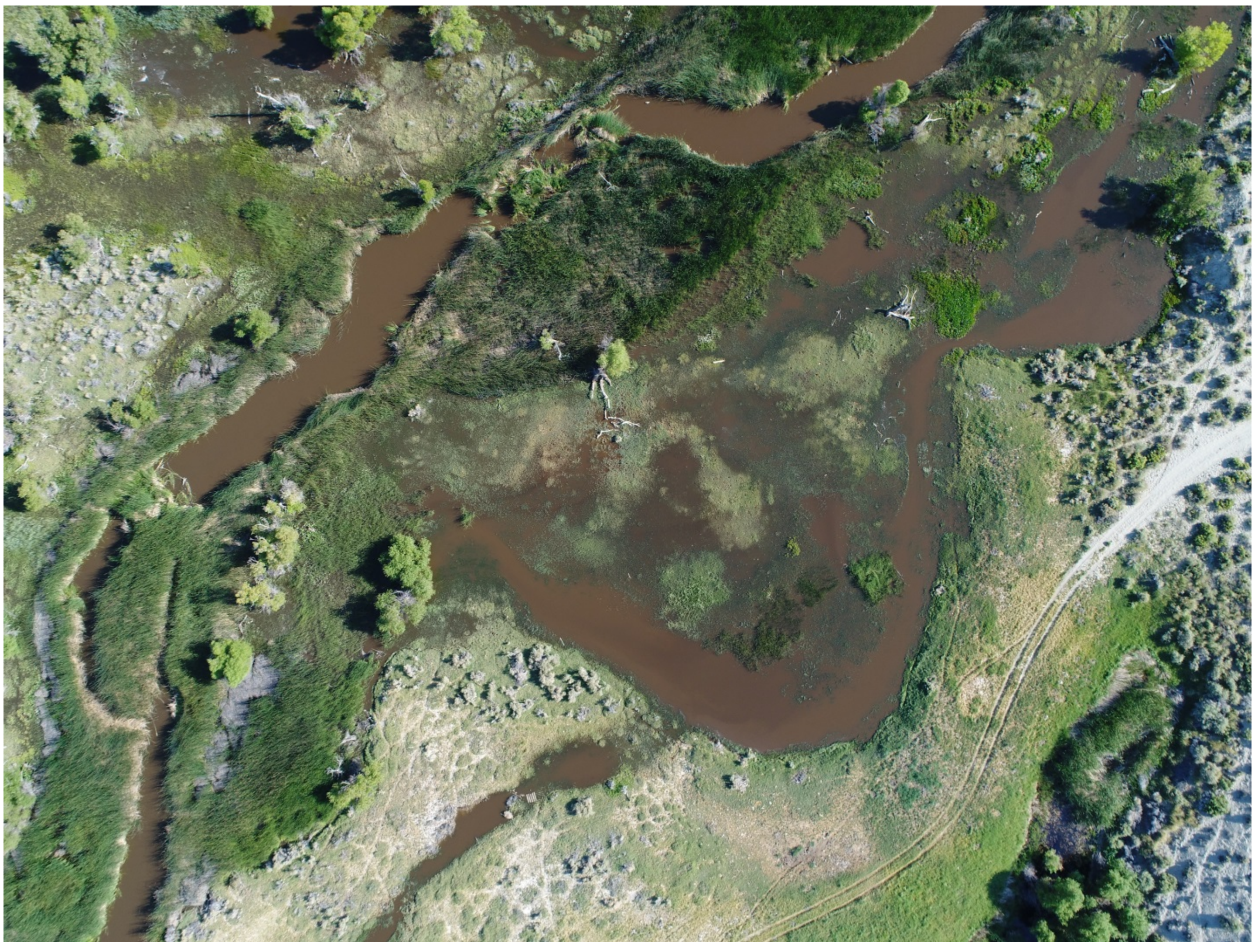
Lower Owens River Project
Annual Report



March 2018

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EXECUTIVE SUMMARY

The 2017 Lower Owens River Project (LORP) Annual Report contains the results from the eleventh year of monitoring for the LORP. Monitoring results contained in this report include hydrologic monitoring, avian census monitoring for the Thibaut Unit of the Blackrock Waterfowl Management Area (BWMA), monitoring of range conditions throughout the project area, water quality monitoring, rapid assessment, weed and saltcedar management. There is also a summary of the pole planting effort that was implemented as an adaptive management measure in 2017.

Hydrologic Monitoring

The hydrologic monitoring section describes flow conditions in the LORP regarding attainment with the 2007 Stipulation & Order flow and reporting requirements and 1991 Environmental Impact Report (EIR) goals. For the 2016-17 water year LADWP was compliant with all the 2007 Stipulation & Order flow and reporting requirements. The mean flow to the Delta Habitat Area (DHA) was 32.4 cfs, exceeding the required 6-9 cfs annual flow, due to high precipitation and runoff. The agreement to manage wetted acreage in the Blackrock Waterfowl Management Area (BWMA) by setting constant flows by seasons continued, but high runoff led additional water releases and large wetted acreage areas, but difficulty with measurement access. The seasonal habitat flow ramping reached a peak of 200 cfs and covered seven days, before ramping down over another seven days. This section also describes flow measurement issues and includes commentary on flow losses and gains through the different reaches of the Lower Owens River.

Avian Census for the Thibaut Unit, Blackrock Waterfowl Management Area

The flooded acreage requirement for the Blackrock Waterfowl Management Area (BWMA) was 500 acres based on the 2017 runoff year. Water was released to the Winterton and Thibaut Units in 2017 to fulfill this requirement. The flooded acreage for both units in fall 2017 was 644 acres; the flooded acreage surpassed that amount during the summer but was unrecorded due to limited accessibility. Avian surveys were conducted seasonally in the Thibaut Unit to detect the presence or absence of LORP Habitat Indicator Species and to provide information regarding use and preferences of these species within the management unit. Results of these surveys are presented in this section.

There was extensive flooding in the Thibaut Unit in response to the high runoff conditions in 2017. The additional flooded acreage corresponded with an approximate 500% increase in Habitat Indicator Species compared to the 2016 count, the majority of which were waterfowl. Seasonally, the highest shorebird counts occurred in the spring, while the highest waterfowl counts occurred in the fall, but waterfowl out-numbered all other habitat indicator species groups for both seasons. Summer counts were lower than spring and fall, indicating that the majority of water birds that use the Thibaut Unit are migratory. Even with the significant increase in flooded acreage in 2017, summer counts were low. On the contrary, fall counts were extremely high, indicating that water birds did respond to the increase in water availability. The 2017 fall count was 435% higher than the 2016 fall count.

In order to maximize water efficiency and habitat benefits, seasonal patterns of use by habitat indicator species should be considered. Since use of BWMA by waterbirds peaks in the spring and fall, it would be beneficial to keep the active ponds flooded during those periods. In contrast, breeding waterbird populations at BWMA are much more limited. Of note is the fact that despite significant increases in the area of open water ponds at Thibaut, all waterbird numbers remained low in the summer.

Land Management

The 2017 LORP land management monitoring efforts continued with monitoring utilization across all leases, irrigated pasture evaluations, and range trend monitoring on the Thibaut and Islands leases inside the LORP management area. After five years of extreme drought, the LORP management area experienced record levels of winter precipitation and high flows on the Lower Owens River in addition to water spreading across the uplands west of the Lower Owens River and to a lesser degree on the east side of the river. High flows led to significant decreases in shrub cover on moist floodplains along Reach 2. This area has not yet reached its potential as an herbaceous dominated meadow. The high shrub mortality have created niches that will be exploited in the following years by ruderal species. Land managers should consider this disturbance as a potential opportunity to further develop these areas into meadows.

The water spreading contributed to high plant vigor on the Blackrock and Thibaut leases. With the surplus of water, all irrigated pastures received an irrigation score of at least 80%. Pasture utilization for leases within the LORP was below the allowable levels of use established for both riparian (up to 40%) and upland (up to 65%) areas.

Analysis of Conditions of the Islands East Side Channel

Minor overflow of the Lower Owens River to the Islands East Side Channel (East Channel) above the Island was first observed in 2014. Wet meadow and riparian woodland vegetation was prominent throughout most of the East Channel bottom; marsh was prominent in the lower part of the East Channel transitional to the Island. In July 2017, seasonal habitat flow flooded the entire width of the East Channel and much of the wet meadow in the channel bottom was either flooded or replaced by marsh. In September 2017, the Owens River continued to spill significant flow into the East Channel after seasonal habitat flow receded. Continued aggradation may lead to the further occlusion of the East Channel as additional meadow and open water are replaced by marsh. Existing riparian woodland may become decadent in response to the saturated conditions. The channels above the Island, including the East Channel, are aggrading.

Water Quality

In anticipation of high flow releases to the LORP in 2017, continuous recording instruments were operated by LADWP to measure five water quality parameters at four locations from March thru August. Numerous manual measurements were also collected by ICWD and LADWP staff. The data analysis concentrated on dissolved oxygen (DO) and temperature as the parameters most indicative of a threat to the fishery.

LADWP released a pulse of water in early April similar to that proposed by Inyo and Los Angeles in 2015. DO declined 2-3 mg/L in response to the spring pulse suggesting the organic matter was mobilized and temperatures were sufficient for microbial respiration. DO remained above the threshold for the onset of fish stress, suggesting that the spring pulse had the desired effect.

Operational releases from Tinemaha Reservoir diverted into the Intake in June and July resulted in the highest flows in the river since the LORP was initiated. Water arriving at the Intake in July had slightly depressed DO beyond that due to warmer temperatures alone. The high flows in the LORP occurred when water temperatures were above that desired to avoid impacts to the fishery based on anecdotal experience from previous seasonal habitat flows. The combination of slightly depressed DO in the Owens River at the Intake, high water temperatures, and high flows caused DO to drop well below the 1 mg/L threshold from near Goose Lake to the PBS for approximately 4-5 weeks. The drop in DO was accompanied by a noticeable release of H2S and fish kills observed at numerous locations along the channel.

Rapid Assessment Survey

The LORP Rapid Assessment Survey was conducted in August. Inyo County staff surveyed the river riparian area, the Blackrock Waterfowl Management Area (BWMA) except for the flooded Thibaut unit, Off-River Lakes and Ponds (OLP), and the Delta Habitat Area (DHA). The report describes impacts that were observed and recorded by staff walking about 200 miles around the wetted perimeter of LORP water features. Crews looked for woody recruitment, saltcedar, Russian olive, noxious weeds, trash, recreation impacts, cut fence, and elk and beaver activity. Also recorded were revisits to impact sites identified during the 2016 RAS to assess persistence of the impact; including beaver evidence, woody recruitment, and new roads.

Notable is that due to a well above average snowpack the 2017 RAS was affected by flooding related to water spreading. During the survey, flows in the river ranged from 98-125 cfs, which is at least twice the flow experience during all previous surveys, and all of the BWMA units were full. As a result, floodplain and upland that had not been walked in previous years were surveyed, and 44% of areas where impacts were noted last year could not be revisited due to flooding.

Also of interest is that woody recruitment was not exceptional, but it was well above what had been found the previous two years.

LORP Adaptive Management – Pole Planting of Tree Willow and Cottonwood

This was an adaptive management attempt to boost natural recruitment of trees in the LORP. Included in the report is a discussion of the challenges to natural recruitment and our attempt at adaptive management to create tree groves for arboreal habitat and to encourage future recruitment. This was to be accomplished through vegetative propagation—the planting of prepared pole stock taken from the Owens Valley. As described in the report, the project was largely unsuccessful due to emergency water spreading that led to extensive and long-term flooding in the project area.

Saltcedar Control Program

From October 2016 to March 2017, the Inyo County Water Department saltcedar field crews cut and treated with herbicide approximately 102 sites of the total 195 sites that were discovered in the 2016 RAS. Flooding made some of the sites inaccessible. About 85 piles of dry slash were burned, more than in previous years.

Special effort was put into clearing the floodplain surrounding Upper Twin Lake, Blackrock Ditch East, and the Upper Twin Lake crossover road ditch. A significant amount of Russian olive was cut in the Twin Lakes area.

The Saltcedar Manager retired after the 2016-17 season, and there are no plans to continue the program until additional funding is found. The program in 2017-18 will be limited to monitoring through the RAS-- if that program is continued.

Weed Report

This report is produced by the Inyo Mono Agricultural Commissioner's Office that is contracted by LADWP and the County to treat weeds in the LORP. They are tasked with managing and controlling all California Department of Food and Agriculture (CDFA) designated weeds. In the LORP, the weed crews focus on eradicating Perennial pepperweed (*Lepidium latifolium*), which is the dominant herbaceous invasive in the LORP and Owens Valley.

According to the Agricultural Commissioner's Office, 2017 was a challenging year for invasive weed treatments within the LORP. The record runoff from the 2016-17 winter had a significant impact on treatment activity and plant growth and likely will result in still unforeseen impacts for many years to come.

The report describes the number of total sites, including new sites discovered this year, and compares the net acreage of weed populations on the LORP 2002 to present. The report documents a steady increase in acres of infestation from the beginning of the LORP to 2010, followed by a steep increase in the number of affect acres in 2010-11, and an equally steep decline in 2013-14.

Adaptive Management Recommendations

The singular responsibility of the MOU Consultants is to provide LORP managers (LADWP and ICWD), the Standing Committee, and MOU Parties with adaptive management recommendations each year. We review and evaluate the monitoring results along with staff conclusions and suggestions, combined with an annual on-sight examination of the LORP environmental components (river, wetlands, off-channel lakes and ponds, delta, and range). As described in the project guiding documents (MOU 1997; EMP 2002; FEIR 2004; MAMP 2008), adaptive management recommendations will be the cornerstone of LORP management. The MOU states "Should the reported information reveal that adaptive modifications to the LORP management are necessary to ensure the successful implementation of the project, or the attainment of the LORP goals, such adaptive modifications will be made". In practice, the MOU Consultants make their recommendations for modifications, actions or changes then consultant with LADWP and ICWD staff. The Technical Committee then makes its recommendations to the Standing Committee.

The MOU Consultant's adaptive management recommendations are presented at the end of each section in this chapter and summarized below.

- MOU Consultants recommend all present (2017) and future City-County Annual Report Executive Summaries include a summary of the Adaptive Management Chapter of the report.
- MOU Consultants recommend the LORP Scientific Team, during the winter of 2017-2018, develop a "Draft River Rehabilitation Status Report." A report that

describes and documents the present environmental status of the Lower Owens River.

- MOU Consultants recommend the City and County complete a preliminary ballpark only estimate, of infrastructure modification needed and the cost to complete these modifications (within the Lower Owens River flood-plain) in order to safely pass river flows up to 800 cfs without damaging infrastructure or cause safety concerns.
- MOU Consultants recommend no active restoration be implemented in the future without first developing a sufficient justification, testing, monitoring, and evaluation plan.
- MOU Consultants recommend the Scientific Team conduct an initial evaluation of those feasible active rehabilitation interventions that could be tested for success in the future.
- MOU Consultants recommend the LORP Scientific Team develop a scientific based testing, monitoring, and evaluation plan to evaluate all future flushing flow effects. This methodology should be capable of determining success, failure, no effect, or any needed flow modifications.
- MOU Consultants recommend the MOU Parties hold a "Working-Decision Meeting" during the winter of 2017-2018. Meeting purpose is to determine those river flows, if any, the "Parties" would agree to test and evaluate.
- MOU Consultants recommend the LORP Scientific Team "draft" a series of feasible flushing-augmentation flow scenarios along with a predicted effect analysis. The team produced "draft" report would then be submitted to the County and City for review and then forwarded to the MOU Parties prior to their Working-Decision Meeting.
- MOU Consultants recommend that the County, in their 2018 Annual Report, be in position to provide the evidence they believe is missing that does not allow them to evaluate proposed seasonal habitat and flushing flow effectiveness.
- MOU Consultants recommend the 2018 seasonal habitat flow be augmented from the Alabama Gates. The volume and duration of the augmentation flow will be recommended by the Consultants to the City and County when Owens Basin run-off conditions become available to the Consultants.
- MOU Consultants recommend the LORP Scientific Team test, monitor, and evaluate the Consultants recommended 2018 flushing flows to determine their success, failure, non-effect, or any flow modifications needed.
- MOU Consultants recommend that the Scientific Team "draft" report their flushing flow test and evaluation findings to the County and City for their review. The "draft" report will then be sent to the MOU Parties for their information and necessary action.
- MOU Consultants recommend the LORP Scientific Team be given the responsibility to properly evaluate all future fish kills. This would be accomplished via reliable data collection, documentation, analysis and report submission. Using the findings, the Scientific Team will develop information for the MOU Parties to better understand what is causing fish kills.

- MOU Consultants recommend the County and the City conduct a recreational fishery survey in 2018. Results, with suggestions for methodology improvement should be documented in the 2018 LORP Annual Report.
- MOU Consultants again recommend the County develop a "draft" recreational fishing evaluation methodology that meets their expectations. The County will then send this "draft" to the LORP Scientific Team for review and evaluation.
- In 2016, the MOU Consultants recommended employing a remote sensing approach to improve accuracy and reduce the labor effort associated with walking the perimeter of units. While both LADWP and ICWD agreed to give this recommendation consideration, it has not been adopted. The inability to walk the units this last spring and summer adds weight to the recommendation to rely upon remote imagery for this monitoring.
- MOU Consultants concur that American Coot as an indicator species in the BWMA and Thibaut Units is counterproductive and recommend removing it from the indicator species list. As in 2015 and 2016, we recommend that LADWP and ICWD work together to refine the indicator species list to better reflect the actual presence and usage of targeted animals.
- In the response to the MOU Consultants' recommendation in previous years to develop and initiate a plan for the BWMA to seasonally wet and dry management units, LADWP and ICWD agreed to pursue such a plan in cooperation with CDW. We again urge the managing entities to address the legal and operational constraints and establish a more beneficial management plan that would be agreeable to the MOU Parties. The avian survey results clearly indicate that seasonal flooding and drying similar to the Thibaut Unit management will result in far greater bird use.
- Effects of the high flows this year on the DHA should be evaluated using remote imagery taken during the flood periods to identify the location (east and west channels) and extent of open-water since this type of habitat has been shown to have greater value to some indicator species. Then initiate a study to determine the most suitable flow pattern for the DHA for the three periods recommended previously.
- MOU Consultants recommend that if LADWP is interested in increasing utilization standards in riparian pastures that they design a rigorous scientific experiment to test the effects of increased grazing on key LORP goals such as woody riparian recruitment and indicator species habitat.
- MOU Consultants have wavered back and forth on the advisability of continuing the RAS beyond next year when it is programmed to terminate. Our recommendation is to continue part of the RAS beyond next year and that is just observing and counting riparian recruitment and conditions.
- MOU Consultants recommend that before more pole plantings are attempted, a detailed experimental plan be developed and vetted through the Scientific Committee and the adaptive management process.
- MOU Consultants recommend refunding the saltcedar control program for at least this coming year because of the risk of substantial increase in noxious

weeds and saltcedar. We further recommend that eradication effort be focused on the river corridor and the flooding basins be a secondary priority as funding permits.

- MOU Consultants recommend increasing the CAC funding and staffing in 2017-18 to address the expected increase in lepidium and other noxious weeds throughout the LORP.
- MOU Consultants recommend that LADWP and ICWD development a contingency monitoring plan to account for extreme flood conditions such as this year. Monitoring should focus on discharge throughout the river, flood extent and water quality.

1.0 LOWER OWENS RIVER PROJECT INTRODUCTION

The Lower Owens River Project (LORP) is a large-scale habitat restoration project in Inyo County, California being implemented through a joint effort by the Los Angeles Department of Water and Power (LADWP) and Inyo County (County). The LORP was identified in a *1991 Environmental Impact Report* (EIR) as mitigation for impacts related to groundwater pumping by LADWP from 1970 to 1990. The description of the project was augmented in a *1997 Memorandum of Understanding* (MOU), signed by LADWP, the County, California Department of Fish and Game (CDFG), California State Lands Commission (SLC), Sierra Club, and the Owens Valley Committee. The MOU specifies the goal of the LORP, timeframe for development and implementation, and specific actions. It also provides certain minimum requirements for the LORP related to flows, locations of facilities, and habitat and species to be addressed.

The overall goal of the LORP, as stated in the MOU, is as follows:

> "The goal of the LORP is the establishment of a healthy, functioning Lower Owens River riverine-riparian ecosystem, and the establishment of healthy, functioning ecosystems in the other physical features of the LORP, for the benefit of biodiversity and Threatened and Endangered Species, while providing for the continuation of sustainable uses including recreation, livestock grazing, agriculture and other activities."

LORP implementation included release of water from the Los Angeles Aqueduct (LAA) to the Lower Owens River, flooding of up to approximately 500 acres depending on the water year forecast in the Blackrock Waterfowl Management Area (BWMA), maintenance of several Off-River Lakes and Ponds, modifications to land management practices, and construction of new facilities including a pumpback station to capture a portion of the water released to the river.

The LORP was evaluated under CEQA resulting in the completion of an EIR in 2004.

1.1 Monitoring and Reporting Responsibility

Section 2.10.4 of the Final LORP EIR states that the County and LADWP will prepare an annual report that includes data, analysis, and recommendations. Monitoring of the LORP will be conducted annually by the Inyo County Water Department (ICWD), LADWP and the MOU consultants, Mr. Mark Hill and Dr. William Platts, according to the methods and schedules described under each monitoring method as described in Section 4 of the *Lower Owens River Monitoring Adaptive Management and Reporting Plan* (Ecosystem Sciences 2008).

Specific reporting procedures are also described under each monitoring method. The MOU requires that the County and LADWP provide annual reports describing the environmental conditions of the LORP. LADWP and the County are to prepare an annual report and include the summarized monitoring data collected, the results of analysis, and recommendations regarding the need to modify project actions as recommended by the MOU consultants. This LORP Annual Report describes monitoring data, analysis, and recommendations for the LORP based on data collected during the 2017 field season (March-October). The development of the LORP Annual Report is a collaborative effort between the ICWD, LADWP, and the MOU consultants. Personnel from these entities participated in different sections of the report writing, data collection, and analysis.

The 2007 Stipulation & Order also requires the release to the public and representatives of the Parties identified in the MOU a draft of the annual report. The 2007 Stipulation & Order states in Section L:

> "LADWP and the County will release to the public and to the representatives of the Parties identified in the MOU a draft of the annual report described in Section 2.10.4 of the Final LORP EIR. The County and LADWP shall conduct a public meeting on the information contained in the draft report. The draft report will be released at least 15 calendar days in advance of the meeting. The public and the Parties will have the opportunity to offer comments on the draft report at the meeting and to submit written comments within a 15 calendar day period following the meeting. Following consideration of the comments submitted the Technical Group will conduct the meeting described in Section 2.10.4 of the Final LORP EIR."

Generally, LADWP is the lead author for a majority of the document and is responsible for overall layout and content management. In 2017, LADWP wrote Sections 1.0 Introduction; 2.0 Hydrologic Monitoring; 3.0 Avian Census for the Thibaut Unit, Blackrock Waterfowl Management Area; 4.0 Land Management, and 5.0 Analysis of Conditions of the Islands East Side Channel. ICWD completed Sections 6.0 Water Quality; 7.0 Rapid Assessment Survey; 8.0 LORP Adaptive Management – Pole Planting of Tree Willow and Cottonwood; and 9.0 Saltcedar Control Program. Section 10.0 Weed Report was authored by the Inyo/Mono Counties Agricultural Commissioner's Office.

The annual report will be available to download from the LADWP website link: http://www.ladwp.com/LORP.

This document fulfills the reporting requirements for the LORP Annual Report for 2017.

2.0 HYDROLOGIC MONITORING

2.1 2017 High Runoff Conditions Commentary

Due to the extremely high runoff experienced this year (approximately 225% of normal for April-September), excess water was released into the Lower Owens River Project (LORP) during the summer as reservoirs and the Los Angeles Aqueduct operated at maximum capacity and could not handle additional flows. For over a month during June and July, inflow into the LORP exceeded 240 cfs and reached a high of 325 cfs. Also, in order to take advantage of the excess runoff, a flushing flow was released in April peaking at an average daily flow of 274 cfs at the recommendation of the MOU consultants.

The area between the Los Angeles Aqueduct and the Lower Owens River were used extensively as spreading grounds to prevent even more water being released into the Lower Owens River (and thus to Owens Lake via the LORP). This area also includes the Blackrock Waterfowl Management Area. During the summer months this area was highly inundated making measurement of the waterfowl areas and pond elevations of the Off-River Lakes and Ponds impossible.

Finally, in addition to spreading efforts west of the Lower Owens River noted above, two abandoned canals called the McIver Canal and the Eclipse Ditch (also called the East Side Ditch) were used to remove excess flow from the LORP when flows were released into the LORP to avoid overtopping the capacity of the Los Angeles Aqueduct and LADWP's reservoirs (see Appendix 3 for flows in these canals).

2.2 River Flows

On July 12, 2007, a Court Stipulation & Order was issued requiring LADWP to meet specific flow requirements for the LORP. The flow requirements are listed below:

1. Minimum of 40 cubic feet per second (cfs) released from the Intake at all times.

2. None of the in-river measuring stations have a 15-day running average of less than 35 cfs.

3. The mean daily flow at each of the in-river measuring stations must equal or exceed 40 cfs on 3 individual days out of every 15 days.

4. The 15-day running average of the in-river flow measuring stations is no less than 40 cfs.

On July 14, 2009, 6 of the 10 original temporary in-river measuring stations were taken out of service, while the Below LORP Intake, Mazourka Canyon Road, Reinhackle Springs, and Pumpback Stations remained in service.

The flow data graphs show that LADWP was in compliance with the Stipulation & Order, from October 2016 through September 2017, for the 4 in-river stations (see Hydrological Appendix 2).

2.2.1 Web Posting Requirements

The Stipulation & Order also outlined web posting requirements for the LORP data. LADWP has met all the posting requirements for the daily reports, monthly reports, and real time data.

Daily reports listing the flows for the LORP, Blackrock Waterfowl Management Area (BWMA) wetted acreage, and Off-River Lakes and Ponds depths are posted each day on the Web at <http://www.ladwp.com> under About Us → Los Angeles Aqueduct → LA Aqueduct Conditions Reports → LORP Flow Reports and click on the ‘List of LORP Flow Reports’ link.

Monthly reports summarizing each month and listing all of the raw data for the month are posted to the Web at <http://www.ladwp.com> under About Us → Los Angeles Aqueduct → LA Aqueduct Conditions Reports → LORP Monthly Reports.

Real time data showing flows at Below LORP Intake, Owens River at Mazourka Canyon Road, Owens River at Reinhackle Springs, and Pumpback Station are posted to the Web at <http://www.ladwp.com> under About Us → Los Angeles Aqueduct → LA Aqueduct Conditions Reports → Real Time Data and click on the ‘Lower Owens River Project’ link.

2.2.2 Measurement Issues

LORP in-river flows are measured using Sontek SW acoustic flow meters. Both of the Sontek SW meters located in the main channel of the LORP are mounted on the bottom of concrete sections. These devices are highly accurate and final records for the LORP generally fall within normal water measurement standards of +/- 5%.

The accuracy of the Sontek meters are affected by factors which change the levels or velocities in the river. One of those factors is seasonal changes, such as spring/summer vegetation growth, which cause water levels to increase and velocities to decrease. Another factor is sediment build-up. As a band of sediment builds up on or near the measuring station section, the water levels of the section can increase or velocities can be shifted-both of which affect the accuracy of the Sontek meters. In order to account for these environmental changes, LADWP manually meters flows at all of the stations along the LORP to check the accuracy of the meters. Each time current metering is performed, a 'shift' is applied to the station to take into account the difference in flow determined by the current metering. If a fundamental change in the flow curve is observed then a new index is created from the current metering data and downloaded to the meter. All of the meters on the LORP are calibrated at a minimum of once per month, per the 2007 Stipulation & Order, to maintain the accuracy of the meters.

A commentary on each station along the LORP follows:

Below LORP Intake

Measurement Device: Langemann Gate

The Langemann Gate regulates and records the flow values at the Intake. This has had very good accuracy and reliability as long as the gate does not become submerged (submergence may be possible at higher flows such as when the seasonal habitat flows are released). In order to attempt to solve the water measurement problems when the Langemann Gate is submerged, a WaterLOG H-350XL was installed as a back up to the Langemann Gate measurement. After a few years of attempting to apply a rating curve to the level measured by the bubbler, it has been determined that the large fluctuations in stage as conditions in the river channel go through seasonal cycles are too large and unpredictable to sustain an accurate measurement using the bubbler. As such, the bubbler has been abandoned and LADWP will no longer use the bubbler as a backup device to measure flow at the Intake.

LORP at Mazourka Canyon Road

Measurement Devices: Sontek SW Meter

The station utilizes a single Sontek SW flow meter in a concrete measuring section and flow measurement accuracy has been excellent.

LORP at Reinhackle Springs

Measurement Device: Sontek SW Meter

The station utilizes a single Sontek SW flow meter in a concrete measuring section and measurement accuracy has been excellent.

<u>LORP at Pumpback Station</u>

Measurement Devices: Pumpback Station Discharge Meter, Langemann Gate, Weir

At the Pumpback Station, the flow is a calculated by adding the Pumpback Station, Langemann Gate Release to Delta, and Weir to Delta. In most flow conditions these stations have proven to be very accurate. However, during the higher flows, the Weir and/or the Langemann Gate can become submerged, thus lowering the measuring accuracy of the submerged device.

2.3 Flows to the Delta

Based upon a review of the flow to Brine Pool and flow to Delta data, and after filtering out unintended spillage at the Pumpback Station to average a flow of 6 to 9 cfs, the flows to the Delta were set to the following approximate schedule (per the LORP Environmental Impact Report (EIR), section 2.4):

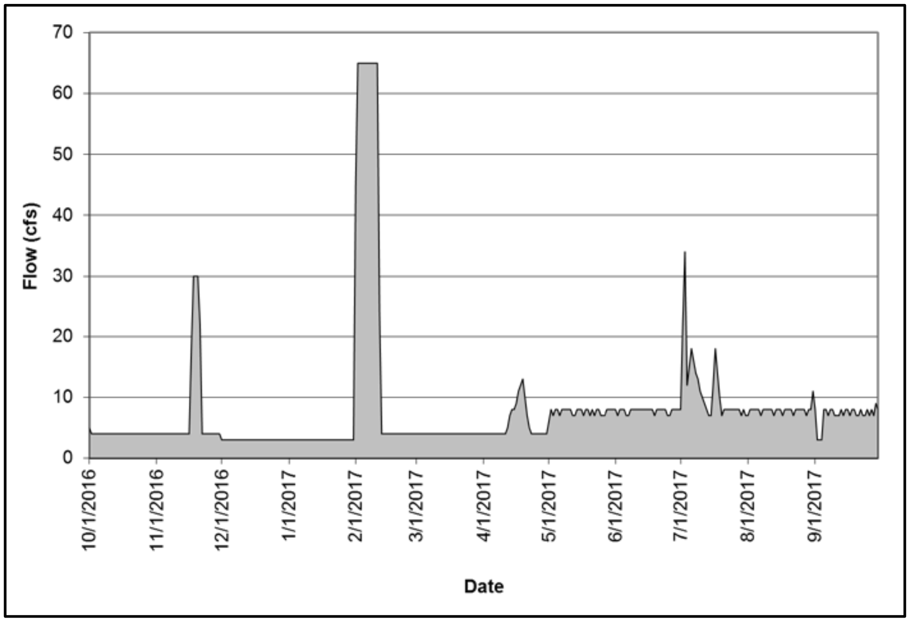
- October 1 to November 30 4 cfs
- December 1 to February 28 3 cfs
- March 1 to April 30 4 cfs
- May 1 to September 30 7.5 cfs

Additionally, pulse flows were scheduled to be released to the Delta (LORP EIR, section 2.4):

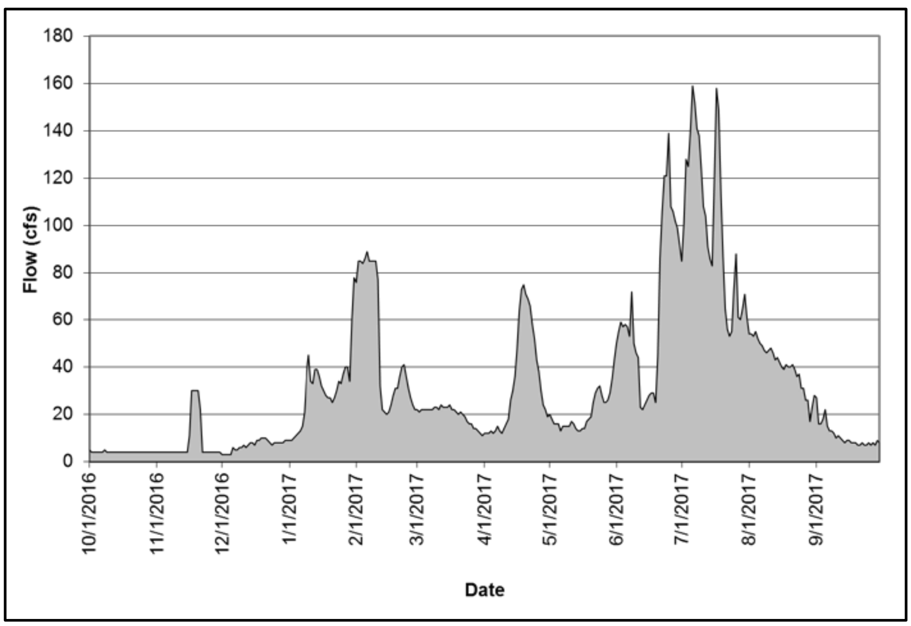
- Period 1: March-April 10 days at 25 cfs
- Period 2: June-July 10 days at 20 cfs
- Period 3: September 10 days at 25 cfs
- Period 4: November-December 5 days at 30 cfs

Only the Period 4 scheduled flow to the Delta was released as planned. The other pulse flows were cancelled due to significant excess flows to the Delta between January 2017 and September 2017.

The releases to the Delta for the 2016-17 water year resulted in an average of 32 cfs flow to the Delta. Flows to the Delta increased significantly this year, due to heavy winter precipitation and high spring and summer runoff. Unintended flows are also released to the Delta when intense rainstorms cause river flows to exceed the maximum allowed flowrate of the Pumpback Station or when pump outages occur at the Pumpback Station. Flows over the weir are generally unintended flows and flows over the Langemann Gate are scheduled flows, but the high runoff this year led to atypical releases from both the weir and Langemann Gate.



