parcels currently in the wellfield group have higher water tables than during the 1987 to 1993 period, but remain in the wellfield group because of their close proximity to pumping wells and potential for pumping-induced drawdown. Each parcel is classified by its Holland plant community type and by its status as either wellfield or control.

Most parcels were sampled in 1984-1987 using line-point-intercept sampling. Some parcels were not directly sampled but rather assigned cover and composition values from parcels with similar vegetation conditions. The sample of baseline transects is compared to reinventory data with Welch's t-test; and where only a single cover value has been assigned to the parcel, a one-sample t-test is used to compare monitoring year data to a single value.

Data Sets

Field Data (line-point-intercept)

The number of parcels sampled each year as well as the number of transects sampled per parcel has varied due to fluctuations in annual staffing. Thus, some parcels have varying numbers of transects sampled across time. Other parcels have not been sampled continuously during the entire monitoring period. In 2016, 141 parcels were sampled.

Perennial species cover is considered in this report, because annual species are not dependent on groundwater. Perennial cover was further aggregated into grass, non-gramminoid herbaceous (herb), and shrub. In order to analyze the changes in the composition of total perennial cover, the proportion of shrub, herb and grass cover as a fraction of total perennial cover was calculated. Transect data are summarized for each parcel and year using the arithmetic average, creating a history of cover over time for each parcel.

For determinations of change from baseline, several subsets of the entire field-measured data set were used as follows:

Full transect data (n = 86): The set of parcels with transect data from both the current year (2016) and at least one associated transect conducted during the baseline monitoring period (1984-1987). These parcels were further identified as belonging to the control (n = 33) or wellfield parcel group (n = 53).

Continuous parcel data (n = 36): The subset of full transect data that was sampled in every year from 1992 to the present. The year 1992 was chosen for the continuous parcel data because the sample size was greater than the set of parcels sampled each year from 1991 to the present. The baseline year was assigned to the nominal value of 1986 for these data. These data were further identified as either control (n= 12) or wellfield (n = 24) and by alkali meadow (n = 10, n = 15 respectively).

Regression data set (n = 111): The subset of full transect data with at least 10 years of data including the nominal baseline year. This set also includes parcels that were not sampled in 2016 if the time series contained at least 10 years of data (wellfield n = 71; control n = 40)

NDVI

Normalized difference vegetation index (NDVI) derived from Landsat 5/7/8 was extracted from google earth engine and pixels were zonally averaged to the parcel polygons over the growing season creating a full history of remotely-sensed vegetation change starting during the baseline period in 1985. "The LandSat dataset is originally produced by NASA/USGS, but the LandSat Science Team does the processing (masking clouds, preparing best images for 8-day,16-day images) for the dataset on the Google Cloud. It is a daily dataset of historically observed remote sensing variables from Jan 1, 1982 to about a month-lag from the current date. It is produced over the globe" – (Climate Engine manual available at climateengine.org).

Precipitation

Precipitation dataset was acquired using the gridMET/METDATA dataset produced at the University of Idaho. It is a daily dataset of historically observed meteorological variables from Jan 1, 1979 to 2-days lag from the current date. It is produced over the contiguous United States (CONUS). GridMet is produced by bias correcting the daily NLDAS2 dataset to monthly PRISM values producing values on a 4-km (1/24-deg) grid." (climateengine.org)

Wellfield and Control Areas Vegetation Change 1984-2016

To assess directly whether there was a change from baseline across parcel groups (wellfield or control) in mean perennial cover and mean grass cover, a paired t-test was used. Tests were performed using the full parcel data. Wellfield and control parcels were analyzed separately.

To characterize whether temporal trends in total perennial cover, grass cover, herb cover and shrub cover differed significantly in wellfield vs control groups, Analysis of covariance (ANCOVA) was used with the continuous parcel data (1986, 1992-2016 = 26 years). The group averaged perennial cover over time is plotted with linear model fits separately for wellfield and control groups for the visual interpretation of the ANCOVA model.

Individual Parcel Vegetation Change 1984-2016

To evaluate in which parcels and in which year(s) total perennial cover and perennial grass cover has significantly differed from baseline, Welch's t-test for unequal variance was used to evaluate significant changes compared to baseline for each year that the parcel was sampled. Since the sample standard deviation is used to construct 95% confidence interval, this method can be used for parcels in which baseline data contained more than one transect or nonzero sample variance. The results of these tests, line-point data, parcel-averaged depth-to-water hydrographs, NDVI, and precipitation time series are plotted by parcel in Appendix. Statistical significance was declared at the alpha = 0.05 level.

Results

Wellfield and Control Area comparison

Vegetation cover in 2016 increased slightly from 2015. The control parcel group reached the baseline mean while the wellfield parcel group has remained below baseline since 2008 (Figure 5.1). Total cover and grass cover has decreased in both wellfield and control parcel groups over the past 30 years (Figure 5.2, 5.3, 5.4). Shrub cover, however, has increased in the wellfield group although not statistically significant at this level of aggregation (Figure 5.2, 5.5).

Individual Parcel Vegetation Change

Consideration of individual parcel conditions removes the noise in the grouped analysis stemming from opposite trends in individual parcels within the same group. At the individual parcel level, 45 out of 91 wellfield parcels were statistically below baseline perennial cover (49%) and 53 were below baseline grass cover (66%). For control parcels, cover was below baseline in 20 out of 50 parcels (40%) and grass cover was below baseline in 26 out of 50 parcels (52%). Current year cover and the differences from baseline in grass and shrub cover are provided in tabular form in Appendix 5.1. Results from statistical tests on parcel means compared to baseline are translated to parcel polygon attributes and provided as maps in Appendix 5.1. Individual parcel time series plots of perennial cover, grass cover, depth to water, NDVI and precipitation are provided in Appendix 5.2.

Discussion

The primary type of vegetation change in both pumped and unpumped areas, as of 2016, is a decline in grass cover, typically associated with an increase in woody shrub cover when considered at the individual parcel. Aggregated to the wellfield and control group, these relationships are noisy owing to the non-linear nature of water table fluctuations, wet/dry climate cycles and within group variance in temporal trend, however individual parcel trends in shrub and grass cover over time are evidence of long-term transitions to plant communities increasingly dominated by woody above-ground cover in many wellfield and control parcels. With the wet winter of 2016-2017, it is likely that perennial grass cover will recover to some extent during the 2017 growing season. Water table recovery will continue through the 2017-2018 winter likely positively influencing grass persistence and recovery in the 2018 growing season. However the reversibility of herbaceous dominance to woody dominance of above-ground biomass may require management in addition to water table recovery. Prescribed burns are one option to reduce woody cover but the restrictions on timing of range burns and perceived risk of escape have limited the frequency prescribed burns are conducted and have limited the geographic extents to areas that can be safely burned with a low probability of unintentional escape and potential damage to resources such as groves of trees. Under these restrictions, the frequency and extent of recent burns is likely inadequate to facilitate reversing such woody dominance at scale. Mechanical removal of woody biomass, although replete with its own challenges, in combination with grazing management and water table recovery compatible with resilient perennial grass communities may offer a path toward reversing apparent transitions to a woody-dominated vegetation state.

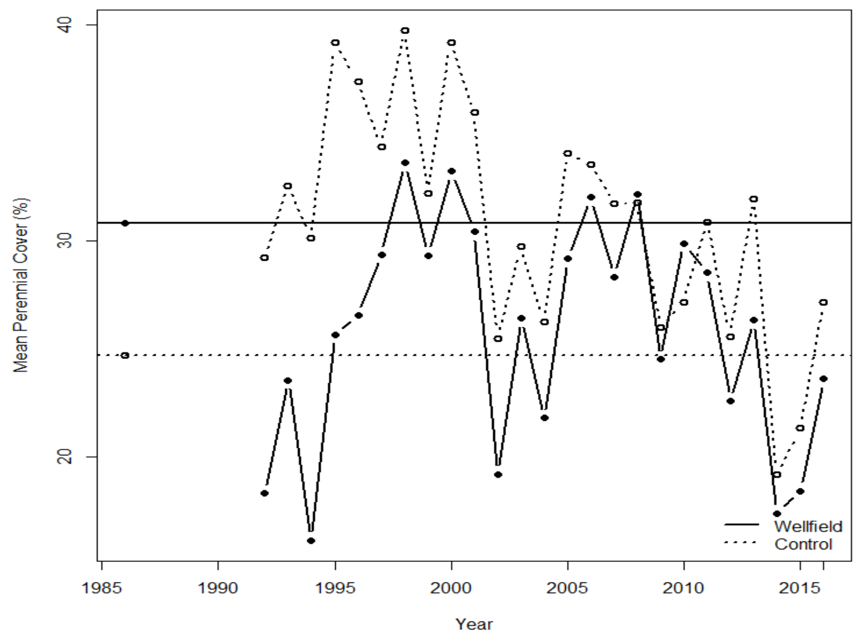


Figure 5.1. Mean perennial vegetation cover in rarefied (sampled every year) wellfield (n=12) and control parcels (n=24) 1992-2016 [Horizontal lines indicate baseline mean].

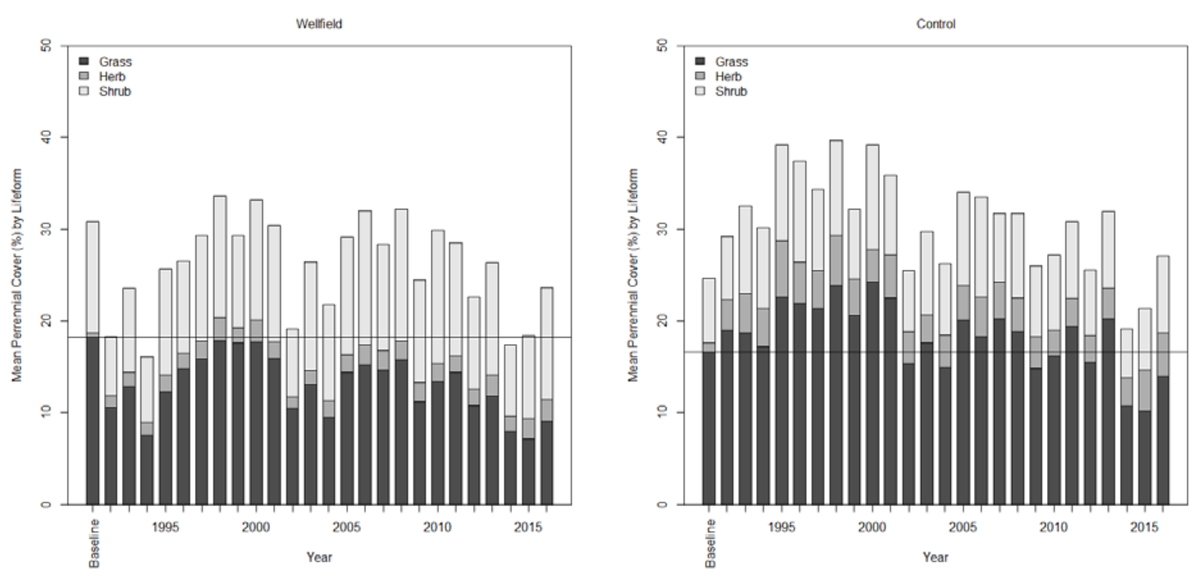


Figure 5.2. Time profile of grass, herb and shrub cover for baseline and each reinventory year for the control and wellfield parcel sampled each year between 1992 and 2015 (n = 24 wellfield parcels, n = 12 control parcels, n = 26 yrs including nominal baseline year). Horizontal line shows the mean baseline grass cover value.

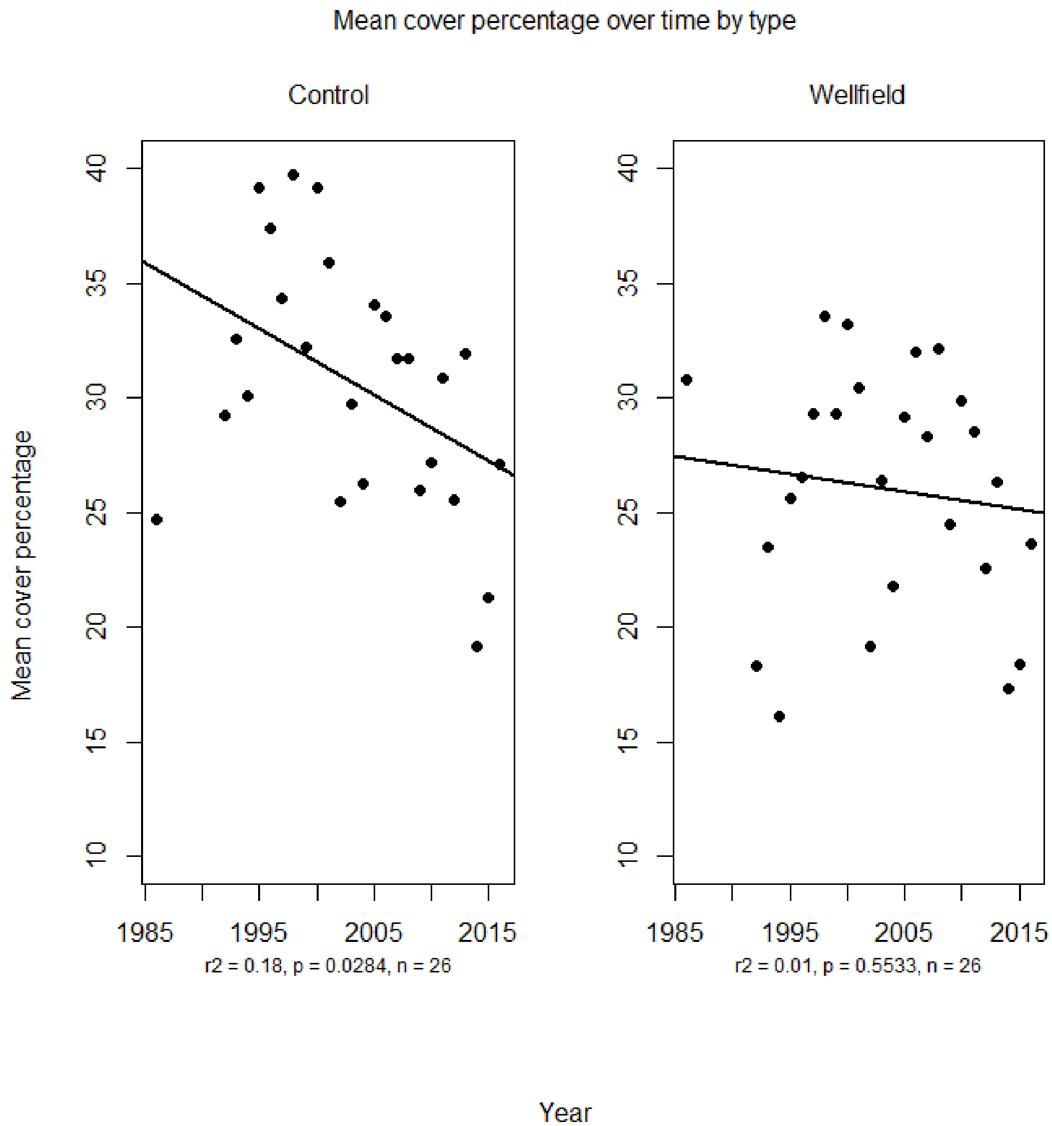


Figure 5.3. Mean perennial cover aggregated to parcel groups (wellfield and control) and plotted over the baseline and reinventory period. The baseline year is plotted at the nominal year 1986 for brevity. Variance in cover explained by linear temporal trend is reported in R2 values below plots, p-values less than 0.05 denote slopes statistically different from zero. Number of years input into regressions are provided below plots (n).