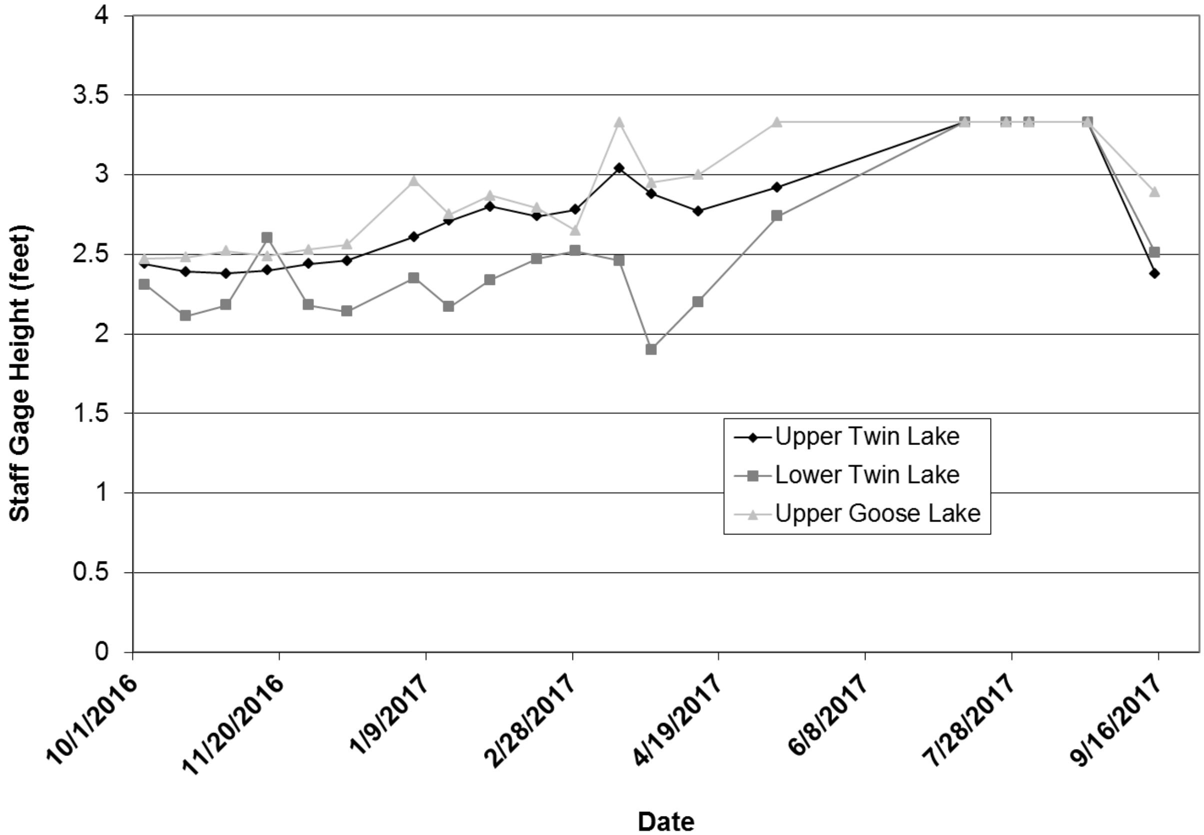
Hydrologic Figure 1. Langemann Release to Delta



Hydrologic Figure 2. Langemann and Weir Release to Delta

Off-River Lakes and Ponds

The BWMA and Off-River Lakes and Ponds Hydrologic Data Reporting Plan requires that Upper Twin Lake, Lower Twin Lake, and Goose Lake be maintained between 1.5 and 3.0 feet on their respective staff gauges, and that Billy Lake be maintained full (i.e., at an elevation that maintains outflow from the lake). All of the staff gages measured above 1.5 feet stage height for the October 2016 to September 2017 reporting period. Due to high runoff, the staff gages exceeded their maximum value of 3.33 feet during parts of the year.



Hydrologic Figure 3. Off-River Lakes and Ponds Staff Gages

Billy Lake

Due to the topography of Billy Lake in relation to the Billy Lake Return station, whenever the Billy Lake Return station is showing flow, Billy Lake is full. LADWP maintains Billy Lake by monitoring the Billy Lake Return station to always ensure some flow is registering there. The table in Hydrological Appendix 2 presents the annual summary of flows, and shows that at no time did the flow at Billy Lake Return Station fall to zero for a day. Billy Lake Return had a minimum daily average flow of 0.4 cfs for the year, so Billy Lake remained full for the entire year (see the following table).

Hydrologic Table 1. LORP Flows – Water Year 2016-17

Station Name	Average Flow (cfs)	Maximum Flow (cfs)	Minimum Flow (cfs)
Below River Intake	84.6	326.0	41.0
Blackrock Return Ditch	1.7	13.0	0.3
Goose Lake Return	0.9	4.9	0.0
Billy Lake Return	1.9	8.2	0.4
Mazourka Canyon Road	82.7	270.0	38.0
Locust Ditch Return	1.6	12.0	0.0
Georges Ditch Return	2.6	28.1	0.0
Reinhackle Springs	77.2	221.0	35.0
Alabama Gates Return	0.5	56.6	0.0
At Pumpback Station	75.6	206.0	42.0
Pump Station	43.2	48.0	0.0
Langemann Gate to Delta	7.9	65.0	3.0
Weir to Delta	24.5	141.0	0.0

Thibaut Pond

Thibaut Pond is contained completely within the Thibaut Unit of the BWMA. Each day the Thibaut Pond acreage is posted to the web in the LORP daily reports.

2.4 Blackrock Waterfowl Management Area

Flows for the BWMA are set based upon previous data relationships between inflows to an area and the resulting wetted acreage measurements during each of the four seasons based on evapotranspiration (ET) rates.

The seasons are defined as:

Spring	April 16 – May 31
Summer	June 1 – August 15
Fall	August 16 – October 15
Winter	October 16 – April 15

Up until the end of the 2012-13 Runoff Year, wetted acreage measurements were collected eight times per year, once in the middle of each season and once at the end of each season. Starting on the 2013-14 Runoff Year, only the middle of each season measurements have been collected. The end of season measurements were discontinued because they added very little information compared to the middle of season measurements and required extensive manpower for taking the measurement. The measurements are performed by using GPS and walking the perimeter of the wetted edges of the waterfowl area.

Hydrologic Table 2. BWMA Wetted Acreage

Winterton Unit				Thibaut Unit			
ET Season	Read Date	Wetted Acreage	Average Inflow	ET Season	Read Date	Wetted Acreage	Average Inflow
Spring	5/17/2016	111	5.3	Spring	5/17/2016	176	2.8
Summer	7/11/2016	213	5.1	Summer	7/8/2016	112	2.8
Fall	9/16/2016	167	5.4	Fall	9/20/2016	108	1.6
Winter	1/18/2017	243	1.8	Winter	1/12/2017	467	2.4
Spring	n/a	500+	10	Spring	n/a	500+	14.5
Summer	n/a	500+	21	Summer	n/a	500+	8.8
Fall	10/3/2017	190	n/a	Fall	10/3/2017	454	n/a

Drew Unit				Waggoner Unit			
ET Season	Read Date	Wetted Acreage	Average Inflow	ET Season	Read Date	Wetted Acreage	Average Inflow
Spring				Spring			
Summer				Summer			
Fall				Fall			
Winter	n/a	n/a	0.5	Winter	n/a	n/a	2.2
Spring	n/a	500+	4.2	Spring	n/a	500+	5.5
Summer	n/a	500+	3.2	Summer	n/a	500+	15.3
Fall				Fall			

Notes:
Measurements before 4/1/17 count towards the 2016-2017 runoff year acreage goal.
Measurements after 4/1/17 count towards the 2017-2018 runoff year acreage goal.
Thibaut wetted acreage does not include the 28 acres of the Thibaut Pond area.
Spring and Summer values of "500+" are for the total combined wetted acreage in the BWMA. Flows were also released to Drew and Waggoner areas during Water Year 2016-2017 due to high runoff.
Wetted acreage measurements were not conducted in Spring or Summer 2017 due to high runoff, saturated ground and difficult access conditions, the significant flows being released to the BWMA, and the 700+ wetted acres measured during January 2017.

2.4.1 Blackrock Waterfowl Management Area Results for April 2016 to March 2017

The runoff forecast for runoff year 2016-17 was 71%, so the waterfowl acreage goal for this year was 355 acres.

On April 7, 2016 the flow to Thibaut Waterfowl Area was increased from 0 cfs to 4 cfs.

On April 16, 2016 the flow to Thibaut Waterfowl Area was decreased from 4 cfs to 3.3 cfs. Also on April 16, 2016 flow to Winterton Waterfowl Area was increased from 1.6 cfs to 6 cfs.

On May 17, 2016 the wetted extent of Thibaut Waterfowl Area and Winterton Waterfowl Area were measured with GPS. Thibaut Waterfowl Area measured 204 acres, and Winterton Waterfowl Area measured 111 acres.

On June 1, 2016 flows to Thibaut Waterfowl Area were changed from 3.3 to 2.8 cfs, and flows to Winterton Waterfowl Area were changed from 6 cfs to 5.1 cfs.

On July 11, 2016 the wetted extent of Winterton Waterfowl Area was measured with GPS as 213 acres. On July 8, 2016 the wetted extend of Thibaut Waterfowl Area was measured with GPS as 140 acres.

On August 16, 2016 flows to Thibaut Waterfowl area were changed from 2.8 cfs to 1.6 cfs. Flows to Winterton Waterfowl area remained at 5.1 cfs.

Fall wetted extents were measured with GPS as 167 acres for Winterton on September 14, 2016, and 136 acres for Thibaut on September 20, 2016.

On October 16, 2016 flows to Thibaut Waterfowl Area were changed from 1.6 cfs to 1.0 cfs, and flows to Winterton Waterfowl Area were changed from 5.1 cfs to 1.7 cfs.

On January 12, 2017 the wetted extent for Thibaut Waterfowl area was measured as 495 acres. On January 18, 2017 the wetted extend for Winterton Waterfowl area was measured as 243 acres. On January 27, 2017 flows to Thibaut Waterfowl area were turned off.

The average waterfowl wetted area for the runoff year was 530 acres, which was above the target goal of 355 acres.

2.4.2 Blackrock Waterfowl Management Area Results for April 2017 to September 2017

The runoff forecast for runoff year 2017-18 was 197% of normal, so the waterfowl acreage goal for this year was 500 acres.

On April 16, 2017 the flow to Thibaut Waterfowl Area was increased from 0 cfs to 6.5 cfs, and flow to Winterton Waterfowl Area was increased from 1.7 cfs to 5.8 cfs.

An average daily inflow of 46 cfs entered the Blackrock Ditch via the Blackrock Spillgate and Blackrock Siphon for the month of May. An average of 1.1 cfs returned to the LORP via Blackrock Return Ditch, netting an approximate average delivery of 45 cfs into the Waterfowl Area, in addition to ongoing Winterton and Thibaut flows.

No wetted acreage survey was done in the first season of runoff year 2017-18 as the Waterfowl Area is quite wet, has difficult access given current conditions, the final wetted acreage survey of runoff year 2016-17 was over 700 acres, and water inflows are substantially above those required to provide 500 acres of habitat, as described above.

For the month of June, an average of approximately 133 cfs entered the Blackrock Ditch, with roughly 2 cfs average returning to the LORP. Flow releases from Winterton and Thibaut also continued. For the reasons noted above, no wetted perimeter survey was done during June.

On July 27, 2017 flows to Thibaut Waterfowl Area were set to 6.4 cfs and flows to Winterton Waterfowl Area were set to 2.9 cfs.

On August 15, 2017 flows to Thibaut Waterfowl Area were set to 3.4 cfs and flows to Winterton Waterfowl Area were set to 3.6 cfs.

2.5 Assessment of River Flow Gains and Losses

This section describes river flow gains and losses for all reaches in the Lower Owens River from the LORP Intake to the Pumpback Station during the period of October 2016 to September 2017. The reaches referred to in this report indicate areas of river between specified permanent gaging stations. This analysis is an attempt at understanding flow losses and gains in the Lower Owens River so that estimates of future water requirements can be made.

2.5.1 River Flow Loss or Gain by Month and Year

Flow losses or gains can vary over time as presented in the table below. ET rates fall sharply during late fall - winter and increase dramatically during the spring - summer plant growing seasons. Thus, the river can lose water to ET during certain periods of the year and maintain or gain water during other periods of the year. December through March are winter periods with low ET that result in gains from increased flows from water stored in the shallow aquifer where groundwater levels are higher than adjacent river levels. Other incoming winter water sources such as local sporadic runoff from storms also result in flow increases.

Hydrologic Table 3. Average Monthly River Flow Losses/Gains From the Intake to the Pumpback Station during the 2016-17 Water Year

	Month	Flow (cfs)	Acre-Feet-Per-Day
2016	OCT	-7	-13
	NOV	+1	+2
	DEC	+10	+19
2017	JAN	+29	+58
	FEB	+32	+64
	MAR	+12	+25
	APR	-9	-18
	MAY	-39	-77
	JUN	-106	-209
	JUL	+7	+13
	AUG	-1	-1
	SEP	-0	-0
	AVG MONTH	**-6 cfs**	**-12 AcFt**

For the entire river, the overall gain or loss is calculated by subtracting Pumpback Station outflow from inflows at the Intake and augmentation spillgates. For this water year, flows out the McIver Canal and Eclipse Ditch were added to Pumpback Station outflows for the gain or loss calculations. Inflows from the Intake were 61,258 acre-feet, inflows from augmentation spillgates were 6,703 acre-feet, and outflows from the Pumpback Station were 54,713 acre-feet, and outflows from McIver and Eclipse were 8,998 acre-feet. This yields a loss of 4,251 acre-feet for the year, a daily average of approximately 5.9 cfs between the Intake and the Pumpback Station. Water loss during the 2016-17 water year represents about 6.3% of the total released flow from the Intake and augmentation spillgates into the river channel.

2.5.2 Flow Loss or Gain by River Reach during the Winter Period

From December 2016 to March 2017, an average flow of 44 cfs was released into the Lower Owens River from the Intake. An additional 4 cfs was provided from augmentation ditches, for a total accumulated release of 48 cfs. The average flow reaching the Pumpback Station was 69 cfs, an increase of 21 cfs during the period. During the winter, ET is low and any “make water” coming into the river is additive. Part of the “make water” was probably stored during earlier periods in subsurface aquifers and may also be a result of higher winter season precipitation.

The river reach from the Intake to the Mazourka Canyon Road gaging station gained 5 cfs, while the reach from Mazourka Canyon Road to the Reinhackle gaging station gained 2 cfs and Reinhackle to the Pumpback Station gained 13 cfs (see table below). A water “gaining” reach, during harsh winter conditions, can benefit an ecosystem in many ways. Incoming water, especially if it is subsurface, tends to: increase winter river water temperatures, reduces icing effects, increases dissolved oxygen when water surface ice is melted by increasing the re-aeration rate, and adds nutrients.

Hydrologic Table 4. Winter Flow Losses/Gains, December 2016 to March 2017

Recording Station	Average Flow (cfs)	Gain or Loss (cfs)	Accumulative (cfs)
Intake	44	N/A	N/A
Mazourka	53	+5	+5
Reinhackle	55	+2	+7
Pumpback	69	+13	+21

Note: All numbers are rounded to the nearest whole value.

Calculations include augmentation and return flows in appropriate reaches, see Appendix 2 for all flows.

2.5.3 Flow Loss or Gain by River Reach during the Summer Period

During the summer period of June 2017 to September 2017, all river reaches lost water. An average flow of 139 cfs was released into the Lower Owens River from the Intake. An additional 18 cfs was provided from augmentation locations throughout the Lower Owens River. An average flow of 18 cfs was diverted down the McIver Canal, and an average flow of 16 cfs was diverted down the Eclipse Ditch. The effects of ET are evident from the high total flow loss (-25 cfs) between the Intake and the Pumpback Station. Summer flow losses were 46 cfs higher than conditions during the winter season. The largest flow losses occurred at the Reinhackle to Pumpback reach (-15 cfs) (see following table).

Hydrologic Table 5. Summer Flow Losses/Gains, June 2017 to September 2017

Recording Station	Average Flow (cfs)	Gain or Loss (cfs)	Accumulative (cfs)
Intake	139	N/A	N/A
Mazourka	127	-1	-1
Reinhackle	112	-9	-10
Pumpback	98	-15	-25

Note: All numbers are rounded to the nearest whole value.
Calculations include augmentation and return flows in appropriate reaches, see Appendix 2 for all flows.

2.6 Seasonal Habitat Flow

2.6.1 Seasonal Habitat Flow

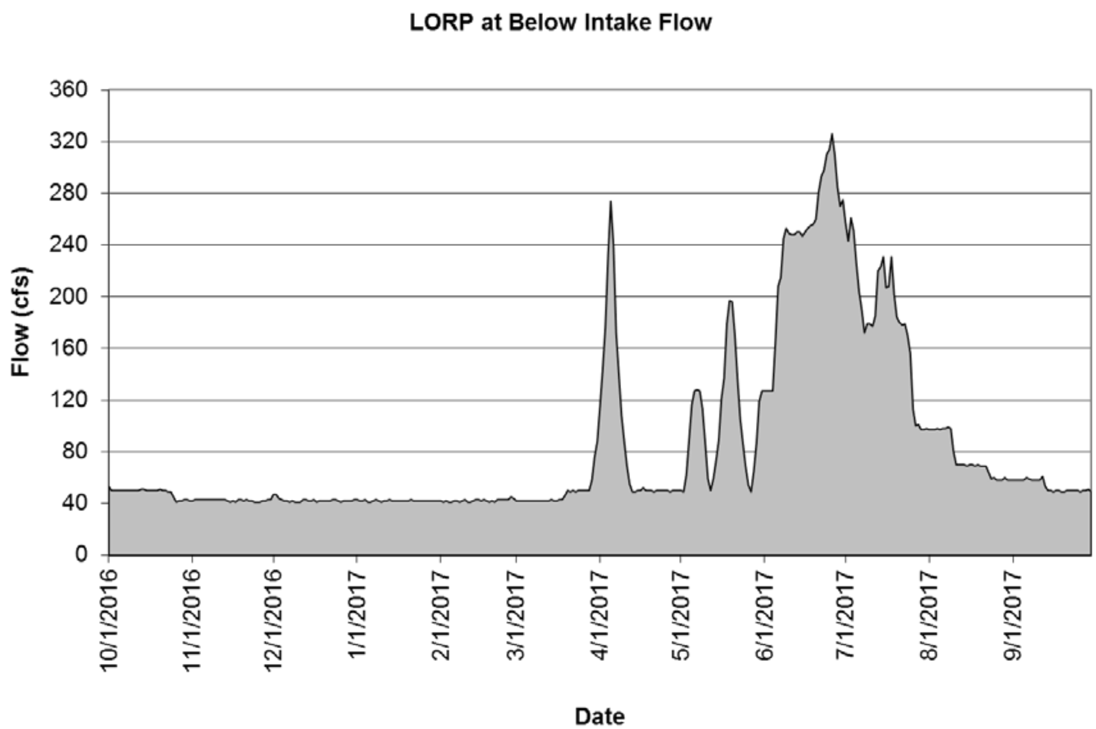
The runoff forecast for runoff year 2017-18 was 197%, and a Seasonal Habitat Flow was released from the LORP Intake in May 2017. Flows from the LORP Intake were ramped up to a peak of 200 cfs over a period of seven days, before ramping down over another seven days.

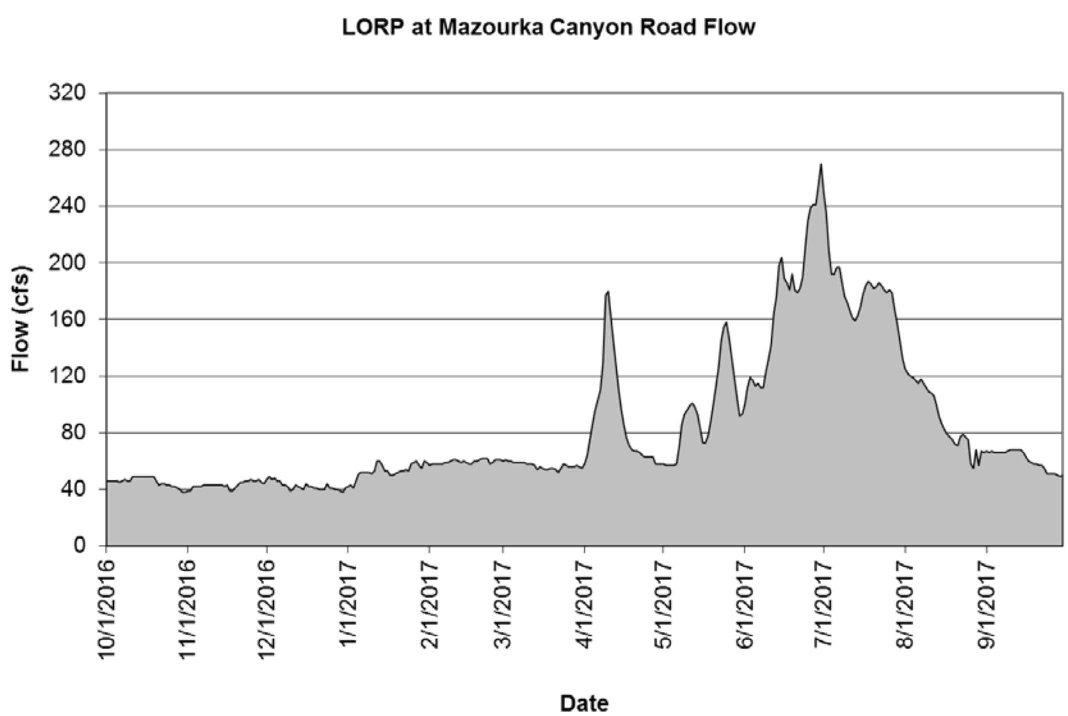
In addition, a spring “flushing flow” was released at the request of the MOU consultants and implemented by LADWP due to excess water being available from the anticipated high runoff. The ramp up for the flushing flow began on March 29 and reached a peak of 274 cfs (daily average) on April 5 and was ramped back down to normal flows by April 13.

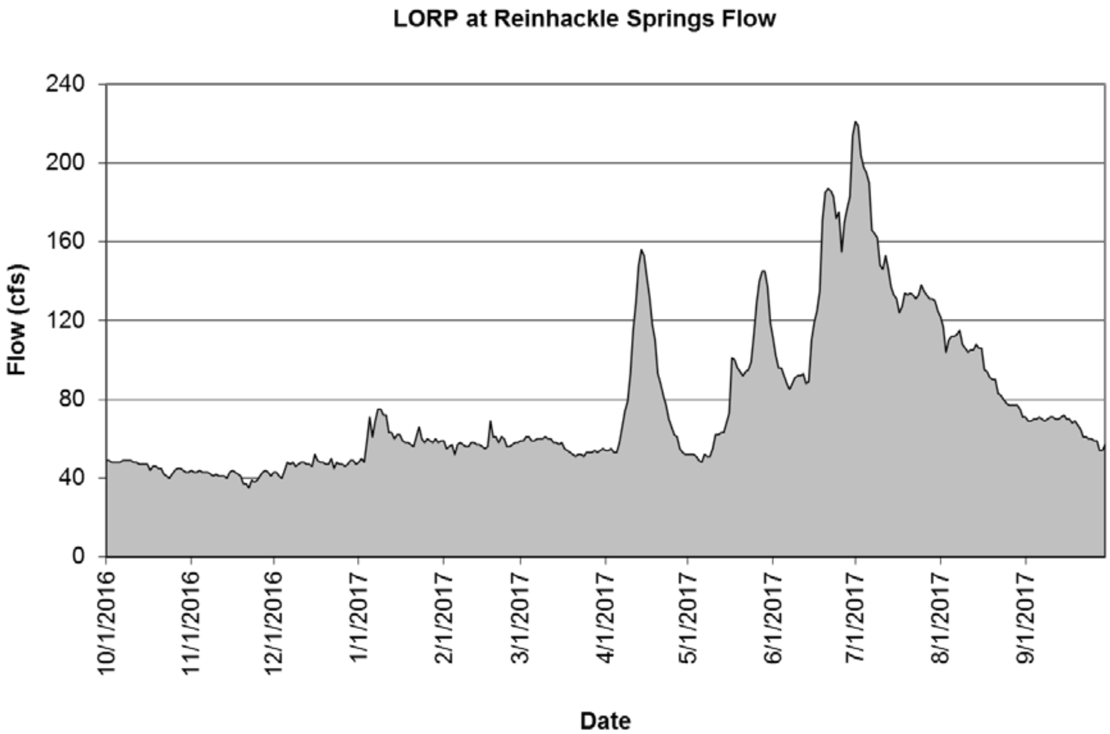
See Appendix 2 for daily flow rates from the LORP Intake.

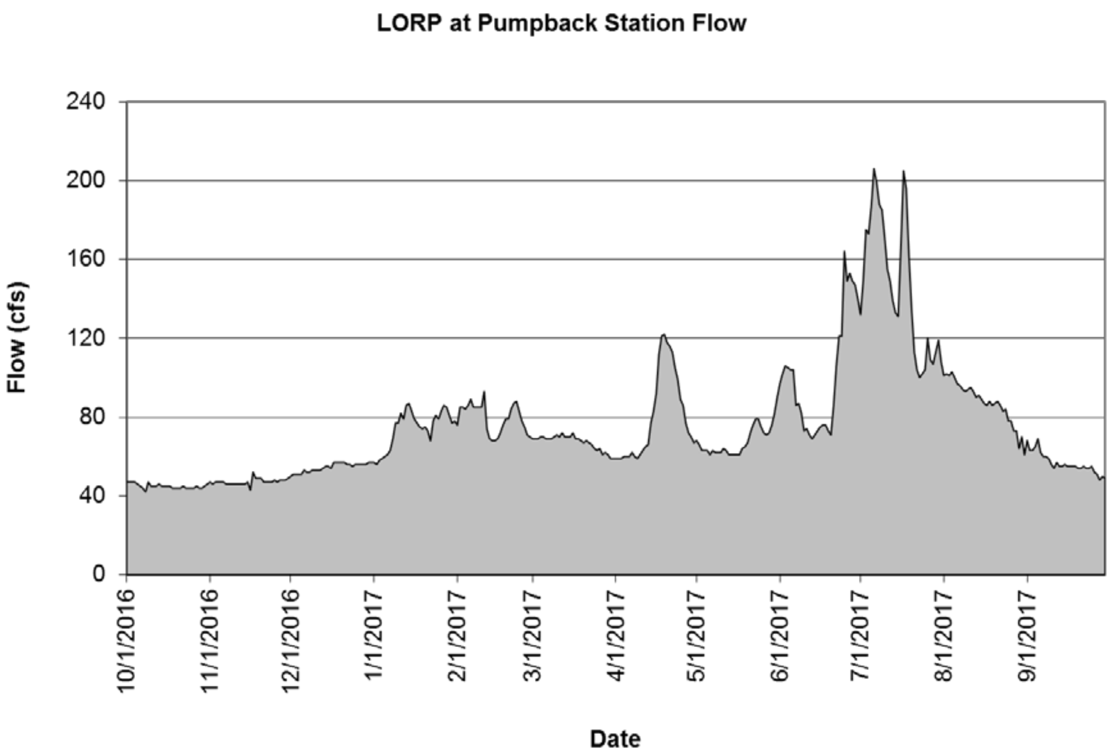
2.7 Appendices

Appendix 1. Hydrologic Monitoring Graphs






LORP at Reinhackle Springs Flow
240
200
160
120
80
40
0
Flow (cfs)
10/1/2016
11/1/2016
12/1/2016
1/1/2017
2/1/2017
3/1/2017
4/1/2017
5/1/2017
6/1/2017
7/1/2017
8/1/2017
9/1/2017
Date


LORP at Pumpback Station Flow
240
200
160
120
80
40
0
Flow (cfs)
10/1/2016
11/1/2016
12/1/2016
1/1/2017
2/1/2017
3/1/2017
4/1/2017
5/1/2017
6/1/2017
7/1/2017
8/1/2017
9/1/2017
Date

Appendix 2. River Flow Tables

Flow Gaging Station / Date	Below River Intake	Blackrock Ditch Return	Goose Lake Return	Billy Lake Return	Mazourka Canyon Road	Locust Ditch Return	Georges Ditch Return	Reinhackle Springs	Alabama Gates Return	At Pumpback Station	Pump Station	Langeman n Gate to Delta	Weir to Delta	In Channel Average Flow
10/1/2016	53.0	1.0	0.8	1.3	46.0	0.0	0.0	49.0	0.0	47.0	42.0	5.0	0.0	48.8
10/2/2016	50.0	1.0	0.7	1.3	46.0	0.0	0.0	49.0	0.0	47.0	43.0	4.0	0.0	48.0
10/3/2016	50.0	1.0	0.8	1.4	46.0	0.0	0.0	48.0	0.0	47.0	43.0	4.0	0.0	47.8
10/4/2016	50.0	1.0	0.8	1.3	46.0	0.0	0.0	48.0	0.0	47.0	43.0	4.0	0.0	47.8
10/5/2016	50.0	1.0	0.8	1.3	46.0	0.0	0.0	48.0	0.0	46.0	42.0	4.0	0.0	47.5
10/6/2016	50.0	1.0	0.8	1.2	45.0	0.0	0.0	48.0	0.0	45.0	41.0	4.0	0.0	47.0
10/7/2016	50.0	1.0	0.9	1.2	46.0	0.0	0.0	49.0	0.0	44.0	40.0	4.0	0.0	47.3
10/8/2016	50.0	1.0	0.9	1.2	47.0	0.0	0.0	49.0	0.0	42.0	37.0	4.0	1.0	47.0
10/9/2016	50.0	1.0	1.0	1.2	46.0	0.0	0.1	49.0	0.0	47.0	43.0	4.0	0.0	48.0
10/10/2016	50.0	1.0	1.0	1.2	46.0	0.0	0.1	49.0	0.0	45.0	41.0	4.0	0.0	47.5
10/11/2016	50.0	1.0	1.0	1.2	49.0	0.0	0.1	48.0	0.0	45.0	41.0	4.0	0.0	48.0
10/12/2016	50.0	1.0	1.0	1.2	49.0	0.0	0.1	48.0	0.0	45.0	41.0	4.0	0.0	48.0
10/13/2016	51.0	1.0	1.0	1.2	49.0	0.0	0.1	47.0	0.0	46.0	42.0	4.0	0.0	48.3
10/14/2016	51.0	1.0	1.0	1.2	49.0	0.0	0.1	47.0	0.0	45.0	41.0	4.0	0.0	48.0
10/15/2016	50.0	1.0	0.9	1.1	49.0	0.0	0.1	47.0	0.0	45.0	41.0	4.0	0.0	47.8
10/16/2016	50.0	1.0	0.9	1.0	49.0	0.0	0.1	47.0	0.0	45.0	41.0	4.0	0.0	47.8
10/17/2016	50.0	1.0	0.9	1.0	49.0	0.0	0.1	44.0	0.0	45.0	41.0	4.0	0.0	47.0
10/18/2016	50.0	0.5	0.9	0.9	49.0	0.0	0.1	46.0	0.0	44.0	40.0	4.0	0.0	47.3
10/19/2016	50.0	0.3	0.9	1.0	49.0	0.0	0.1	46.0	0.0	44.0	40.0	4.0	0.0	47.3
10/20/2016	51.0	2.0	1.0	1.1	46.0	0.0	0.1	45.0	0.0	44.0	40.0	4.0	0.0	46.5
10/21/2016	50.0	1.0	1.0	1.1	43.0	0.0	0.1	45.0	0.0	44.0	40.0	4.0	0.0	45.5
10/22/2016	50.0	1.0	1.1	1.2	44.0	0.0	0.0	42.0	0.0	45.0	41.0	4.0	0.0	45.3
10/23/2016	49.0	1.0	1.1	1.2	44.0	0.0	0.0	41.0	0.0	44.0	40.0	4.0	0.0	44.5
10/24/2016	49.0	1.0	1.1	1.1	43.0	0.0	0.0	40.0	0.0	44.0	40.0	4.0	0.0	44.0
10/25/2016	45.0	1.0	1.1	1.1	43.0	0.0	0.0	42.0	0.0	44.0	40.0	4.0	0.0	43.5
10/26/2016	41.0	1.0	1.1	1.1	42.0	0.0	0.2	44.0	0.0	44.0	40.0	4.0	0.0	42.8
10/27/2016	42.0	1.0	1.2	1.1	42.0	0.0	1.0	45.0	0.0	45.0	41.0	4.0	0.0	43.5
10/28/2016	42.0	1.0	1.2	1.2	41.0	0.0	0.1	45.0	0.0	44.0	40.0	4.0	0.0	43.0
10/29/2016	43.0	1.0	1.3	1.2	40.0	0.0	0.0	44.0	0.0	44.0	40.0	4.0	0.0	42.8
10/30/2016	43.0	1.0	1.3	1.2	38.0	0.0	0.1	43.0	0.0	45.0	41.0	4.0	0.0	42.3
10/31/2016	42.0	1.0	1.3	1.2	38.0	0.0	0.1	43.0	0.0	46.0	42.0	4.0	0.0	42.3
Notes:	These measurements are not on the main channel of the Owens River, therefore highlighted columns are not included in average calculations.													