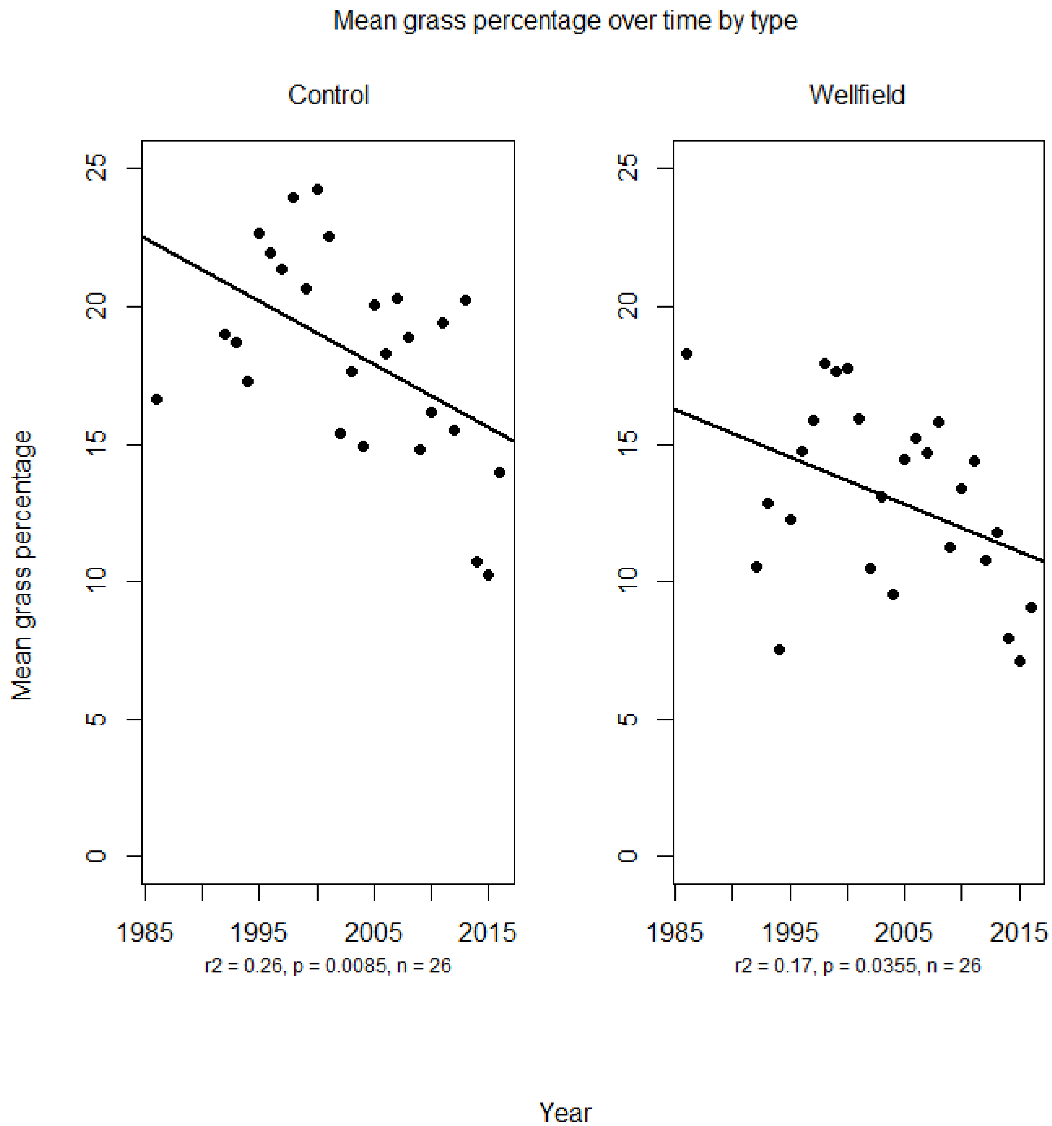


Figure 5.4. Mean perennial grass cover aggregated to parcel groups (wellfield and control) and plotted over the baseline and reinventory period. The baseline year is plotted at the nominal year 1986 for brevity. Variance in cover explained by linear temporal trend is reported in R2 values below plots, p-values less than 0.05 denote slopes statistically different from zero. Number of years input into regressions are provided below plots (n).

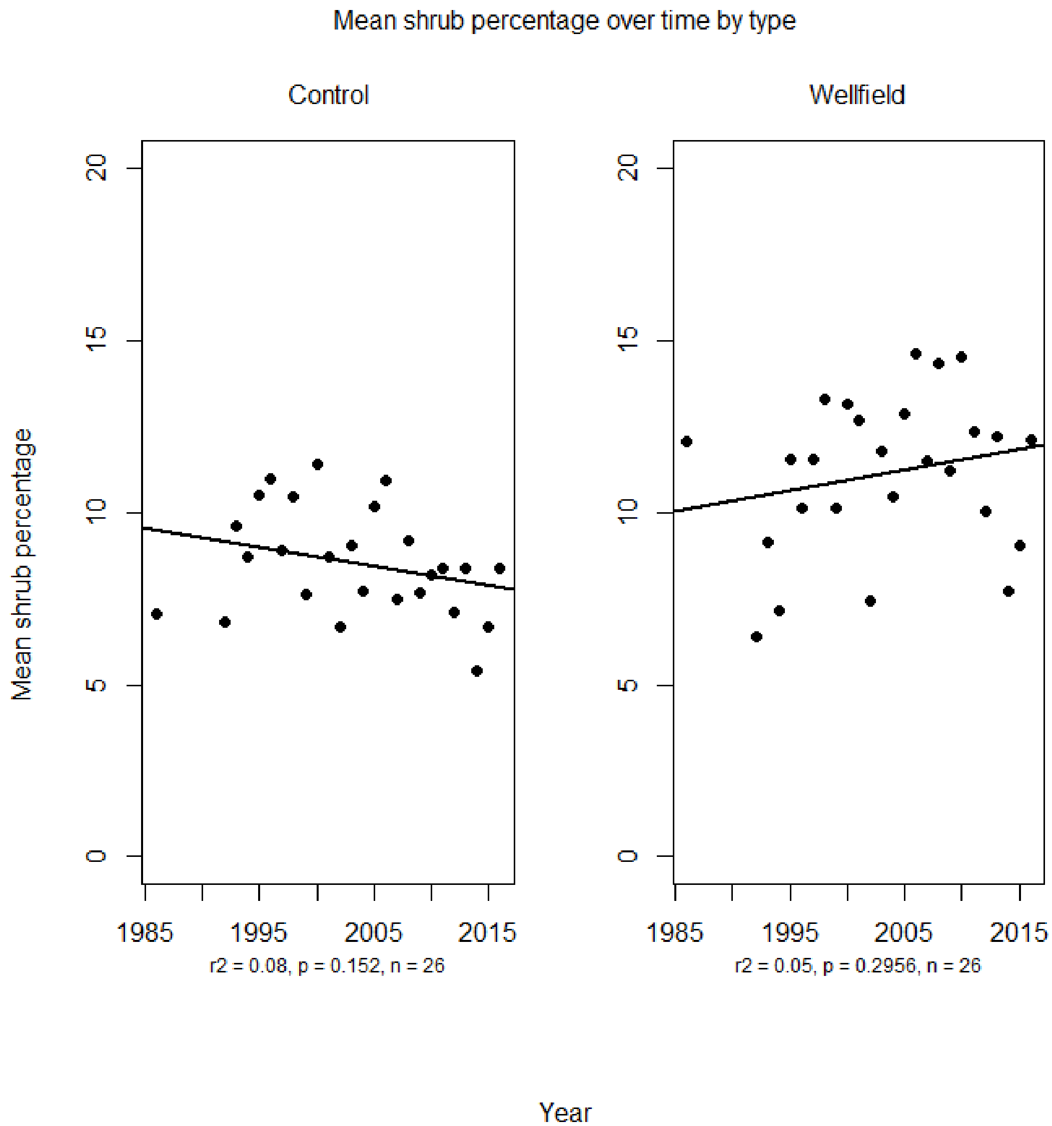


Figure 5.5. Mean perennial shrub cover aggregated to parcel groups (wellfield and control) and plotted over the baseline and reinventory period. The baseline year is plotted at the nominal year 1986 for brevity. Variance in cover explained by linear temporal trend is reported in R2 values below plots, p-values less than 0.05 denote slopes statistically different from zero. Number of years input into regressions are provided below plots (n).

Appendix 5.1 Individual-parcel grass and shrub cover change from baseline

Current parcel-level perennial cover (Cover), perennial grass cover (Grass), perennial shrub cover (Shrub), non-gramminoid perennial herbaceous cover (Herb) and difference from baseline (Grass.Delta, Shrub.Delta, Herb.Delta, Cover.Delta) where negative values represent declines from baseline and positive values represent increases from baseline. Increases greater than 5% cover relative to baseline are highlighted in green and declines greater than 5% cover are highlighted in red.

Parcel	W/C	Grass	Shrub	Herb	Cover	Grass.Delta	Shrub.Delta	Herb.Delta	Cover.Delta
ABD012/BLK029	C	0	8	0	8	0	-10	0	-10
BGP019	C	22	7	1	30	-43	6	1	-36
BGP031	C	13	3	1	17	0	0	1	0
BGP047	C	10	4	1	15	-28	4	-6	-30
BGP086	W	14	13	2	29	-4	-7	1	-9
BGP088	W	1	13	1	16	-4	0	1	-3
BGP094	W	23	5	22	50	-11	-7	20	1
BGP154	W	1	11	0	12	-7	-5	0	-12
BGP157	W	6	12	0	19	0	-10	0	-10
BGP162	W	1	12	0	13	-4	-13	0	-17
BIS055/FSL214	C	16	22	3	41	-9	2	2	-4
BIS060	C	30	11	8	49	-3	9	6	12
BIS085	W	7	16	0	23	-13	5	0	-9
BLK002/TIN061	W	1	17	0	18	0	2	0	2
BLK009	W	7	9	0	16	-11	-1	0	-12
BLK011	W	4	25	0	30	-1	21	0	20
BLK016	W	10	16	2	29	3	2	2	7
BLK021	W	1	19	0	21	-9	-1	0	-10
BLK024	W	5	20	1	25	-3	4	0	0
BLK033	W	3	8	1	12	-6	3	1	-2
BLK039	W	8	10	1	19	-8	4	1	-3
BLK044	W	2	39	3	45	-6	26	3	22
BLK059	C	14	18	0	32	-38	12	0	-26
BLK069	W	10	6	0	16	-1	-2	0	-3
BLK074	W	22	15	1	38	10	-4	1	7
BLK075	W	13	17	5	35	-23	14	5	-4
BLK077	W	8	6	0	14	-1	-1	0	-2
BLK093	W	20	7	0	27	4	4	0	9
BLK094	W	9	14	2	25	-20	4	0	-16
BLK095	W	13	8	0	21	-1	6	0	4
BLK096	W	9	3	0	11	0	-9	0	-10

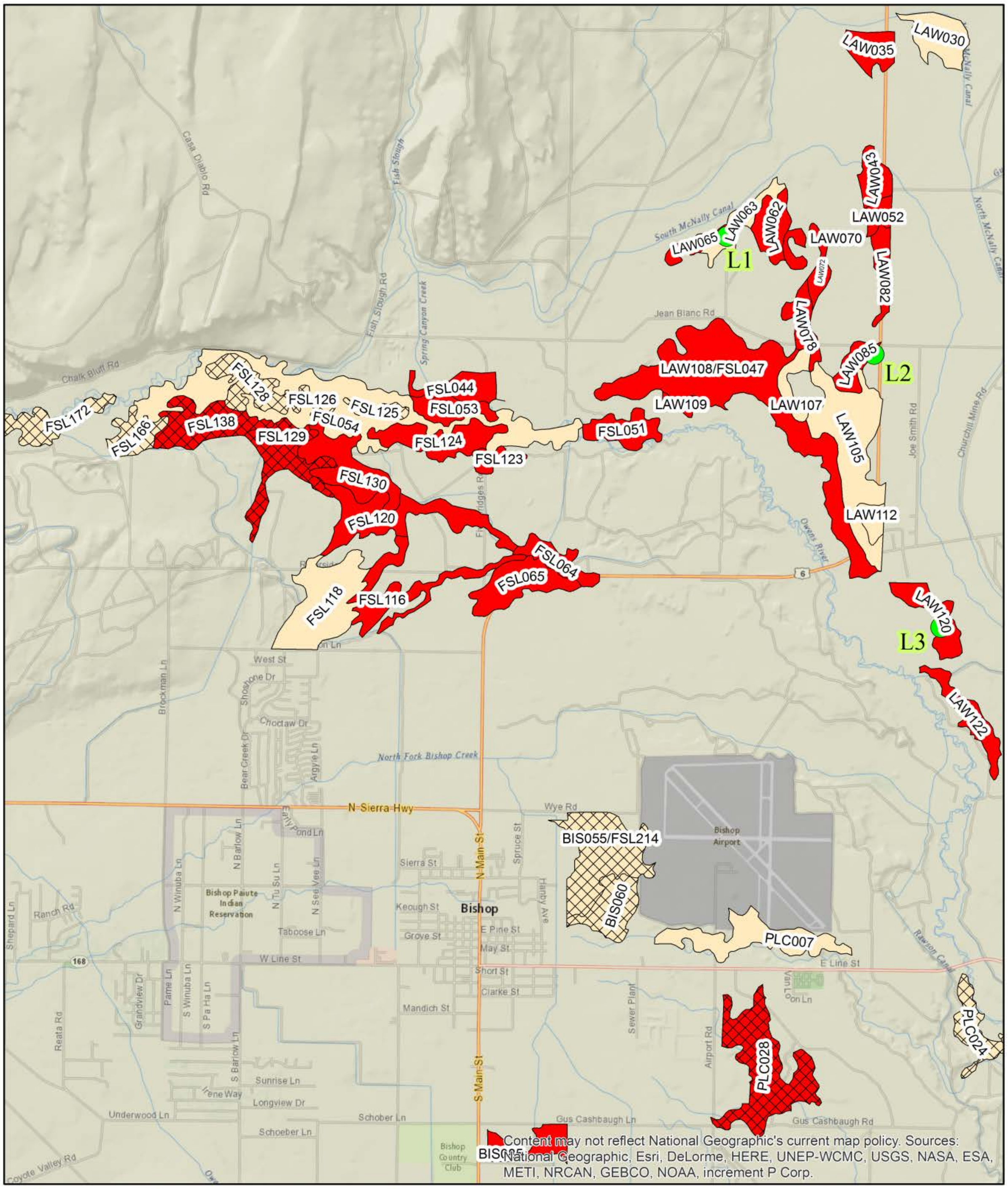
Parcel	W/C	Grass	Shrub	Herb	Cover	Grass.Delta	Shrub.Delta	Herb.Delta	Cover.Delta
BLK099	W	29	6	14	49	-11	0	12	1
BLK115	C	12	2	0	15	6	-1	0	5
BLK142	W	7	18	0	25	-10	9	0	-1
BLK143	W	40	13	7	60	6	8	6	20
FSL044	W	20	8	1	30	-48	8	0	-40
FSL051	W	21	6	3	29	-29	-1	0	-29
FSL053	W	17	24	4	45	-35	17	2	-16
FSL054	W	10	15	7	31	0	-59	7	-52
FSL064	W	19	15	7	41	-17	14	-2	-5
FSL065	W	8	10	0	18	-10	6	0	-4
FSL116	W	9	16	8	34	-26	11	-4	-19
FSL118	W	0	11	0	12	0	2	0	2
FSL120	W	19	9	2	30	-33	9	1	-24
FSL123	W	10	12	7	29	-35	11	-5	-29
FSL124	W	15	5	3	23	-32	-4	1	-35
FSL125	C	22	3	6	30	-25	-6	4	-28
FSL126	C	14	5	4	22	-33	-4	2	-36
FSL128	C	31	20	3	54	-10	18	-3	5
FSL129	C	11	14	2	27	-25	3	0	-22
FSL130	W	8	12	1	21	-7	5	-1	-4
FSL138	C	22	6	6	33	-37	4	-5	-38
FSL166	C	49	3	4	56	3	3	-7	-1
FSL172	C	35	29	2	66	9	-6	-2	1
FSL187	C	30	0	2	32	16	0	1	17
FSP004/BGP188	W	4	7	0	11	0	-5	0	-5
FSP006/BGP182	W	1	11	0	12	-21	9	0	-12
FSP015	W	5	8	0	13	-8	-3	0	-11
FSP020	W	0	7	0	7	-3	-7	0	-10
IND011	W	13	14	1	28	-15	12	1	-2
IND019	W	15	15	4	35	-32	14	-23	-41
IND021	W	5	34	3	42	-23	-5	2	-26
IND024/BLK103	W	24	9	1	35	-3	-6	1	-8
IND026	W	4	27	1	32	-45	27	1	-17
IND029	W	0	25	2	27	-14	17	2	5
IND035	W	22	9	7	38	-24	8	5	-12
IND064	C	7	30	1	38	-28	27	1	0
IND067	C	3	15	0	18	-14	-3	0	-17
IND087	C	8	14	2	24	-16	0	2	-14
IND096	C	3	13	2	18	-2	-10	0	-12
IND106	W	1	14	0	15	0	7	0	8
IND111	W	11	27	3	41	1	-4	3	0
IND119	C	7	4	0	11	-24	1	0	-23