Flow Gaging Station / Date	Below River Intake	Blackrock Ditch Return	Goose Lake Return	Billy Lake Return	Mazourka Canyon Road	Locust Ditch Return	Georges Ditch Return	Reinhackle Springs	Alabama Gates Return	At Pumpback Station	Pump Station	Langemann Gate to Delta	Weir to Delta	In Channel Average Flow
11/1/2016	42.0	1.0	1.3	1.2	39.0	0.0	0.1	44.0	0.0	47.0	43.0	4.0	0.0	43.0
11/2/2016	43.0	1.0	1.2	1.2	39.0	0.0	0.1	43.0	0.0	46.0	42.0	4.0	0.0	42.8
11/3/2016	43.0	1.0	1.2	1.2	42.0	0.0	0.1	43.0	0.0	47.0	43.0	4.0	0.0	43.8
11/4/2016	43.0	2.0	1.2	1.2	42.0	0.0	0.1	44.0	0.0	47.0	43.0	4.0	0.0	44.0
11/5/2016	43.0	1.0	1.2	1.2	42.0	0.0	0.3	43.0	0.0	47.0	43.0	4.0	0.0	43.8
11/6/2016	43.0	1.0	1.2	1.2	42.0	0.0	0.2	43.0	0.0	47.0	43.0	4.0	0.0	43.8
11/7/2016	43.0	1.0	1.3	1.2	43.0	0.0	0.1	43.0	0.0	46.0	42.0	4.0	0.0	43.8
11/8/2016	43.0	1.0	1.3	1.2	43.0	0.0	0.1	42.0	0.0	46.0	42.0	4.0	0.0	43.5
11/9/2016	43.0	1.0	1.3	1.3	43.0	0.0	0.0	41.0	0.0	46.0	42.0	4.0	0.0	43.3
11/10/2016	43.0	1.0	1.3	1.3	43.0	0.0	0.0	42.0	0.0	46.0	42.0	4.0	0.0	43.5
11/11/2016	43.0	1.0	1.3	1.3	43.0	0.0	0.0	41.0	0.0	46.0	42.0	4.0	0.0	43.3
11/12/2016	43.0	2.0	1.2	1.3	43.0	0.0	0.0	41.0	0.0	46.0	42.0	4.0	0.0	43.3
11/13/2016	43.0	1.0	1.2	1.3	43.0	0.0	0.0	41.0	0.0	46.0	42.0	4.0	0.0	43.3
11/14/2016	42.0	1.0	1.2	1.4	43.0	0.0	0.0	40.0	0.0	46.0	42.0	4.0	0.0	42.8
11/15/2016	41.0	1.0	1.1	1.4	42.0	0.0	0.0	43.0	0.0	47.0	43.0	4.0	0.0	43.3
11/16/2016	42.0	1.0	1.1	1.3	43.0	0.0	0.0	44.0	0.0	43.0	32.0	4.0	7.0	43.0
11/17/2016	41.0	1.0	1.1	1.2	39.0	0.0	0.0	43.0	0.0	52.0	22.0	18.0	12.0	43.8
11/18/2016	43.0	1.0	1.0	1.2	39.0	0.0	0.0	42.0	0.0	49.0	19.0	30.0	0.0	43.3
11/19/2016	43.0	1.0	1.0	1.2	41.0	0.0	0.0	41.0	0.0	49.0	19.0	30.0	0.0	43.5
11/20/2016	42.0	1.0	1.0	1.2	43.0	0.0	0.1	37.0	0.0	49.0	19.0	30.0	0.0	42.8
11/21/2016	43.0	2.0	1.1	1.2	45.0	0.0	0.1	37.0	0.0	47.0	25.0	22.0	0.0	43.0
11/22/2016	42.0	1.0	1.1	1.2	45.0	0.0	0.0	35.0	0.0	47.0	43.0	4.0	0.0	42.3
11/23/2016	42.0	1.0	1.1	1.2	46.0	0.0	0.1	39.0	0.0	47.0	43.0	4.0	0.0	43.5
11/24/2016	41.0	1.0	1.1	1.2	46.0	0.0	0.0	38.0	0.0	47.0	43.0	4.0	0.0	43.0
11/25/2016	41.0	1.0	1.1	1.2	47.0	0.0	0.0	39.0	0.0	48.0	44.0	4.0	0.0	43.8
11/26/2016	41.0	1.0	1.1	1.2	46.0	0.0	0.0	41.0	0.0	47.0	43.0	4.0	0.0	43.8
11/27/2016	42.0	1.0	1.1	1.2	46.0	0.0	0.0	43.0	0.0	48.0	44.0	4.0	0.0	44.8
11/28/2016	42.0	1.0	1.1	1.1	47.0	0.0	0.1	44.0	0.0	48.0	44.0	4.0	0.0	45.3
11/29/2016	43.0	1.0	1.1	1.1	45.0	0.0	0.2	43.0	0.0	48.0	44.0	4.0	0.0	44.8
11/30/2016	43.0	1.0	1.1	1.1	44.0	0.0	0.1	41.0	0.0	49.0	45.0	4.0	0.0	44.3

Notes: These measurements are not on the main channel of the Owens River, therefore highlighted columns are not included in average calculations.

Flow Gaging Station / Date	Below River Intake	Blackrock Ditch Return	Goose Lake Return	Billy Lake Return	Mazourka Canyon Road	Locust Ditch Return	Georges Ditch Return	Reinhackle Springs	Alabama Gates Return	At Pumpback Station	Pump Station	Langeman n Gate to Delta	Weir to Delta	In Channel Average Flow
12/1/2016	47.0	1.0	0.7	1.1	47.0	0.0	0.1	43.0	0.0	50.0	47.0	3.0	0.0	46.8
12/2/2016	47.0	1.0	0.0	1.1	49.0	0.0	0.1	43.0	0.0	51.0	48.0	3.0	0.0	47.5
12/3/2016	44.0	1.0	0.0	1.1	47.0	0.0	0.1	41.0	0.0	51.0	48.0	3.0	0.0	45.8
12/4/2016	43.0	1.0	0.0	1.1	48.0	0.0	0.1	40.0	0.0	51.0	48.0	3.0	0.0	45.5
12/5/2016	42.0	1.0	0.0	1.1	46.0	0.0	0.3	44.0	0.0	51.0	48.0	3.0	0.0	45.8
12/6/2016	42.0	1.0	0.0	1.1	46.0	0.0	0.2	48.0	0.0	53.0	47.0	3.0	3.0	47.3
12/7/2016	41.0	1.0	0.0	1.2	43.0	0.0	0.1	47.0	0.0	52.0	47.0	3.0	2.0	45.8
12/8/2016	42.0	1.0	0.0	1.2	43.0	0.0	0.0	48.0	0.0	52.0	47.0	3.0	2.0	46.3
12/9/2016	41.0	1.0	0.0	1.2	42.0	0.0	0.0	46.0	0.0	53.0	47.0	3.0	3.0	45.5
12/10/2016	41.0	1.0	0.0	1.2	39.0	0.0	0.0	47.0	0.0	53.0	47.0	3.0	3.0	45.0
12/11/2016	41.0	1.0	0.0	1.2	40.0	0.0	0.0	48.0	0.0	53.0	46.0	3.0	4.0	45.5
12/12/2016	43.0	1.0	0.0	1.2	43.0	0.0	0.0	48.0	0.0	53.0	47.0	3.0	3.0	46.8
12/13/2016	43.0	1.0	0.0	1.2	42.0	0.0	0.0	47.0	0.0	54.0	47.0	3.0	4.0	46.5
12/14/2016	42.0	1.0	0.0	1.2	41.0	0.0	0.0	47.0	0.0	55.0	47.0	3.0	5.0	46.3
12/15/2016	42.0	1.0	0.0	1.3	40.0	0.0	0.0	46.0	0.0	55.0	47.0	3.0	5.0	45.8
12/16/2016	43.0	1.0	0.0	1.5	44.0	0.0	0.0	52.0	0.0	54.0	47.0	3.0	4.0	48.3
12/17/2016	41.0	1.0	0.0	1.5	42.0	0.0	0.0	49.0	0.0	57.0	48.0	3.0	6.0	47.3
12/18/2016	42.0	1.0	0.0	1.5	42.0	0.0	0.1	48.0	0.0	57.0	48.0	3.0	6.0	47.3
12/19/2016	42.0	1.0	0.0	1.4	41.0	0.0	0.0	48.0	0.0	57.0	47.0	3.0	7.0	47.0
12/20/2016	42.0	0.5	0.0	1.4	41.0	0.0	0.0	47.0	0.0	57.0	47.0	3.0	7.0	46.8
12/21/2016	42.0	1.0	0.0	1.4	40.0	0.0	0.0	47.0	0.0	57.0	47.0	3.0	7.0	46.5
12/22/2016	42.0	1.0	0.0	1.4	40.0	0.0	0.0	50.0	0.0	56.0	47.0	3.0	6.0	47.0
12/23/2016	43.0	1.0	0.0	1.4	40.0	0.0	0.0	45.0	0.0	56.0	48.0	3.0	5.0	46.0
12/24/2016	43.0	1.0	0.0	1.4	44.0	0.0	0.0	48.0	0.0	55.0	48.0	3.0	4.0	47.5
12/25/2016	42.0	1.0	0.0	1.4	41.0	0.0	0.0	47.0	0.0	56.0	48.0	3.0	5.0	46.5
12/26/2016	41.0	1.0	0.0	1.4	41.0	0.0	0.1	47.0	0.0	56.0	48.0	3.0	5.0	46.3
12/27/2016	42.0	1.0	0.0	1.4	40.0	0.0	0.0	46.0	0.0	56.0	48.0	3.0	5.0	46.0
12/28/2016	42.0	1.0	0.0	1.4	40.0	0.0	0.0	47.0	0.0	56.0	48.0	3.0	5.0	46.3
12/29/2016	42.0	1.0	0.0	1.4	39.0	0.0	0.0	49.0	0.0	56.0	48.0	3.0	5.0	46.5
12/30/2016	42.0	1.0	0.0	1.3	38.0	0.0	0.0	49.0	0.0	57.0	48.0	3.0	6.0	46.5
12/31/2016	43.0	1.0	0.0	1.3	41.0	0.0	0.0	47.0	0.0	57.0	48.0	3.0	6.0	47.0

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Flow Gaging Station / Date	Below River Intake	Blackrock Ditch Return	Goose Lake Return	Billy Lake Return	Mazourka Canyon Road	Locust Ditch Return	Georges Ditch Return	Reinhackle Springs	Alabama Gates Return	At Pumpback Station	Pump Station	Langeman n Gate to Delta	Weir to Delta	In Channel Average Flow
1/1/2017	43.0	1.0	0.0	1.3	42.0	0.0	0.0	48.0	0.0	57.0	48.0	3.0	6.0	47.5
1/2/2017	42.0	1.0	0.0	1.2	43.0	0.0	0.0	50.0	0.0	56.0	47.0	3.0	6.0	47.8
1/3/2017	42.0	1.0	0.0	1.2	41.0	0.0	0.0	48.0	0.0	58.0	48.0	3.0	7.0	47.3
1/4/2017	43.0	1.0	0.0	1.5	46.0	0.0	0.1	59.0	0.0	59.0	48.0	3.0	8.0	51.8
1/5/2017	41.0	2.0	0.0	1.6	51.0	0.0	0.2	71.0	0.0	60.0	48.0	3.0	9.0	55.8
1/6/2017	41.0	1.0	0.0	1.5	52.0	0.0	0.1	61.0	0.0	61.0	48.0	3.0	10.0	53.8
1/7/2017	42.0	1.0	0.0	1.5	52.0	0.0	0.2	69.0	0.0	63.0	48.0	3.0	12.0	56.5
1/8/2017	43.0	2.0	0.0	1.6	52.0	0.0	0.3	75.0	0.0	69.0	48.0	3.0	18.0	59.8
1/9/2017	42.0	2.0	0.0	1.6	52.0	0.0	0.7	75.0	0.0	77.0	40.0	3.0	34.0	61.5
1/10/2017	41.0	1.0	0.0	1.6	51.0	0.0	0.4	72.0	0.0	77.0	32.0	3.0	42.0	60.3
1/11/2017	42.0	1.0	0.0	1.6	53.0	0.0	0.2	72.0	0.0	82.0	48.0	3.0	31.0	62.3
1/12/2017	42.0	1.0	0.0	1.5	60.0	0.0	0.1	63.0	0.0	79.0	46.0	3.0	30.0	61.0
1/13/2017	43.0	1.0	0.0	1.6	60.0	0.0	0.1	63.0	0.0	86.0	47.0	3.0	36.0	63.0
1/14/2017	42.0	1.0	0.0	1.6	57.0	0.0	0.1	60.0	0.0	87.0	48.0	3.0	36.0	61.5
1/15/2017	42.0	1.0	0.0	1.5	53.0	0.0	0.0	62.0	0.0	83.0	47.0	3.0	33.0	60.0
1/16/2017	42.0	1.0	0.0	1.5	53.0	0.0	0.1	62.0	0.0	79.0	47.0	3.0	29.0	59.0
1/17/2017	42.0	1.0	0.0	1.4	50.0	0.0	0.1	59.0	0.0	77.0	47.0	3.0	27.0	57.0
1/18/2017	42.0	1.0	0.0	1.2	50.0	0.0	0.1	58.0	0.0	75.0	47.0	3.0	25.0	56.3
1/19/2017	42.0	1.0	0.0	1.4	51.0	0.0	0.1	58.0	0.0	74.0	47.0	3.0	24.0	56.3
1/20/2017	42.0	1.0	0.0	1.4	52.0	0.0	0.1	57.0	0.0	75.0	48.0	3.0	24.0	56.5
1/21/2017	43.0	1.0	0.0	1.4	53.0	0.0	0.1	56.0	0.0	73.0	48.0	3.0	22.0	56.3
1/22/2017	42.0	1.0	0.0	1.5	53.0	0.0	0.3	61.0	0.0	68.0	41.0	3.0	24.0	56.0
1/23/2017	42.0	1.0	0.0	1.5	54.0	0.5	1.6	66.0	0.0	78.0	48.0	3.0	27.0	60.0
1/24/2017	42.0	2.0	0.0	1.5	53.0	0.2	0.5	60.0	0.0	81.0	47.0	3.0	31.0	59.0
1/25/2017	42.0	2.0	0.0	1.5	58.0	0.1	0.2	58.0	0.0	79.0	46.0	3.0	30.0	59.3
1/26/2017	42.0	2.0	0.0	1.5	59.0	0.0	0.2	60.0	0.0	83.0	46.0	3.0	34.0	61.0
1/27/2017	42.0	1.0	0.0	1.5	60.0	0.0	0.2	59.0	0.0	86.0	46.0	3.0	37.0	61.8
1/28/2017	42.0	1.0	0.0	1.5	57.0	0.0	0.2	58.0	0.0	85.0	45.0	3.0	37.0	60.5
1/29/2017	42.0	1.0	0.0	1.5	55.0	0.0	0.2	60.0	0.0	81.0	47.0	3.0	31.0	59.5
1/30/2017	42.0	1.0	0.0	1.5	60.0	0.0	0.2	58.0	0.0	77.0	17.0	3.0	57.0	59.3
1/31/2017	42.0	1.0	0.0	1.5	59.0	0.0	0.3	59.0	0.0	78.0	0.0	3.0	75.0	59.5
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Flow Gaging Station / Date	Below River Intake	Blackrock Ditch Return	Goose Lake Return	Billy Lake Return	Mazourka Canyon Road	Locust Ditch Return	Georges Ditch Return	Reinhackle Springs	Alabama Gates Return	At Pumpback Station	Pump Station	Langeman Gate to Delta	Weir to Delta	In Channel Average Flow
2/1/2017	42.0	1.0	0.0	1.5	57.0	0.0	0.3	59.0	0.0	76.0	0.0	45.0	31.0	58.5
2/2/2017	41.0	1.0	0.0	1.5	58.0	0.0	0.2	55.0	0.0	85.0	0.0	65.0	20.0	59.8
2/3/2017	42.0	2.0	0.0	1.5	58.0	0.0	0.2	56.0	0.0	85.0	0.0	65.0	20.0	60.3
2/4/2017	41.0	1.0	0.0	1.4	58.0	0.0	0.1	57.0	0.0	84.0	0.0	65.0	19.0	60.0
2/5/2017	41.0	1.0	0.0	1.4	58.0	0.0	0.1	52.0	0.0	86.0	0.0	65.0	21.0	59.3
2/6/2017	42.0	1.0	0.0	1.4	58.0	0.1	0.2	57.0	0.0	89.0	0.0	65.0	24.0	61.5
2/7/2017	42.0	1.0	0.0	1.3	59.0	0.2	0.3	58.0	0.0	85.0	0.0	65.0	20.0	61.0
2/8/2017	41.0	2.0	0.0	1.3	59.0	0.4	0.5	57.0	0.0	85.0	0.0	65.0	20.0	60.5
2/9/2017	42.0	1.0	0.0	1.3	60.0	1.1	0.7	56.0	0.0	85.0	0.0	65.0	20.0	60.8
2/10/2017	43.0	1.0	0.0	1.4	61.0	1.4	0.7	56.0	0.0	85.0	0.0	65.0	20.0	61.3
2/11/2017	41.0	1.0	0.0	1.4	61.0	1.6	0.8	58.0	0.0	93.0	16.0	65.0	12.0	63.3
2/12/2017	41.0	1.0	0.0	1.5	60.0	1.0	0.6	58.0	0.0	74.0	42.0	24.0	8.0	58.3
2/13/2017	42.0	1.0	0.0	1.5	59.0	0.4	0.6	57.0	0.0	69.0	47.0	4.0	18.0	56.8
2/14/2017	43.0	1.0	0.0	1.5	60.0	0.2	0.4	57.0	0.0	68.0	47.0	4.0	17.0	57.0
2/15/2017	43.0	1.0	0.0	1.6	59.0	0.1	0.3	56.0	0.0	68.0	48.0	4.0	16.0	56.5
2/16/2017	42.0	1.0	0.0	1.6	58.0	0.2	0.1	55.0	0.0	69.0	48.0	4.0	17.0	56.0
2/17/2017	43.0	1.0	0.0	1.5	58.0	0.6	0.2	56.0	0.0	72.0	48.0	4.0	20.0	57.3
2/18/2017	42.0	2.0	0.0	1.5	60.0	1.1	2.6	69.0	0.0	76.0	48.0	4.0	24.0	61.8
2/19/2017	41.0	1.0	0.0	1.5	60.0	0.7	1.2	61.0	0.0	79.0	48.0	4.0	27.0	60.3
2/20/2017	42.0	1.0	0.0	1.6	61.0	1.3	0.6	61.0	0.0	79.0	48.0	4.0	27.0	60.8
2/21/2017	41.0	2.0	0.0	1.6	62.0	1.9	0.9	58.0	0.0	84.0	48.0	4.0	32.0	61.3
2/22/2017	43.0	1.0	0.0	1.6	62.0	1.9	0.9	61.0	0.0	87.0	47.0	4.0	36.0	63.3
2/23/2017	43.0	1.0	0.0	1.7	62.0	1.9	0.7	60.0	0.0	88.0	47.0	4.0	37.0	63.3
2/24/2017	43.0	1.0	0.0	1.7	58.0	1.9	0.8	56.0	0.0	83.0	47.0	4.0	32.0	60.0
2/25/2017	43.0	1.0	0.5	4.8	59.0	1.9	0.8	56.0	0.0	78.0	47.0	4.0	27.0	59.0
2/26/2017	43.0	1.0	1.8	6.6	61.0	1.9	0.9	57.0	0.0	75.0	48.0	4.0	23.0	59.0
2/27/2017	45.0	1.0	1.8	6.3	61.0	1.8	1.0	58.0	0.0	71.0	47.0	4.0	20.0	58.8
2/28/2017	44.0	1.0	1.7	6.5	61.0	1.7	1.0	58.0	0.0	70.0	48.0	4.0	18.0	58.3
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Flow Gaging Station / Date	Below River Intake	Blackrock Ditch Return	Goose Lake Return	Billy Lake Return	Mazourka Canyon Road	Locust Ditch Return	Georges Ditch Return	Reinhackle Springs	Alabama Gates Return	At Pumpback Station	Pump Station	Langeman n Gate to Delta	Weir to Delta	In Channel Average Flow
3/1/2017	42.0	1.0	1.6	6.8	60.0	1.5	0.9	59.0	0.0	69.0	47.0	4.0	18.0	57.5
3/2/2017	42.0	1.0	1.4	6.9	61.0	1.7	1.0	59.0	0.0	69.0	48.0	4.0	17.0	57.8
3/3/2017	42.0	1.0	1.1	6.8	60.0	1.6	1.0	61.0	0.0	69.0	47.0	4.0	18.0	58.0
3/4/2017	42.0	1.0	0.9	6.9	60.0	1.6	1.1	61.0	0.0	70.0	48.0	4.0	18.0	58.3
3/5/2017	42.0	1.0	0.9	6.9	59.0	1.6	1.0	59.0	0.0	70.0	48.0	4.0	18.0	57.5
3/6/2017	42.0	1.0	1.4	6.9	59.0	1.7	0.9	59.0	0.0	69.0	47.0	4.0	18.0	57.3
3/7/2017	42.0	2.0	1.6	6.8	59.0	1.8	1.0	60.0	0.0	69.0	47.0	4.0	18.0	57.5
3/8/2017	42.0	1.0	1.4	6.8	59.0	1.1	1.1	60.0	0.0	69.0	47.0	4.0	18.0	57.5
3/9/2017	42.0	1.0	0.0	6.8	59.0	0.9	1.5	60.0	0.0	70.0	47.0	4.0	19.0	57.8
3/10/2017	42.0	1.0	0.0	6.8	58.0	0.8	1.6	61.0	0.0	71.0	48.0	4.0	19.0	58.0
3/11/2017	42.0	1.0	0.0	7.0	58.0	0.6	1.6	60.0	0.0	70.0	48.0	4.0	18.0	57.5
3/12/2017	42.0	2.0	0.0	7.0	58.0	0.1	0.9	60.0	0.0	72.0	48.0	4.0	20.0	58.0
3/13/2017	42.0	2.0	0.0	4.6	57.0	0.0	0.4	58.0	0.0	70.0	47.0	4.0	19.0	56.8
3/14/2017	43.0	2.0	0.0	5.5	54.0	0.0	0.4	58.0	0.0	70.0	47.0	4.0	19.0	56.3
3/15/2017	42.0	2.0	0.0	6.5	56.0	0.0	0.8	57.0	0.0	70.0	47.0	4.0	19.0	56.3
3/16/2017	42.0	2.0	0.0	3.9	55.0	0.0	0.2	58.0	0.0	72.0	48.0	4.0	20.0	56.8
3/17/2017	43.0	2.0	0.9	4.1	54.0	0.0	0.3	55.0	0.0	69.0	47.0	4.0	18.0	55.3
3/18/2017	43.0	2.0	0.3	4.5	54.0	0.0	0.2	54.0	0.0	69.0	47.0	4.0	18.0	55.0
3/19/2017	46.0	2.0	0.1	5.0	55.0	0.0	0.2	53.0	0.0	68.0	47.0	4.0	17.0	55.5
3/20/2017	50.0	2.0	0.1	4.8	55.0	0.0	0.3	52.0	0.0	67.0	47.0	4.0	16.0	56.0
3/21/2017	49.0	1.0	0.1	2.8	54.0	0.0	0.5	51.0	0.0	68.0	47.0	4.0	17.0	55.5
3/22/2017	50.0	1.0	0.3	1.5	52.0	0.0	0.2	52.0	0.0	67.0	47.0	4.0	16.0	55.3
3/23/2017	49.0	1.0	0.3	1.3	55.0	0.0	0.1	52.0	0.0	66.0	47.0	4.0	15.0	55.5
3/24/2017	50.0	1.0	0.3	1.3	58.0	0.0	0.2	51.0	0.0	64.0	47.0	4.0	13.0	55.8
3/25/2017	50.0	1.0	0.2	1.3	57.0	0.0	0.3	53.0	0.0	63.0	47.0	4.0	12.0	55.8
3/26/2017	50.0	1.0	0.1	1.2	56.0	0.0	0.2	53.0	0.0	64.0	48.0	4.0	12.0	55.8
3/27/2017	50.0	1.0	0.0	1.2	56.0	0.0	0.1	53.0	0.0	61.0	47.0	4.0	10.0	55.0
3/28/2017	50.0	2.0	0.0	1.1	56.0	0.0	0.1	54.0	0.0	62.0	48.0	4.0	10.0	55.5
3/29/2017	58.0	1.0	0.0	1.0	57.0	0.0	0.2	53.0	0.0	61.0	48.0	4.0	9.0	57.3
3/30/2017	76.0	1.0	0.0	1.0	56.0	0.0	0.2	54.0	0.0	59.0	47.0	4.0	8.0	61.3
3/31/2017	88.0	1.0	0.0	1.0	55.0	0.0	0.1	55.0	0.0	59.0	48.0	4.0	7.0	64.3

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Flow Gaging Station / Date	Below River Intake	Blackrock Ditch Return	Goose Lake Return	Billy Lake Return	Mazourka Canyon Road	Locust Ditch Return	Georges Ditch Return	Reinhackle Springs	Alabama Gates Return	At Pumpback Station	Pump Station	Langeman n Gate to Delta	Weir to Delta	In Channel Average Flow
4/1/2017	115.0	3.0	0.0	1.0	58.0	0.0	0.2	54.0	0.0	59.0	47.0	4.0	8.0	71.5
4/2/2017	144.0	1.0	0.0	0.9	64.0	0.0	0.2	54.0	0.0	59.0	47.0	4.0	8.0	80.3
4/3/2017	177.0	1.0	0.0	0.9	75.0	0.0	0.2	55.0	0.0	59.0	47.0	4.0	8.0	91.5
4/4/2017	232.0	1.0	0.0	0.9	86.0	0.0	0.1	53.0	0.0	60.0	47.0	4.0	9.0	107.8
4/5/2017	274.0	1.0	0.0	0.9	96.0	0.0	0.1	53.0	0.0	60.0	48.0	4.0	8.0	120.8
4/6/2017	240.0	1.0	0.0	0.9	103.0	0.0	0.1	58.0	0.0	60.0	47.0	4.0	9.0	115.3
4/7/2017	172.0	1.0	0.0	1.0	110.0	0.0	0.3	66.0	0.0	62.0	47.0	4.0	11.0	102.5
4/8/2017	140.0	1.0	0.0	1.1	129.0	0.0	0.2	74.0	0.0	60.0	47.0	4.0	9.0	100.8
4/9/2017	108.0	1.0	0.0	1.1	177.0	0.0	0.2	79.0	0.0	59.0	47.0	4.0	8.0	105.8
4/10/2017	88.0	2.0	0.0	1.2	180.0	0.0	0.5	93.0	0.0	61.0	47.0	4.0	10.0	105.5
4/11/2017	69.0	1.0	0.0	1.3	162.0	0.0	0.5	115.0	0.0	63.0	47.0	4.0	12.0	102.3
4/12/2017	55.0	2.0	0.0	1.4	144.0	0.0	2.0	129.0	0.0	65.0	47.0	5.0	13.0	98.3
4/13/2017	49.0	1.0	0.0	1.4	127.0	0.0	2.4	148.0	0.0	66.0	40.0	7.0	19.0	97.5
4/14/2017	49.0	1.0	0.0	1.4	110.0	0.0	1.8	156.0	0.0	77.0	47.0	8.0	22.0	98.0
4/15/2017	50.0	1.0	0.0	1.3	96.0	0.0	1.1	153.0	0.0	83.0	47.0	8.0	28.0	95.5
4/16/2017	50.0	1.0	0.0	1.3	85.0	0.0	0.6	142.0	0.0	92.0	44.0	9.0	39.0	92.3
4/17/2017	52.0	1.0	0.0	1.4	76.0	0.0	0.2	132.0	0.0	112.0	48.0	11.0	53.0	93.0
4/18/2017	50.0	1.0	0.0	1.4	71.0	0.0	0.1	118.0	0.0	121.0	48.0	12.0	61.0	90.0
4/19/2017	50.0	1.0	0.0	1.4	68.0	0.0	0.1	110.0	0.0	122.0	47.0	13.0	62.0	87.5
4/20/2017	50.0	2.0	0.0	1.3	67.0	0.0	0.2	93.0	0.0	118.0	47.0	10.0	61.0	82.0
4/21/2017	49.0	1.0	0.0	1.3	67.0	0.0	0.1	88.0	0.0	116.0	47.0	7.0	62.0	80.0
4/22/2017	50.0	1.0	0.0	1.3	66.0	0.0	0.1	82.0	0.0	113.0	47.0	5.0	61.0	77.8
4/23/2017	50.0	1.0	0.0	1.3	64.0	0.0	0.1	77.0	0.0	105.0	47.0	4.0	54.0	74.0
4/24/2017	50.0	1.0	0.0	1.4	63.0	0.0	0.1	70.0	0.0	99.0	47.0	4.0	48.0	70.5
4/25/2017	50.0	1.0	0.0	1.6	63.0	0.0	0.1	66.0	0.0	89.0	46.0	4.0	39.0	67.0
4/26/2017	50.0	1.0	0.0	1.6	63.0	0.0	0.1	62.0	0.0	86.0	48.0	4.0	34.0	65.3
4/27/2017	49.0	1.0	0.0	1.6	63.0	0.0	0.1	61.0	0.0	77.0	47.0	4.0	26.0	62.5
4/28/2017	50.0	1.0	0.0	1.6	58.0	0.0	0.1	55.0	0.0	72.0	48.0	4.0	20.0	58.8
4/29/2017	50.0	1.0	0.0	1.5	58.0	0.0	0.1	53.0	0.0	70.0	48.0	4.0	18.0	57.8
4/30/2017	50.0	1.0	0.0	1.4	58.0	0.0	0.1	52.0	0.0	67.0	48.0	4.0	15.0	56.8

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Flow Gaging Station / Date	Below River Intake	Blackrock Ditch Return	Goose Lake Return	Billy Lake Return	Mazourka Canyon Road	Locust Ditch Return	Georges Ditch Return	Reinhackle Springs	Alabama Gates Return	At Pumpback Station	Pump Station	Langemann Gate to Delta	Weir to Delta	In Channel Average Flow
5/1/2017	50.0	2.0	0.0	1.4	58.0	0.0	0.2	52.0	0.0	68.0	48.0	6.0	14.0	57.0
5/2/2017	49.0	2.0	0.0	1.5	57.0	0.0	0.4	52.0	0.0	66.0	48.0	8.0	10.0	56.0
5/3/2017	62.0	2.0	0.0	1.3	57.0	0.0	0.1	52.0	0.0	63.0	47.0	7.0	9.0	58.5
5/4/2017	89.0	1.0	0.0	1.2	57.0	0.0	0.0	51.0	0.0	63.0	47.0	8.0	8.0	65.0
5/5/2017	116.0	1.0	0.0	1.2	57.0	0.0	0.0	49.0	0.0	63.0	47.0	8.0	8.0	71.3
5/6/2017	127.0	1.0	0.0	1.1	58.0	0.0	0.0	48.0	0.0	61.0	48.0	7.0	6.0	73.5
5/7/2017	128.0	1.0	0.0	1.1	70.0	0.0	0.1	52.0	0.0	63.0	48.0	8.0	7.0	78.3
5/8/2017	127.0	1.0	0.0	1.1	86.0	1.6	0.1	51.0	0.0	62.0	47.0	8.0	7.0	81.5
5/9/2017	113.0	1.0	0.0	1.3	93.0	3.2	0.2	51.0	0.0	62.0	47.0	8.0	7.0	79.8
5/10/2017	87.0	1.0	0.0	1.6	96.0	0.8	0.3	55.0	0.0	62.0	47.0	8.0	7.0	75.0
5/11/2017	59.0	1.0	0.0	1.7	99.0	0.0	0.2	62.0	0.0	64.0	47.0	8.0	9.0	71.0
5/12/2017	50.0	1.0	0.0	1.8	101.0	0.0	1.1	62.0	0.0	63.0	47.0	7.0	9.0	69.0
5/13/2017	59.0	1.0	0.0	1.7	98.0	3.6	3.3	63.0	0.0	61.0	47.0	7.0	7.0	70.3
5/14/2017	73.0	1.0	0.0	1.3	93.0	7.4	3.8	63.0	0.0	61.0	48.0	8.0	5.0	72.5
5/15/2017	89.0	1.0	0.0	0.9	83.0	7.1	3.8	68.0	0.0	61.0	48.0	8.0	5.0	75.3
5/16/2017	121.0	1.0	0.0	0.5	73.0	7.2	3.5	73.0	0.0	61.0	47.0	8.0	6.0	82.0
5/17/2017	137.0	1.0	0.0	0.4	73.0	7.3	3.2	101.0	0.0	61.0	47.0	7.0	7.0	93.0
5/18/2017	179.0	1.0	0.0	0.9	78.0	7.8	3.0	100.0	0.0	64.0	47.0	8.0	9.0	105.3
5/19/2017	197.0	1.0	0.0	1.3	88.0	8.4	2.3	96.0	0.0	65.0	47.0	8.0	10.0	111.5
5/20/2017	196.0	1.0	0.0	1.6	100.0	8.2	1.8	94.0	0.0	67.0	48.0	7.0	12.0	114.3
5/21/2017	170.0	1.0	0.0	1.7	113.0	7.9	1.8	92.0	0.0	72.0	47.0	8.0	17.0	111.8
5/22/2017	135.0	1.0	0.0	1.8	126.0	7.6	2.5	94.0	0.0	76.0	47.0	7.0	22.0	107.8
5/23/2017	105.0	1.0	0.0	1.8	145.0	7.9	4.2	95.0	0.0	79.0	48.0	8.0	23.0	106.0
5/24/2017	86.0	1.0	0.0	1.5	155.0	8.4	4.0	99.0	0.0	79.0	47.0	8.0	24.0	104.8
5/25/2017	68.0	1.0	0.0	1.4	158.0	8.6	3.1	113.0	0.0	75.0	47.0	7.0	21.0	103.5
5/26/2017	54.0	1.0	0.0	1.4	147.0	9.1	5.9	129.0	0.0	72.0	47.0	7.0	18.0	100.5
5/27/2017	49.0	1.0	0.0	1.5	133.0	9.7	6.2	140.0	0.0	71.0	46.0	7.0	18.0	98.3
5/28/2017	65.0	1.0	0.0	1.6	119.0	8.2	6.2	145.0	0.0	72.0	46.0	8.0	18.0	100.3
5/29/2017	87.0	1.0	0.0	1.8	105.0	5.4	6.2	145.0	0.0	76.0	47.0	8.0	21.0	103.3
5/30/2017	119.0	1.0	0.0	5.0	92.0	5.7	5.5	137.0	0.0	82.0	47.0	8.0	27.0	107.5
5/31/2017	127.0	1.0	0.0	8.2	93.0	10.7	4.9	119.0	0.0	90.0	47.0	8.0	35.0	107.3
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6/1/2017	127.0	3.0	0.0	7.9	100.0	12.0	4.6	111.0	0.0	97.0	47.0	8.0	42.0	108.8
6/2/2017	127.0	4.0	0.0	7.0	112.0	11.0	4.7	102.0	0.0	102.0	47.0	7.0	48.0	110.8
6/3/2017	127.0	4.0	0.0	2.5	119.0	7.8	5.6	96.0	0.0	106.0	47.0	8.0	51.0	112.0
6/4/2017	127.0	3.0	0.0	1.5	117.0	4.5	7.0	96.0	0.0	105.0	48.0	8.0	49.0	111.3
6/5/2017	165.0	4.0	0.0	3.9	113.0	3.2	7.1	92.0	0.0	104.0	46.0	8.0	50.0	118.5
6/6/2017	208.0	4.0	0.0	3.5	115.0	3.4	6.7	88.0	0.0	104.0	47.0	7.0	50.0	128.8
6/7/2017	215.0	1.0	0.0	2.2	112.0	3.5	7.4	85.0	0.0	86.0	33.0	7.0	46.0	124.5
6/8/2017	245.0	2.0	0.0	1.7	112.0	3.8	19.8	88.0	0.0	87.0	15.0	8.0	64.0	133.0
6/9/2017	253.0	1.0	0.0	1.9	123.0	3.8	21.7	91.0	0.0	82.0	32.0	8.0	42.0	137.3
6/10/2017	249.0	1.0	0.0	1.7	132.0	3.4	24.5	92.0	0.0	73.0	27.0	8.0	38.0	136.5
6/11/2017	248.0	1.0	0.0	1.7	142.0	3.3	24.4	92.0	0.0	74.0	30.0	8.0	36.0	139.0
6/12/2017	248.0	1.0	0.0	1.8	164.0	4.0	15.5	93.0	0.0	71.0	48.0	8.0	15.0	144.0
6/13/2017	250.0	1.0	0.0	1.8	176.0	6.1	1.3	88.0	0.0	69.0	47.0	8.0	14.0	145.8
6/14/2017	250.0	1.0	0.2	1.8	198.0	6.3	0.9	89.0	0.0	71.0	47.0	8.0	16.0	152.0
6/15/2017	247.0	1.0	0.7	1.7	204.0	4.0	1.3	110.0	0.0	73.0	47.0	8.0	18.0	158.5
6/16/2017	250.0	1.0	1.2	1.6	189.0	4.1	2.8	119.0	0.0	75.0	47.0	8.0	20.0	158.3
6/17/2017	253.0	1.0	0.6	1.4	186.0	5.7	9.0	125.0	0.0	76.0	47.0	8.0	21.0	160.0
6/18/2017	255.0	1.0	0.5	1.3	181.0	5.6	14.7	135.0	0.0	76.0	47.0	8.0	21.0	161.8
6/19/2017	256.0	1.0	0.4	1.3	192.0	5.7	24.5	171.0	0.0	73.0	48.0	7.0	18.0	173.0
6/20/2017	260.0	1.0	0.4	1.4	181.0	5.8	26.7	185.0	0.0	71.0	26.0	8.0	37.0	174.3
6/21/2017	281.0	1.0	0.6	1.6	179.0	5.9	28.1	187.0	0.0	86.0	0.0	8.0	78.0	183.3
6/22/2017	293.0	1.0	1.2	3.2	182.0	5.7	24.5	186.0	0.0	106.0	0.0	8.0	98.0	191.8
6/23/2017	298.0	1.0	2.0	3.5	190.0	5.5	26.3	183.0	0.0	121.0	0.0	8.0	113.0	198.0
6/24/2017	310.0	1.0	2.5	1.9	211.0	5.4	20.3	172.0	0.0	121.0	0.0	8.0	113.0	203.5
6/25/2017	314.0	1.0	2.8	1.9	230.0	5.2	7.7	175.0	0.0	164.0	25.0	7.0	132.0	220.8
6/26/2017	326.0	2.0	2.3	1.8	239.0	5.6	8.2	155.0	0.0	149.0	41.0	7.0	101.0	217.3
6/27/2017	310.0	2.0	3.2	1.9	241.0	6.0	9.3	170.0	0.0	153.0	47.0	8.0	98.0	218.5
6/28/2017	285.0	2.0	3.4	5.4	241.0	6.1	11.3	177.0	0.0	149.0	47.0	8.0	94.0	213.0
6/29/2017	270.0	3.0	2.0	6.2	255.0	7.4	14.8	183.0	0.0	147.0	48.0	8.0	91.0	213.8
6/30/2017	275.0	4.0	1.7	5.2	270.0	7.3	17.5	214.0	0.0	140.0	48.0	8.0	84.0	224.8

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7/1/2017	257.0	5.0	1.0	5.5	250.0	6.2	18.8	221.0	0.0	132.0	47.0	8.0	77.0	215.0
7/2/2017	243.0	5.0	0.6	6.3	235.0	5.0	17.8	219.0	0.0	149.0	48.0	22.0	79.0	211.5
7/3/2017	261.0	5.0	0.7	4.9	208.0	4.6	16.0	204.0	0.0	175.0	47.0	34.0	94.0	212.0
7/4/2017	251.0	4.0	1.8	4.5	192.0	4.2	14.4	198.0	0.0	173.0	48.0	12.0	113.0	203.5
7/5/2017	226.0	6.0	3.0	4.5	192.0	4.5	12.7	195.0	0.0	187.0	47.0	15.0	125.0	200.0
7/6/2017	204.0	10.0	3.0	4.5	197.0	4.6	11.2	190.0	0.0	206.0	47.0	18.0	141.0	199.3
7/7/2017	190.0	5.0	4.7	4.4	197.0	4.3	10.5	166.0	0.0	199.0	47.0	16.0	136.0	188.0
7/8/2017	172.0	10.0	4.8	4.4	186.0	3.8	10.1	164.0	0.0	188.0	47.0	14.0	127.0	177.5
7/9/2017	179.0	12.0	4.8	4.0	176.0	5.5	9.2	162.0	0.0	185.0	47.0	13.0	125.0	175.5
7/10/2017	179.0	13.0	4.8	3.4	172.0	6.2	8.2	148.0	0.0	171.0	47.0	11.0	113.0	167.5
7/11/2017	177.0	8.0	4.8	3.2	166.0	5.7	8.6	146.0	0.0	155.0	47.0	10.0	98.0	161.0
7/12/2017	185.0	6.0	4.1	3.2	161.0	6.1	18.3	153.0	21.6	149.0	45.0	9.0	95.0	162.0
7/13/2017	220.0	5.0	3.3	3.1	159.0	6.6	20.4	146.0	56.6	139.0	48.0	8.0	83.0	166.0
7/14/2017	223.0	4.0	3.1	2.9	163.0	3.9	7.0	137.0	40.7	133.0	47.0	7.0	79.0	164.0
7/15/2017	231.0	5.0	3.2	2.7	169.0	3.0	6.2	133.0	30.7	131.0	48.0	7.0	76.0	166.0
7/16/2017	207.0	5.0	3.2	2.7	178.0	3.0	5.7	131.0	11.5	166.0	47.0	12.0	107.0	170.5
7/17/2017	208.0	5.0	3.4	2.7	184.0	3.2	10.8	124.0	0.0	205.0	47.0	18.0	140.0	180.3
7/18/2017	231.0	5.0	3.2	2.4	187.0	3.3	16.0	127.0	0.0	196.0	47.0	14.0	135.0	185.3
7/19/2017	202.0	5.0	4.9	2.1	185.0	3.1	14.2	134.0	0.0	162.0	47.0	10.0	105.0	170.8
7/20/2017	184.0	5.0	4.7	1.7	182.0	2.8	7.2	133.0	0.0	135.0	48.0	7.0	80.0	158.5
7/21/2017	180.0	4.0	4.7	1.0	183.0	2.5	6.9	134.0	0.0	113.0	48.0	8.0	57.0	152.5
7/22/2017	178.0	5.0	4.7	0.6	186.0	2.4	5.9	133.0	0.0	104.0	48.0	8.0	48.0	150.3
7/23/2017	179.0	6.0	4.7	1.1	184.0	4.4	5.4	131.0	8.1	100.0	47.0	8.0	45.0	148.5
7/24/2017	170.0	5.0	4.7	2.4	181.0	4.1	6.7	133.0	0.0	102.0	47.0	8.0	47.0	146.5
7/25/2017	156.0	5.0	4.7	2.9	179.0	2.4	6.7	138.0	0.0	104.0	31.0	8.0	65.0	144.3
7/26/2017	113.0	7.0	4.6	2.1	181.0	3.3	6.8	135.0	0.0	120.0	32.0	8.0	80.0	137.3
7/27/2017	100.0	7.0	4.4	1.3	179.0	3.8	6.5	133.0	0.0	109.0	48.0	8.0	53.0	130.3
7/28/2017	101.0	7.0	4.3	1.3	167.0	3.8	6.4	131.0	0.0	107.0	47.0	8.0	52.0	126.5
7/29/2017	97.0	6.0	4.2	1.4	157.0	3.8	5.9	131.0	0.0	113.0	48.0	7.0	58.0	124.5
7/30/2017	97.0	5.0	4.2	1.5	145.0	3.9	7.0	130.0	0.0	119.0	48.0	8.0	63.0	122.8
7/31/2017	98.0	5.0	4.1	1.7	133.0	3.8	6.0	125.0	0.0	108.0	47.0	7.0	54.0	116.0

Notes: These measurements are not on the main channel of the Owens River, therefore highlighted columns are not included in average calculations.

Flow Gaging Station / Date	Below River Intake	Blackrock Ditch Return	Goose Lake Return	Billy Lake Return	Mazourka Canyon Road	Locust Ditch Return	Georges Ditch Return	Reinhackle Springs	Alabama Gates Return	At Pumpback Station	Pump Station	Langeman n Gate to Delta	Weir to Delta	In Channel Average Flow
8/1/2017	97.0	5.0	4.0	1.8	125.0	3.8	5.5	122.0	0.0	101.0	47.0	7.0	47.0	111.3
8/2/2017	97.0	5.0	4.0	1.8	122.0	3.8	5.2	117.0	0.0	102.0	48.0	8.0	46.0	109.5
8/3/2017	97.0	5.0	4.2	1.8	120.0	4.0	5.2	104.0	0.0	101.0	48.0	8.0	45.0	105.5
8/4/2017	98.0	5.0	4.3	2.1	119.0	5.2	5.7	110.0	0.0	103.0	48.0	8.0	47.0	107.5
8/5/2017	97.0	4.0	4.3	2.2	117.0	5.2	5.9	112.0	0.0	100.0	48.0	8.0	44.0	106.5
8/6/2017	98.0	4.0	4.4	2.2	115.0	4.9	6.5	112.0	0.0	97.0	47.0	8.0	42.0	105.5
8/7/2017	98.0	5.0	3.9	4.2	118.0	4.8	6.2	113.0	0.0	96.0	47.0	7.0	42.0	106.3
8/8/2017	99.0	3.0	1.7	1.7	115.0	4.4	6.5	115.0	0.0	94.0	47.0	8.0	39.0	105.8
8/9/2017	98.0	2.0	0.9	1.6	112.0	4.5	5.9	108.0	0.0	93.0	47.0	8.0	38.0	102.8
8/10/2017	80.0	3.0	1.1	1.6	109.0	4.4	5.3	106.0	0.0	94.0	47.0	8.0	39.0	97.3
8/11/2017	70.0	3.0	1.5	1.7	108.0	4.5	5.1	104.0	0.0	95.0	47.0	8.0	40.0	94.3
8/12/2017	70.0	2.0	1.2	1.7	106.0	6.0	4.2	105.0	0.0	93.0	47.0	8.0	38.0	93.5
8/13/2017	70.0	2.0	1.2	1.8	99.0	6.1	4.7	105.0	0.0	90.0	47.0	7.0	36.0	91.0
8/14/2017	70.0	3.0	1.3	1.8	91.0	5.5	4.5	108.0	0.0	91.0	47.0	8.0	36.0	90.0
8/15/2017	69.0	1.0	1.1	1.8	86.0	5.4	2.7	106.0	0.0	89.0	47.0	8.0	34.0	87.5
8/16/2017	70.0	1.0	1.0	1.8	82.0	5.2	3.9	106.0	0.0	87.0	47.0	8.0	32.0	86.3
8/17/2017	70.0	1.0	1.1	1.8	79.0	5.2	3.4	95.0	0.0	86.0	47.0	7.0	32.0	82.5
8/18/2017	69.0	1.0	1.2	1.7	77.0	5.4	1.7	94.0	0.0	88.0	47.0	8.0	33.0	82.0
8/19/2017	70.0	2.0	1.2	1.7	75.0	5.7	2.5	91.0	0.0	86.0	46.0	8.0	32.0	80.5
8/20/2017	69.0	2.0	1.2	1.7	72.0	5.7	4.1	90.0	0.0	87.0	47.0	8.0	32.0	79.5
8/21/2017	69.0	2.0	1.7	2.4	71.0	4.2	3.5	90.0	0.0	88.0	47.0	8.0	33.0	79.5
8/22/2017	69.0	1.0	1.7	2.8	77.0	0.3	0.4	83.0	0.0	86.0	47.0	7.0	32.0	78.8
8/23/2017	64.0	2.0	3.0	2.7	79.0	0.6	0.4	82.0	0.0	83.0	47.0	8.0	28.0	77.0
8/24/2017	59.0	1.0	2.7	2.5	77.0	0.0	0.3	80.0	0.0	84.0	47.0	8.0	29.0	75.0
8/25/2017	60.0	1.0	2.5	1.7	75.0	0.0	0.2	78.0	0.0	78.0	47.0	8.0	23.0	72.8
8/26/2017	58.0	0.5	2.5	1.0	58.0	0.0	0.6	77.0	0.0	78.0	47.0	8.0	23.0	67.8
8/27/2017	58.0	2.0	2.4	1.0	55.0	0.0	0.2	77.0	0.0	73.0	47.0	8.0	18.0	65.8
8/28/2017	58.0	2.0	2.3	1.1	68.0	0.0	0.1	77.0	0.0	73.0	47.0	7.0	19.0	69.0
8/29/2017	60.0	1.0	2.2	1.1	57.0	0.0	0.1	77.0	0.0	64.0	47.0	8.0	9.0	64.5
8/30/2017	58.0	2.0	2.0	1.1	67.0	0.0	0.1	75.0	0.0	70.0	47.0	8.0	15.0	67.5
8/31/2017	58.0	1.0	1.9	1.3	66.0	0.0	0.1	71.0	0.0	61.0	33.0	11.0	17.0	64.0

Notes: These measurements are not on the main channel of the Owens River, therefore highlighted columns are not included in average calculations.

Flow Gaging Station / Date	Below River Intake	Blackrock Ditch Return	Goose Lake Return	Billy Lake Return	Mazourka Canyon Road	Locust Ditch Return	Georges Ditch Return	Reinhackle Springs	Alabama Gates Return	At Pumpback Station	Pump Station	Langeman n Gate to Delta	Weir to Delta	In Channel Average Flow
9/1/2017	58.0	1.0	1.9	1.4	67.0	0.0	0.1	71.0	0.0	68.0	41.0	8.0	19.0	66.0
9/2/2017	58.0	1.0	1.8	1.4	66.0	0.0	0.1	69.0	0.0	63.0	47.0	3.0	13.0	64.0
9/3/2017	58.0	2.0	1.7	1.4	67.0	0.0	0.1	69.0	0.0	63.0	47.0	3.0	13.0	64.3
9/4/2017	58.0	1.0	1.6	1.4	66.0	0.0	0.1	70.0	0.0	65.0	47.0	3.0	15.0	64.8
9/5/2017	58.0	0.5	1.5	1.3	66.0	0.0	0.1	70.0	0.0	69.0	47.0	8.0	14.0	65.8
9/6/2017	60.0	1.0	1.4	1.3	66.0	0.0	0.1	71.0	0.0	62.0	47.0	8.0	7.0	64.8
9/7/2017	59.0	1.0	1.3	1.2	66.0	0.0	0.1	70.0	0.0	60.0	47.0	7.0	6.0	63.8
9/8/2017	58.0	1.0	1.1	1.1	66.0	0.0	0.4	69.0	0.0	60.0	47.0	8.0	5.0	63.3
9/9/2017	58.0	1.0	1.0	1.1	67.0	0.0	1.5	70.0	0.0	59.0	47.0	8.0	4.0	63.5
9/10/2017	58.0	1.0	0.9	1.1	68.0	0.0	1.1	71.0	0.0	56.0	46.0	7.0	3.0	63.3
9/11/2017	58.0	1.0	0.9	1.1	68.0	0.0	0.9	71.0	0.0	54.0	43.0	7.0	4.0	62.8
9/12/2017	61.0	1.0	0.8	1.1	68.0	0.0	0.8	70.0	0.0	57.0	47.0	7.0	3.0	64.0
9/13/2017	53.0	0.5	0.8	1.1	68.0	0.0	0.7	70.0	0.0	55.0	46.0	8.0	1.0	61.5
9/14/2017	50.0	1.0	0.7	1.1	68.0	0.0	0.7	71.0	0.0	55.0	47.0	7.0	1.0	61.0
9/15/2017	50.0	1.0	0.7	1.1	66.0	0.0	0.5	72.0	0.0	56.0	47.0	8.0	1.0	61.0
9/16/2017	49.0	0.5	0.6	1.1	63.0	0.0	0.4	70.0	0.0	55.0	46.0	8.0	1.0	59.3
9/17/2017	50.0	1.0	0.6	1.1	60.0	0.0	0.3	70.0	0.0	55.0	47.0	7.0	1.0	58.8
9/18/2017	50.0	1.0	0.5	1.1	59.0	0.0	0.2	68.0	0.0	55.0	47.0	8.0	0.0	58.0
9/19/2017	49.0	1.0	0.4	1.1	58.0	0.0	0.2	69.0	0.0	55.0	47.0	8.0	0.0	57.8
9/20/2017	49.0	2.0	0.4	1.1	58.0	0.0	0.1	67.0	0.0	54.0	47.0	7.0	0.0	57.0
9/21/2017	50.0	1.0	0.4	1.1	57.0	0.0	0.0	65.0	0.0	54.0	47.0	7.0	0.0	56.5
9/22/2017	50.0	1.0	0.3	1.1	57.0	0.0	0.1	61.0	0.0	55.0	47.0	8.0	0.0	55.8
9/23/2017	50.0	1.0	0.3	1.0	55.0	0.0	0.1	61.0	0.0	54.0	47.0	7.0	0.0	55.0
9/24/2017	50.0	2.0	0.3	1.0	51.0	0.0	0.1	60.0	0.0	54.0	47.0	7.0	0.0	53.8
9/25/2017	50.0	1.0	0.3	1.0	51.0	0.0	0.1	60.0	0.0	55.0	47.0	8.0	0.0	54.0
9/26/2017	49.0	1.0	0.2	1.1	51.0	0.0	0.0	59.0	0.0	52.0	45.0	7.0	0.0	52.8
9/27/2017	50.0	1.0	0.2	1.1	51.0	0.0	0.0	59.0	0.0	51.0	43.0	8.0	0.0	52.8
9/28/2017	50.0	1.0	0.2	1.1	50.0	0.0	0.0	54.0	0.0	48.0	41.0	7.0	0.0	50.5
9/29/2017	51.0	1.0	0.2	1.1	49.0	0.0	0.0	54.0	0.0	50.0	41.0	9.0	0.0	51.0
9/30/2017	49.0	1.0	0.1	1.2	50.0	0.0	0.1	57.0	0.0	49.0	41.0	8.0	0.0	51.3

Notes: These measurements are not on the main channel of the Owens River, therefore highlighted columns are not included in average calculations.

Appendix 3. McIver Canal and Eclipse Ditch Flows

McIver Canal and Eclipse Ditch Water Year 2016/17 Flows (cfs)		
**any date not shown on table is a 0 cfs flow for both McIver Canal and Eclipse Ditch*		
	McIver Canal	**Eclipse Ditch**
10/1/2016	0.0	0.0
4/3/2017	0.0	0.0
4/4/2017	10.6	6.3
4/5/2017	21.1	12.6
4/6/2017	21.1	12.6
4/7/2017	10.6	12.6
4/8/2017	0.0	6.3
5/7/2017	7.7	0.0
5/8/2017	15.4	12.5
5/9/2017	15.4	25.0
5/10/2017	15.4	25.0
5/11/2017	15.4	25.0
5/12/2017	7.7	12.5
5/13/2017	0.0	0.0
5/31/2017	0.0	0.0
6/1/2017	9.3	10.4
6/2/2017	16.8	19.2
6/3/2017	15.0	17.6
6/4/2017	14.6	20.7
6/5/2017	15.7	24.2
6/6/2017	18.1	26.8
6/7/2017	19.7	26.1
6/8/2017	22.8	25.4
6/9/2017	20.2	29.0
6/10/2017	22.7	19.4
6/11/2017	23.8	18.7
6/12/2017	17.5	29.4
6/13/2017	17.7	32.2
6/14/2017	28.0	36.4
6/15/2017	40.8	31.6
6/16/2017	44.2	24.8
6/17/2017	47.5	23.0
6/18/2017	50.0	21.0
6/19/2017	50.2	21.0
6/20/2017	53.8	21.4
6/21/2017	57.2	22.0
6/22/2017	57.0	21.5
6/23/2017	57.0	21.0
6/24/2017	57.0	21.0
6/25/2017	58.5	23.0
6/26/2017	60.0	27.5
6/27/2017	61.6	35.4
6/28/2017	55.5	42.3
6/29/2017	45.3	40.9
6/30/2017	43.0	38.0

McIver Canal and Eclipse Ditch Water Year 2016/17 Flows (cfs)		
**any date not shown on table is a 0 cfs flow for both McIver Canal and Eclipse Ditch*		
	McIver Canal	**Eclipse Ditch**
7/1/2017	43.0	38.0
7/2/2017	50.7	35.6
7/3/2017	56.7	33.6
7/4/2017	52.8	34.2
7/5/2017	50.3	35.2
7/6/2017	49.5	38.2
7/7/2017	49.0	40.2
7/8/2017	49.5	40.0
7/9/2017	47.5	40.0
7/10/2017	42.2	40.9
7/11/2017	39.3	43.7
7/12/2017	39.5	45.3
7/13/2017	40.0	45.0
7/14/2017	40.0	45.0
7/15/2017	40.0	45.0
7/16/2017	42.8	43.0
7/17/2017	45.2	40.7
7/18/2017	43.9	39.3
7/19/2017	44.8	38.7
7/20/2017	45.7	39.7
7/21/2017	45.0	40.0
7/22/2017	45.0	40.0
7/23/2017	41.3	40.9
7/24/2017	37.5	41.0
7/25/2017	34.7	40.9
7/26/2017	27.3	42.5
7/27/2017	11.3	42.7
7/28/2017	0.0	41.0
7/29/2017	0.0	37.5
7/30/2017	0.0	35.0
7/31/2017	0.0	17.5
8/1/2017	0.0	0.0
9/30/2017	0.0	0.0

3.0 AVIAN CENSUS FOR THE THIBAUT UNIT, BLACKROCK WATERFOWL MANAGEMENT AREA

3.1 Introduction

The Blackrock Waterfowl Management Area (BWMA) component of the Lower Owens River Project (LORP) is a managed wetland area comprised of four separate management units (Drew, Waggoner, Winterton and Thibaut). Rotational flooding of the BWMA units occurs in order to provide habitat for waterfowl, shorebirds, wading birds, and other indicator species.

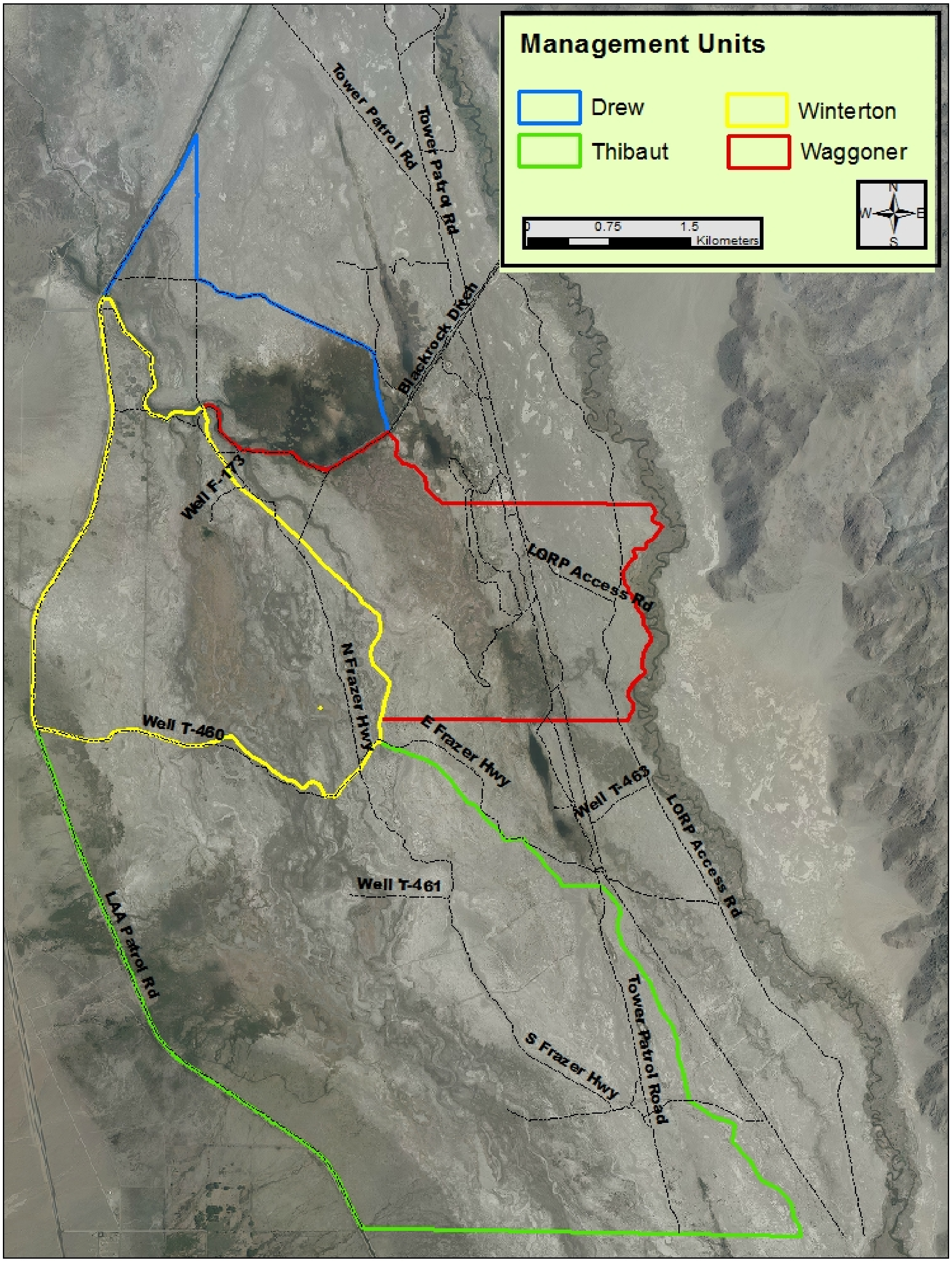
Under the LORP, LADWP is required to flood up to 500 acres in the BWMA to provide habitat consistent with the needs of indicator species (MOU 1997). The specific amount of flooded acreage to be maintained in any one year is dependent upon the percent of forecasted runoff. The 1997 MOU specifies that approximately 500 acres of BWMA will be flooded at any given time in years of average or above-average runoff. Per the 1997 MOU, in years when the forecasted runoff is estimated to be less than average, the flooded acreage will be set by the Standing Committee in consultation with the California Department of Fish and Wildlife (CDFW).

Avian surveys were conducted in order to evaluate use by indicator species. In 2017, avian surveys were conducted by LADWP Watershed Resources Specialists Debbie House and Chris Allen and Inyo County Water Department (ICWD) Field Program Coordinator, Jerry Zatorski and Vegetation Scientist, Zach Nelson. Data compilation and reporting was completed by Chris Allen.

3.2 Study Area Description and Field and Analysis Methods

3.2.1 Survey Area

The BWMA is located near the Blackrock Springs Fish Hatchery north of Independence and as noted above, is composed of four management units, all lying east of the Los Angeles Aqueduct and west of the Owens River (Avian Census Figure 1). The BWMA was historically used for water-spreading (LORP EIR 2004). The area supports natural basins, playas, and springs, as well as constructed ditches, levees, culverts and roads.



Avian Census Figure 1. Map of BWMA Management Units

The four units of BWMA encompass a total of 1,987 acres. Based on the 197% of normal conditions forecasted in the 2017 runoff year, the required flooded acreage for the BWMA was 500 acres in 2017. The Winterton and Thibaut Units were flooded to attain this acreage requirement.

The flooded acreage is determined quarterly by LADWP or ICWD staff by walking the wetted perimeter of each active unit. Normally the flooded acreage is recorded for all four seasons: winter, spring, summer and fall. In 2017, the wetted perimeter was walked and recorded by LADWP in the winter (January) and ICWD in the fall (October). Spring and summer flooded acreage surveys were not conducted in 2017 due to excessive flooding of the area from high runoff. Total acreage recorded in fall 2017 was 190 acres for Winterton and 454 acres for Thibaut. Although the actual acreage was not measured, the 644 acres recorded in fall were significantly down from the summer peak based on qualitative observations, yet were still well above the required 500 acres.

Avian surveys were only conducted at Thibaut in 2017 because it was in its second active year. No surveys were conducted at Winterton since two surveys were completed in 2015 and 2016 since it became active.

3.3 BWMA Habitat Indicator Species

Habitat indicator species for the BWMA were initially identified in the *Lower Owens River Project Ecosystem Management Plan - Action Plan and Concept Document* (Ecosystem Sciences 1997). The presence of these species was thought to indicate whether or not the desired range of habitat conditions were being achieved (MOU 1997). Habitat indicator species for BWMA include all waterfowl, wading birds, shorebirds, plus Northern Harrier, Least Bittern, rails, and Marsh Wren (Avian Census Table 1). The resident, migratory and wintering waterfowl indicator group includes all species in the Family Anatidae. Geese, swans, dabbling ducks (Anas spp.), and divers (scaup, Ruddy Duck, Bufflehead) are all included in this group. Wading birds include species in the Family Ardeidae (egrets and herons) and Threskiornithidae (i.e. White-faced Ibis). The shorebird group includes all species in the Order Charadriiformes, exclusive of gulls and terns (Family Laridae). The MOU also identified Least Bittern and Northern Harrier, both California Species of Special Concern as habitat indicator species. Virginia Rail, Sora and American Coot are the three rail species that occur at BWMA. Marsh Wren is the only songbird species that is designated as an indicator species.

Avian Census Table 1. BWMA Habitat Indicator Species (MOU 1997)

WILDLIFE	
Resident migratory and wintering waterfowl	Least bittern
Resident, migratory and wintering wading birds	Northern harrier
Resident, migratory and wintering shorebirds	Rails
	Marsh wren

3.4 Avian Survey Methodology

Avian surveys were conducted to assess use and seasonal abundance of BWMA habitat indicator species. A total of 13 surveys are conducted annually in each active unit. They include 2 winter surveys, 4 spring surveys, 2 summer surveys and 5 fall surveys. Avian Census Table 2 contains the survey dates by season for the Thibaut Unit. All 13 surveys were conducted in 2017, but in 2016 there were no winter surveys since the water was not released until spring. Also, there were only 3 spring surveys in 2016.

Avian Census Table 2. Seasonal Survey Dates for the Thibaut Unit

	Winter		Spring				
Thibaut 2016				4/20/16	5/4/16	5/18/16	
Thibaut 2017	12/8/16	3/5/17	4/5/17	4/27/17	5/9/17	5/24/17	
	Summer		Fall				
Thibaut 2016	6/9/16	6/22/16	8/5/16	8/17/16	8/31/16	9/16/16	9/28/16
Thibaut 2017	6/20/17	7/11/17	8/2/17	8/18/17	9/1/17	9/14/17	9/27/17

Surveys were conducted as area counts with observers walking the perimeter of the flooded area and recording all species encountered. Surveys began within 30 minutes of local sunrise, and a unit was generally surveyed within 4-5 hours. Bird activity was recorded using one of the following categories: foraging, perching, calling, locomotion, flying over (not using habitat), flushed, unknown, and reproductive. If reproductive activity was noted, the specific evidence of breeding was also noted in order to allow the determination of breeding status.

In 2017, several aerial counts by helicopter were incorporated to augment the ground counts when ground access was limited due to flooding. Aerial counts were generally conducted the day after the ground count.

As noted above, the flooded area was much greater in 2017 than in 2016. In 2016, the Thibaut Unit was divided into subunits for the purpose of surveying and evaluating the effectiveness of attracting habitat indicator species in different ponds and basins. This division was useful under normal conditions, however, in 2017, excessive flooding resulted in a merging of previously separate ponds and basins and difficulty in defining basins within some areas of Thibaut. Consequently, data below is presented for the entire Thibaut Unit rather than divided by subunits.

3.5 Results and Discussion

3.5.1 Avian Surveys – Thibaut Unit

A total of 45 habitat indicator species and 14,968 individuals were detected at Thibaut during the thirteen surveys in 2017 (Avian Census Table 3). Waterfowl were the most abundant habitat indicator species group, comprising 55% of the total number of indicator species. Gadwall was the most abundant species in this group. The second most abundant habitat indicator species group was rails. American Coot was the most abundant representative of this habitat indicator species group, representing 93% of all rails. Wading birds represent the third most abundant habitat indicator species group, due to high numbers of White-faced Ibis. Shorebirds were the least abundant habitat indicator species group. Numbers of Northern Harrier and Marsh Wren were significantly lower than the other habitat indicator species groups and Least Bittern was not detected at Thibaut. The total number of each species for 2017 is presented in Avian Census Table 4.