Parcel	W/C	Grass	Shrub	Herb	Cover	Grass.Delta	Shrub.Delta	Herb.Delta	Cover.Delta
IND122	C	2	21	3	26	-3	-2	2	-3
IND124	W	7	14	0	21	7	-27	0	-20
IND132	W	0	17	0	17	0	-15	0	-16
IND133	W	0	11	0	11	0	-3	0	-3
IND139/MAN005	W	5	20	1	26	-13	-11	1	-23
IND151	C	16	6	2	23	-29	5	2	-22
IND163/BEE017	C	4	7	0	11	-3	4	-2	-2
IND205	W	24	26	2	51	0	24	2	25
IND231	W	0	9	2	10	0	1	2	3
LAW030	W	11	5	1	17	4	-11	1	-6
LAW035	W	0	1	0	1	-27	1	-6	-32
LAW043	W	0	4	0	4	-60	3	0	-57
LAW052	W	0	3	0	3	-22	-2	0	-25
LAW062	W	0	2	0	2	-8	-12	0	-19
LAW063	W	0	5	0	5	-1	-5	0	-6
LAW065	W	0	2	0	2	-8	1	0	-8
LAW070	W	0	3	0	3	-58	2	0	-56
LAW072	W	1	4	0	4	-64	4	0	-60
LAW078	W	5	10	2	16	-36	7	-6	-36
LAW082	W	0	6	0	6	-6	-3	-1	-10
LAW085	W	2	4	0	6	-28	4	0	-24
LAW105	W	11	8	3	22	-6	-1	2	-4
LAW107	W	27	12	7	46	-15	11	3	-1
LAW108/FSL047	W	9	5	8	21	-44	4	7	-32
LAW112	W	3	7	0	10	-2	-9	0	-11
LAW120	W	12	8	1	21	-10	4	1	-5
LAW122	W	16	5	7	28	-41	4	6	-31
LAW137/PLC210	W	1	15	0	16	-10	6	-1	-6
LNP018	C	4	6	2	12	-11	3	2	-6
LNP019	C	7	14	4	25	6	0	3	9
LNP045	W	3	15	6	24	-18	-11	5	-24
LNP050	C	2	15	3	19	-35	8	-2	-29
LNP095	C	15	10	1	25	-8	7	-2	-2
MAN006/IND229	W	18	6	1	25	3	-1	1	2
MAN007	W	4	20	1	25	3	-7	1	-3
MAN014	C	2	10	0	12	-8	-3	0	-11
MAN034	W	4	6	0	10	-5	0	0	-5
MAN037	W	1	21	4	26	-3	-17	4	-16
MAN042	W	1	15	2	18	-1	0	1	0
MAN060	C	25	10	45	79	-29	6	43	20
PLC007	W	1	24	1	25	-2	2	-2	-1
PLC024	C	25	15	2	42	-4	11	-1	6

Parcel	W/C	Grass	Shrub	Herb	Cover	Grass.Delta	Shrub.Delta	Herb.Delta	Cover.Delta
PLC028	C	4	22	1	27	-28	17	0	-12
PLC056	C	3	15	0	18	-5	6	0	1
PLC059	C	2	14	1	17	-3	2	1	0
PLC070	C	1	17	1	19	-17	-12	1	-28
PLC072	C	0	19	0	19	-1	4	0	3
PLC088	C	20	15	0	35	-17	8	0	-9
PLC092	C	0	14	0	14	-1	5	0	4
PLC097	C	26	11	4	40	-7	10	2	5
PLC106	C	2	12	0	14	-8	-8	0	-15
PLC107	C	1	15	0	16	-5	-21	0	-25
PLC121	C	25	9	3	37	-10	6	0	-4
PLC136	C	4	12	1	17	-3	7	1	5
PLC137	C	12	15	2	29	-3	3	2	2
PLC144	C	20	12	0	32	-2	4	-1	1
PLC223	C	5	14	1	20	-4	8	1	5
TIN028/FSP022/FSP019	W	1	11	0	12	0	-6	0	-6
TIN030	W	6	18	4	27	-5	4	-3	-3
TIN050	W	10	21	0	31	-24	19	-1	-6
TIN053	W	13	22	0	35	-17	17	0	0
TIN064	W	2	13	0	14	-19	3	-1	-17
TIN068	W	2	6	0	8	-7	2	0	-5
UNW029	C	9	9	0	18	-1	3	0	2
UNW031	C	45	4	25	74	-18	4	19	5
UNW039	C	13	12	1	26	11	-13	1	-2
UNW079	C	72	1	4	77	54	-21	4	37

Grass Change Maps

The following maps show parcels monitored in 2016 in which grass cover was significantly above or below baseline ($p < 0.05$) using a two-sample t-test or one-sample t-test depending on the type of data available for the baseline period.

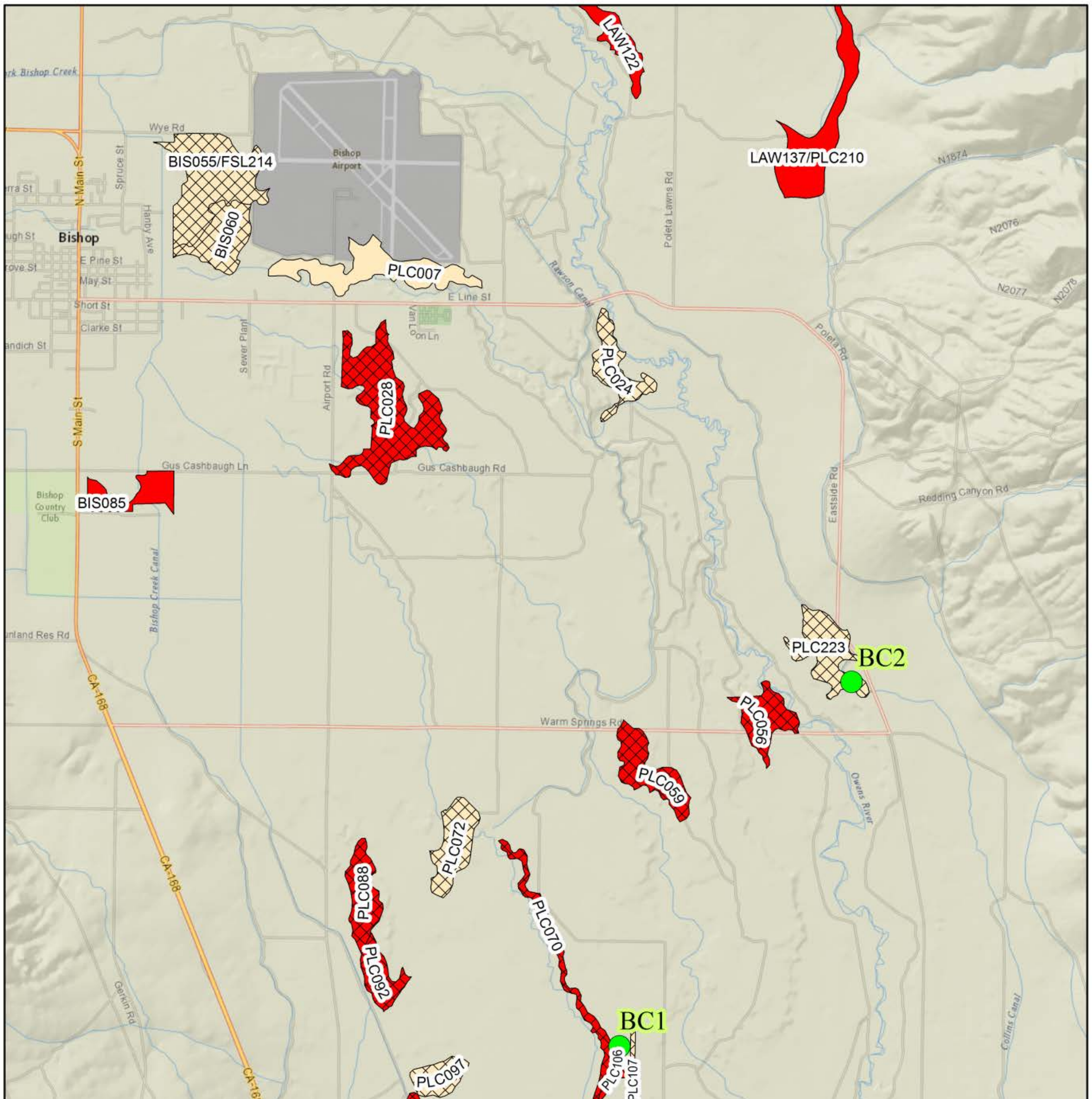


2016 Perennial Grass Cover Status Compared to Baseline

0 0.25 0.5 1 Miles N

- No significant change in grass cover
- Grass cover significantly below baseline
- Grass cover significantly above baseline
- Permanent Monitoring Sites

Hatch markings indicate control parcels



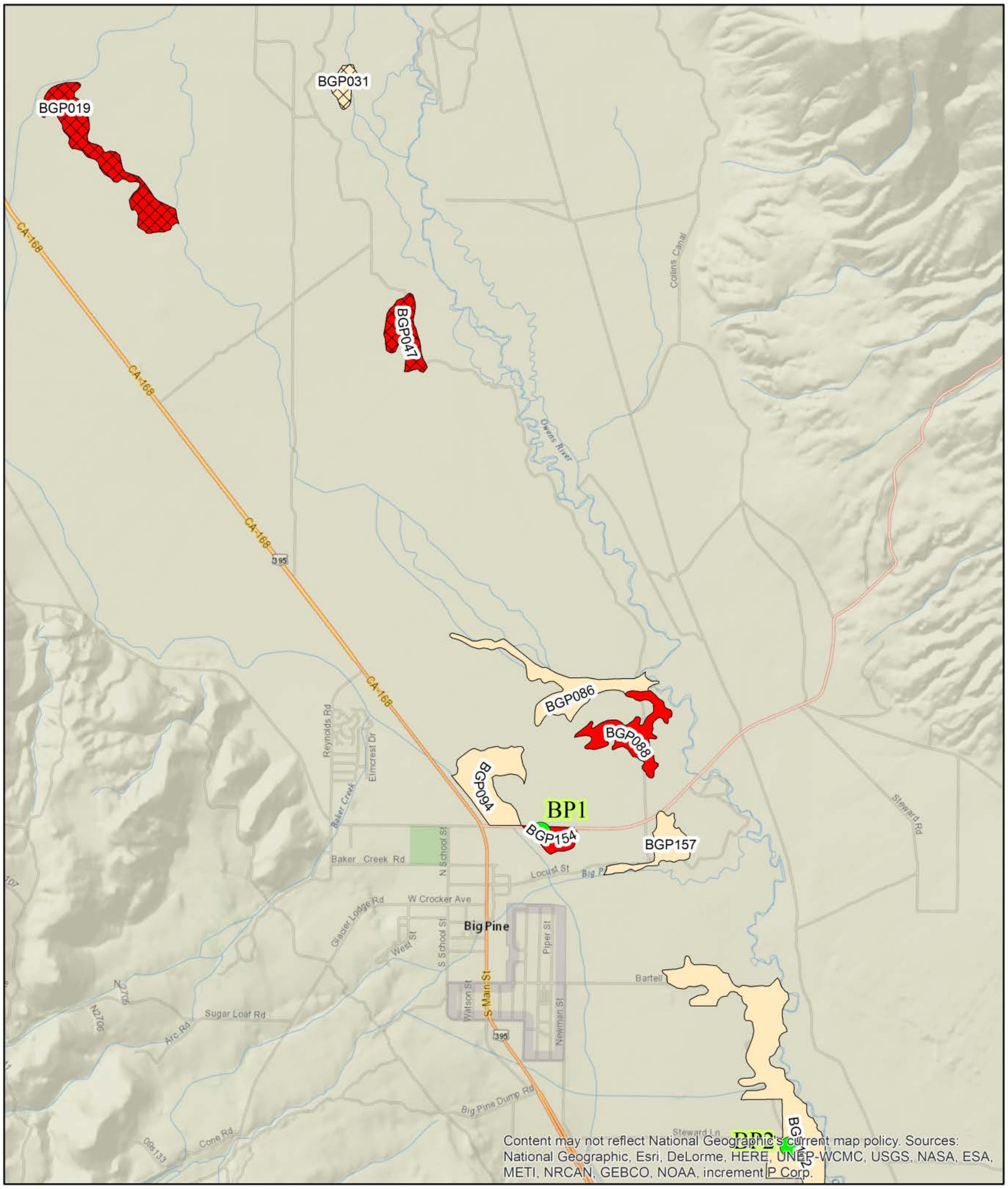
2016 Perennial Grass Cover Status Compared to Baseline

0 0.25 0.5 1 Miles

N

- No significant change in grass cover
- Grass cover significantly below baseline
- Grass cover significantly above baseline
- Permanent Monitoring Sites

Hatch markings indicate control parcels



2016 Perennial Grass Cover Status Compared to Baseline

0 0.25 0.5 1 Miles

N

- No significant change in grass cover
- Grass cover significantly below baseline
- Grass cover significantly above baseline
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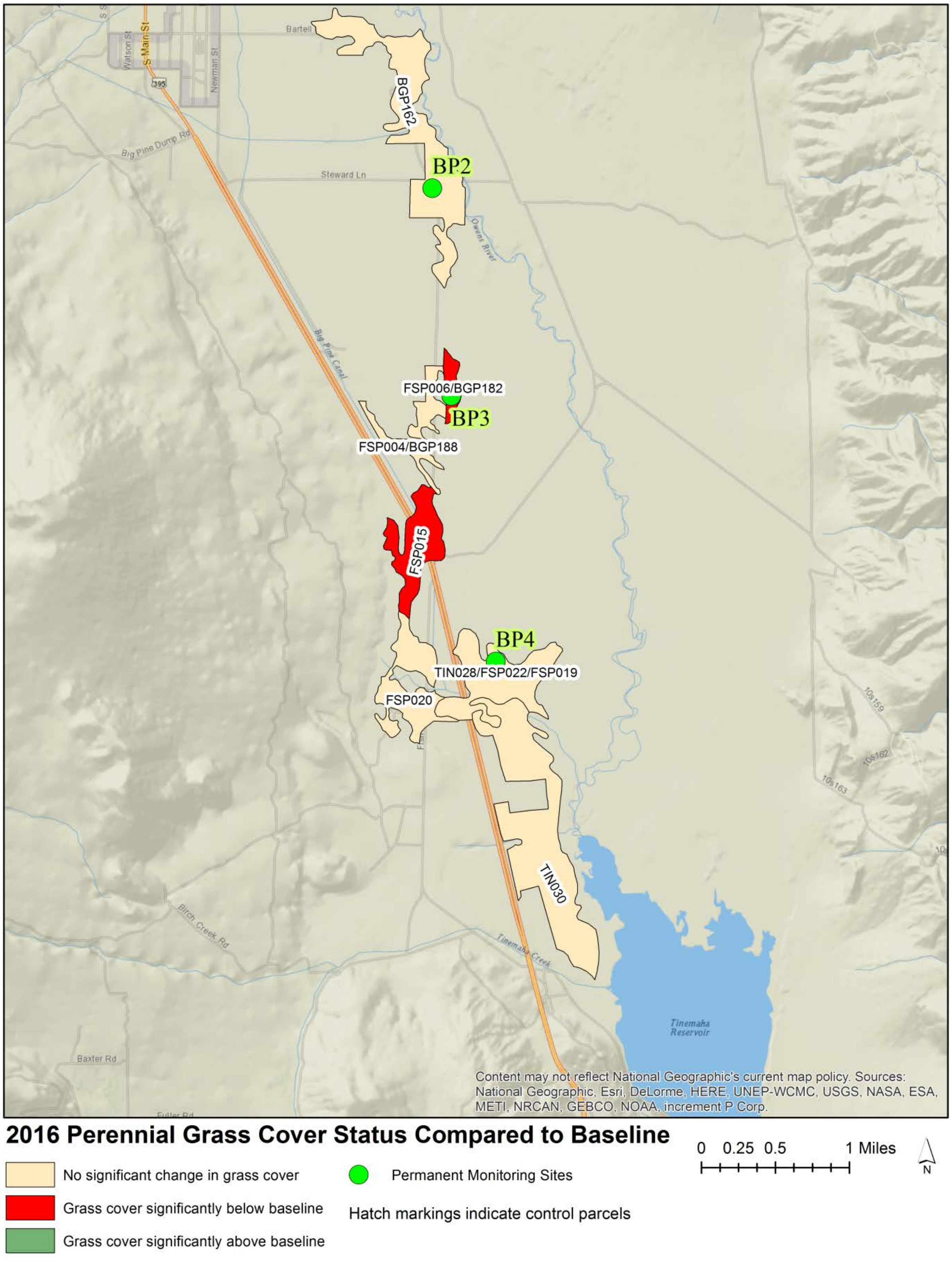
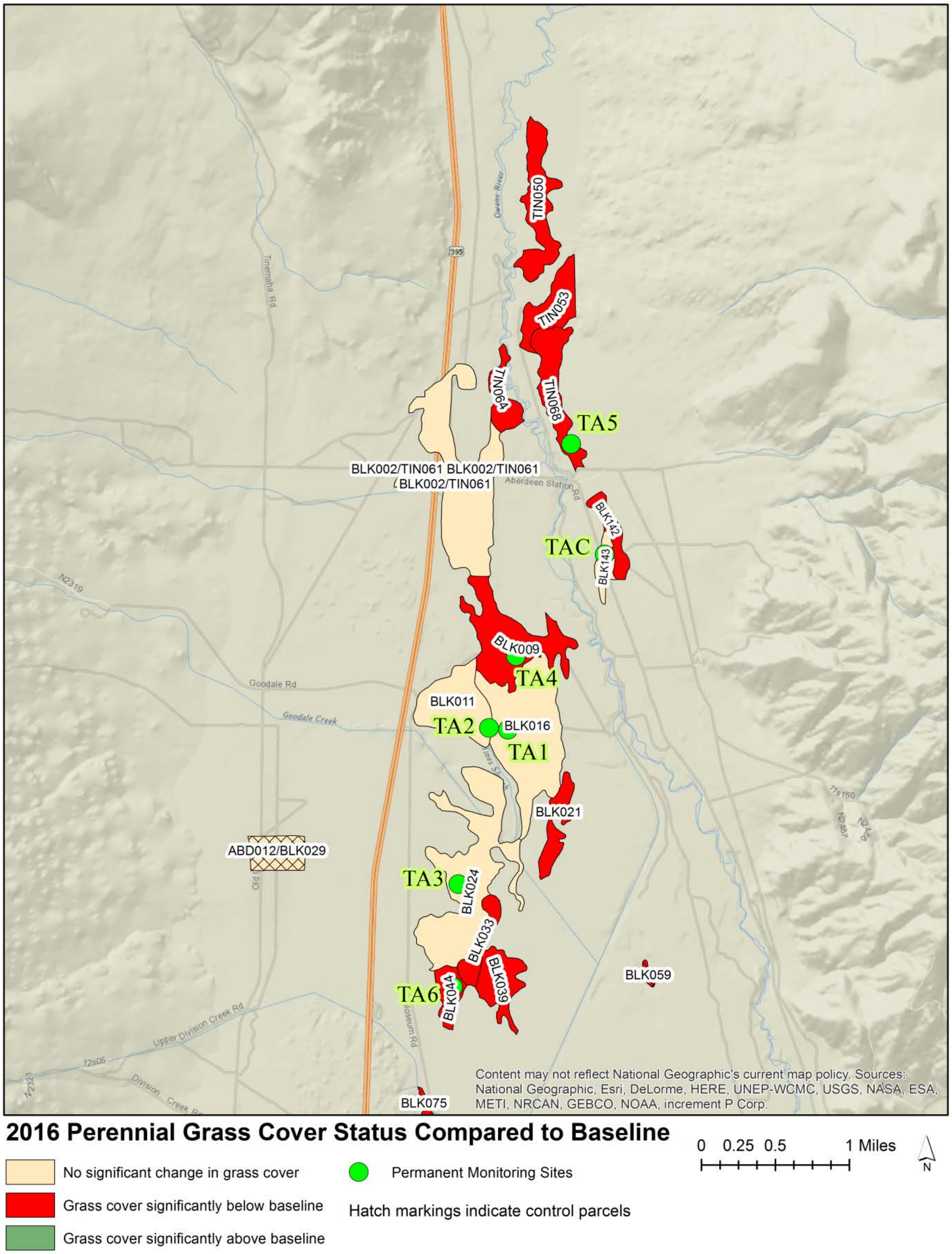
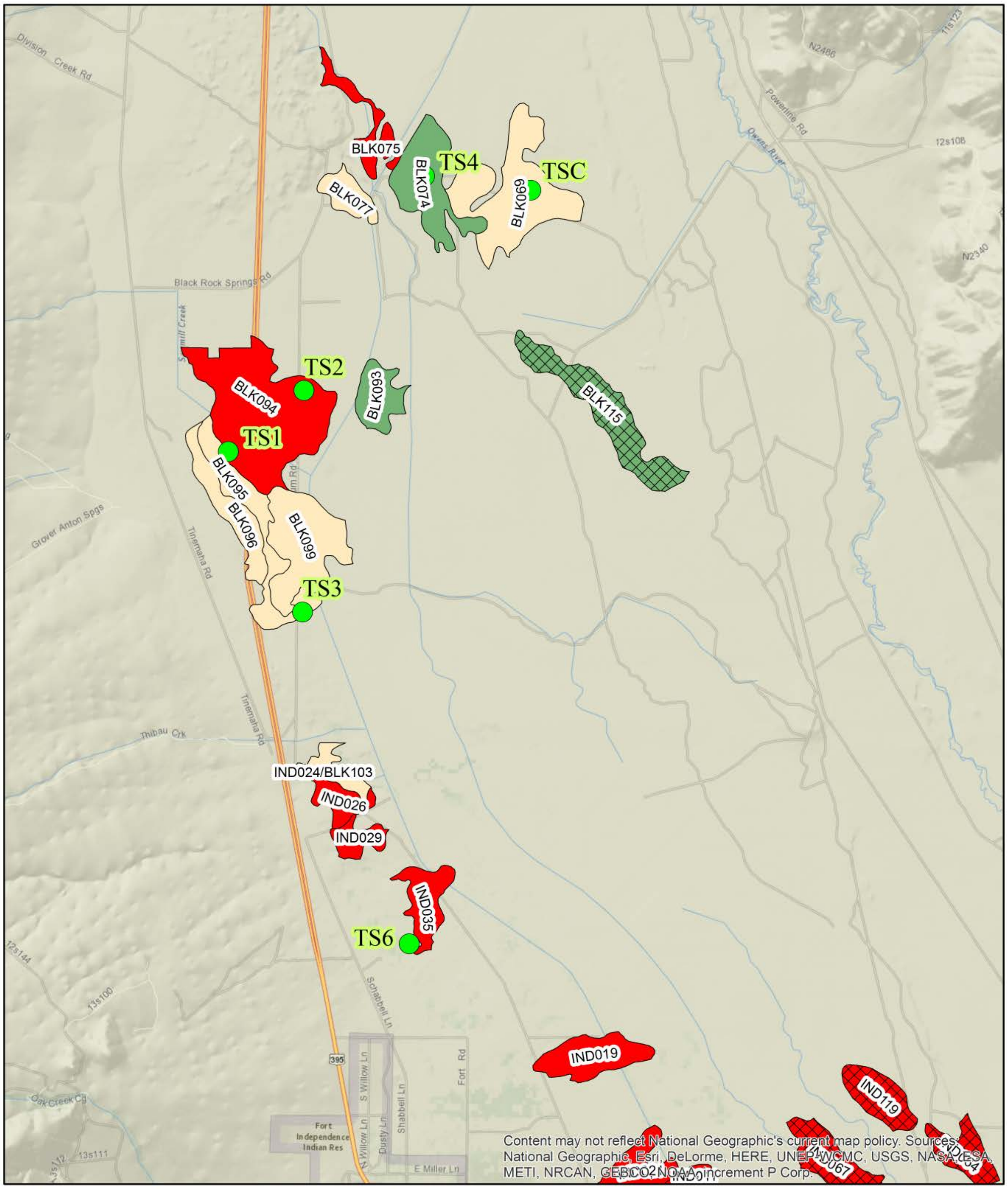
Hatch markings indicate control parcels


Bartell
S Main St
Watson St
Newman St
395
BGP162
Big Pine Dump Rd
Steward Ln
BP2
Owens River
Big Pine Canal
FSP006/BGP182
BP3
FSP004/BGP188
FSP015
BP4
TIN028/FSP022/FSP019
FSP020
TIN030
Birch Creek Rd
Tinemaha Creek
Tinemaha Reservoir
Baxter Rd
Fuller Rd
10s159
10s162
10s163
Content may not reflect National Geographic's current map policy. Sources: National Geographic, Esri, DeLorme, HERE, UNEP-WCMC, USGS, NASA, ESA, METI, NRCAN, GEBCO, NOAA, increment P Corp.
2016 Perennial Grass Cover Status Compared to Baseline
0 0.25 0.5 1 Miles
N
No significant change in grass cover
Grass cover significantly below baseline
Grass cover significantly above baseline
Permanent Monitoring Sites
Hatch markings indicate control parcels

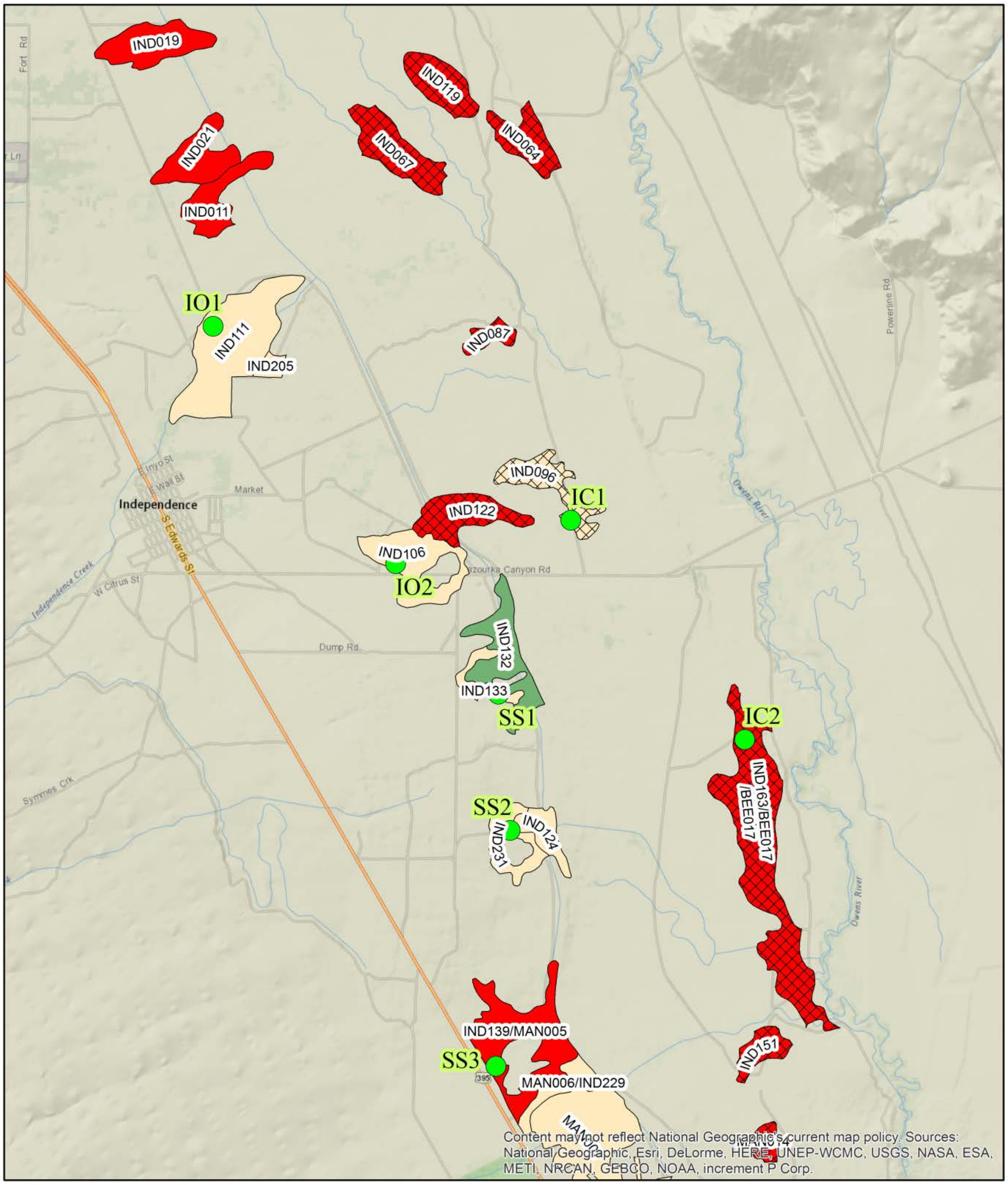

TIN050
TIN053
TIN064
TIN068
TA5
BLK002/TIN061 BLK002/TIN061
BLK002/TIN061
Aberdeen Station Rd
BLK142
TAC
BLK143
BLK009
TA4
Goodale Rd
Goodale Creek
BLK011
TA2
BLK016
TA1
BLK021
ABD012/BLK029
TA3
BLK024
BLK033
BLK039
BLK059
TA6
BLK044
Upper Division Creek Rd
BLK075
Owens River
Tinemaha Rd
395
Content may not reflect National Geographic's current map policy. Sources: National Geographic, Esri, DeLorme, HERE, UNEP-WCMC, USGS, NASA, ESA, METI, NRCAN, GEBCO, NOAA, increment P Corp.
2016 Perennial Grass Cover Status Compared to Baseline
0 0.25 0.5 1 Miles
N
No significant change in grass cover
Grass cover significantly below baseline
Grass cover significantly above baseline
Permanent Monitoring Sites
Hatch markings indicate control parcels



2016 Perennial Grass Cover Status Compared to Baseline

- No significant change in grass cover
- Grass cover significantly below baseline
- Grass cover significantly above baseline
- Permanent Monitoring Sites