Avian Census Table 3. Total Habitat Indicator Species Detected in the Thibaut Unit by Functional Group, 2016 and 2017

Year	Waterfowl	Wading Birds	Rails	Shorebird	orthern Harri	Marsh Wren	Total
2016	1506	464	138	386	9	10	2513
2017	8290	2152	2602	1769	37	118	14968
Increase	450%	366%	1786%	358%	311%	1080%	496%

Avian Census Table 4. Habitat Indicator Species Detected in the Thibaut Unit, 2017

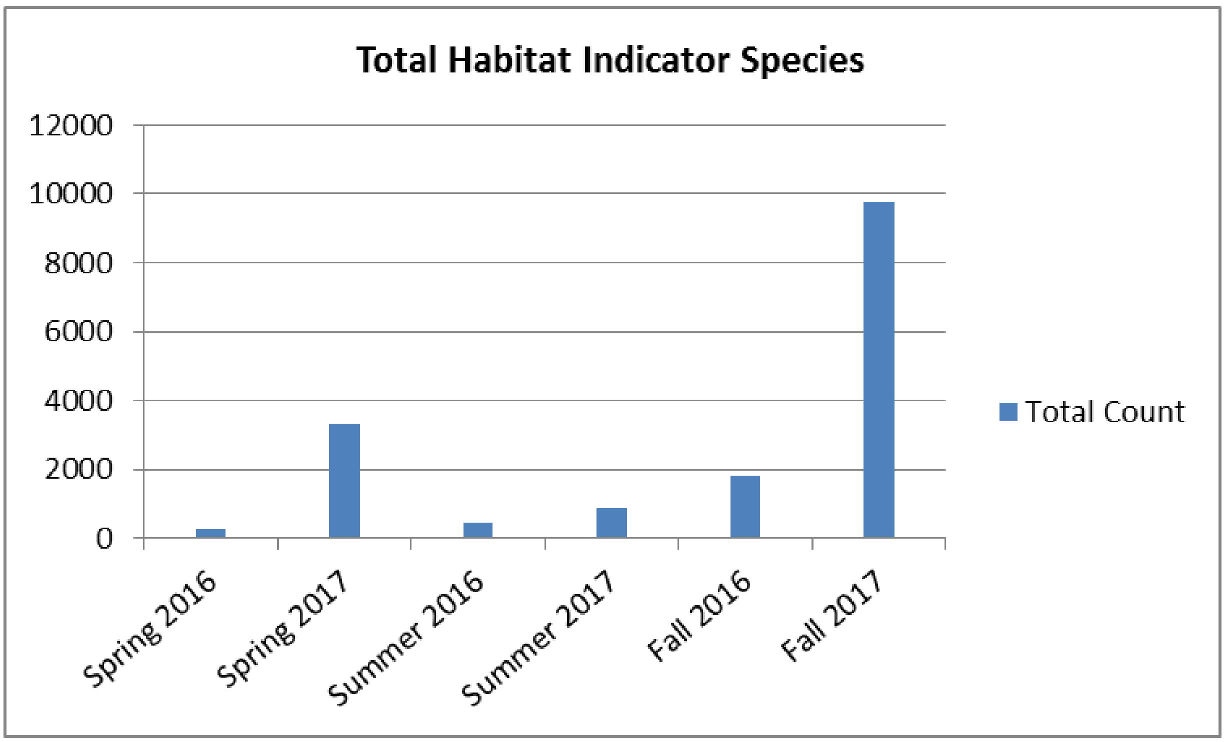
Species	Total	Species	Total
Snow Goose	1	Virginia Rail	10
Canada Goose	25	Sora	165
Gadwall	2634	American Coot	2427
American Wigeon	246	Black-bellied Plover	2
Mallard	1248	Semipalmated Plover	16
Blue-winged Teal	29	Killdeer	155
Cinnamon Teal	829	Black-necked Stilt	267
Northern Shoveler	257	American Avocet	148
Northern Pintail	242	Spotted Sandpiper	6
Green-winged Teal	2071	Solitary Sandpiper	2
Unidentified Teal	105	Greater Yellowlegs	146
Canvasback	18	Willet	38
Redhead	42	Lesser Yellowlegs	4
Ring-necked Duck	2	Long-billed Curlew	14
Lesser Scaup	2	Western Sandpiper	20
Bufflehead	51	Least Sandpiper	540
Hooded Merganser	1	Calidris sp.	46
Ruddy Duck	487	Short-billed Dowitcher	4
Great Blue Heron	184	Long-billed Dowitcher	147
Great Egret	56	Unidentified Dowitcher	144
Snowy Egret	8	Wilson's Snipe	8
Black-crowned Night-Heron	160	Wilson's Phalarope	54
White-faced Ibis	1744	Red-necked Phalarope	8
Northern Harrier	37	Marsh Wren	118

Comparison between 2016 and 2017

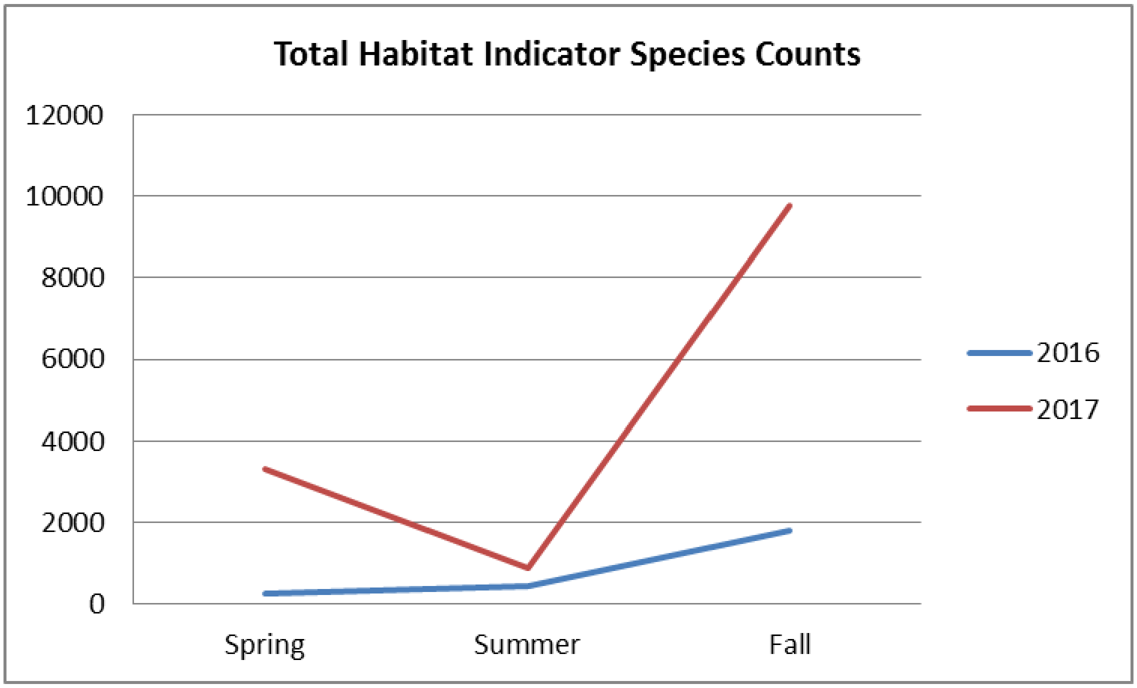
There was a significant increase in habitat indicator species use in 2017 during both the spring and fall migratory periods (Avian Census Table 5 and Avian Census Figures 2, 3, and 4). For both years the highest counts were observed in the fall with the 2017 fall count being 435% higher than 2016. Waterfowl were the most abundant indicator species group in the fall for both years. In 2017 the number of habitat indicator species decreased in the summer and then peaked in the fall. In 2016, the lowest count was in the spring consistent with when the Thibaut Unit was initially flooded. No winter surveys were conducted in 2016 since water was released in spring 2016, therefore no comparisons were drawn for the winter season between 2016 and 2017.

Avian Census Table 5. Thibaut Unit Comparison between 2016 and 2017

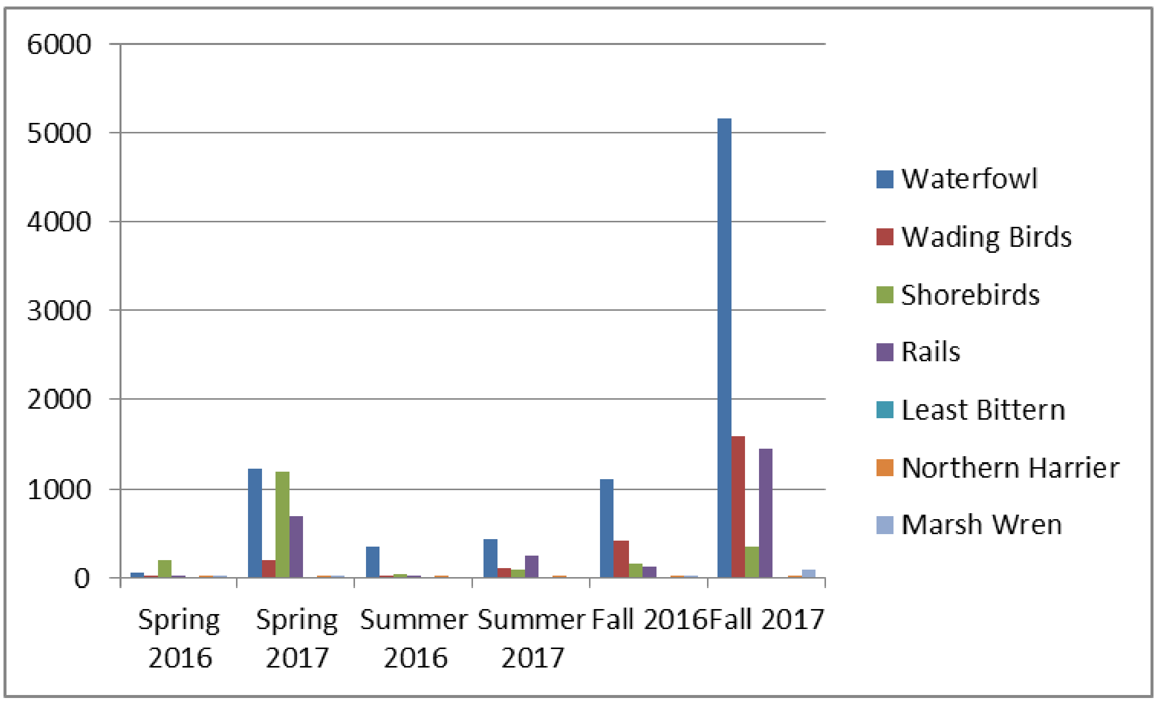
Habitat Indicator Species Group	Spring 2016	Spring 2017	Summer 2016	Summer 2017	Fall 2016	Fall 2017
Waterfowl	50	1232	353	442	1103	5774
Wading Birds	11	203	32	103	421	1842
Shorebirds	195	1190	36	91	155	467
Rails	8	689	9	239	121	1554
Least Bittern	0	0	0	0	0	0
Northern Harrier	1	2	1	1	7	29
Marsh Wren	4	7	0	0	6	99
Total	269	3323	431	876	1813	9765



Avian Census Figure 2. Total Habitat Indicator Species Comparisons, 2016 and 2017



Avian Census Figure 3. Total Habitat Indicator Species Comparisons, 2016 and 2017



Avian Census Figure 4. Habitat Indicator Species Group Comparison by Season, 2016 and 2017

3.6 Discussion

The high runoff conditions in 2017 presented the unique opportunity to observe habitat indicator species use in areas that are not normally flooded, and to evaluate the response of habitat indicator species to additional flooded acreage. The habitat indicator species responded positively to the increase in available habitat, as indicated by the almost 500% increase in total numbers as compared to 2016. Although significant increases were observed in almost all habitat indicator species groups (waterfowl, wading birds, shorebirds, rails, Marsh Wren and Northern Harrier), the increased use by waterfowl in fall was most dramatic.

In order to maximize water efficiency and habitat benefits, seasonal patterns of use by habitat indicator species should be considered. Since use of BWMA by waterbirds peaks in the spring and fall, it would be beneficial to keep the active ponds flooded during those periods. In contrast, breeding waterbird populations at BWMA are much more limited. Breeding waterfowl populations are low in the Great Basin Intermountain West region in general representing approximately 5% of the breeding waterfowl in the United States (Petrie 2013). The low abundance of breeding waterfowl in the Great Basin is due to variation in annual patterns of precipitation and wetland abundance (Petrie 2013). Of note is the fact that despite significant increases in the area of open water ponds at Thibaut, all waterbird numbers remained low in the summer.

Conditions may not be optimal for breeding waterfowl, leading to low breeding counts even under conditions of increased flooding as was observed in 2017. The majority of migrating waterfowl exhibit a behavior called “homing” (Johnson. 1988), meaning that they return to the locale from which they originated. That is their primary instinct, regardless of available habitat along the migration route. The 2017 count data for Thibaut supports this concept. Even in a year when there was an abundance of breeding habitat, the breeding population remained similar to 2016. Conditions at BWMA vary annually as the amount of flooded acreage increases in wet years and decreases in dry years, and the active status of each unit periodically changes, potentially influencing breeding waterfowl use.

In 2017, and in most years prior to that, the maximum wetted extent has been in the summer. A typical wildlife management area is flooded for three seasons, fall, winter and spring, to ensure that there is habitat available for migratory waterfowl. It would be beneficial to maintain the maximum wetted extent from fall through spring at BWMA for migratory waterfowl, since they constitute the highest counts. Increasing the wetted extent during summer will only benefit cattail growth and the American Coot population; and appears to have limited effects on breeding waterfowl populations. With less water in the summer, there will still be sufficient breeding waterfowl habitat as long as some open water area is maintained.

In the Thibaut Unit, the highest waterfowl count was in the farthest open water pond to the south, so it would be optimal for this pond to be full early in the spring and late in the fall. However, it is the last to be filled in the spring and the first to be drained in the fall because of where it lies in reference to where water is diverted to the Thibaut Unit. In 2017, the water drew down in September, and the pond was a mudflat by October. Waterfowl that just started to accumulate in that pond during fall migration had to go elsewhere. If the maximum wetted extent was maintained fall through spring, waterfowl would have had a longer period to accumulate and the counts would likely have been higher.

Less flooding during summer could also be a valuable tool for cattail management. Two basins have little to no waterfowl habitat left due to cattail encroachment, and another will soon follow suit. Data indicates that these basins are no longer attractive to waterfowl, but are attracting wading birds instead. Cattail management is expensive and time consuming. It would be more beneficial to inhibit growth by drying those basins in the summer, rather than allowing them to grow into unmanageable dense stands.

American Coot is the most abundant rail species at BWMA, and their numbers cloud interpretation of use by other species. They are a common and widespread species in the Owens Valley, but are included in the list of indicator species. Consideration should be given to remove this species from the indicator species list in order to allow for other species to be more accurately represented. In particular, the high numbers of American Coot cause Virginia Rail and Sora counts to appear insignificant. Virginia Rail and Sora are not easily detected so counts are consistently low, due on part to the survey methodology. In order to accurately detect the presence of these two species, callback surveys are needed. Virginia Rail and Sora are most often hidden in fresh emergent vegetation. It is difficult to manage for these two species concurrently with the other indicator species groups because Virginia Rail and Sora prefer dense cattails, or other types of fresh emergent vegetation. More evaluation is needed in order to create habitat diverse enough to accommodate all indicator species.

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4.0 LAND MANAGEMENT

4.1 Land Management Summary

The 2017 Lower Owens River Project (LORP) land management monitoring efforts continued with monitoring utilization across all leases, irrigated pasture evaluations, and range trend monitoring on the Thibaut and Islands leases inside the LORP management area. Five years of drought were followed by record snowpack and valley precipitation in 2016-17, resulting in high flows on the Lower Owens River, both in early April and from mid-June through late July (Figure 1). A summary of impacted range trend transects from high flood levels follows. In addition to above average precipitation, upland areas on both sides of the Owens River received significant runoff as a result of water spreading efforts.

Utilization estimates were conducted on all leases in 2016-17. Pasture utilization within the LORP was below the allowable levels of use established for both riparian (up to 40%) and upland (up to 65%) areas. Valley floor precipitation was well above normal during the winter (Figure 2); resulting in massive production of annual forbs and grasses in the uplands that in turn decreased grazing intensity along the Lower Owens River corridor.

All irrigated pastures were evaluated in 2016. Pastures that scored below 80% in 2016 were revisited in the summer of 2017. All irrigated pastures in the LORP management area in 2017 scored above 80%.

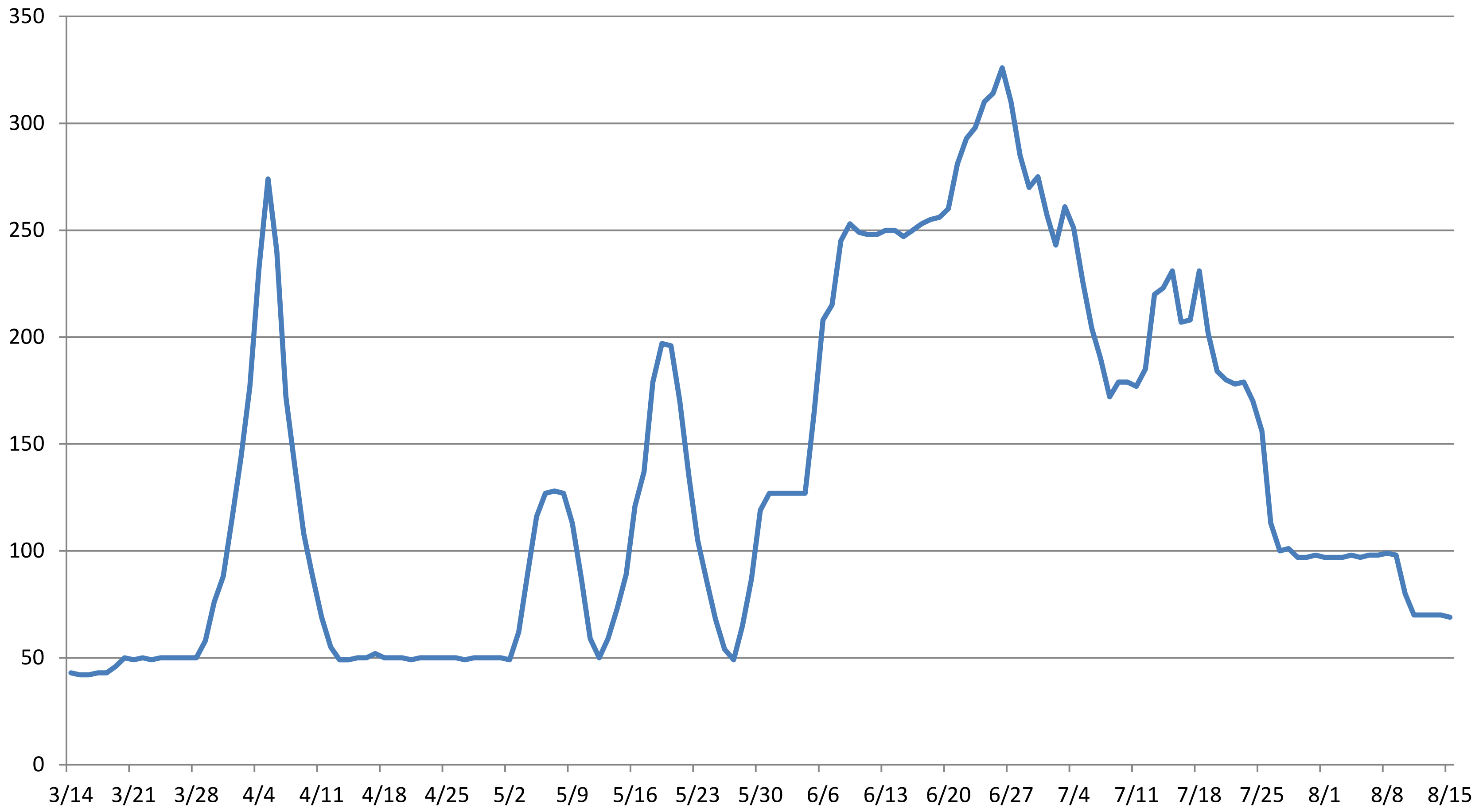


Figure 1. Flow Data (CFS), Owens River Below Intake Spill Gates Station #0088 From March 14-August 15, 2017

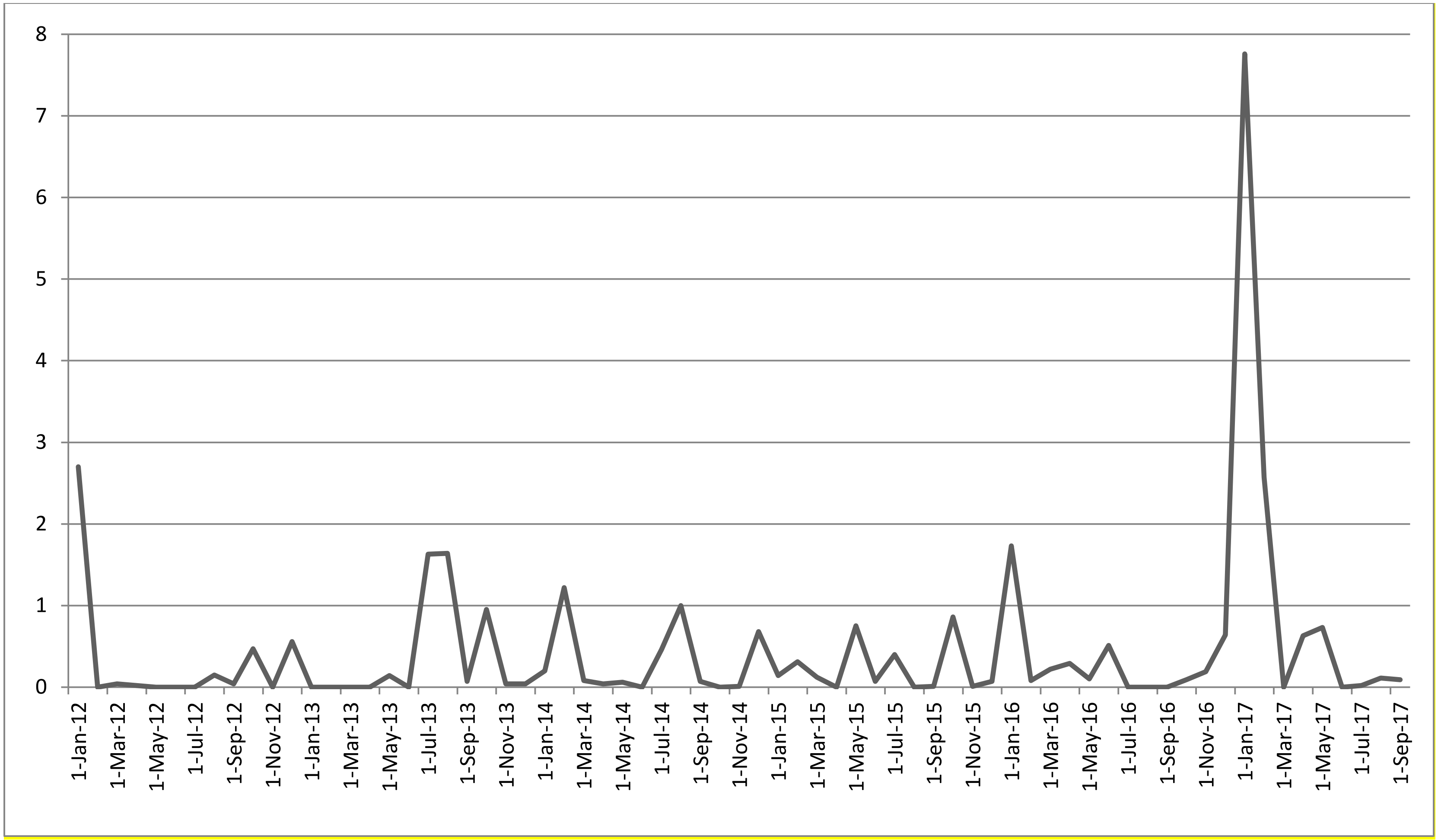


Figure 2. Monthly precipitation for Independence, CA from January 2012 to September 2017

4.2 Introduction

The land use component of this report is composed of project elements related to livestock grazing management. Under the land management program, the intensity, location, and duration of grazing are managed through the establishment of riparian pastures, forage utilization rates, and prescribed grazing periods (described in Section 2.8.1.3 and 2.8.2 LORP EIR, 2004). Other actions include the monitoring and protection of rare plant populations, establishment of off-river watering sources (to reduce use of the river and off-river ponds for livestock watering), and the monitoring of utilization and rangeland trend on the leases.

Grazing management plans developed for the ranch leases in the LORP modified grazing practices in riparian and upland areas on seven LADWP leases in order to support the 40 LORP goals as described in the LORP EIR (2007). The seven leases within the LORP planning area are: Intake, Twin Lakes, Blackrock, Thibaut, Islands, Lone Pine, and the Delta. LORP-related land use activities and monitoring that took place in 2017 are presented by lease below.

4.3 Utilization

The Lower Owens River Monitoring Adaptive Management and Reporting Plan (MAMP, Ecosystem Sciences, 2008), developed as part of the LORP Plan, identifies grazing utilization standards for upland and riparian areas. Utilization is defined as the percentage of the current year's herbage production consumed or destroyed by herbivores. Grazing utilization standards identify the maximum amount of biomass that can be removed by grazing animals during specified grazing periods. LADWP has developed height-weight relationship curves for native grass and grass-like forage species in the Owens Valley using locally-collected plants. These height-weight curves are used to relate the percent of plant height removed with the percent of biomass removed by grazing animals. Land managers can use these data to document the percent of biomass removed by grazing animals and determine whether or not grazing utilization standards are being exceeded. The calculation of utilization (by transect and pasture) is based on a weighted average. Species that only comprise a small part of available forage contribute proportionally less to the overall use value than more abundant species. Utilization data collected on a seasonal basis (mid- and end-points of a grazing period) will determine compliance with grazing utilization standards, while long-term utilization data will aid in the interpretation of range trend data and will help guide future grazing management decisions.

4.3.1 Riparian and Upland Utilization Rates and Grazing Periods

Under the LORP MAMP, livestock are allowed to graze in riparian pastures during the grazing periods prescribed for each lease (see Sections 2.8.2.1 through 2.8.2.7 LORP EIR, 2004). Livestock are to be removed from riparian pastures when the utilization rate reaches 40% or at the end of the grazing period, whichever occurs first. The beginning and ending dates of the lease-specific grazing periods may vary from year-to-year depending on conditions such as climate and weather, but the duration remains approximately the same. The grazing periods and utilization rates are designed to facilitate the establishment of riparian shrubs and trees.

In upland pastures, the maximum utilization allowed on herbaceous vegetation is 65% annually if grazing occurs only during the plant dormancy period. Once 65% is reached, all pastures must receive 60 continuous days of rest for the area during the plant “active growth period” to allow seed set between June and September. If livestock graze in upland pastures during the active growth period (that period when plants are “active” in putting on green growth and seed), maximum allowable utilization on herbaceous vegetation is 50%. The utilization rates and grazing periods for upland pastures are designed to sustain livestock grazing and productive wildlife through efficient use of forage. Riparian pastures may also contain upland habitat. If significant amounts of upland vegetation occur within a riparian pasture or field, upland grazing utilization standards will also apply to these upland habitat types. Livestock will be removed from a riparian pasture when either the riparian or the upland grazing utilization standards are met. Typically, the riparian utilization rate of 40% is reached before 65% use in the uplands occurs. Because of this pattern, utilization is not quantitatively sampled in adjacent upland areas, but use is assessed based on professional judgment. If utilization appears greater than 50% then utilization estimates using height weight curves will be implemented on the upland areas in the riparian field.

4.3.2 Utilization Monitoring

Monitoring methodologies are fully described in Section 4.6.2 of the *Lower Owens River Monitoring Adaptive Management and Reporting Plan* (Ecosystem Sciences, 2008).

Utilization is compliance monitoring and involves determining whether the utilization guidelines set forth in the grazing plans are being adhered to. Similar to precipitation data, utilization data alone cannot be used to assess ecological condition or trend. Utilization data is used to assist in interpreting changes in vegetative and soil attributes collected from other trend monitoring methods.

These standards are not expected to be met precisely every year because of the influence of annual climatic variation, livestock distribution, and the inherent variability associated with techniques for estimating utilization. Rather, these levels should be reached over an average of several years. If utilization levels are consistently 10% above or below desired limits over an average of several years, then adjustments should be implemented (Holecheck and Galt, 2000; Smith et al. 2007).

Utilization monitoring is conducted annually. Permanent utilization transects have been established in upland and riparian areas of pastures within the LORP planning area. An emphasis has been placed on establishing utilization monitoring sites within riparian management areas. Each monitoring site is visited prior to any grazing in order to collect ungrazed plant heights for the season. Sites are visited again mid-way through the grazing period (mid-season) and again at the conclusion of the grazing period or immediately prior to the end of plant dormancy (end-of-season).

4.4 Range Trend

4.4.1 Overview of Range Trend Monitoring and Assessment Program

A description of monitoring methods, data compilation, and analysis techniques can be found in the 2008 LORP MAMP. More detailed discussion of the Range Trend methods and considerations for interpretation can be found in previous LORP Annual Monitoring reports as well as descriptions of the range trend monitoring sites and their locations. Nested frequency and shrub cover data collected in 2017 are presented for each lease. Major departures from historic ranges of variability will be discussed at the lease level in the following sections.

Range trend monitoring for 2017 involves the quantitative sampling of the following attributes: nested frequency of all plant species and line intercept sampling for shrub canopy cover. Photo documentation of site conditions is included as part of range trend monitoring.

Because frequency data is sensitive to plant densities and dispersion, frequency is an effective method for monitoring and documenting changes in plant communities (Mueller-Dombois and Ellenberg, 1974; Smith et al., 1986; Elzinga, Salzer et al., 1988; BLM 1996; Heywood and DeBacker, 2007). For this reason, frequency data is the primary means for evaluating trend at a given site. Based on recommendations for evaluating differences between summed nested frequency plots (Smith et al., 1987 and Mueller-Dombois and Ellenberg, 1974), a Chi-Square analysis with a Yate's correction factor was used to determine significant differences between years. The 2017 results were compared to all sampling events during the baseline period to determine if results in 2017 were ecologically significant or remained within the typical range of variability observed for that particular site.

The ecological site on the LORP where the majority of land management monitoring transects are located is the Moist Floodplain ecological site (MLRA 29-20). The site describes axial-stream floodplains. Moist Floodplain sites are dominated by saltgrass (*Distichlis spicata*), plant symbol DISP and to a lesser extent alkali sacaton *(Sporobolus airoides*), plant symbol SPAI and creeping wildrye *(Leymus triticoides*), plant symbol LETR5. Only 10% of the total plant community is expected to be composed of shrubs and the remaining 10% forbs. This ecological site does not include actual river or stream banks. Stream bank information is available from the 2016 Rapid Assessment Survey (RAS) report and the Streamside Monitoring Report from 2014.

Saline Meadow ecological sites (MLRA 29-2) are the second most commonly encountered ecological sites on the LORP range trend sites. These sites are located on fan, stream, lacustrine terraces, and may also be found on axial stream banks. Potential plant community groups are 80% perennial grass with a larger presence of alkali sacaton than Moist Floodplain sites. Shrubs and trees comprise up to 15% of the community while forbs are only 5% of the community at potential. Saline Bottom (MLRA 29-7) and Sodic Fan (MLRA 29-5) ecological sites were also associated with several range trend sites. These are more xeric stream and lacustrine terrace sites. Saline Bottom ecological sites still maintain up to 65% perennial grasses, the majority of which is alkali sacaton, while shrubs compose up to 25% of the plant community, and forbs occupy the remaining 10%. Sodic Fan ecological sites are 70% shrubs, primarily Nevada saltbush *(Atriplex torreyi)*, plant symbol ATTO, with a minor component of alkali sacaton of up to 25% and 5% forbs.

During the pre-project period, a range of environmental conditions were encountered including “unfavorable” growing years, when precipitation in the southern Owens Valley was less than 50% of the 1970-2009 average; “normal” years, when precipitation was 50-150% of average; and “favorable” conditions, when precipitation was greater than 150% of average. Many of the monitoring sites responded differently to the variable precipitation conditions during the baseline period. This provided the Watershed Resources staff an opportunity to sample across a broad amplitude of ecological conditions for these sites, which contributed to a robust baseline dataset. Data from the Lone Pine rain gauges are used to determine the growing conditions for each sampling year on the Islands, Lone Pine, and Delta Leases. Precipitation data from Independence are used for the Thibaut and Blackrock Leases, and data from the Intake are used for the Intake, Twin Lakes, and the northern portion of the Blackrock Leases.

Adaptive management recommended that a modified range trend schedule be implemented in 2012. This schedule ensures that there will be some monitoring across the landscape annually, increasing the probability of documenting the influence of significant changes in climate or management on the various ecological sites in the LORP area.

Table 1. Revised LORP Range Trend Monitoring Schedule

2016	2017	2018	2019	2020	2021
Blackrock	Thibaut	Twin Lakes	Blackrock	Thibaut	Twin Lakes
Delta	Islands	Lone Pine	Delta	Islands	Lone Pine

4.4.2 Irrigated Pastures

Monitoring of irrigated pastures consists of Irrigated Pasture Condition Scoring following protocols developed by the (NRCS, 2001). Irrigated pastures that score 80% or greater are considered to be in good to excellent condition. If a pasture rates below 80%, changes to pasture management will be implemented.

Pasture condition scoring was conducted in 2016 in all irrigated pastures. Pastures which scored below 80% in 2016 were revisited in the summer of 2017. This data is presented by lease (where applicable) below. All irrigated pastures in the LORP management area in 2017 scored above 80%.

4.4.3 Fencing

The LORP EIR identified approximately 44 miles of new fencing to be built in the project area to improve grazing management and help meet the LORP goals. The new fencing consisted of riparian pastures, upland pastures, riparian exclosures, rare plant exclosures, and rare plant management areas. Rare plant exclosures were constructed on the Blackrock and Thibaut Leases (see Sections 2.8.1.4, 2.8.2.2, and 2.8.2.3 of the LORP EIR, 2004). Fence construction began in September 2006 and was completed in February 2009 with approximately 50 miles of new fence constructed.

No new fence construction occurred within the LORP project boundaries. Some repairs did occur along with general maintenance.

4.4.4 Discussion of Range Trend

Range Trend transects on the Thibaut and Delta Leases were read in late July 2017. As noted above, the Eastern Sierra experienced record snowpack and the Owens Valley received record precipitation during the 2016-17 winter. Continued significant declines of Nevada saltbush along multiple locations on Reach 2 of the Lower Owens accelerated this year with the rising water table associated with both high summer flows in the LORP and off-river water spreading activities. Frequency trends on moist floodplain sites increased with fivehorn smotherweed (*Bassia hysopifolia*), and other annuals and early successional forbs significantly increasing. Perennial grass species decreased on four sites. This decrease was a result from the sites being submerged for several months during the summer.

Table 2. Significant Changes Between 2016 and 2017 Plant Frequencies (p=0.1) on the Thibaut Lease

	No Change	DISP	DESO2	HECU3	BAHY	MALE3	SCAM6	TYLA
Moist Floodplain								
THIBAUT_04				↑				
THIBAUT_05					↑	↑		
THIBAUT_06		↑	↑	↑				
THIBAUT_07					↑	↑		
Saline Meadow								
THIBAUT_1B					↑		↑	↑
THIBAUT_02	↔							
THIBAUT_03		↓						

Table 3. Significant Changes Between 2016 and 2017 Plant Frequencies (p=0.1) on the Islands Lease

	No Change	DISP	DESO2	HECU3	BAHY	SPAI	SCAM6	TYLA
Moist Floodplain								
ISLAND_06						↓		
ISLAND_08		↑						
ISLAND_09	↔							
ISLAND_10		↓						
ISLAND_11	↔							
ISLAND_13		↓						

4.5 Impacts from High Flows on Moist Floodplains in 2017

In addition to the regularly scheduled program involving range trend sampling across the entire Islands and Thibaut leases, LADWP Watershed staff sampled 17 range trend transects on the Lower Owens where at least 30% of each transect was inundated from high flows. All of these additional flood impacted sites were on moist floodplain ecological sites. Twelve of the 17 sites are located in Reach 2, a dry incised floodplain approximately 15.6 miles long, and is the largest reach in on the river (see Map 1. in Section 7.0, Rapid Assessment Survey). This is the same area that did not receive surface flows of any kind following the diversion of the Lower Owens River into the LA Aqueduct.

Fivehorn smotherweed frequency significantly increased on 7 of the 12 flooded sites in Reach 2. These increases were similar to levels observed during the first few years of LORP implementation. Fivehorn smotherweed was static on all other flooded sites (5 sites) that were outside of Reach 2. Other early seral species such as alkali mallow and salt heliotrope significantly increased on Reach 2 but remained static elsewhere on the river. This pattern of ruderal species responding to dramatic climatic changes in one part of the river and not on other portions that experienced the same climatic influences substantiates observations that Reach 2 has not yet reached an equilibrium and managers should continue to expect additional changes in the future.