Hatch markings indicate control parcels



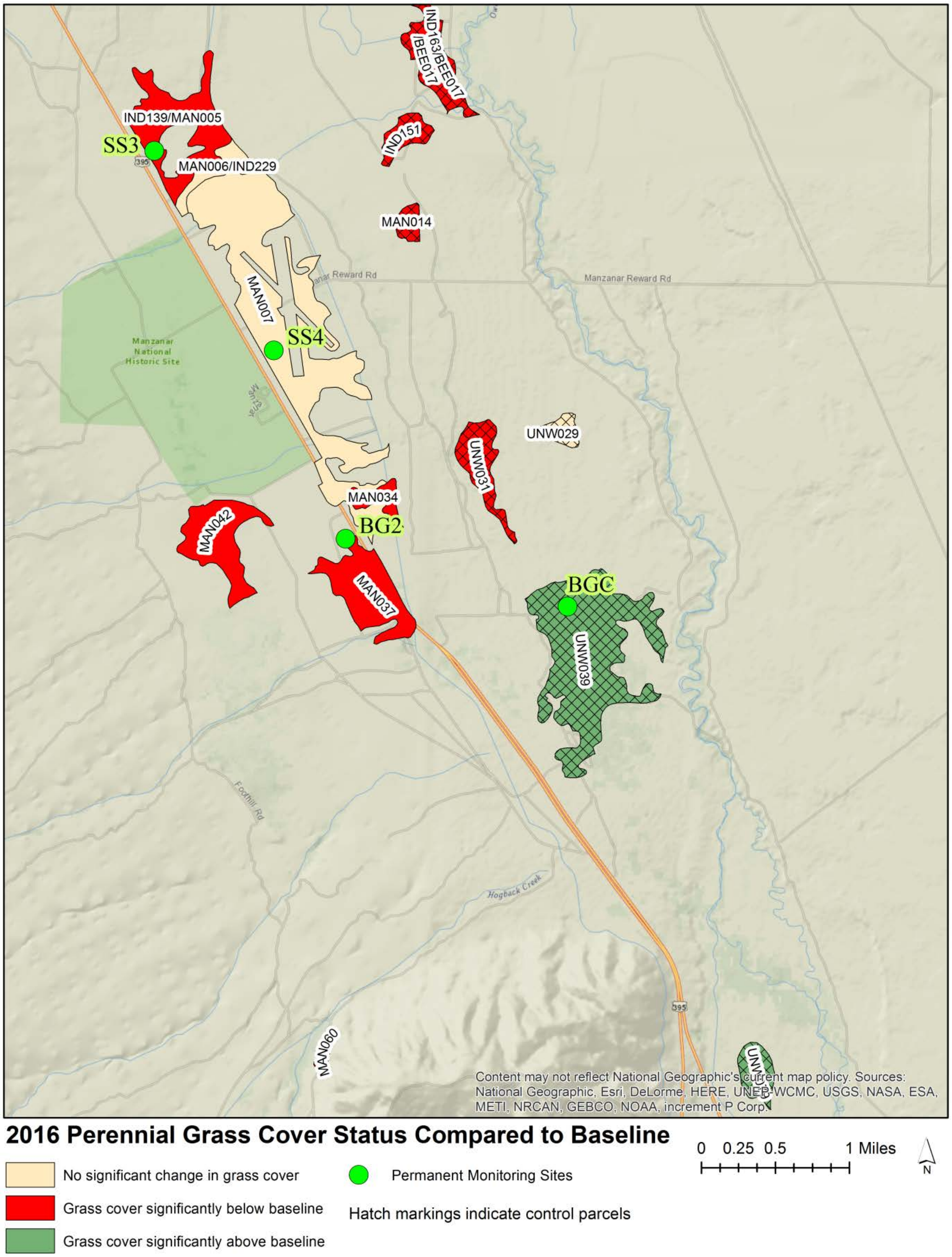
2016 Perennial Grass Cover Status Compared to Baseline

0 0.25 0.5 1 Miles

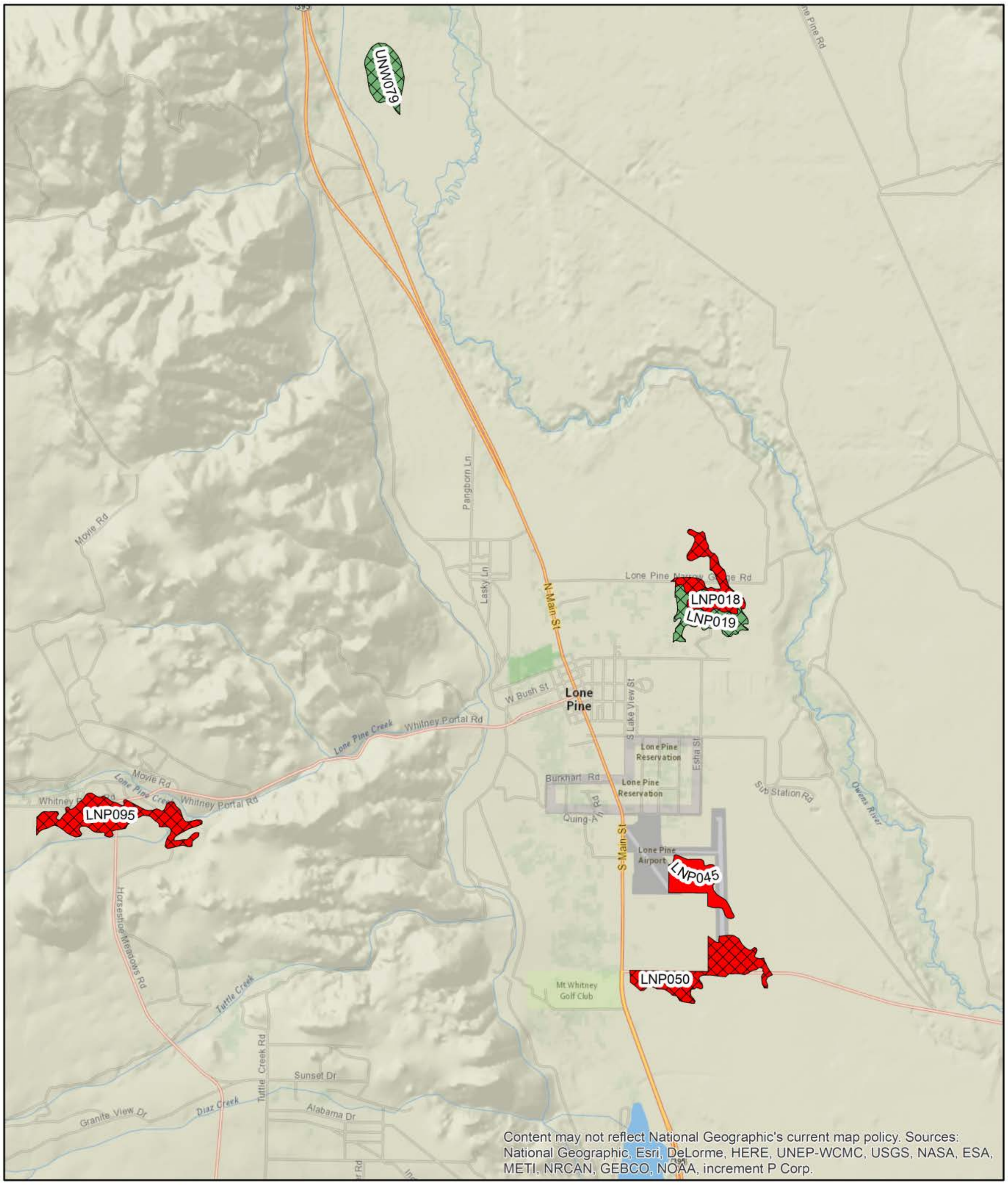
N

- No significant change in grass cover
- Grass cover significantly below baseline
- Grass cover significantly above baseline
- Permanent Monitoring Sites

Hatch markings indicate control parcels



2016 Perennial Grass Cover Status Compared to Baseline



2016 Perennial Grass Cover Status Compared to Baseline

0 0.25 0.5 1 Miles

N

- No significant change in grass cover
- Grass cover significantly below baseline
- Grass cover significantly above baseline
- Permanent Monitoring Sites

Hatch markings indicate control parcels

SECTION 6: MITIGATION

The Inyo County Water Department monitors and reports on the staus of environmental mitigation projects in the owens Valley.

Inyo County is also a partne in funding and implementing the Lower Owens River Project.

Introduction

One on the roles of the Inyo County Water Department (ICWD) is to monitor and report on the status of environmental mitigation projects in the Owens Valley. More than 62 projects, spread throughout the Valley, mitigate for a range of environmental impacts due to abandonment of irrigated agriculture and groundwater pumping in the Owens Valley. These improvements range in size from single-acre spring projects to the 78,000-acre Lower Owens River Project (LORP). The majority of these projects are described in the Water Agreement and associated 1991 EIR (*Water from the Owens Valley to Supply the Second Los Angeles Aqueduct*), and in the 1997 MOU (*Resolving conflicts and concern over the 1991 EIR*), which can be found on the ICWD website (www.inyowater.org).

ICWD participates in the development of new projects, evaluates the effectiveness of ongoing mitigation, and oversees modifications of existing projects that have been changed by the Inyo/LADWP Standing Committee or the courts.

This report provides background and status on all mitigation projects and other commitments in the Water Agreement. This section includes tables summarizing the origin and status of projects described in the 1991 EIR and other documents (Table 6.1). Projects where Inyo and Los Angeles staff disagree on the status are depicted in table. Table 6.2 summarizes the status of other obligations in the Water Agreement that were not identified as mitigation. Many of these obligations are ongoing assistance, consultation, or land management and planning efforts that LADWP has committed to

Mitigation Projects Origins and Background

The Los Angeles Department of Water and Power (LADWP) is legally obligated to implement mitigation projects to enhance recreation, diversify land use, improve or create habitat for wildlife and vegetation, and mitigate for a range of impacts in the Owens Valley. Descriptions of mitigation projects are found in the collection of documents that govern the activities of the LADWP in the Owens Valley. These documents.

were developed over time and include the 1991 Long Term Water Agreement and associated EIR, the 1997 MOU, and other court stipulations and orders

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Although the environment of the Owens Valley had begun to suffer the effects of large-scale water diversions to supply water to Los Angeles Aqueduct beginning in 1913, all of the mitigation projects described in this report mitigate for impacts after 1970 that resulted from the operation of the second Los Angeles Aqueduct. These mitigation projects will to a certain degree repair, restore and compensate for adverse impacts from the operation of the second aqueduct.

More than 58,000 acres of groundwater dependent vegetation is found in the Owens Valley. Between 1970 and 1990, increased groundwater pumping, and the resulting fluctuations in groundwater table, has had a significant effect on more than 1,000 acres; 655 acres of groundwater dependent vegetation has entirely died-off. Most of the mitigation projects include goals to improve vegetation in the Owens Valley.

Mitigation Alternatives

With respect to mitigation, the Water Agreement generally follows the framework of the California Environmental Quality Act (CEQA), which allows several alternative forms of mitigation. These are generally considered in sequence (i.e., with preference given to avoidance first and compensation last). These actions include:

- **Avoiding the impact altogether by not taking a certain action or parts of an action.**
  Local example: Well on/off provisions. When soil water and projected contribution from precipitation is inadequate to maintain vegetation, wells are not operated.
- **Minimizing impact by limiting the degree or magnitude of the action and its implementation.**
  Local example: Shutting down pumping wells, as was done at Five Bridges when groundwater drawdown degraded nearby vegetation.
- **Rectifying the impact by repairing, rehabilitating, or restoring the impacted environment.**
  Local example: Revegetation and regreening projects, which compensate for the effects of the abandonment of irrigated agriculture leading to areas of blowing dust and dirt.
- **Reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action. Local example: Salt cedar control, ongoing irrigation of fields**
- **Compensating for the impact by replacing or providing substitute resources or environments.**
  Local example: Lower Owens River Project, civic projects, recreational

facilities, habitat enhancement projects, and fish hatcheries.

Origin of Mitigation Efforts

Mitigation planning, development, and implementation are ongoing activities that are undertaken cooperatively with LADWP; Inyo County and LADWP developed the majority of mitigation projects in the Owens Valley during three discrete periods of time in response to judgments or potential legal and administrative actions:

Environmental Projects (EP), 1970-1984

Between 1970 and 1984, LADWP committed about 10,000 acre-feet of water annually to implement twelve environmental projects (Table 6.1). The primary purpose of these projects was to restore habitat that had been negatively affected or lost due to water gathering. These areas may have exhibited vegetation changes, or reduction in wildlife using a particular habitat. The goal was to provide a regular water supply to habitats such as ponds, lakes, sloughs, springs, and the Lower Owens River (LOR). Objectives differed between the projects, depending on the type of the impact that had occurred, but the overall goal of the environmental projects was to improve wildlife, forage, fisheries, and public recreation facilities.

In many instances it was impractical to mitigate at the original impact site, or the affected area was not well defined, or the impact was sporadic. In these cases a project was constructed at a site that would best accommodate the goals of the mitigation.

Enhancement/Mitigation Projects 1985-1991

The Enhancement Mitigation (E/M) projects are environmental projects that were implemented prior to adoption of the 1991 EIR (Table 6.2). The Water Agreement required that all E/M project continue. Some of these projects were included in the 1991 EIR as mitigation for impacts due to LADWP's water gathering activities.

These projects addressed a number of environmental impacts and filled community needs. Projects include the revegetation of abandoned agricultural lands and lands that experienced vegetation loss due to groundwater pumping, delivery of water for public parks, improved wildlife habitat, and a partial rewatering of the lower Owens River. For each project, specific goals and objectives were established and environmental documentation was prepared in accordance with CEQA.

dditional Mitigation Projects, 1997 MOU and 2004 Amended Stipulation and Order

The 1997 MOU identifies *Additional Commitments* that include studies, evaluations and commitments to specific issues (Section III.A). One of the issues brought forward in the MOU in Section III.A.3. is *Additional Mitigation* that requires a total of 1,600 acre-feet of water per year to be supplied by Los Angeles Department of Water and Power (LADWP). This water is to be used for the implementation of on-site mitigation measures at Hines Springs that were identified in the 1991 EIR and on-site or off-site mitigation that is in addition to the mitigation measures identified in the EIR for impacts at Fish Springs, Big and Little Seeley Springs and Big and Little Blackrock Springs.

- **Yellow-Billed Cuckoo (YBC) Enhancement Mitigation Project:** These projects located near Big Pine on Baker Creek and Hogback Creek near Lone Pine were designed to enhance vegetation conditions and direct land management actions to enlarge and enhance existing YBC habitat.

Table 6.1 Status of Environmental Projects.

Description	Impact	Status
Farmers Ponds: Water is provided each fall of each year to offer habitat for migrating waterfowl. The Project is two miles north of Bishop just off Highway 6.	The Laws area has lost all or part of its vegetation cover due to increased groundwater pumping, abandonment of irrigated agriculture to supply water to the second aqueduct, livestock grazing and drought.	East of the main Farmers Pond are a series of four cascading spreading basins that drain overflow from the main Farmers Pond. These additional basins, which are typically dry, along with another spreading basin two miles west, where the C-Drain intersects Riverside Road, might be used as replacement mitigation for the McNally ponds. It is expected these additional ponds could be supplied annually, as opposed to the existing McNally, which are at this point only filled for operational purposes. A formal mitigation substitute proposal will be developed and presented to the Technical Group. A substitute project would need to provide equal or greater mitigation value.
Buckley Ponds: Water is provided for a warm-water fishery and waterfowl area, which is located three miles southeast of Bishop.	Non-specific compensation.	This main pond and string of other ponds were created in the 1950's. In 1976 LADWP and CDFW created a Habitat Management Plan. The string of ponds were treated and excavated in 2012-14 to remove emergent vegetation.
Saunders Pond: Water is provided to a warm-water fishery and waterfowl area, which is located five miles southeast of Bishop.	Non-specific compensation.	Implemented and ongoing.
Millpond Recreation Area: Water is provided either by creek flow or a well at the site. The project is located five miles northwest of Bishop.	Non-specific compensation.	Implemented and ongoing.
Klondike Lake: Improve waterfowl habitat and provide recreation in the Big Pine area.	Non-specific compensation.	Motorized recreation on the lake has been limited to prevent the introduction of the freshwater quagga mussel. LADWP reports runoff year 2016-17 water supplied was 1,496 acre-feet.

		The Big Pine Ditch MND (2004) reduced the water supply to the lake from 2,500 to 1,700 acre-feet, and provided that native pasture and wetland habitats adjacent to Lyman ditch were to be preserved, and committed LADWP to maintain a described a lake level. In addition, up to 200 acre-feet would be used for a native habitat area immediately south of the Lake. The project is located 2 mile north of Big Pine.
Klondike South Shore Waterfowl Management Area (160 acres):	Compensation for the inability to supply a full allocation of water to the Klondike Lake Project.	The elevation between the Lake and the Project is minimal and sediment in the water conveyance limited flow to the project. A new water gate was installed and from the 2011-12 runoff year to present, a full 200 af allocation was supplied. With the use of the new water gate new habitat has been created and is being used by desired species; however the original project area receives little water and is almost completely tule chocked. A habitat management plan needs to be prepared for this project. It has been the practice of LADWP to release water to the project area during waterfowl migration season, usually beginning releases in late winter, but as of April 2013 water had not been supplied to the project, and in 2014 only 52 acre-feet was delivered, in 2016 the ponds were dry in mid-June.
Tule Elk Field: Provides water in summer to field used by Tule Elk. Located between Fish Springs Road and Tinemaha Reservoir.	Non-specific compensation.	The water supply to this project has been reduced since 2002. ICWD does not believe the project water provided is sufficient in all years to meet project goals, especially in the area east of highway 395. In 2016-17 high runoff allowed flooding of the fields east of cultivated fields east of Highway 395.
Big and Little Seeley Spring: Two miles south of Tinemaha Reservoir LADWP well number 349 near the Owens River discharges water into a pond approximately one acre in size. This pond provides a temporary resting place for waterfowl and shorebirds when	Non-specific compensation.	Riparian vegetation has become established around this pond.

the pumps are operating or Big Seely Spring is flowing.		
Calvert Slough: Water is provided to maintain habitat in a small pond and marsh area near LADWP Aqueduct Intake.	Non-specific compensation.	This project has not been receiving a regular water supply since 1998. LADWP reported that low flows in the creek do not allow supplying the project because of high ditch losses and the off status of the two wells upstream of the project. No water was supplied to this project for seven years (1998-2004). The enhancement of the Calvert Slough wetland was a possible Additional Mitigation measure, but was not selected as one of the final 1600 acre-foot projects.
Little Blackrock Spring: Water is diverted from ditch to maintain wetland area at original spring site; west of the aqueduct intake.	Ground water pumping has lowered depth to water to a level where springs and seeps no longer flow. Associated riparian and wetland vegetation is lost.	The Technical Group does not have a plan for monitoring flows or vegetation at springs and seeps. Ecosystem Sciences had developed an inventory of springs and seeps. According to the MOU, the inventory should provide baseline data adequate for monitoring change.
Lone Pine Pond: Water is provided by natural seep or spring flow in river with supplemental releases from Alabama Gates (now incorporated in the Lower Owens River E/M Project). The project is located just north of Lone Pine Narrow Gauge Road.	Non-specific compensation.	Included in the LORP. The Lone Pine Ponds are managed under the LORP Monitoring, Adaptive Management, and Reporting Plan as a component of the River-Riverine system. With the 40 cfs maintained flow, the ponds have largely converted to marsh.
Lower Owens River Rewatering Project: Water releases began in 1975 to provide year-long minimal flows along the lower Owens	The Lower Owens Rewatering Project was initiated in 1986 by the LADWP and Inyo County	Superseded by the Lower Owens River Project. Billy lake is managed under the LORP Monitoring, Adaptive Management, and Reporting Plan as an Off River Lake.

River, as well as releases to Twin Lakes, Billy Lake, and Thibaut Ponds. The goal is to maintain waterfowl, marsh, shorebird, and upland gamebird habitat, as well as provide for a warm-water fishery. The project has now been replaced by the Lower Owens River E/M Project, which provides water to all of the formerly dry stretch of the Owens River. The 78,000 acre project site is located east of the towns of Aberdeen, Independence, and Lone Pine.	to improve habitat for shorebirds, waterfowl, and fish in the river corridor and at the Delta. The project was one of 25 Enhancement/Mitigation Projects jointly implemented between 1985 and 1990.	
Diaz Lake: A supplemental water supply is provided to Diaz Lake recreational area. The accounting of water supplied to this project has been revised as part of the MOU 1600 ac-ft. projects described below. The lake is three miles south of Lone Pine.	Non-specific compensation.	Under the Additional Mitigation project description, Diaz Lake will be supplied a secure source of water, which reduces dependence on water pumped by Inyo County up to 250 afy. LADWP's lease with Inyo County (Lease No. 1494, in effect until June 30, 2015) has been updated to reflect these additional water supply commitments and accounting requirements of this project agreed to by LADWP.

Table 6.2 Status of E/M Projects.

Description	Impact	Status
Millpond Recreation Area Project: Located west of Bishop, was the first E/M measure to be completed. Since October 1985, funds have been provided to operate the recreation area's sprinkler irrigation system that waters 18 acres of the community park, including two softball fields.	Non-specific compensation.	Implemented and ongoing.
Shepherd Creek Alfalfa Lands Project: Revegetated 198 acres of abandoned cropland adjacent to U.S. Highway 395 with sprinkler-irrigated alfalfa and windbreak trees. The property between Lone Pine and Independence had only sparse annual vegetation since 1976, and was a source of blowing dust creating a traffic hazard.	Primarily Dust mitigation.	Alfalfa planted and maintained on approx. 185 acres. LADWP reports that water supply for runoff year 2016-17 was 920 acre-feet.
Klondike Lake Project: Previously, the 160-acre lake located north of Big Pine had been filled only during above-normal runoff years. Now, less than 1,700 af of water maintains the lake year-round. Benefits include nesting and feeding areas for waterfowl, and recreation including skiing, windsurfing, and other water	Non-specific compensation.	Due to the shape and size of the Klondike lakebed, the full volume of water (2,200 af) allocated to the project was more than the lake required, so the project was modified to permanently reduce the water allotment. The balance of this unused water allocation was apportioned the Big Pine Ditch System and the Klondike South Shore Habitat Area.

sports in summer months. Due to the shape and size of the Klondike lakebed, the full volume of water (2,200 af) allocated to the project was more than the lake required, so the project was modified to permanently reduce the water allotment. The balance of this unused water allocation was apportioned the Big Pine Ditch System and the Klondike South Shore Habitat Area.		
Laws Historical Museum Project: Provides a regular water supply to improve the native vegetation on a 21-acre parcel, provide for irrigated pasture on 15 acres, and establish windbreak trees, all adjacent to the museum.	Non-specific compensation.	Implemented and ongoing.
640 acres near Laws: Revegetate with non-groundwater dependent native plants (potential project that would require Standing Committee approval to implement).	Between 1987 and 1988, two wells in the Five Bridges area that were pumped to supply water to enhancement mitigation projects contributed to a lowering of the water table under riparian and meadow areas along Owens River. Approximately 300 acres of vegetation were	The Standing Committee has not evaluated the need for mitigation of this area. Desert Aggregates expanded gravel mine operation includes at least 174 acres in the western part this potential mitigation site.

	affected, and within this area, approximately 36 acres lost all vegetation due to a wildfire. EIR v1 (10-58).	
Laws-Poleta Native Pasture Project: Provides water for irrigation of approximately 216 acres of sparsely vegetated land to reestablish native vegetation on abandoned pasturelands and increase livestock grazing capabilities.	The Laws area has lost all or part of its vegetation cover due to increased groundwater pumping, abandonment of irrigated agriculture to supply water to the second aqueduct, livestock grazing and drought.	One pasture, 2.5 miles north of Laws and just east of Hwy. 6 (160 acres, parcel 44) has achieved good pasture cover on 65-70% of the eastern half of the parcel. The other 60-acre pasture two miles southeast of Laws (parcel 138) adjoins the McNally Ponds and Pasture project. Due to the configuration of release points and topography, not all of this pasture can be effectively irrigated. LADWP had reported that they couldn't separate this project's water accounting from adjacent irrigated parcels. LADWP reports these projects were supplied a combined 1,530 acre-feet in 2016-2017.
McNally Ponds and Pasture: To povides a regular water supply to existing ephemeral ponds (60 acres) in the Laws area to create waterfowl habitat, and to provide spring and summer irrigation to enhance and maintain existing vegetation on 300 acres of pastureland.	The Laws area has lost all or part of its vegetation cover due to increased groundwater pumping, abandonment of irrigated agriculture to supply water to the second aqueduct, livestock grazing, and drought.	The ponds served as a flooding basin this year and the ponds, as well as adjoining basins were filled to capacity. The adjacent 100-acre pasture to the east is maintaining patchy grass cover. The ponds have received their full share of water only 3 times since 2004. Water for the pasture, east of the ponds, can only be supplied infrequently when the Lower McNally Ditch is run. To provide substitute mitigation, the Inyo Supervisors have approved diversion of water from Bishop Creek Canal to supply pasture north Riverside Drive. During the 2016-17 runoff year the ponds received 1,500 af. McNally Ditch losses were estimated by LADWP to be 600 cfs.
Independence Pasture Lands/and Spring Field Projects: Provides approximately 910 acres of abandoned croplands and sparsely vegetated land with	Regreening project to improve abandoned agricultural or pasture lands in areas around the town. Provides	Site topography prevents flood irrigation from reaching some portions of the project. LADWP reports runoff year 2016-2017 water use was 1,900 af for the

irrigation to create native pasturelands and provide water to native vegetation. Flood irrigation converted sparsely vegetated land east of Independence into productive native pasture. The project mitigated a source of blowing dust and stabilized soil previously affected by severe wind erosion.	irrigation to lands formerly removed from irrigation.	pastureland and 1,476 af for the Springfield.
Lone Pine Riparian Park: Provides a continuous water supply to a ditch running through Russell Spainhower Park then easterly to supply water to Lone Pine Woodlot and Richards and Van Norman Fields projects.	The park is a non-mitigation E/M project. Water conveyed through the park provides irrigation to lands formerly removed from irrigation.	LADWP, in their annual Owens Valley Report, lists water use for this project and Richards Field together. In 2016-17, water use reported for these projects was 644 acre-feet—nearly double the amount released in 2015-16. For the park, water use is conveyance loss.
Van Norman Field (170 acres) and Richards Field (160 acres): Provides surface and pumped water to establish pastureland and increase livestock grazing capabilities on abandoned agricultural land.	Regreening project implemented to enhance the aesthetics of abandoned agricultural or pasture lands in areas around the town. Water is supplied from LADWP to promote and maintain vegetation.	A replacement well was drilled in the fall of 2012 and began production in April 2014. The new well is located in a position that should allow the establishment of additional acres of pasture. In 2013, as part of an E/M evaluation, Inyo County and LADWP agreed to expand the project to include irrigating an adjacent 10 acre parcel operated as a school farm by Lone Pine High School. On April 29, 2014 the Standing Committee agreed to modify the Van Norman Field Enhancement/Mitigation (E/M) Project by adding approximately ten acres of the Lone Pine High School Farm on to the Van Norman Field E/M Project. The total acreage of the modified Van Norman Field E/M Project is now about 170 acres. The additional acres will be irrigated pasture. The total annual water supply for the project will remain 480 acre-feet, which will result in an annual water distribution within the project boundaries of approximately

		2.8 acre-feet per acre. LADWP reports water use for runoff year 2016-2017 was 481 acre-feet.
Lone Pine Sports Complex: At the request of the community, portions of the Lo-Inyo Elementary School and vacant LADWP property were converted to an outdoor sports complex consisting of baseball fields, soccer fields, and related parking, picnic and park areas.	Non-mitigation E/M project (community project).	Includes 3 irrigated ball fields and two multipurpose fields, with an irrigated area totaling 12.5 acres Asphalt replaced the former dirt parking area in 2013 and 139 parking spaces were outlined
Independence and Lone Pine Woodlots: Two irrigated projects in Lone Pine and Independence provide a greenbelt and are harvested as sustainable source of firewood for those in need.	Regreening project implemented to enhance the aesthetics of abandoned agricultural or pasture lands in areas around the town. Water is supplied from LADWP to promote and maintain vegetation.	Lone Pine FFA is managing both woodlot projects, with some wood going to Independence residents and other wood being sold in Lone Pine to support FFA activities. An operations plan is needed based on management guidelines agreed to by Inyo Co. and LADWP. Drought stress resulted in dieback of cottonwood in both llots. Many of the larger trees show crown loss. LADWP thinned the trees in 2016-17. The Independence lot was supplied 110 af and Lone Pine 90 af during 2016-17.
Independence Roadside Rest: This project consisted of planting and maintaining shade and windbreak trees and grass, installation of an irrigation system, and placement of picnic table on a 1/2-acre site south of the town of Independence. The project improves a previously barren parcel at the entrance to	Non-mitigation E/M project (community project to improve aesthetics on LADWP lands near towns).	Implemented and ongoing.

town.		
Eastern California Museum: This project enhanced the appearance of the Eastern California Museum grounds in Independence. It consisted of a small pond, trees, expanded lawn areas, and installation of an irrigation system.	Non-mitigation E/M project (community project to improve aesthetics on LADWP lands near towns).	Implemented and ongoing. Flooding in 2017 resulted natural stream alteration.
Town Regreening Projects: Three projects designed to enhance the aesthetics of abandoned agricultural or pasture lands in areas around the towns of Big Pine, Independence, and Lone Pine. Lone Pine has been implemented; Big Pine and Independence should come into operation in 2014.	Non-mitigation E/M project. These projects were implemented to enhance the aesthetics of abandoned agricultural or pasture lands in areas around the towns of Big Pine, Independence, and Lone Pine. Water was supplied from LADWP facilities to promote and maintain vegetation.	In 2015-2016 it was evident that many trees have died in Lone Pine, Big Pine, Independence, and Bishop due to reductions or elimination of irrigation during recent years of drought.
Lower Owens River Rewatering E/M Project: This project provided up to 18,000 AFY of continuous flow of water in the previously dry (1913-1986) portion of the river channel, creating a warm water fishery and wildlife habitat in the southern Owens Valley. The project also	The Lower Owens Rewatering Project was initiated in 1986 by the LADWP and Inyo County to improve habitat for shorebirds, waterfowl, and fish in the river corridor and at the Delta. The project was	Superseded by the Lower Owens River Project. Billy lake is managed under the LORP Monitoring, Adaptive Management, and Reporting Plan as an Off River Lake.

supplies water to five small lakes along the river route providing improved waterfowl habitat in the region. This project has been superseded by the Lower Owens River Project, which was fully implemented in December 2006.	one of 25 Enhancement/Mitigation Projects jointly implemented between 1985 and 1990.	
Hines Springs: Create 1-2 acres of aquatic, riparian, and marshland habitats. Project will serve as a research project on how to reestablish a damaged aquatic habitat.	Ground water pumping has lowered depth to water to a level where springs and seeps no longer flow. Associated riparian and wetland vegetation is lost.	The initial concept, to provide water at the spring vent, proved impractical. MOU Parties entered into an ad hoc process and agreed to build two projects at the spring site; 1) water from Well 355 now supplies water to a small pond used by livestock. The solar power source designed to power Well 355 would be insufficient, so the project was modified to include a new above-ground power line to the project; 2) Aberdeen Ditch. A 2700' pipeline now supplies water to a ditch just southeast of the former spring to be used by livestock. The ground in the area is highly permeable so conveyance of the water along natural contours has proven challenging. To overcome the losses LADWP installed PVC pipe to extend the flow, but even this has proven ineffective. ICWD has suggested installing T-valves along the length of the extension pipe to better direct water. This was rejected by LA. 1600 acre-feet was released to the projects in 2017, so no water was required to be released at Warren Lake.

- **1600 acre-feet of water:** Commits 1600 acre-feet of water at seven sites. The initial project recommended by the MOU consultant was replaced by seven projects prepared by an Ad Hoc group of Inyo, LADWP, and CFW staff, local lessees, and representatives of the Owens Valley Committee and the Sierra Club. A report describing these projects can be found on the ICWD website.