Photo 1. Blackrock_10 Range Trend Monitoring Site

Note high mortality of Nevada saltbush (Atriplex torreyi). Nevada saltbush cover on this site decreased from 38% in 2016 to 6% in 2017.

Based on observation, die-off of Nevada saltbush on moist floodplains has occurred throughout the river. Reach 2, however, experienced significant decreases in Nevada saltbush. Range trend monitoring data, specifically from line intercept transects, confirms this observation (Figure 3 and Figure 4).

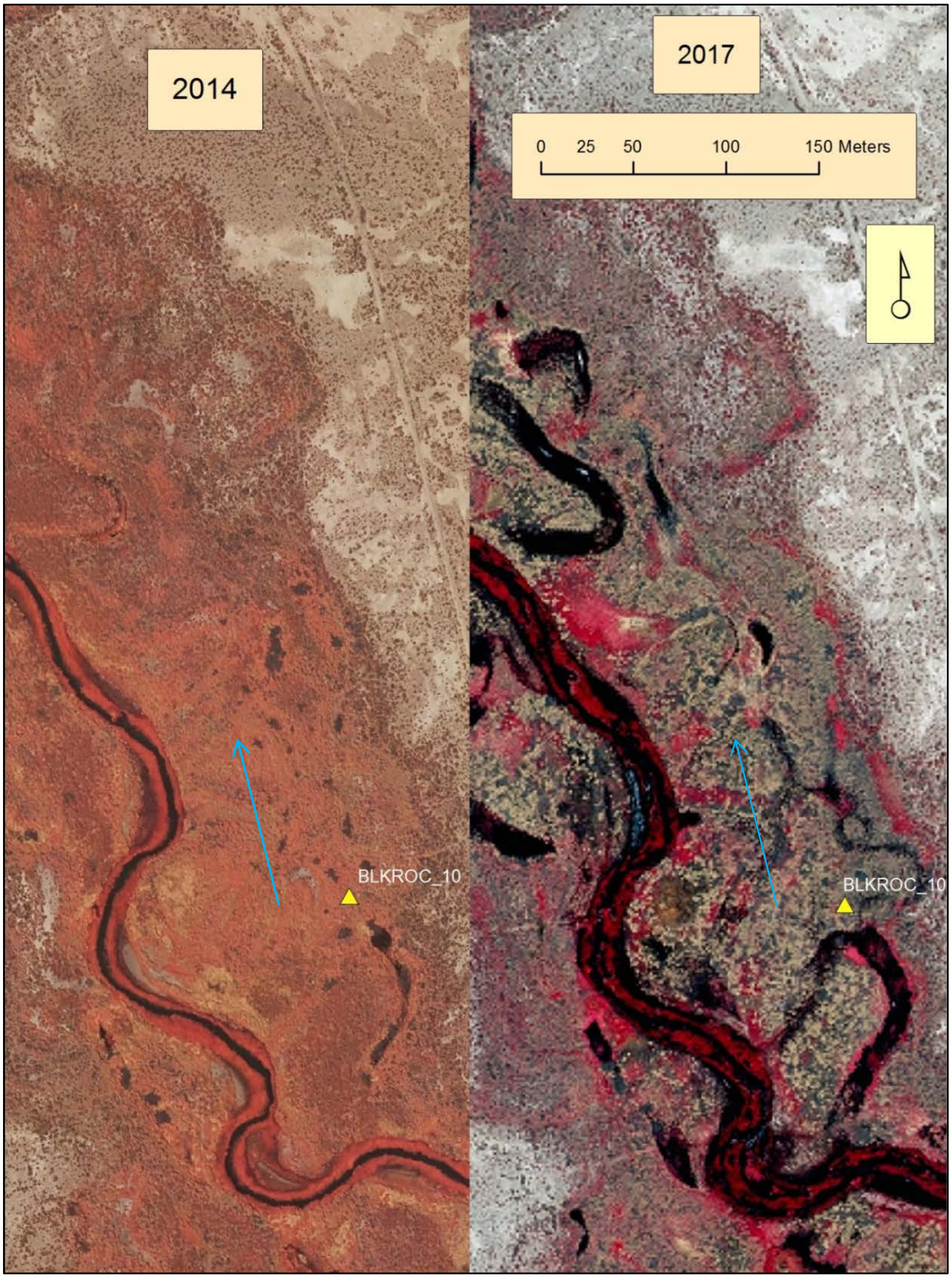


Figure 3 Comparison Between Infrared Imagery from 2014 and 2017 in the Vicinity of Blackrock_10 Transect.

Nevada saltbush cover decreased on all sites where it was present during sampling in 2016 (Figure 3, Figure 4, Figure 5). The widespread decrease in cover (plant mortality) was a result from plant stress during prolonged saturation in the shrub's rooting zone.

In flooded areas where there was a pre-existing herbaceous understory, meadow development should continue, although standing dead shrubs may retard understory development. Burning, mowing or dragging these floodplain sites has the potential to quickly accelerate meadow development. Livestock grazing, at a slower rate, should also open up these dead, closed shrub canopies through trailing and grazing in locations that maintain a grass understory. Based on observation, areas in the grazed White Meadow Riparian pasture are much more open compared to the Thibaut Livestock exclosure. LIDAR data from 2017 will be analyzed this winter along the river to validate this observation.

Increasing perennial grass cover on moist floodplain sites in Reach 2 should reduce turbidity and contribute to improving water quality during overbank flow scenarios such as the two experienced this year in April and during the summer by creating an herbaceous layer which will act as a filtering system for sediments. Facilitating meadow development will also bring these moist floodplain sites closer to their potential, which will increase Reach 2's resilience to significant climatic changes such as what occurred in 2017.

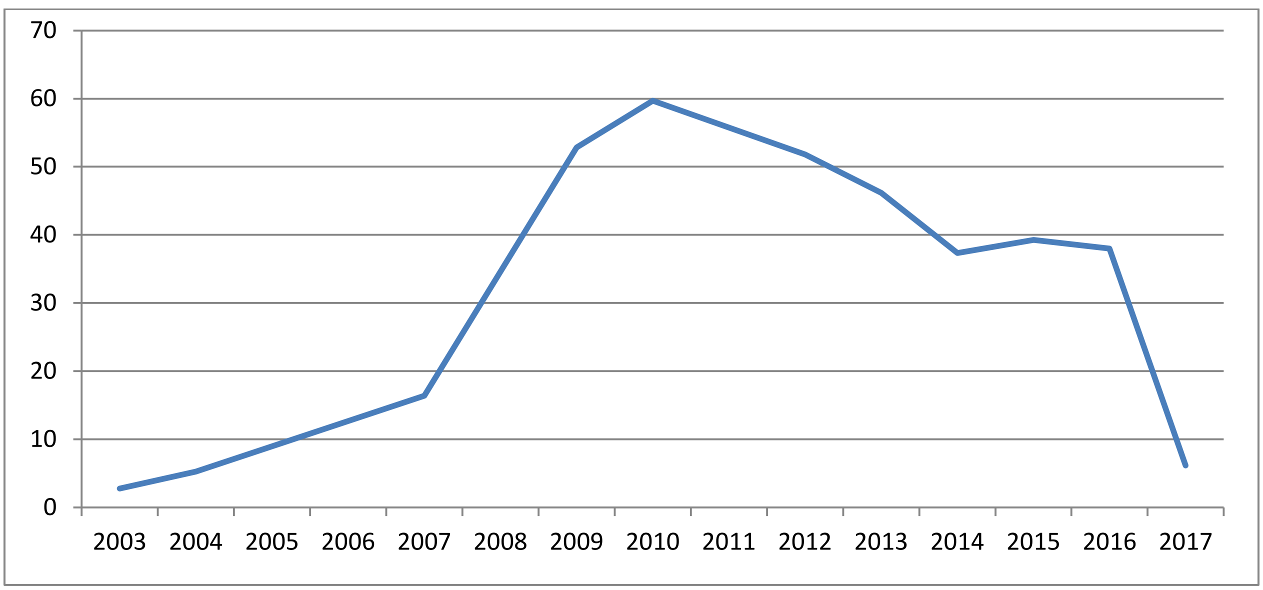


Figure 4 Nevada Saltbush Cover from 2003-17 on Blackrock_10

Locations that contain very little herbaceous understory and limited Nevada saltbush are typically the same locations that produce fivehorn smotherweed during high precipitation years. These same sites will maintain a dense thatch layer over the next several years, preventing both the colonization of desirable plant species as well as reducing any further increases of the annual fivehorn smotherweed. Late winter burns on average years may help prepare these sites to become colonized by plant species other than the fivehorn smotherweed. However, early winter burns in average to above average years may not kill fivehorn smotherweed seedlings and would add to an even more robust emergence of the plant. On sites with abundant standing dead Nevada saltbush that lack herbaceous understory, further reduction of the dead Nevada saltbush will merely prepare the sites for fivehorn smotherweed invasions.

The following photos, taken in the Thibaut grazing exclosure, illustrate how sites with heavy fivehorn smotherweed thatch will consistently produce fivehorn smotherweed when adequate spring moisture is available. Fivehorn smotherweed quantities in 2017 are at similar levels as they were nine years earlier in 2008. This site was also burned as part of the saltcedar slash pile burning efforts in 2007. The high temperatures associated with these fires are the same sites where fivehorn smotherweed has persisted. This possible connection should be considered by managers as a cautionary tale with regards to the present massive fuel load of Nevada saltbush. If an accidental fire were to consume portions of Reach 2, edaphic impacts from high temperatures could result in an expanded and persistent fivehorn smotherweed community.

Photo 2 Thibaut_04, 2009 Dead
Dead BAHY in photo is from summer of 2008.

Photo 3. Thibaut_04, 2016

Note minimal thatch from decayed fivehorn smotherweed produced in 2011 and healthy stand of Nevada saltbush in background.

Photo 4. Thibaut_04, 2017

Note fivehorn smotherweed in foreground where no flooding occurred and brown canopy of dead Nevada saltbush where flooding did occur. Nevada saltbush decreased by 20% on this site in 2017. Also BAHY cover appears to have returned to levels not observed since 2008.

4.5.1 Recommendations for Reach 2

Data from range trend sites on Reach 2 show that the area remains in an early seral state. Other portions of the river remained relatively unaffected by the record flows this summer. Although the high flows did not contain enough energy to mechanically alter the riverine landscape during the actual event, prolonged inundation did eventually impact extensive areas of the river corridor in Reach 2 by drowning large areas of Nevada saltbush. Land managers are now presented with a unique opportunity to accelerate meadow development on Nevada saltbush sites containing grass understories by eliminating standing dead Nevada saltbush in Reach 2. Increased moist flood plain meadows will contribute to improved water quality and greater ecological resilience during future climatic events. The accumulated fuel load from Nevada saltbush both in areas with grass understory and in areas absent of a grass component are now facing a real possibility of catastrophic fire that could potentially invite a greater abundance of fivehorn smotherweed onto Reach 2. Tools available to managers are prescribed fire, mowing, dragging, and allowing for an increase in grazing intensity by lifting of the 40% utilization ceiling on pastures in Reach 2. Land managers should also avoid additional impacts to sites that have a minimal grass understory. LADWP Watershed Staff is proposing a series of mowing treatments and controls this year on Reach 2 to evaluate the efficacy of large scale mowing on shrub dominated floodplains that hold potential for meadow conversion.

Table 1. Significant changes between 2016 and 2017 in plant frequencies (p=0.1) on moist floodplain sites that experienced some flooding during the high flows on the Owens River in 2017.

	No Change	DISP	ANCA10	MALE3 *	BAHY*	SPAI	SCAM6	FRSA	HECU3*	DESO2	LETR5	ATTO
TWINLAKES_03		↑										
TWINLAKES_04					↑						↑	
TWINLAKES_06					↑				↑			↓
BLACKROCK_10											↓	↓
BLACKROCK_25		↓			↑							
BLACKROCK_11		↑			↑							
BLACKROCK_14					↑							
THIBAUT_07				↑	↑							
THIBAUT_06		↑							↑	↑		
THIBAUT_04									↑			
THIBAUT_05				↑	↑							
BLACKROCK_15	↔											
BLACKROCK_19						↓						
ISLANDS_13		↓						↓				
ISLANDS_08		↑										
LONEPINE_08			↑				↑					
DELTA_05	↔											

Shaded transects are located in Reach 2

*ruderal or early successional plant species

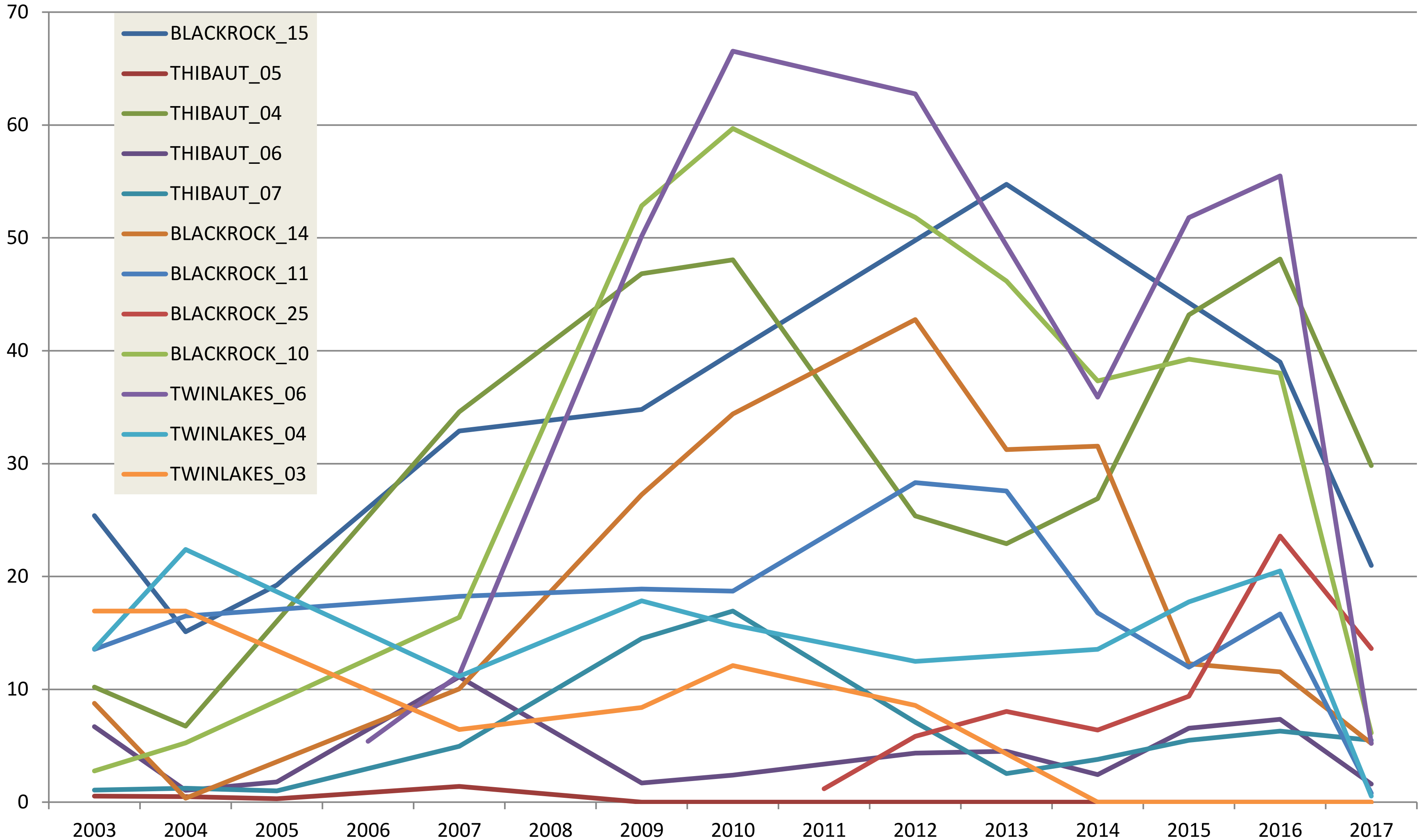


Figure 5. Percent Cover for Nevada Saltbush on all Moist Floodplain Sites in Reach 2 From 2003 to 2017

4.6 LORP Ranch Lease Summary and Monitoring Results

The following sections are presented by ranch lease. The discussion includes an introduction describing the lease operations, pasture types, a map of the lease, utilization results from 2017, a summary of range trend results at the lease level, and a presentation of range trend results by transect when significant changes occurred. Reference to plant species by plant symbol are found in the following list of the plant species, scientific names, common names, plant symbol, and functional group assignment for species encountered on the range trend transects.

Land Management Table 2. Common Species in Range Trend Transects

USDA Plant Code	Species Name	Common Name
ANCA10	*Anemopsis californica*	yerba mansa
ARPU9	*Aristida purpurea*	purple threeawn
ATSES2	*Atriplex serenana*	bractscale
ATTO	*Atriplex torreyi*	saltbush
ATTR	*Atriplex truncata*	wedgescale saltbush
BAHY	*Bassia hysopifolia*	fivehorn smotherweed
CHHI	*Chenopodium hians*	hians goosefoot
CHIN2	*Chenopodium incanum*	mealy goosefoot
CHLE4	*Chenopodium leptophyllum*	narrowleaf goosefoot
DESO2	*Descurainia sophia*	herb sophia
DISP	*Distichlis spicata*	saltgrass
EQAR	*Equisetum arvense*	field horsetail

Common Species Encountered in Range Trend Transects, continued:

USDA Plant Code	Species Name	Common Name
FOPU2	*Forestiera pubescens*	stretchberry
GITR	*Gilia transmontana*	transmonte gilia
GLLE3	*Glycyrrhiza lepidota*	American licorice
HECU3	*Heliotropium curassavicum*	salt heliotrope
JUBA	*Juncus balticus*	Baltic rush
LASE3	*Langloisia setosissima*	Great Basin langloisia
LEFL2	*Lepidium flavum*	yellow pepperweed
LELA2	*Lepidium latifolium*	broadleaf pepperweed
LETR5	*Leymus triticoides*	beardless wildrye
MALE3	*Malvella leprosa*	alkali mallow
NADE	*Nama demissum*	purplemat
POMO5	*Polypogon monspeliensis*	annual rabbitsfoot grass
SAEX	*Salix exigua*	narrowleaf willow
SAGO	*Salix gooddingii*	Goodding's willow
SALA3	*Salix laevigata*	red willow
SAVE4	*Sarcobatus vermiculatus*	greasewood
SCAC3	*Schoenoplectus acutus*	hardstem bulrush
SCAM6	*Schoenoplectus americanus*	chairmaker's bulrush
SCMA	*Schoenoplectus maritimus*	cosmopolitan bulrush
SPAI	*Sporobolus airoides*	alkali sacaton
TARA	*Tamarix ramosissima*	saltcedar
TYDO	*Typha domingensis*	southern cattail
TYLA	*Typha latifolia*	broadleaf cattail

4.6.1 Intake Lease

The Intake Lease is utilized by horses and mules. The lease, which is approximately 102 acres, is comprised of three fields: Intake, Big Meadow Field, and East Field. The Intake Field contains riparian vegetation and an associate range trend transect. The Big Meadow Field contains upland and riparian vegetation; however, it is not within the LORP project boundaries. There are no utilization or range trend transects in the Big Meadow Field due to a lack of adequate areas to place a transect that would meet the proper range trend/utilization criteria. Much of the meadow in the Big Meadow Field was covered with dredged material from the LORP Intake during the implementation of the LORP project. The East Field consists of upland and riparian vegetation. There are no irrigated pastures on the Intake Lease. There are no identified water sites needed for this pasture and no riparian exclosures planned due to the limited amount of riparian area within the both pastures.

Summary of Utilization

The following table presents the summarized utilization data for each field for the current year.

End of Grazing Season Utilization on the Intake Lease, RLI-475, 2017

Field	Utilization
Intake *	0%

*Riparian Utilization 40%**

Utilization for the Intake Lease in 2017 was 0%.

Summary of Range Trend Data and Conditions

Range Trend data was not collected in 2017 on the Intake Lease.

Irrigated Pastures

There are no irrigated pastures on the Intake Lease.

Stockwater Sites

There are no stockwater sites on the lease. Stockwater is provided by the Owens River.

Fencing

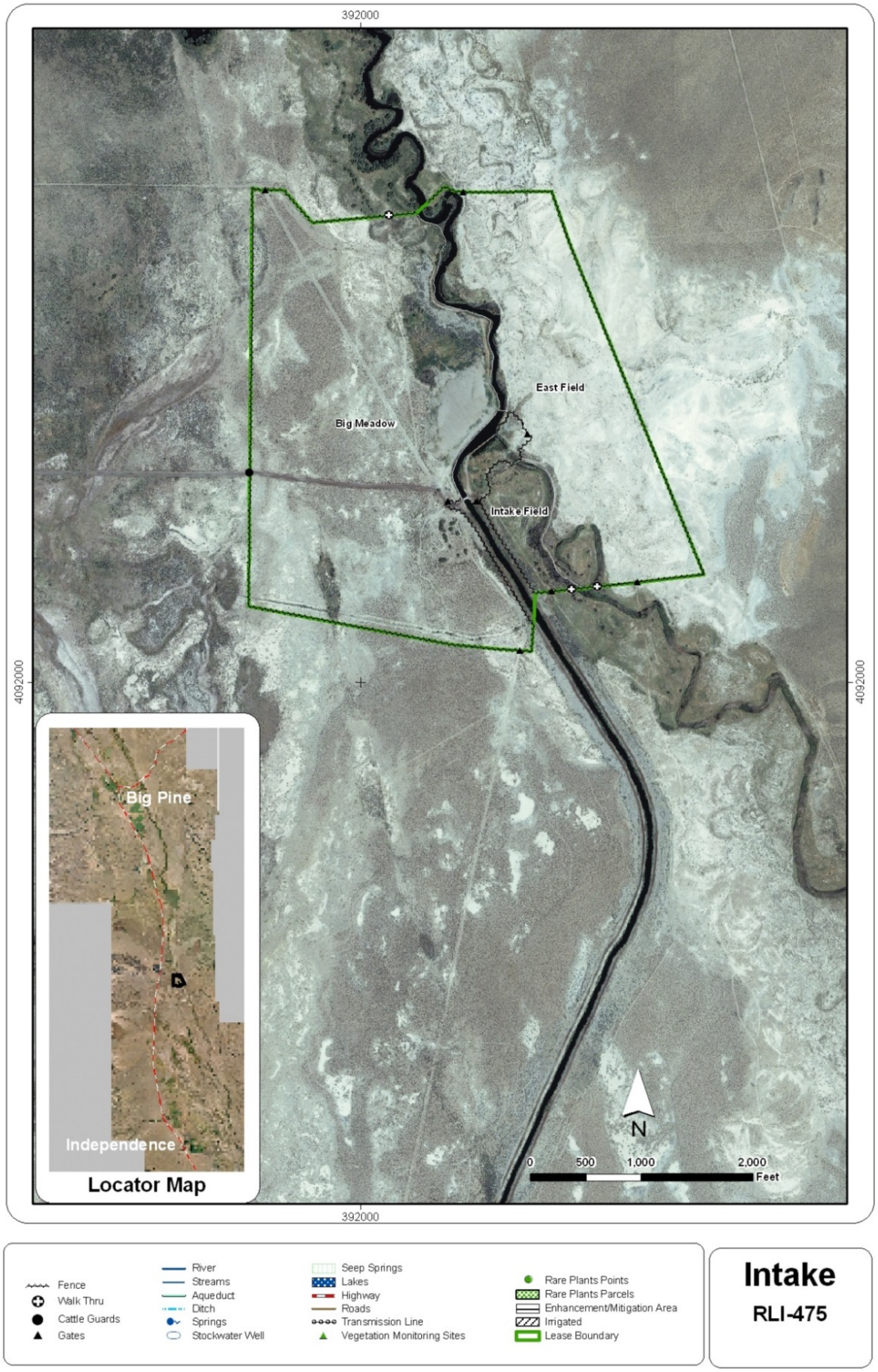
There was no new fence construction on the lease in 2017.

Salt and Supplement Sites

There are no salt and supplement sites on the lease.

Burning

No burns were conducted on the lease in 2017.



Land Management Figure 1. Intake Lease

4.6.2 Twin Lakes Lease

The Twin Lakes Lease is a 4,912-acre cow/calf operation situated just south of the Los Angeles Aqueduct Intake. It includes a reach of the Owens River that lies mainly north of Twin Lakes, which is located at the southern end of the Twin Lakes Lease. Of the 4,912 acres, approximately 4,200 acres are used as pastures for grazing; the other 712 acres are comprised of riparian/wetland habitats and open water. Cattle usually graze the lease from late October or early November to mid-May.

There are four pastures on the Twin Lakes Lease within the LORP boundary: Lower Blackrock Riparian Field, Upper Blackrock Field, Lower Blackrock Field, and the Holding Field. The Lower Blackrock Riparian, Upper Blackrock Riparian, and Lower Blackrock Fields contain both upland and riparian vegetation. The Holding Field contains only upland vegetation. There are no irrigated pastures on the Twin Lakes Lease. Range trend and utilization transects exist in all fields except the Holding Field where livestock grazing does not occur.

Summary of Utilization

The following table presents the summarized utilization data for each field for the current year.

End of Grazing Season Utilization on the Twin Lakes Lease, RLI-491, 2017

Field	Utilization
Lower Blackrock Field	4%
Lower Blackrock Riparian Field*	7%
Upper Blackrock Field*	10%

*Riparian Utilization 40%**

Riparian Management Areas

Utilization in the Lower Blackrock Riparian (7%) and Upper Blackrock Field (10%) was well below the allowable utilization for the grazing season. Much of the grazing occurred around Drew Slough (Lower Blackrock Field, 4%) early in the season and then in the adjacent upland areas as spring ephemerals began to emerge. There are no recommended management changes for the lease.

Upland Management Area

Upland utilization was below the allowable standard of 65% in all fields.

Summary of Range Trend Data and Conditions

Range trend data were not collected in 2017.

Irrigated Pastures

There are no irrigated pastures on the Twin Lakes Lease.

Fencing

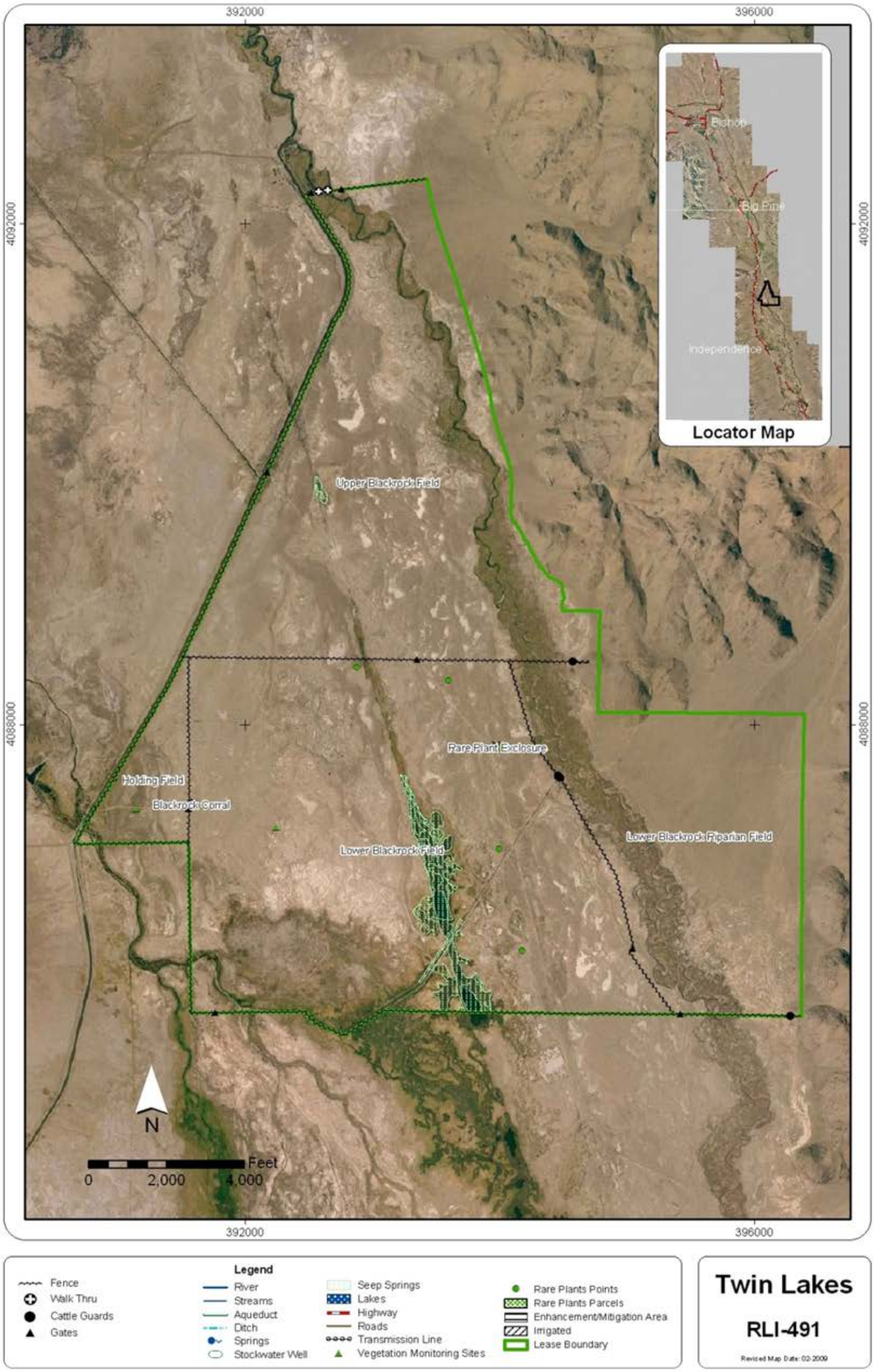
There was no new fencing constructed on the lease in 2017.

Salt and Supplement Sites

Supplement is composed of a liquid mix that is put in large tubs with rollers that the cattle consume. These tubs are placed in established supplement sites and are used every year.

Burning

No burns were conducted on the lease in 2017.



Land Management Figure 2. Twin Lakes Lease

4.6.3 Blackrock Lease

The Blackrock Lease is a cow/calf operation consisting of 32,674 acres divided into 24 management units or pastures. Blackrock is the largest LADWP grazing lease within the LORP area. The pastures on the Blackrock Lease provide eight months of fall through spring grazing, which can begin any time after 60 continuous days of rest. A normal grazing season begins in early to mid-October and ends in mid-May or June.

There are twenty pastures on the Blackrock Lease within the LORP boundary: South Blackrock Holding, White Meadow Field, White Meadow Riparian Field, Reservation Field, Reservation Riparian Field, Little Robinson Field, Robinson Field, East Robinson Field, North Riparian Field, Russell Field, Locust Field, East Russell Field, South Riparian Field, West Field, Wrinkle Field, Wrinkle Riparian Field, Spring Field, Wrinkle Holding, Horse Holding, and North Blackrock Holding. Twelve of these pastures are monitored using range trend and utilization. The other eight are holding pastures for cattle processing or parts of the actual operating facilities. As outlined in the lease management plans, holding pastures, traps, and corrals are not monitored because of their small size and/or their role in operations.

Major portions of the White Meadow Field, Reservation Field, Robinson, Russell, East Russell Field, and Wrinkle Field were flooded during this past summer’s water spreading activities. The shallow water table contributed to exceedingly high perennial grass vigor in areas that were not completely submerged.

Summary of Utilization

The following tables present the summarized utilization data for each field for the current year.

End of Grazing Season Utilization on the Blackrock Lease, RLI-428, 2017

Fields	Utilization
North Riparian Field*	22%
Horse Holding	0%
Wrinkle Riparian Field*	5%
Locust Field	0%
Reservation Field	14%
Robinson Field	0%
Russell Field	0%
White Meadow Field	0%
White Meadow Riparian Field*	13%
Wrinkle Field	0%
South Riparian Field*	7%
West Field	0%

**Riparian utilization 40% **

Riparian Management Area

Riparian grazing on the Blackrock Lease was below the allowable 40% utilization standard. High flows this summer contributed to both an expansion of meadow as well as a loss of meadow due to portions of the moist floodplain remaining underwater for extended periods.

Upland Management Areas

Fields in the upland portions of the Blackrock Lease remained well below upland utilization standard of 65%.

Summary of Range Trend Data and Condition Blackrock Lease

Range trend data were not collected in 2017.

Irrigated Pastures

There are no irrigated pastures on the Blackrock Lease.

Stockwater Sites

Two new stockwater wells were drilled this fall on the Blackrock Lease. One south of Mazourka Canyon Road and one north of Mazourka Canyon Road. The wells will be fitted with a solar pumps and necessary plumbing for the trough. The lessee will be responsible for water troughs and installation.

Fencing

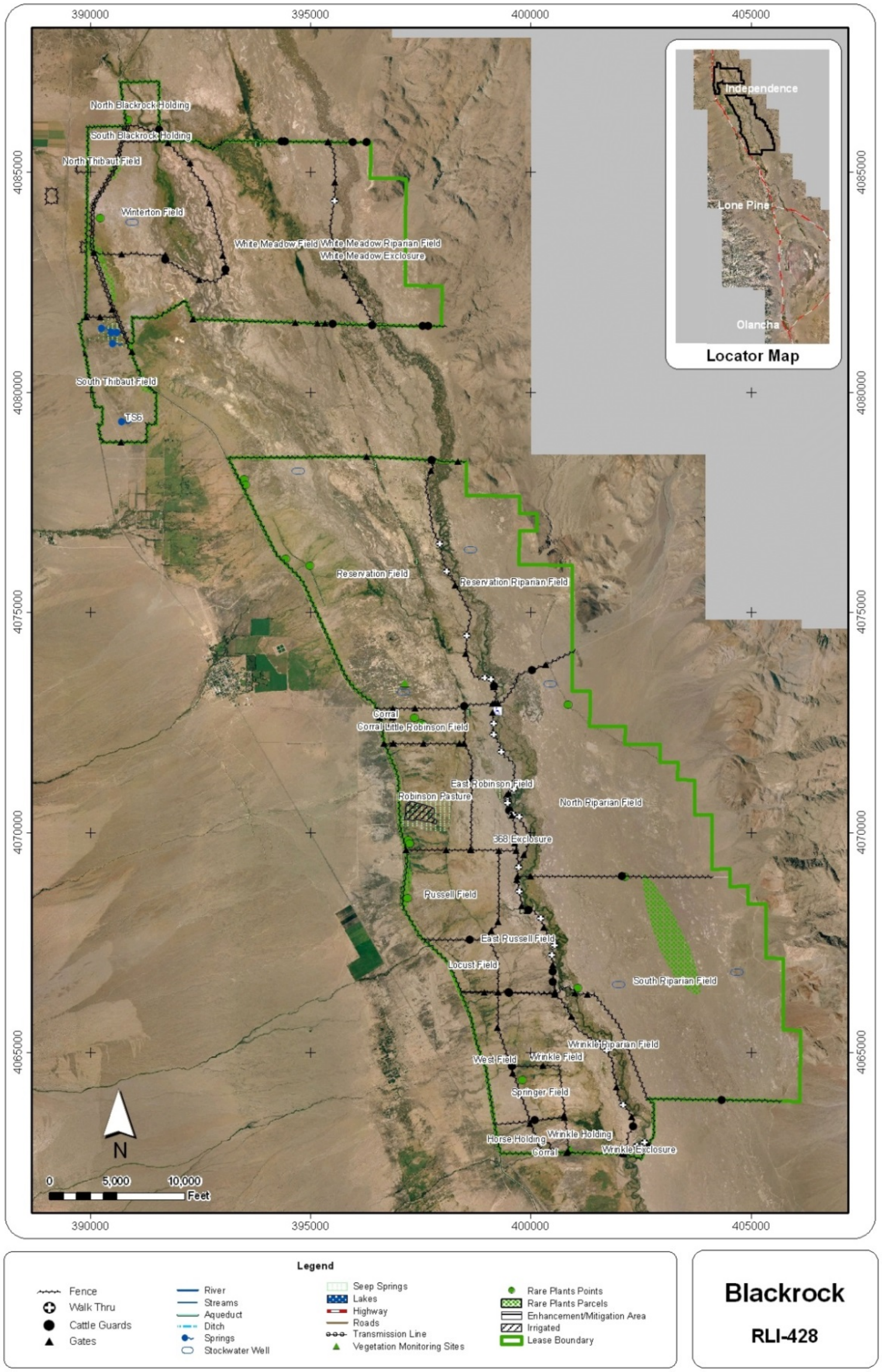
There was no new fencing constructed on the lease in 2017.

Salt and Supplement Sites

Many of the supplement sites located on the Blackrock Lease have been in place for many years and are located in upland management areas. Some of these sites have been moved in order to adapt to the installation of new fencing. These new locations were selected to better distribute cattle within and near the newly created riparian pastures. A liquid molasses protein is placed in portable feeding stations at these locations.

Burning

In 2016 LADWP finalized Vegetation Management Plans (VMP) for the Winterton and Long Pond Prescribed Burns with Calfire. Per these agreements, Calfire will serve as the lead agency implementing the burns on City of Los Angeles property and LADWP will serve in a contingency role and provide manpower and resources as necessary. These agreements are both valid until March 2020. Due to highly saturated conditions, these burns were not conducted in the 2016-2017 winter or spring. Burn prep for the Long Pond Burn is anticipated to occur in fall 2017 with the burn occurring shortly thereafter. The Winterton Burn and associated preparation will also occur in winter 2017-2018 if conditions allow.



Land Management Figure 3. Blackrock Lease

4.6.4 Thibaut Lease

The 5,259-acre Thibaut Lease is utilized by three lessees for wintering pack stock. Historically, the lease was grazed as one large pasture by mules and horses. Since the implementation of the LORP and installation of new fencing, four different management areas have been created on the lease. These areas are the Blackrock Waterfowl Management Area, Rare Plant Management Area, Thibaut Field, and the Thibaut Riparian Exclosure. The irrigated pasture portion located in Thibaut Field was assessed using irrigated pasture condition scoring and the upland portions of the field were evaluated using utilization transects. Large areas of the Thibaut Lease were flooded beginning in early January. Similar to the flooded portions of the Blackrock Lease, areas that were not totally underwater exhibited unusually high plant vigor while other areas that were underwater showed a decrease in forage production due to plant mortality.

Summary of Utilization

The following tables present the summarized utilization data for each field for the current year.

End of Grazing Season Utilization for Fields on the Thibaut Lease, RLI-430, 2017

Fields	Utilization
Rare Plant Management Area	14%
Thibaut Field	13%
Waterfowl Management Area	8%

**Riparian utilization 40% **

Riparian Management Areas

The riparian pasture for the Thibaut Lease has been excluded from grazing since the implementation of the LORP project. A grazing exclosure is planned for this fall inside the riparian pasture. Once the exclosure is completed, livestock will be permitted to access the remaining portions of the riparian pasture.

Upland Management Areas

The end-of-season use in the Thibaut Field was 13%. Use in the Rare Plant Management Area was 14%, which is well below the allowable utilization grazing standard. Utilization in the Waterfowl Management Area was 8%.

Summary of Range Trend Data and Conditions

A portion of all moist floodplain transects were submerged on the Thibaut Lease in mid-March and again from early June through late July. In response to both record level winter precipitation and flooding during an abundance of early succession forbs increased across moist floodplain sites in areas that were not underwater.

	No Change	DISP	DESO2	HECU3	BAHY	MALE3	SCAM6	TYLA
Moist Flood Plain								
THIBAUT_07					↑	↑		
THIBAUT_06		↑	↑	↑				
THIBAUT_04				↑				
THIBAUT_05					↑	↑		
Saline Meadow								
THIBAUT_1B					↑		↑	↑
THIBAUT_02	↔							
THIBAUT_03		↓						

Conversely, the increased flows on the Lower Owens River contributed to a large decrease in Nevada saltbush (*Atriplex torreyi* [ATTO]) shrub cover likely caused by steady inundation throughout the growing season.

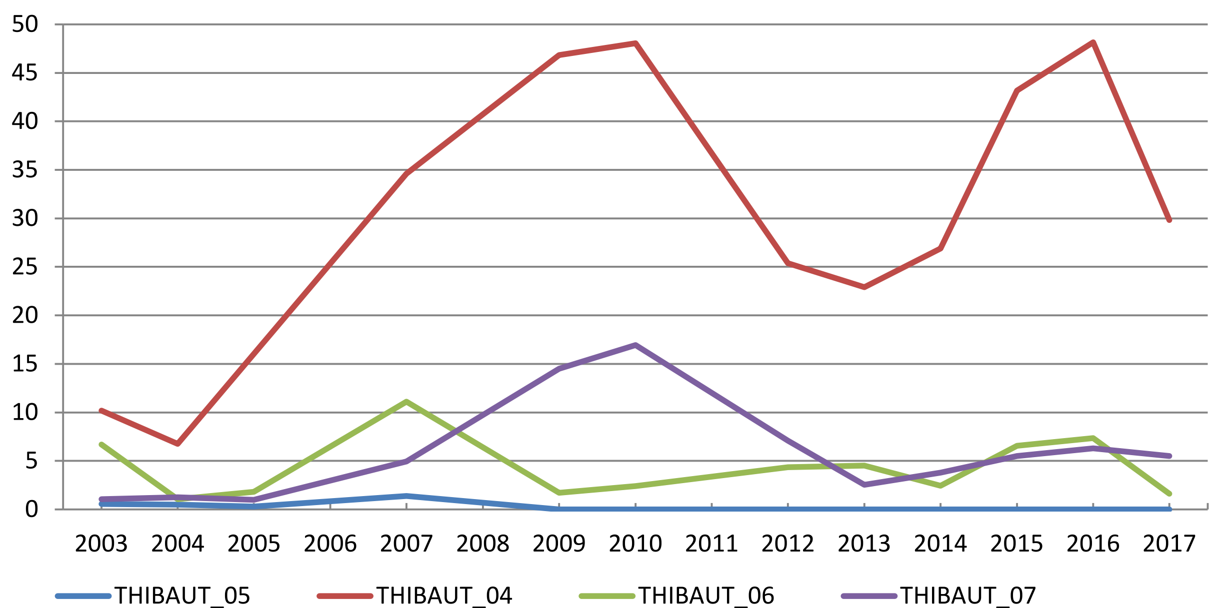


Figure 6. Percent Cover for Nevada Saltbush on Four Moist Floodplain Sites, Thibaut Lease

Three saline meadow sites were sampled; Thibaut_02 and Thibaut_03 are typical saline meadows while Thibaut_1B was established in a recently dewatered portion of the Thibaut Pond complex to monitor the transition back to meadow from marsh. Thibaut_02 remained static while saltgrass on Thibaut_03 significantly decreased, excessive grazing (78%) occurred on the same site and likely influenced the decrease in saltgrass. Thibaut_1B received water during the early summer runoff which precipitated an increase in chairmaker's bulrush (*Schoenoplectus americanus* [SCAM6]) and broadleaf cattail (*Typha latifolia* [TYLA]). The bare ground also facilitated an increase in BAHY.

Irrigated Pastures

Irrigated Pasture Condition Scores 2011-16

Pasture	2011	2012	2013	2014	2015	2016	2017
Thibaut Field	82%	81%	78%	X	X	80%	X

X indicates no evaluation made

No irrigated pasture evaluations were conducted in 2017. The irrigated pasture in the Thibaut Field met the minimum standard of 80% in 2016.

Stockwater Sites

Stockwater is provided by the aqueduct and a stockwater well located in the Thibaut Field.

Fencing

There was no new fencing on the lease in 2017. There are plans to construct a grazing exclosure in the Thibaut Riparian pasture in 2017-18.

Salt and Supplement Sites

Horses and mules are fed hay in the winter. There are no established supplement sites on the lease.

Burning

No burns were conducted on the lease in 2017.

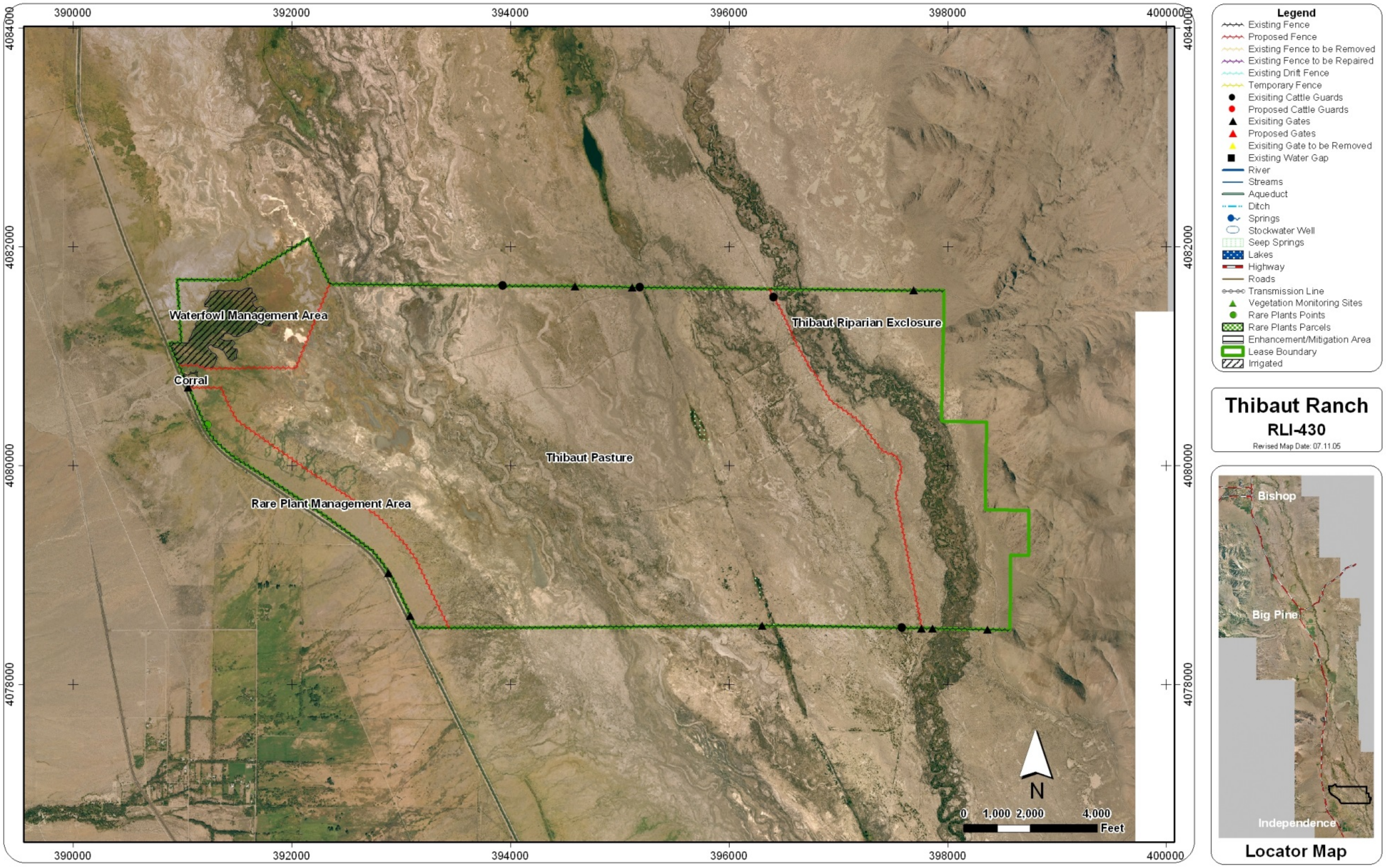


Figure 5. Thibaut Lease

4.6.5 Islands Lease

The Islands Lease is an 18,970-acre cow/calf operation divided into 11 pastures. In some portions of the lease, grazing occurs year round with livestock rotated between pastures based on forage conditions. Other portions of the lease are grazed October through May. The Islands Lease is managed in conjunction with the Delta Lease. Cattle from both leases are moved from one lease to the other as needed throughout the grazing season.

There are eight pastures located within the LORP boundary of the Islands Lease:

- Bull Field
- Reinhackle Field
- Bull Pasture
- Carasco North Field
- Carasco South Field
- Carasco Riparian Field
- Depot Riparian Field
- River Field

The Bull Field, Reinhackle Field, and Bull Pasture are spring dominated pastures and are evaluated based on a pasture condition score.

Summary of Utilization

The following tables present the summarized utilization data for each pasture for the current year.

End of Grazing Season Utilization for Fields on the Islands Lease, RLI-489, 2017.

Fields	Utilization
Carasco Riparian Field*	3%
Depot Riparian Field*	6%
Lubkin Field	33%
River Field *	4%

**Riparian utilization 40%*

Riparian Management Areas

On the Islands Lease all transects were evaluated. Use in the Depot Riparian Field was 6% and the River Field was 4%. Because of the wet winter and spring, livestock concentrated use on ephemeral forage in the upland areas east of the river.

Upland Management Areas

All upland pastures are well below the allowable 65% utilization rate.

Summary of Range Trend Data

	No Change	DISP	DESO2	HECU3	BAHY	SPAI	SCAM6	TYLA
Moist Flood Plain								
ISLAND_06						↓		
ISLAND_08		↑						
ISLAND_09	↔							
ISLAND_10		↓						
ISLAND_11	↔							
ISLAND_13		↓						

Six range trend sites were sampled on the Islands Lease in 2017; all sites were located on moist floodplain ecological sites. Alkali sacaton continues to decline on Island_06 while saltgrass remains stable. Grazing utilization on the Island_06 transect was 3%. Saltgrass increased significantly on Island_08 and trends were static on Island_09. Island_10 and Island_13 (Island_13 is in a grazing exclosure) showed declines in saltgrass. Both sites were inundated for extended periods from June through July which led to heavy plant mortality on the transects. Nevada saltbush cover dropped on Island_13 from 14% in 2014 to 6% in 2017. Frequency numbers on Island_09 and Island_11 remained static.

Irrigated Pastures

Irrigated Pasture Condition Scores 2011-17

Pasture	2011	2012	2013	2014	2015	2016	2017
B Pasture	X	90%	90%	X	X	88%	X
D Pasture	X	90%	90%	X	X	88%	X

X indicates no evaluation made.

The B and D Pastures located near Reinhackle Spring were rated in 2013 and received an irrigated pasture condition score of 90%. No evaluations were conducted in 2014-15 due to drought conditions. The B and D Pastures rated 88% in 2016. Pasture evaluations were not conducted in 2017. There are no management changes recommended.

Stockwater Sites

There are two stockwater sites located 1-1.5 miles east of the river in the River Field uplands. These wells were drilled in 2010 and are now operational. The lessee has yet to install the water troughs at the wells.

Fencing

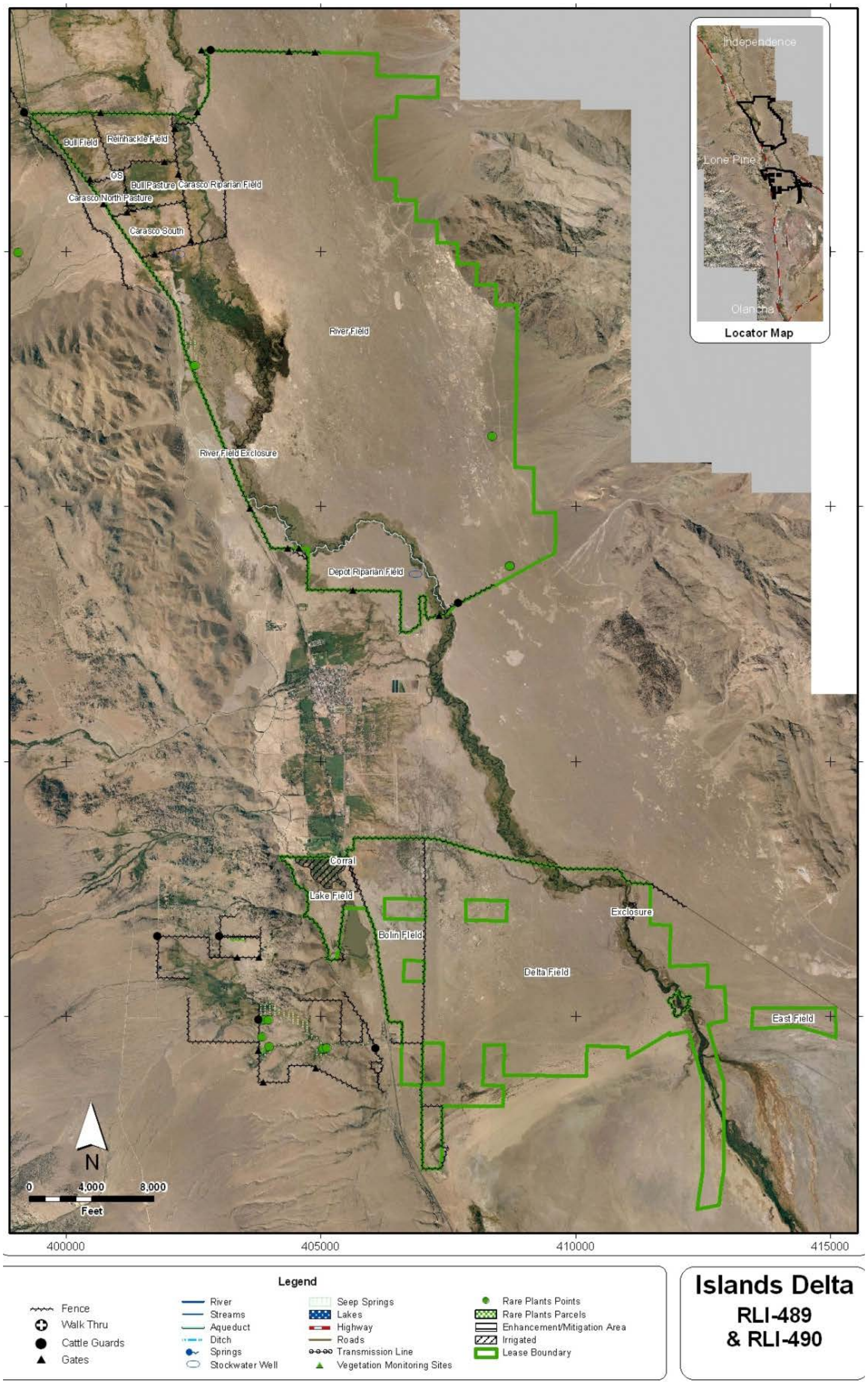
There was no new fence constructed on the lease in 2017.

Salt and Supplement Sites

Cake blocks and molasses tubs that contain trace minerals and protein are distributed for supplement on the lease. The blocks and tubs are dispersed randomly each time and if uneaten they are collected to be used in other areas.

Burning

No burns were conducted on the lease in 2017.



Land Management Figure 4. Islands and Delta Leases

4.6.6 Lone Pine Lease

The Lone Pine Lease is an 8,274-acre cow/calf operation divided into 11 pastures and adjacent private ranch land. Grazing on the lease typically occurs from January 1 to March 30 and then again in late May to early June. In early June the cattle are moved south to Olancha and then to Forest Service grazing allotments on the Kern Plateau.

There are 11 pastures on the Lone Pine Lease located within the LORP project boundary:

East Side Pasture	Airport Field
Edwards Pasture	Miller Pasture
Richards Pasture	Van Norman Pasture
Richards Field	Dump Pasture
Johnson Pasture	River Pasture
Smith Pasture	

Two of these pastures contain utilization and range trend transects. The remaining nine pastures/fields are irrigated pastures, holding pastures for cattle processing or parts of the actual operating facilities. As outlined in the lease management plans, holding pastures, traps, and corrals are not monitored because of their small size and/or their role in operations. Irrigated pastures are evaluated using the Irrigated Pasture Condition protocol.

Summary of Utilization

The following tables present the summarized utilization data for each pasture for the current year.

End of Grazing Season Utilization for Pastures and Fields, Lone Pine Lease, RLI-456, 2017

Pastures	Utilization
Johnson Pasture	0%
River Field - Lone Pine*	25%

*Riparian utilization 40%**

Riparian Management Area

The River Field utilization was 25%; no transects approached 40% use. Recovery from the burn in 2013 is continuing; herbaceous vegetation has fully recovered.

The Johnson Pasture had virtually no use and was flooded throughout the summer.

Summary of Range Trend Data and Conditions

Range trend transects were not read in 2017.

Irrigated Pastures

Irrigated Pasture Condition Scores 2011-17

Pasture	2011	2012	2013	2014	2015	2016	2017
Edwards	X	X	84%	X	X	84%	X
Richards	X	X	84%	X	X	84%	X
Van Norman	X	X	84%	X	X	84%	X
Smith	X	X	84%	X	X	84%	X
Old Place	X	X	84%	X	X	76%	86%

X indicates no evaluation made

The irrigated pastures within the LORP project area for the Lone Pine Lease are the Edwards, Richards, Smith, Old Place, and Van Norman Pastures. All of the pastures were rated in 2013 and were above the required minimum irrigated pasture condition score of 80%, despite a dry year and lack of irrigation water. No evaluations were conducted in 2014-15 due to drought conditions. Irrigated pasture evaluations were conducted in 2016 and all pastures except the Old Place rated above the minimum score of 80%. The Old Place pasture needs more irrigation water and better distribution. In 2017 the Old Place pasture rated 86%.

Stockwater Sites

One stockwater well was drilled on the Lone Pine Lease located in the River Pasture uplands, approximately two miles east of the river on an existing playa. The lessee had made an effort to install a trough but the well had a silting problem that plugged the pipes and floats. Watershed Resources staff and pump mechanics assessed the condition of the well and determined that the well was not drilled deep enough and is not operable. A new well location has been selected a quarter of a mile south of the current location and is planned to be drilled in the fall of 2017.

Fencing

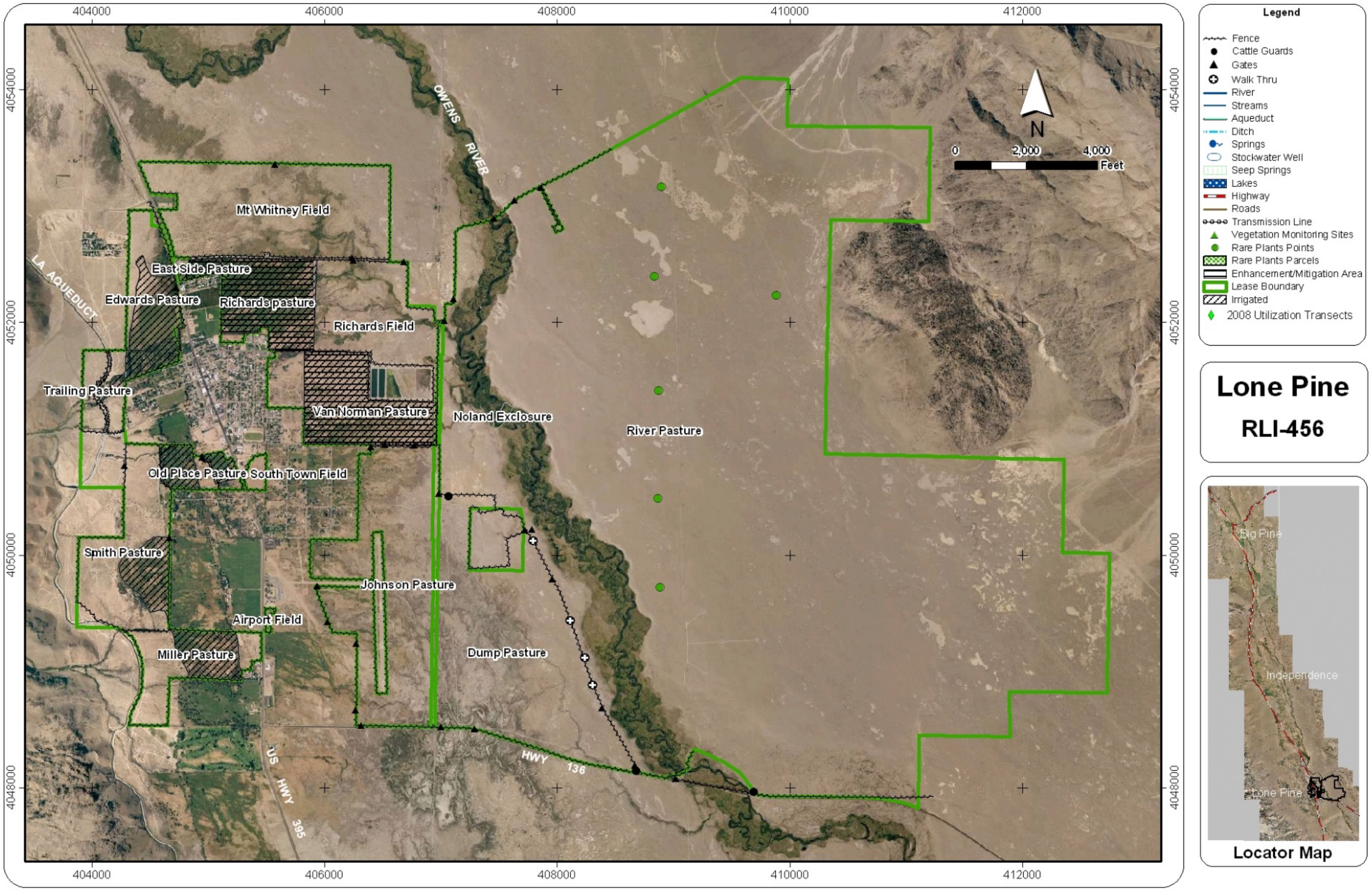
There was no new fencing constructed on the lease during 2017. Repairs have been made to the existing exclosure due to the fire in 2013.

Salt and Supplement Sites

All supplement tubs were situated outside of the flood plain.

Burning

No burns were conducted on the lease in 2017.



Land Management Figure 5. Lone Pine Lease

4.6.7 Delta Lease

The Delta Lease is a cow/calf operation and consists of 7,110 acres divided into four fields within the LORP project boundary: Lake Field, Bolin Field, Main Delta Field, and the East Field. Grazing typically occurs for 6 months, from mid-November to April. Grazing in the Bolin Field may occur during the growing season. The Delta and Islands Leases are managed concurrently with California State Lands Commission leases.

Grazing utilization estimates are taken in the Bolin Field and Main Delta Field which contains the Owens River. The Lake Field is evaluated using irrigated pasture condition scoring. The East Field, located on the upland of Owens Lake, supports little in the way of forage and has no stockwater. Large areas of the Bolin Field were flooded in 2017.

<u>Summary of Utilization</u>

The following tables present the summarized utilization data for each field for the current year.

End of Grazing Season Utilization for Fields on the Delta Lease, RLI-490, 2017

Fields	Utilization
Main Delta Field*	18%
Bolin Field	0%

*Riparian utilization 40%**

<u>Riparian Management Areas</u>

End-of-season utilization in the Main Delta Field was 18%.

<u>Upland Management Areas</u>

The Bolin Field was 0%, well below the upland grazing utilization prescription of 65%.

<u>Summary of Range Trend Data and Conditions</u>

No range trend transects were read on the Delta Lease.

<u>Irrigated Pastures</u>

Irrigated Pasture Condition Scores 2011-17

Pasture	2011	2012	2013	2014	2015	2016	2017
Lake Field	X	X	74%	X	X	88%	X

X indicates no evaluation made

The Lake Field is located west of U.S. Highway 395 north of Diaz Lake. This irrigated pasture was evaluated in 2016 and received a score of 88%.

Stockwater Sites

The Bolin Field was supposed to receive stockwater, supplied by the Lone Pine Visitor Center's well in 2010. After a more in-depth analysis of water availability, it was determined that there was not an adequate amount of water to sustain the visitor center and provide stockwater. Stockwater is supplied from a diversion that runs from Tuttle Creek.

Fencing

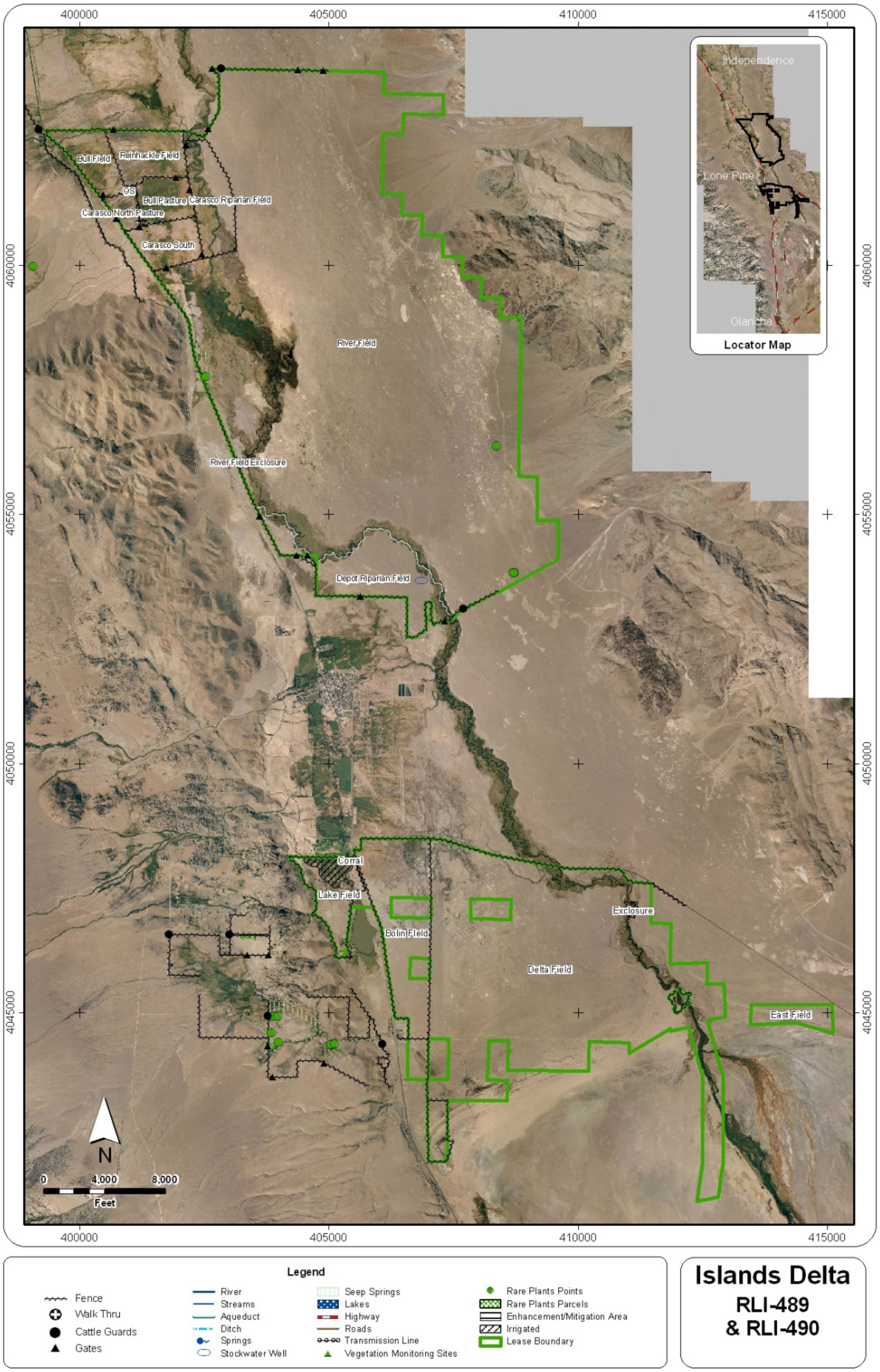
There was no new fencing on the lease for 2017.

Salt and Supplement Sites

Supplement tubs containing protein and trace minerals are used in established supplement sites. Empty tubs are collected by the lessee.

Burning

No burns were conducted on the lease in 2017.



Land Management Figure 6. Islands and Delta Leases

4.7 Land Management Conclusion

Utilization

Utilization on all leases continues to be consistent with grazing management plan utilization standards.

All ranch leases within the LORP project area remain understocked and will continue to graze below normal cattle numbers in 2017-18.

Range Trend

Riparian Management Areas

Range trend results point towards stable or upward trends on moist floodplain sites. The available riparian pasture forage production and health should continue to be productive. Over the long term, there are meadows inundated by the expanding back water effect of the Owens River. Over the short term, flooding this summer contributed to both a decline in shrub cover and perennial grass cover.

Upland Management Areas

Upland management areas received additional surface water during the water spreading this summer. The influx of water and resulting rising water table in the spreading basins south of Blackrock Ditch has increased plant productivity, particularly among alkali sacaton stands.

The northern tamarisk beetle (*Diorhabda carinulata*) was observed on the Lower Owens River this summer. There is evidence of some impacts from the beetle northwest of Twin Culverts. Following the dry out of the spreading basins large areas now contain widespread infestations of tamarisk seedlings.

Irrigated Pastures

All irrigated pastures were evaluated in 2016. Pastures that scored below 80% in 2016 were revisited in the summer of 2017. All irrigated pastures in the LORP management area in 2017 scored above 80%.