Additional Mitigation Projects 2016 Annual Monitoring Report

The Additional Mitigation Projects prescribed a five-year monitoring program for the eight projects. These projects were monitored for water deliveries, and assessed using pedestrian surveys, photo points, and vegetation and flooded extent is mapped. Data collections, and monitoring, were tasks shared by Inyo County and LADWP. LADWP was required to document the five-year finding in a report. This report is found in their 2017 Annual Owens Valley Report (Section 3.2.1.1).

Revegetation projects in the 1991 EIR and Irrigation in the Laws Area MND

Revegetation projects mitigate for environmental damages due to groundwater pumping and/or discontinuation of agriculture. The 1991 EIR identified land that had become barren due to changes in surface or groundwater management (Figure 6.1). A mitigation plan prepared by the Inyo/Los Angeles Technical Group for these projects was submitted to the Standing Committee in 1999.

The Environmental Impact Report (EIR) pertaining to the second Los Angeles aqueduct identified land that had become barren due to changes in surface or groundwater management (City of Los Angeles Department of Water and Power and County of Inyo 1990). Table 6.3 shows the status of the performance of revegetation projects relative to prescriptions found in the 1999 *Revegetation Plan for Impacts Identified in the LADWP, Inyo County EIR for Groundwater Management (1999 Plan)*, as well as projects related to the 2003 *Irrigation in the Laws Area* MND (ILA).

The County and LADWP disagree over the authority provided by the 1999 Plan. Inyo County believes the plan is an approved guiding document that serves as the revegetation Mitigation Plan for the 1991 EIR. LADWP contends that the document is a draft, which only offers guidance. However, in their annual reporting they use the metrics in the 1999 Plan to assert that three sites have met goals and for these projects mitigation is complete. Inyo County might accept findings that cover and composition goals described in the 1999 Plan have been met, but the plan also requires that specific recruitment goals be achieved. Recruitment has not been surveyed so full success has not been established and none of these projects can be considered complete.

A second attempt to revise the 1999 Plan revegetation mitigation plan, and a first revision of the ILA Plan is under review. Inyo County and LADWP are exchanging drafts and hope to have a plan that can be approved by the Technical Group before March 2018.

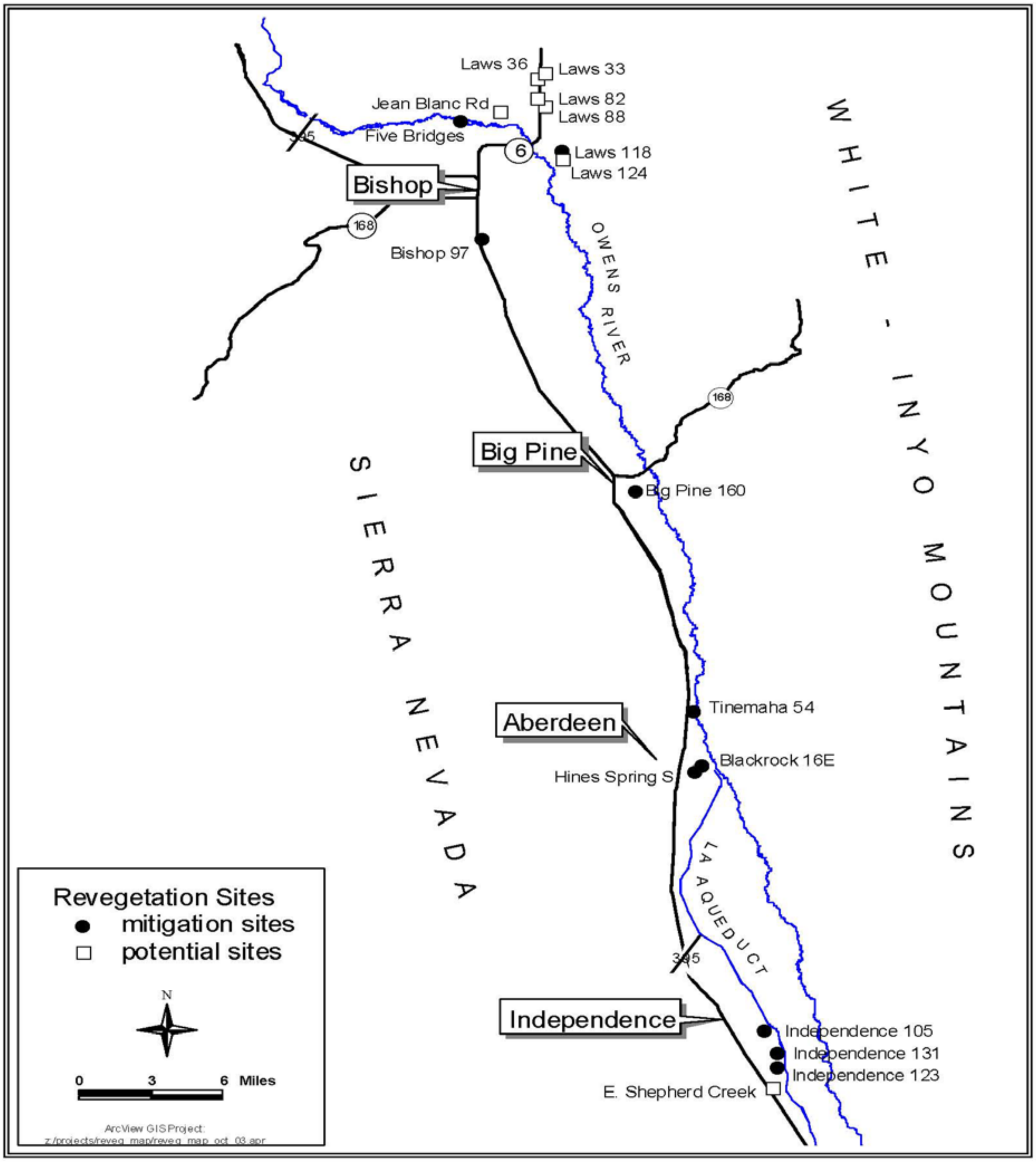


Figure 6.1. Locations of revegetation projects in the Owens Valley described in the 1991 EIR.

Table 6.3. Status of Revegetation Projects 2017.

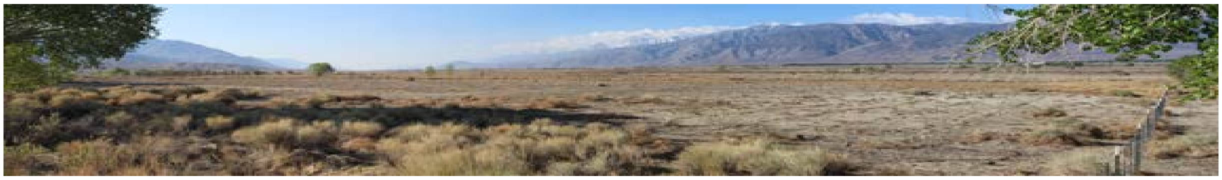
					Percent Live Native Cover		Number of Species		Recruitment Success
Guidance*	**Project name**	**Acres**	**Impact[3]**	**Met goal**	**Goal % (90%)**	**Reported % (survey year)**	**Goal (75%)**	**Reported**	**25% of surveyed hits**
91 EIR/99 MP	LAWS 118	107	ABAG	NO	11.5 (10.4)	2	11 (8.25)	Not reported	Not reported
91 EIR/99 MP	BISHOP 120	124	ABAG	NO	15 (13.5)	6 (2016)	12 (9)	4	Not reported
91 EIR/99 MP	FIVE BRIDGES	300	GP	NO	60 (54)	7/35 at 2 sites (2016)	4 (3)	2/6 at 2 sites	Not reported
91 EIR/99 MP	BIG PINE 20	20	ABAG	NO	17.7 (15.9)	Not surveyed	10 (7.5)	Not surveyed	Not reported
91 EIR/99 MP	BIG PINE 160	211	ABAG	NO	17.7 (15.9)	3 (2016)	10 (7.5)	9	Not reported
91 EIR/99 MP	TINEMAHA 54	0.4	GP	NO	33 (29.7)	1 (2016)	3 (2.3)	Not reported	Not reported
91 EIR/99 MP	BLACKROCK 16E	7.5	GP	NO	34 (31.5)	31 (2010)	6 (4.5)	5	Not reported
91 EIR/99 MP	HINES SOUTH	9	GP	NO	35 (31.5)	Assessed 2015	4 (3)	Not surveyed	Not reported
91 EIR/99 MP	INDEPENDENCE 105	13.4	GP	UNK	17 (15.3)	15 (2006)	4 (3)	3	Not reported
91 EIR/99 MP	INDEPENDENCE 123	42	GP	UNK	17 (15.3)	17 (2006)	4 (3)	4	Not reported
91 EIR/99 MP	INDEPENDENCE 131 N	23	GP	UNK	17 (15.3)	16.2 (2012)	4 (3)	5	Not reported
91 EIR/99 MP	INDEPENDENCE 131 S	50	GP	NO	17 (15.3)	6.2 (2012)	4 (3)	Not reported	Not reported
ILA	LAWS 90	101	ABAG	NO	10 (9)	Not surveyed	10 (7.5)	Not surveyed	Not reported
ILA	LAWS 94	40	ABAG	NO	10 (9)	Not surveyed	10 (7.5)	Not surveyed	Not reported
ILA	LAWS 95	46	ABAG	NO	10 (9)	Not surveyed	10 (7.5)	Not surveyed	Not reported
91 EIR/99 MP	LAWS 118	140	ABAG	NO	10 (9)	3 (2016)	8 (6)	Not reported	Not reported
ILA	LAWS 118/129	65	ABAG	NO	10 (9)	3 (2016)	8 (6)	Not reported	Not reported
ILA	LAWS 27 (SEED FARM)	118	ABAG	NO	10 (9)	Not surveyed	8 (6)	Not surveyed	Not reported

YES	Meeting Goals
YES	Cover and composition appear to have met goals, but recruitment goal has not been established
NO	Not meeting goals

*1991 EIR; 99 Mitigation Plan for revegetation; ILA, Irrigation in the Laws Area MND

Bishop 120, April 2015

Bishop 120, April 2015



Laws 118, April 2015

Big Pine 160, April 2015

Mitigation Project Status Table

The current status of all mitigation measures and other requirements of the Water Agreement and associated documents is summarized in Tables 6.1 and 6.2. The tables below contains general information about mitigation projects identified in the 1991 EIR and other agreements including their origin, description, impact mitigated, and status as of April 2017.

The Mitigation Origin columns list the project starting point and any subsequent consideration of the project over time. Many of the Enhancement Mitigation projects (E/M) that were implemented prior to the 1991 EIR were continued. Some of the pre 1985 Environmental Projects (EP) are identified as mitigation in the EIR. The Impact Number, if provided, is the 1991 EIR, and associates the mitigation measure with the pre-project setting and type of environmental impact being mitigated; it also describes the significance of the environmental impact.

Inyo County and LADWP agreed on the status of all but four of the mitigation projects, and one of the other outside commitments. Our disagreements stem from different interpretations of project goals, mitigation requirements, and commitments to obligations. The County contends that Calvert Slough should be provided a year-round flow of water in order to maintain habitat, while LADWP only provides water when it is operationally convenient. In the case of the Independence 131 revegetation project, the disagreements stems over whether the revegetation requirement is confined to one or two sections of the parcel. Disagreement over the LORP is in regard to achieving project goals. LADWP indicates that the LORP can be considered as meeting goals, while the County contends the project has not achieved a healthy, functioning riverine-riparian ecosystem, and has not met a number of specific goals including the continuation of sustainable livestock grazing and recreation. For the reason that McNally Ponds and Pasture has received water only five times in 27 years and is not providing the mitigation values specified in the 1991 EIR, Inyo County deems this project as not meeting goals. LADWP argues that past practices of not supplying the McNally Ponds and Pasture project due to limited water availability relieves them of meeting goals in all years. Finally, Inyo County believes the water agreement requires LADWP to open Haiwee Reservoir to the public for recreation. LADWP contends that security threats exist that prohibit public access. The County argues that if Haiwee is off-limits to the public then a substitute recreation plan be developed on another water body in the southern Owens Valley.

The Mitigation Project Status table is an active document. This reporting is as of 2016-17. The standing of projects relative to goals, or changes in mitigation requirements, will result in a reassessment of individual project status. For example, it is not clear if any of the 91 EIR revegetation projects can be considered complete. The mitigation plan for revegetation sets goals for recruitment. No recruitment studies have been performed on any of the parcels. A revision of the revegetation plan may move some of the revegetation projects from not meeting goals to complete. Or, in another example, the development of substitute mitigation for the McNally Ponds and Pasture could satisfy both Inyo and LADWP that the project is implemented and ongoing.

1991 EIR	1991 EIR Environmental Project (1970-1984)	1991 EIR E/M Project (1985-present)	Revegetation Project	1997 MOU	LADWP MITIGATION PROJECT COMMITMENTS	Complete[1]	Ongoing as Necessary/ Required[2]	Implemented and Ongoing[3]	Fully Implemented but not meeting goals[4]	Not fully implementd[5]
				X	Aberdeen Ditch Project (Additional Mitigation Projects Developed by the MOU Ad Hoc Group (MOU Section III.A.3))			X		
X	X				Big and Little Seely Springs (1 acre pond near Well W349; EIR Impact 10-14, EIR Table 5-2)			X		
X			X		Big Pine Area Revegetation Project (160 acres; EIR Impact 10-19)				X	
X			X		Big Pine Area Revegetation Project (20 acres; EIR Impact 10-19)				X	
X					Big Pine Ditch System (EIR Impact 10-19)			X		
X		X	X		Big Pine Northeast Regreening (30 acres; EIR Impact 10-11, EIR Table 5-3)			X		
X			X		Bishop Area Revegetation Project (124 acres; EIR Impact 10-16)				X	
X			X		Blackrock 16E Revegetation Project (EIR Impact 10-11)	X				
X	X				Blackrock Hatchery (EIR Impact 10-14)			X		
X	X				Buckley Ponds (EIR Impact 10-5 and 11-1, EIR Table 5-2)			X		
X	X				Calvert Slough (EIR Impact 10-5, EIR Table 5-2)			X		
X	X			X	Diaz Lake (EIR Table 5-2, Additional Mitigation Projects Developed by the MOU Ad Hoc Group (MOU Section III.A.3))			X		
X		X			Eastern California Museum (EIR Tables 4-3 and 5-3)			X		
X	X				Farmers Pond (EIR Impact 10-5, 10-18, 11-1, EIR Table 5-2)			X		
X	X				Fish Springs Hatchery (EIR Impact 10-14)			X		
X			X		Five Bridges Area Revegetation Project (300 acres; EIR Impact 10-12)				X	
				X	Freeman Creek Project (Additional Mitigation Projects Developed by the MOU Ad Hoc Group (MOU Section III.A.3))			X		
X				X	Hines Spring (1 to 2 acres, EIR Impact 10-14), implemented as the Additional Mitigation Projects Developed by the MOU Ad Hoc Group (MOU Section III.A.3)			X		
X			X		Hines Spring South (EIR Impact 10-11)				X	
				X	Hines Spring Well 355 Project (Additional Mitigation Projects Developed by the MOU Ad Hoc Group (MOU Section III.A.3))			X		
				X	Homestead Project (Additional Mitigation Projects Developed by the MOU Ad Hoc Group (MOU Section III.A.3))			X		

1991 EIR	1991 EIR Environmental Project (1970-1984)	1991 EIR E/M Project (1985-present)	Revegetation Project	1997 MOU	LADWP MITIGATION PROJECT COMMITMENTS	Complete[1]	Ongoing as Necessary/ Required[2]	Implemented and Ongoing[3]	Fully Implemented but not meeting goals[4]	Not fully implementd[5]
X			X		Independence 105 (EIR Impact 10-13)	X				
X			X		Independence 123 (EIR Impact 10-13)	X				
X			X		Independence 131 (EIR Impact 10-13)	LA			IC	
X		X			Independence Ditch System (EIR Table 4-3)			X		
X		X	X		Independence East Side Regreening Project (23 acres; EIR Impact 10-11, EIR Table 5-3)			X		
X		X			Independence Pasturelands and Native Pasturelands (610 acres; EIR Impact 12-1, EIR Tables 4-3 and 5-3)			X		
X		X			Independence Roadside Rest Area (0.5 acres; EIR Tables 4-3 and 5-3)			X		
X		X			Independence Springfield (286 acres; EIR Impact 12-1, EIR Tables 4-3 and 5-3)			X		
X		X			Independence Woodlot (20 acres; EIR Impact 10-11, EIR Table 4-3)			X		
X	X	X			Klondike Lake Aquatic Habitat (160 acres; EIR Impact 10-5 and 11-1, EIR Tables 4-3, 5-2, and 5-3)			X		
					Klondike SSHA (Big Pine Ditch System MND)			X		
			X		LAWS 118 (19 acre portion) (Laws Type E Transfer MND)				X	
			X		LAWS 129 (Laws Type E Transfer MND)				X	
			X		LAWS 27 (Native Seed Farm) (Laws Type E Transfer MND)					X
			X		LAWS 90 (Laws Type E Transfer MND)				X	
			X		LAWS 94 (Laws Type E Transfer MND)				X	
			X		LAWS 95 (Laws Type E Transfer MND)				X	
X			X		Laws Area Revegetation Project (140 acres; EIR Impact 10-18)				X	
X		X			Laws Historical Museum Pasturelands (21+15 acres; EIR Impact 10-18, EIR Table 5-3)			X		
X		X			Laws/Poleta Native Pasture (216 acres; EIR Impact 10-16, EIR Tables 4-3 and 5-3)			X		
X	X				Little Blackrock Springs (EIR Impact 10-14, EIR Table 5-2)			X		
X		X			Lone Pine East Side Regreening (11 acres; EIR Impact 10-16, EIR Table 5-3)			X		
X		X			Lone Pine-North Lone Pine Clean Up (EIR Table 4-3)	X				
X		X			Lone Pine Riparian Park (320 acres, EIR Tables 4-3 and 5-3)			X		
X		X			Lone Pine Sports Complex (EIR Table 5-3)	X				

1991 EIR	1991 EIR Environmental Project (1970-1984)	1991 EIR E/M Project (1985-present)	Revegetation Project	1997 MOU	LADWP MITIGATION PROJECT COMMITMENTS	Complete[1]	Ongoing as Necessary/ Required[2]	Implemented and Ongoing[3]	Fully Implemented but not meeting goals[4]	Not fully implemend[5]
X		X			Lone Pine West Side Regreening (8 acres; EIR Impact 10-16, EIR Tables 4-3 and 5-3)			X		
X		X			Lone Pine Woodlot (12 acres; EIR Impact 10-11, EIR Table 4-3)			X		
X	X	X		X	LORP Project (60 miles, perhaps more than 1,000 acres)/ Lower Owens Rewatering Project)			LA	IC[6]	
X		X			McNally Ponds and Native Pasturelands (300 acres pasture, 60 acres ponds; EIR Impact 10-5 and 10-18, EIR Tables 4-3 and 5-3)			LA	IC	
X	X	X			Millpond Recreation Area (EIR Impact 10-5, EIR Table 5-2 and 5-3)			X		
				X	North of Mazourka Canyon Road Project (Additional Mitigation Projects Developed by the MOU Ad Hoc Group (MOU Section III.A.3))			X		
X					Reinhackle Spring (EIR Impact 10-14)			X		
X		X			Richards Fields (160 acres; EIR Impact 10-16, EIR Table 4-3)			X		
X	X				Saunders Pond (EIR Impact 10-5, EIR Table 5-2)			X		
X		X			Shepherd Creek Alfalfa Field (198 acres; EIR Impact 10-11, EIR Tables 4-3 and 5-3)			X		
X		X			Shepherd Creek Potential (60 acres; EIR Impact 10-11, EIR Table 5-3)	X				
X					Steward Ranch (EIR Impact 9-14)	X				
X			X		Tinemaha 54 Revegetation Project (EIR Impact 10-11)				X	
X		X			Tree Planting along Roadways (EIR Table 4-3)			X		
X	X				Tule Elk Field (EIR Table 5-2)			X		
X		X			Van Norman Fields (170 acres; EIR Impact 10-16, EIR Table 4-3)			X		
				X	Warren Lake Project (Additional Mitigation Projects Developed by the MOU Ad Hoc Group (MOU Section III.A.3))			X		
				X	Well 368 Project (Additional Mitigation Projects Developed by the MOU Ad Hoc Group (MOU Section III.A.3))			X		
64 TOTAL MITIGATION COMMITMENTS					**LADWP Totals**	**8**	**0**	**43**	**12**	**1**
					Inyo County Totals	**7**	**0**	**41**	**15**	**1**

1991 EIR	1991 EIR Environmental Project (1970-1984)	1991 EIR E/M Project (1985-present)	Revegetation Project	1997 MOU	LADWP MITIGATION PROJECT COMMITMENTS	Complete[1]	Ongoing as Necessary/ Required[2]	Implemented and Ongoing[3]	Fully Implemented but not meeting goals[4]	Not fully implementd[5]

[1]Project has no additional commitments required (no water allotment or other financial or environmental mitigation; no continual monitoring and reporting)

[2]These measures are only applied when necessary (monitoring and reporting for mitigation measures for new projects, construction, etc.)

[3]Project is fully implemented and is currently meeting goals; however, there may be ongoing water or financial commitments or monitoring and reporting requirements

[4]Project is fully implemented but has not yet met prescribed goals or success criteria

[5]Project under development or under construction, but not fully implemented

[6]Inyo County- Most but not all LORP goals have been achieved (see LORP Annual Report)

Inyo/LA Water Agreement	1991 EIR	1991 EIR Environmental Project (1970-1984)	1991 EIR E/M Project (1985-present)	Revegetation Project	1997 MOU	LADWP OTHER OBLIGATIONS	Complete[1]	Ongoing as Necessary/ Required[2]	Implemented and Ongoing[3]	Fully Implemented but not meeting goals[4]	Not fully implementd[5]
					X	Aerial Photo Analysis (MOU Section III.E)	X				
					X	Annual Report on the Owens Valley (MOU Section III.H)			X		
X						Cooperative Studies (Water Agreement Section IX)			X		
X						Dispute Resolution (Water Agreement Section XXVI)		X			
					X	Dispute Resolution and Litigation (MOU Section VI)		X			
X						Enhancement/ Mitigation Projects (Water Agreement Section X)			X		
X						Exchange of Information and Access (Water Agreement Section XVII)			X		
X						Financial Assistance- Big Pine Ditch System (Water Agreement Section XIV.E)			X		
X						Financial Assistance- General Financial Assistance to the County (Water Agreement Section XIV.D)			X		
X						Financial Assistance- Park & Environmental Assistance to City of Bishop (Water Agreement Section XIV.F)			X		
X						Financial Assistance- Park Rehabilitation, Development, & Maintenance (Water Agreement Section XIV.B)			X		
X						Financial Assistance- Salt Cedar Control (Water Agreement Section XIV.A)			X		
X						Financial Assistance- Water and Environmental Activities (Water Agreement Section XIV)			X		
					X	Financial Provisions (MOU Section IX)	X				
					X	Fish Slough (MOU Section IV)			X		
X						Groundwater Management (Water Agreement Section II)			X		
X						Groundwater Pumping on the Bishop Cone (Water Agreement Section VII)			X		

Inyo/LA Water Agreement	1991 EIR	1991 EIR Environmental Project (1970-1984)	1991 EIR E/M Project (1985-present)	Revegetation Project	1997 MOU	LADWP OTHER OBLIGATIONS	Complete[1]	Ongoing as Necessary/ Required[2]	Implemented and Ongoing[3]	Fully Implemented but not meeting goals[4]	Not fully implementd[5]
X						Groundwater Recharge Facilities (Water Agreement Section VIII)		X			
					X	Habitat Conservation Plan (MOU Section III.B)	X				
X						Haiwee Reservoir (Water Agreement Section XIII)	LA	IC			
					X	Inventory of Plants and Animals at Spring and Seeps (outside LORP Planning Area) (MOU Section III.C)	X				
	X					Laws Area Potential Mitigation-Consideration by Standing Committee (640 acres; EIR Impact 10-18)		X			
X						Legislative Coordination (Water Agreement Section XVI)			X		
					X	LORP Agency Consultation and Public Involvement (MOU Section II.D)	X				
					X	LORP EIR (MOU Section II.F)	X				
					X	LORP Implementation (MOU Section II.H)	X				
					X	LORP Monitoring and Adaptive Management Plan (MOU Section II.E)			X		
					X	LORP Permits Approvals and Licenses (MOU Section II.I)	X				
					X	LORP Plan (MOU Section II.A)	X				
					X	LORP Planning Area- Inventory of Plants and Animals at Spring and Seeps (MOU Section III.A.2)	X				
					X	LORP Pumpback System (MOU Section II.G)	X				
					X	Lower Owens Off River Lakes and Ponds (MOU Section II.C.3)			X		
X						Lower Owens River (financial commitment) (Water Agreement Section XII)			X		
					X	Lower Owens River Delta Habitat Area (MOU Section II.C.2)			X		

Inyo/LA Water Agreement	1991 EIR	1991 EIR Environmental Project (1970-1984)	1991 EIR E/M Project (1985-present)	Revegetation Project	1997 MOU	LADWP OTHER OBLIGATIONS	Complete[1]	Ongoing as Necessary/ Required[2]	Implemented and Ongoing[3]	Fully Implemented but not meeting goals[4]	Not fully implementd[5]
					X	Lower Owens River Project 1500-Acre Blackrock Waterfowl Habitat Area (MOU Section II.C.4)			X		
					X	Lower Owens River Riverine- Riparian System (MOU Section II.C.1)			X		
					X	Mitigation Plans for Impacts Identified in the 1991 EIR and the Water Agreement (MOU Section III.F)					X
X						New Wells & Production Capacity (Water Agreement Section VI)					X
X						Owens River Recreational Use Plan (Water Agreement XV.B)					X[6]
					X	Owens Valley Land Management Plans (MOU Section III.B)			X		
X						Release of City Owned Lands - Lands for Public Purposes (Water Agreement Section XV.D)		X			
X						Release of City Owned Lands- Bishop (Water Agreement Section XV.B)	X				
X						Release of City Owned Lands- Inyo County (Water Agreement Section XV.A)	LA				IC
X						Release of City-owned lands- Additional Sales (Water Agreement Section XV.C)	X				
					X	Technical Group Meetings (MOU Section III.G)		X			
X						Town Water Systems (Water Agreement Section XI)	X				
					X	Type E Vegetation Inventory (MOU Section III.D)	X				
					X	Yellow-billed Cuckoo Habitat (MOU Section III.A.1)			X		
48 TOTAL OTHER OBLIGATIONS						**LADWP Totals**	**17**	**6**	**22**	**0**	**3**
						Inyo County Totals	**15**	**7**	**22**	**0**	**4**

Inyo/LA Water Agreement	1991 EIR	1991 EIR Environmental Project (1970-1984)	1991 EIR E/M Project (1985-present)	Revegetation Project	1997 MOU	LADWP OTHER OBLIGATIONS	Complete[1]	Ongoing as Necessary/ Required[2]	Implemented and Ongoing[3]	Fully Implemented but not meeting goals[4]	Not fully implementd[5]

[1]*Project has no additional commitments required (no water allotment or other financial or environmental mitigation; no continual monitoring and reporting)*
[2]*These measures are only applied when necessary (monitoring and reporting for mitigation measures for new projects, construction, etc.)*
[3]*Project is fully implemented and is currently meeting goals; however, there may be ongoing water or financial commitments or monitoring and reporting requirements*
[4]*Project is fully implemented but has not yet met prescribed goals or success crieria*
[5]*Project under development, or under construction, but not fully implemented*
[6]*Inyo County Commitment*

Water Supplied to Enhancement/Mitigation Projects ROY 2004-2017

Table 6.4 documents the amount of water applied to E/M projects in acre-feet in runoff years 2004-2017. The source of the data is LADWP's Annual Owens Valley Report. The *Normal Year Water Supply* is the allocation afforded the project in the 1991 EIR and is 14,420 acre-feet per year. That figure is what might be expected if all E/M projects were supplied their entire allocation (1991 EIR Table 4-3). The totals for all years are less than expected due in part to drought and not supplying water to the McNally Ponds. From 2006-2017, the Big Pine Ditch used an average of 460 acre-feet per year, and from 2007-2013 the Klondike South Shore Habitat Area used on average 99 acre-feet per year. These projects, each of which use a portion of the original 2,500 acre-foot allocation for Klondike Lake, are not presented in the table. Also, McNally ditch losses, which are not in this table totaled 3,262 acre-feet over the past 13 years.

The *13-Year Average Supplied* is the average supply of water provided each project. The *13-Year Actual* represents the total amount of water supplied a project over the course of 13 years. The *13-Year EIR Total* is amount of water that would have been supplied the individual projects given their full allocation over 13 normal years. Water allocations over the past 13 years are about 30% less than expected if all years were "normal." If the McNally Ponds and Pasture project had received their full allocation in all years, the difference between expected and recorded water use would be on the order of 10% of expected total.

Table 6.4. History of water delivered to E/M projects.

Project	Normal Year Water Supply (EIR)	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	13-Year Average *Supplied*	13-Year *Actual*	13-Year EIR Total
McNallyLaws/Poleta Native Pasture Lands	660	1,682	1,269	1,241	1,396	1,320	1,764	1,267	2,306	1,460	1,149	1,376	1,259	1,530	**1,463**	**19,019**	**8,580**
McNally Ponds	4,000	0	1,522	1,491	0	0	0	368	857	0	0	0	0	1500	**441**	**5,738**	**52,000**
Laws Historical Museum	150	32	59	99	147	63	131	152	105	138	112	119	101	113	**105**	**1,371**	**1,950**
Klondike Lake	1,700	1,278	1,203	314	1,201	1,195	1,169	1,195	1,086	1,144	1,515	1,600	1,411	1,496	**1,216**	**15,807**	**22,100**
Big Pine NE Regreening	150	0	0	0	0	0	0	0	0	0	0	103	75	110	**22**	**288**	**1,950**
Independence Pasture Land	2,350	2,489	3,330	2,785	3,272	2,588	1,962	2,397	2,545	2,324	1,852	1,932	1,731	1,900	**2,393**	**31,107**	**30,550**
Independence Springfield	1,500	280	519	1,850	1,962	1,554	1,530	1,356	1,136	1,188	958	1,427	1,569	1,476	**1,293**	**16,805**	**19,500**
Independence Ditch System	725	451	356	359	380	515	446	497	496	165	129	343	65	260	**343**	**4,462**	**9,425**
Independence Woodlot	120	276	190	226	237	335	220	569	175	334	150	186	64	110	**236**	**3,072**	**1,560**
Independence East Regreening	150	0	0	0	0	0	0	0	0	0	0	63	71	70	**16**	**204**	**1,950**
Shepherd Creek Alfalfa Lands	990	1,072	1,152	1,206	1,100	1,183	1,166	1,212	1,073	1,019	884	980	872	920	**1,065**	**13,839**	**12,870**
Lone Pine Park/Richards Field	1,230	916	1,085	870	570	1,012	1,037	1,037	1,194	481	416	429	344	644	**772**	**10,035**	**15,990**
Lone Pine Woodlot	120	76	100	120	78	51	58	123	120	156	70	74	55	60	**88**	**1,141**	**1,560**
Lone Pine Van Norman Field	480	337	474	512	306	28	147	102	116	97	79	343	426	481	**265**	**3,448**	**6,240**
Lone Pine Regreening	95	238	180	107	232	228	283	257	298	223	216	233	211	230	**226**	**2,936**	**1,235**
Total	**14,420**	**9,127**	**11,439**	**11,180**	**10,881**	**10,072**	**9,913**	**10,532**	**11,507**	**8,729**	**7,530**	**9,208**	**8,254**	**10,900**	**9,944**	**129,272**	**187,460**

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