4.8 References

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5.0 ANALYSIS OF CONDITIONS OF THE ISLANDS EAST SIDE CHANNEL

The Island area (Figure 1) was distinguished as an aggraded, wet, unconfined reach of the Lower Owens River (WHA 2004) with extensive marsh through which the river diffuses. Flow is attenuated in the reach, spreading more than a mile wide, and depleted by bedloss and ET. Effluent is expected to be warmer with higher dissolved organics, and corresponding lower dissolved oxygen. Evapotranspiration (ET) and bedloss for the Island reach was estimated from summer (May through October) measurements at the Reinhackle and Lone Pine Station gages[1] for 2007 through 2009[2]. The average summer loss (9.4 cfs[3]) amounts to about 3,435 acre-feet. The extent of open water and marsh increased about 116 acres (28 percent) between 2000 and 2009 and another 60 acres between 2009 and 2014. General observations indicate these communities have continued to expand since 2016.

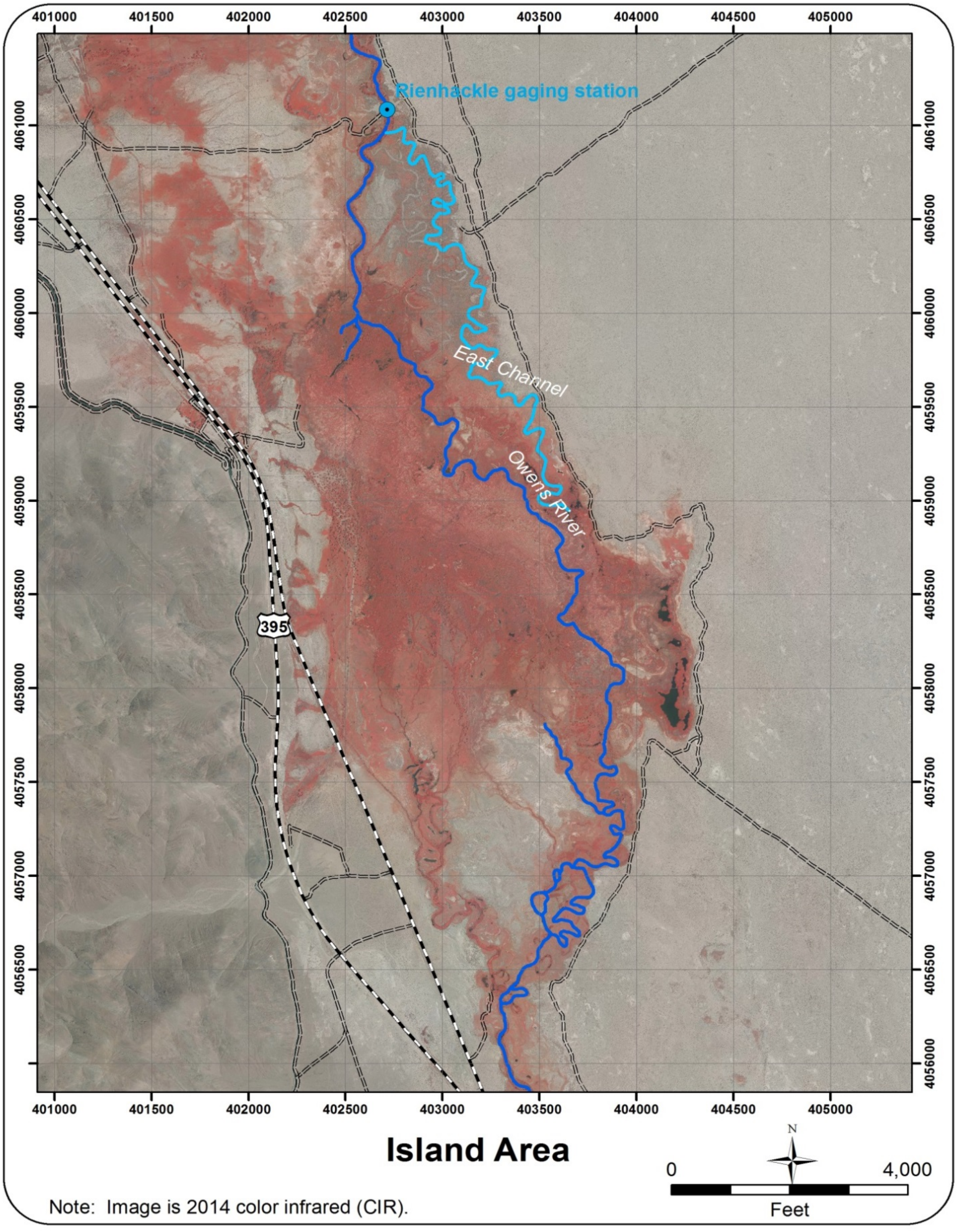
Diversion of the Owens River to the East Channel (Figure 2) was considered as an alternative to reduce adverse conditions resulting from aggradation in the Island reach (LADWP 2014). The East Channel is 2.8 miles long with a sinuosity of 2.0 and an average grade of 0.13%. In 2014, the East Channel was mostly wet meadow and riparian woodland (Figure 3; Figure 4); the lower part of the East Channel was marsh (Figure 5).

It was suggested (*ibid*) that intervention to divert water to the East Channel was unnecessary. It was predicted that, as the Island reach continued to aggrade, the Owens River would spill to the East Channel without intervention and that the channel would eventually capture most of the flow. It was also predicted that the East Channel would fill with tules in response to the flow and grow to resemble impounded conditions that existed along the main channel of the Owens River above the Island.

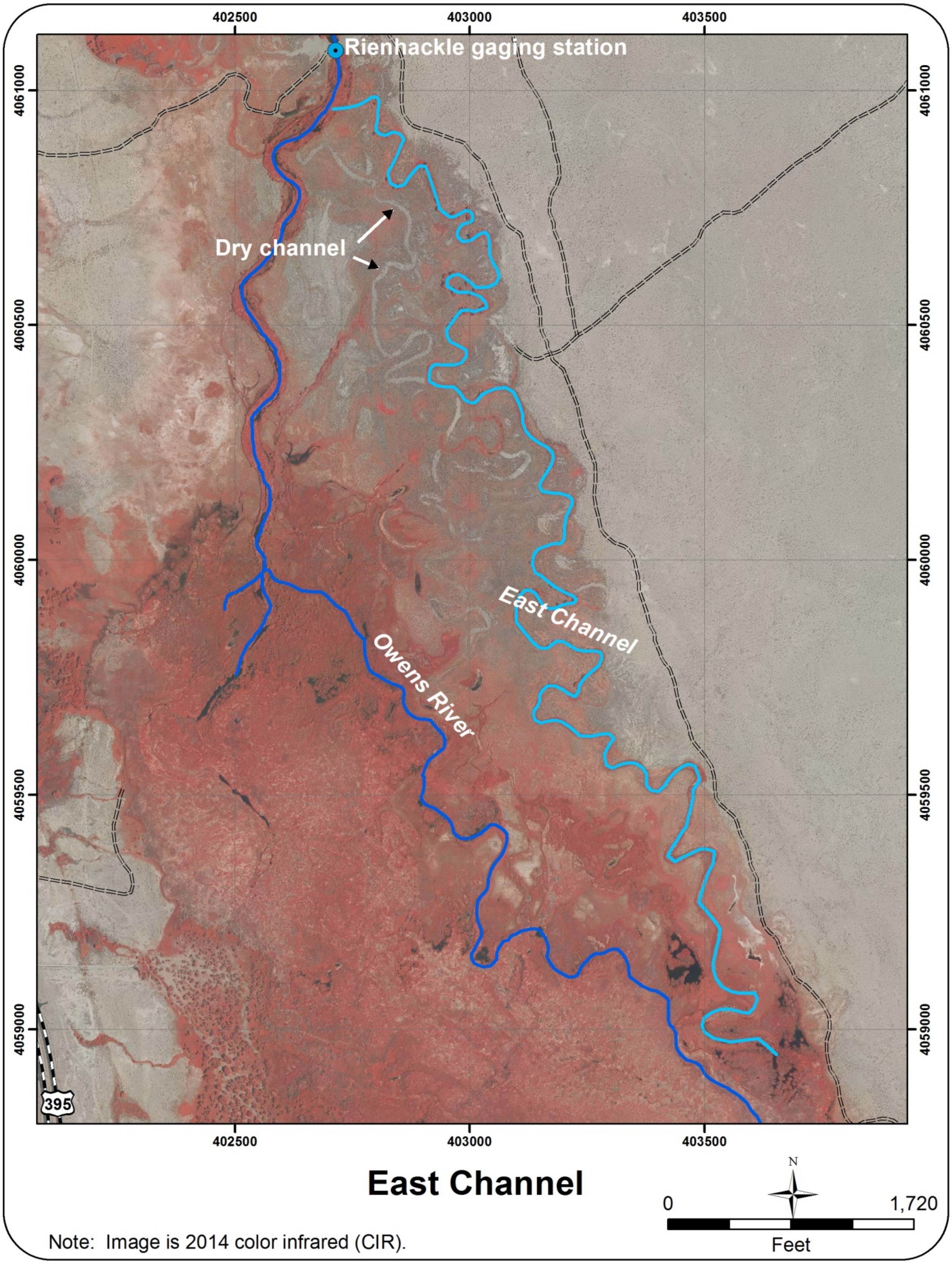
These predictions have proved true. During a field reconnaissance in July 2017, seasonal habitat flow was observed overflowing to the East Channel (Figure 6) and much of the wet meadow in the channel bottom had been replaced by marsh (Figure 7). In September 2017, the Owens River continued to spill significant flow into the East Channel after seasonal habitat flow receded (Figure 8).

Continued aggradation will lead to the further occlusion of the East Channel as additional meadow and open water are replaced by marsh. Existing riparian woodland will become decadent in response to the saturated conditions. Eventually, water may overflow to the dry channel (Figure 2) and we can start all over again.

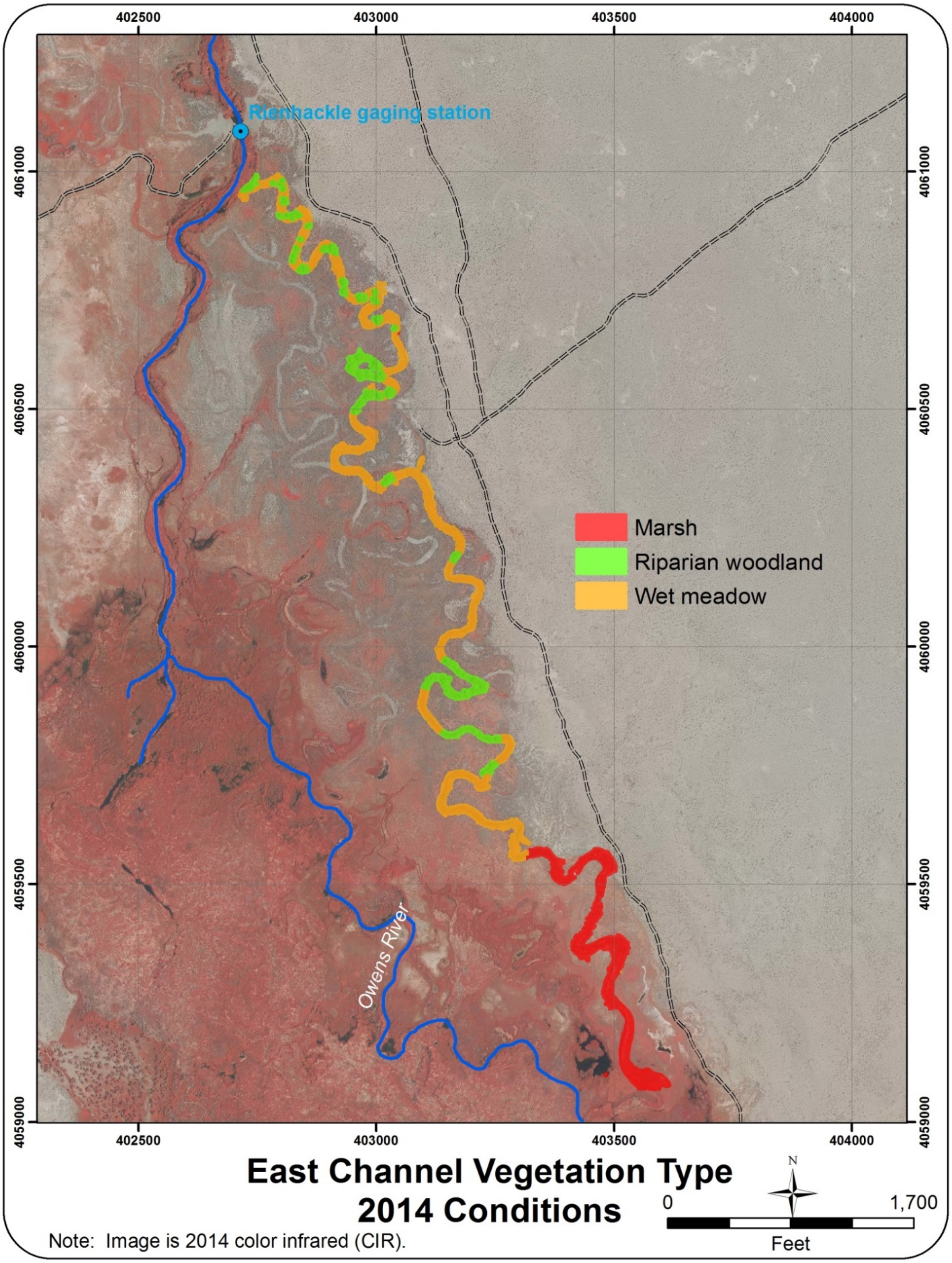
[1] Discharge from Alabama Gates was also accounted.
[2] Measurement of the Lone Pine Station gage was discontinued on July 12, 2009.
[3] This compares to a summer loss of 18 cfs between Reinhackle and Pumpback gages.



Analysis of Conditions Figure 1. Island Area



Analysis of Conditions Figure 2. East Channel



Analysis of Conditions Figure 3. East Channel Vegetation Type 2014 Conditions

Analysis of Conditions Figure 4. Wet Meadow in East Channel (2013 Conditions)

Analysis of Conditions Figure 5. Marsh in East Channel (2013 Conditions)

Analysis of Conditions Figure 6. East Channel Near Head (July 2017 Conditions)

Analysis of Conditions Figure 7. Marsh in East Channel (July 2017 Conditions)

Analysis of Conditions Figure 8. East Channel Near Head (September 2017 Conditions)

6.0 LORP WATER QUALITY

Introduction

Multiparameter water quality instruments were installed near the four permanent flow measuring locations in the Lower Owens River in anticipation of the exceptionally high forecasted runoff in 2017. LADWP planned to release a spring pulse similar to that proposed by Inyo County and LADWP in 2015. LADWP also expected that runoff would exceed the capacity of the aqueduct system and that it would be necessary to release water to the LORP exceeding the required seasonal habitat flow for an extended period. A monitoring program including continuous recorders and manual reads was established to track water quality parameters that were indicative of conditions detrimental to the fishery during previous LORP studies.

Methods

Hydrolab DataSonde 4 and 5 multiparameter water quality instruments were installed in existing monitoring enclosures just downstream of the Intake, at Mazourka Canyon Road, at the Reinhackle flow measuring station, and in the edge of the pond at the Pumpback Station (PBS). Instruments were installed in March (Intake, Reinhackle, PBS) or April (Mazourka). The DataSondes were programmed to record hourly temperature, dissolved oxygen (DO), pH, specific conductivity (SpC), and turbidity. The instruments were recalibrated before deployment, and internal calibration parameters were adjusted after deployment based on independent measurements using a portable Hydrolab multiparameter instrument or the Winkler titration method for DO. LADWP staff visited the gauges to download data, clean, collect manual measurements, and recalibrate the instruments approximately every three weeks. Measurements of DO and temperature were collected by Inyo County using a portable YSI DO meter at several locations along the LORP. The YSI meter was calibrated at the beginning of each day.

The record from the DataSondes was less complete at all four sites compared with 2015 results. Occasionally, the raw files downloaded noted that the loss of data was due to power failure. The problem was most prevalent for instruments that had an external power supply and was probably caused by condensation in the monitoring exclosure during high flows. In addition, data from some individual sensors failed intermittently through the summer. Fortunately, an extensive record of manual reads were collected by ICWD and LADWP for the most important parameters of temperature and DO as well as turbidity. Only a few manual reads for conductivity and pH were collected but these parameters were not indicative of the condition of the fishery in previous monitoring results in the LORP. Raw DataSonde data and manual measurements were compared against previously established thresholds (Table 1) for potential post-processing corrections of the Datasonde data. Thresholds for DO and temperature were only exceeded negligibly in three instances (DO at Mazourka and twice for temperature at the Intake) or the manual measurement was in question. In three instances for pH at PBS, Reinhackle, and Mazourka Canyon, the manual data were too infrequent to justify altering the continuous dataset. No post processing adjustments were made to the DataSonde measurements in 2017. At Reinhackle, ICWD measurements of DO were consistently higher than LADWP data but the seasonal trends were the same. ICWD and LADWP manual measurements were taken at the center of the channel while the DataSonde measurements were collected at the edge of the channel. ICWD and LADWP temperature measurements at Reinhackle were similar.

Table 1. Thresholds for instrument recalibration or post processing of raw logged data.

Parameter	Threshold
Water Temperature	$\pm$ 1 ^{o}C (approximately 2 ^{o}F)
Dissolved Oxygen	$\pm$ 1 mg/L
pH	$\pm$ 0.2 pH units
Specific Conductivity	$\pm$ 0.2 mS/cm
Turbidity	$\pm$ 50 NTU

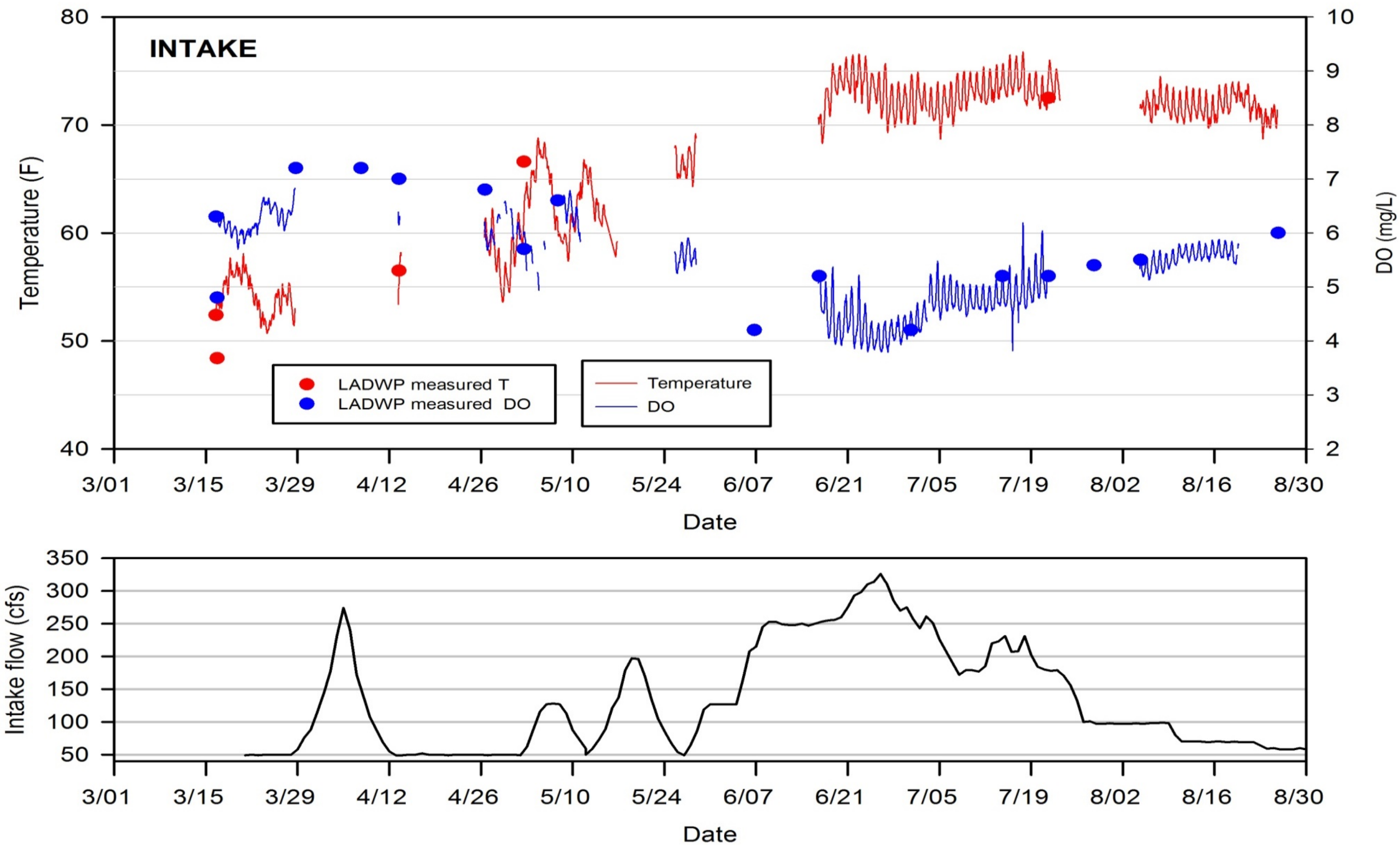


Figure 1. Dissolved oxygen and temperature (top graph) and daily flow (bottom graph) measured at the Intake measuring station. Individual points are manual reads.

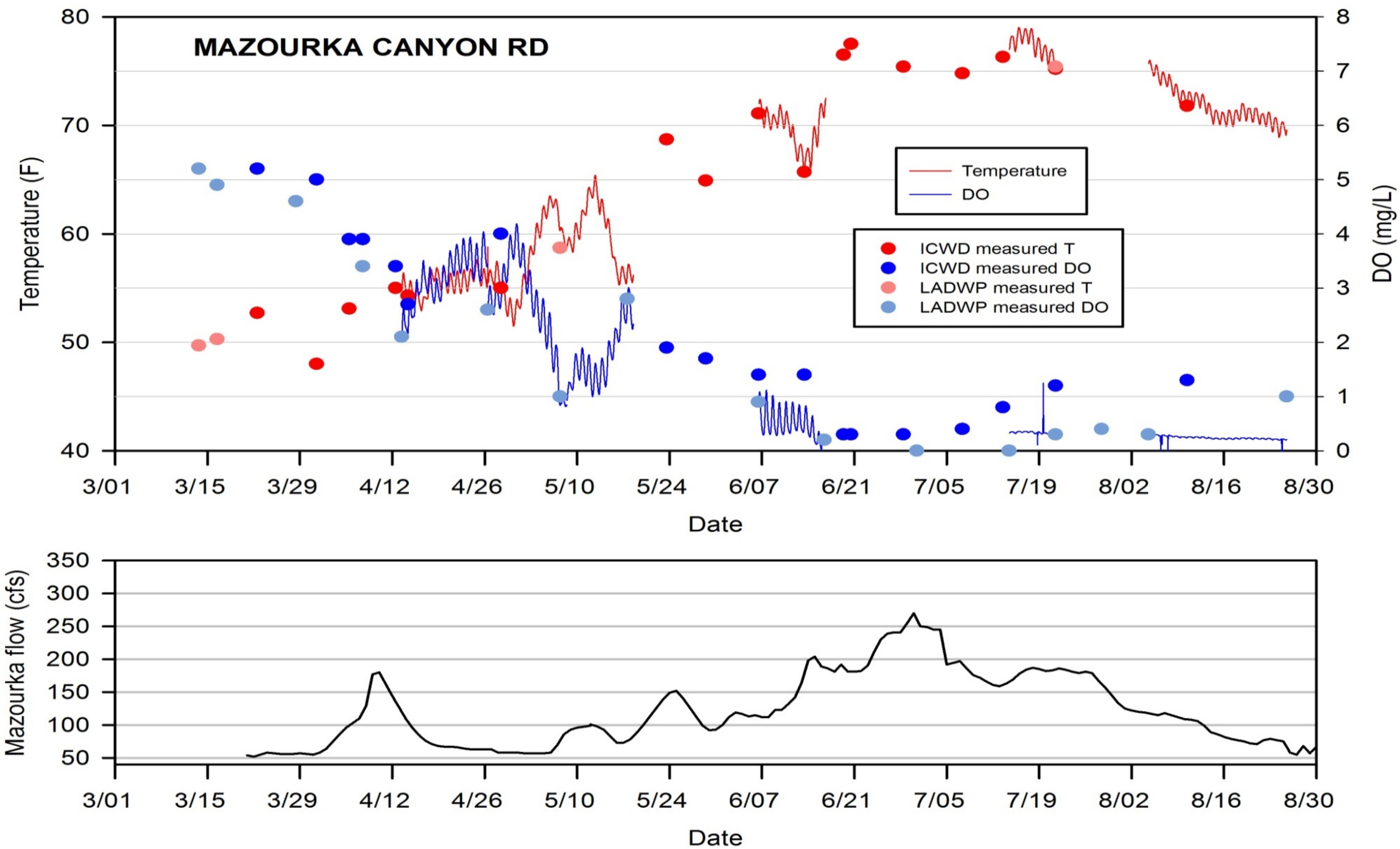


Figure 2. Dissolved oxygen and temperature (top graph) and daily flow (bottom graph) measured at Mazourka Canyon Rd. Individual points are manual reads.

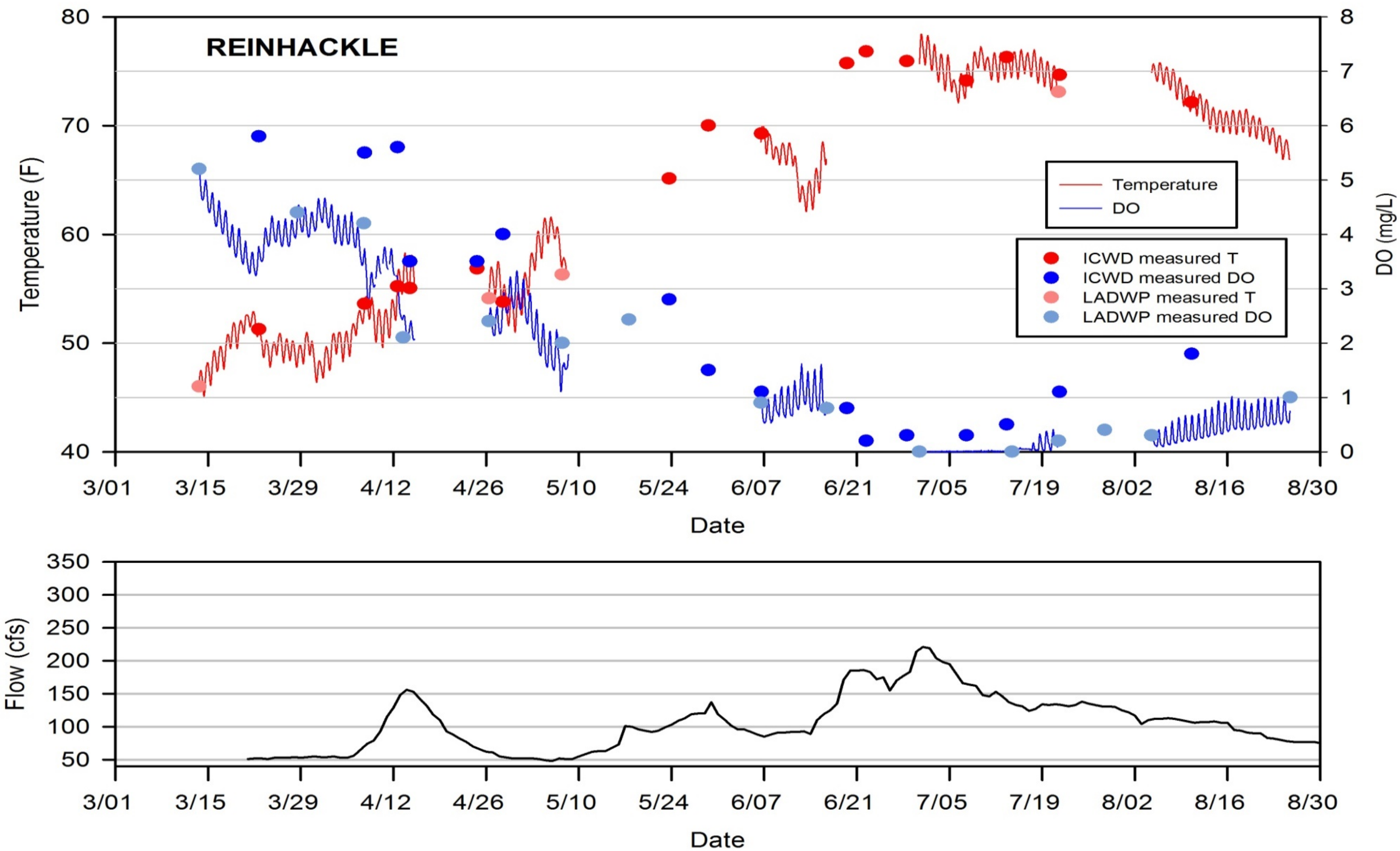


Figure 3. Dissolved oxygen and temperature (top graph) and daily flow (bottom graph) measured at Reinhackle station. Individual points are manual reads.

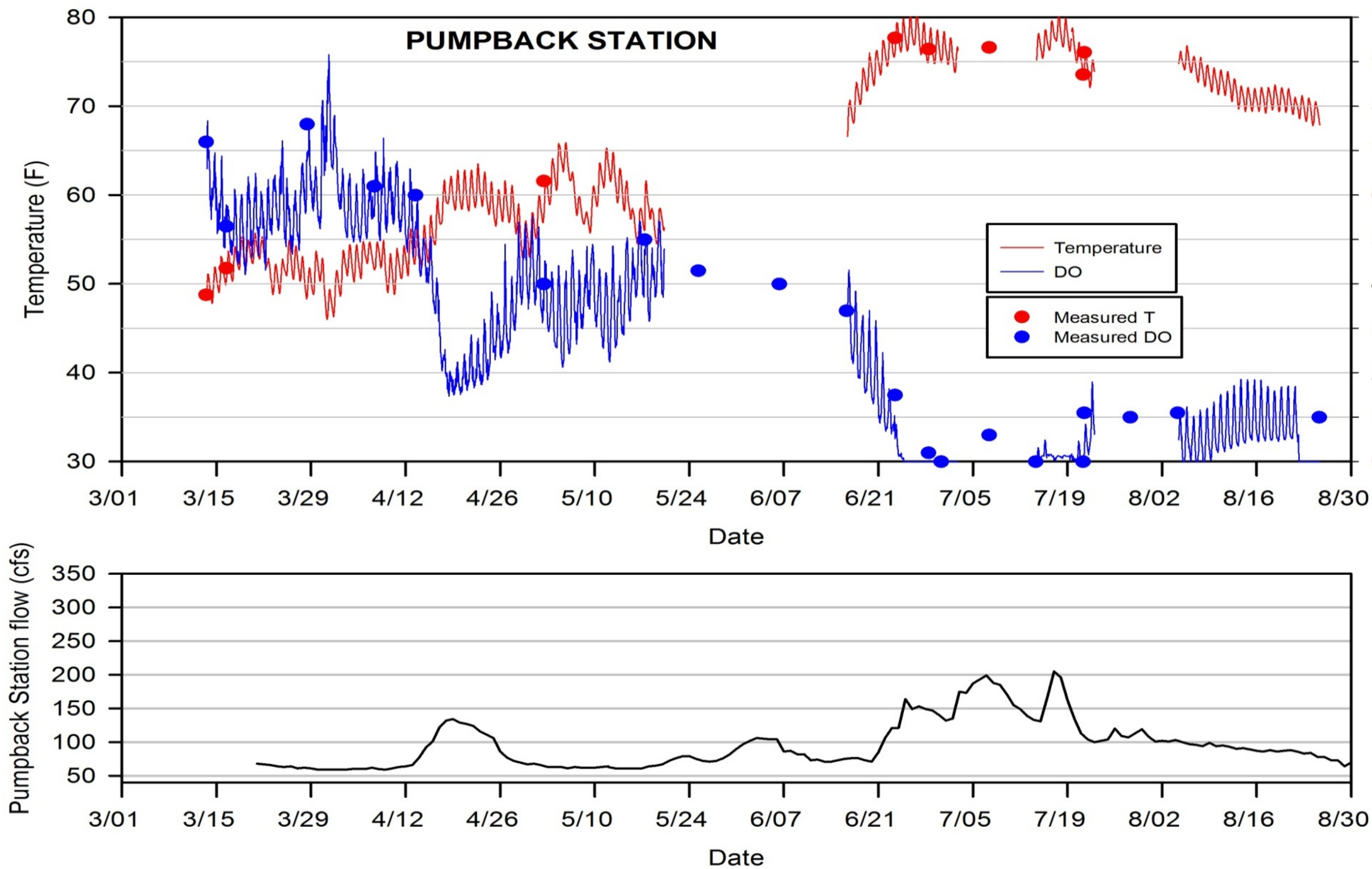


Figure 4. Dissolved oxygen and temperature (top graph) and estimated daily flow (bottom graph) arriving at the Pumpback Station. Individual points are manual reads.

Results

DO and Water Temperature

Previous water quality monitoring in the LORP concluded that water temperature and DO were the key parameters related to flow management and fish stress. Two general observations were evident in the DO and water temperature data (Figures 1-4). At all sites, DO was generally lowest in the early morning hours before dawn and highest in the late afternoon. The precise timing of the diurnal cycle depended on sunrise/sunset times, and the diurnal pattern was suppressed during periods of high flow and extremely low DO. Seasonally, the inverse relationship between water temperature and DO is evident at each site; water was cooler and DO higher in March-April. Neither of these patterns was surprising. The remainder of this discussion will focus on DO and temperature measured during the summer months, May-August.

Temperature and DO were generally highest at the Intake. DO was never below 3.8 mg/L and usually fluctuated between 4-7 mg/L despite water temperatures in excess of 70 ^{o}F for most of the summer (Figure 1). Measured DO in the river differed only 0.2 mg/L from concurrent DO measurements at the DataSonde just downstream of the Langemann gate suggesting the Intake dataset is indicative of river water little affected by spilling over the gate. DO in the river water was usually below theoretical saturated values by approximately 2 mg/L.

Flow releases for the spring pulse at the Intake began to ramp up March 29 and peaked at 274 cubic feet per second (cfs) on April 5. Unfortunately the Intake DataSonde failed during this period, but spot measurements of DO immediately before, during, and after the spring pulse flow show that DO remained above 7.0 mg/L (Figure 1). Water temperature during this event was less than 60 ^{o}F. Flows were increased again in late April and the middle of May with little negative effect on DO although the water quality data in May were fragmentary. Flows began to ramp up quickly on May 27 and peaked at over 325 cfs on June 26 and remained high through July 26. Flows stepped down from 100 cfs to 60 cfs in August. The June/July peak flows coincided with increasing releases from Tinemaha reservoir from approximately 650 cfs to 850-950 cfs to the Owens River upstream of the Intake. Water temperatures during the extended mid-summer high flows were above 70 ^{o}F.

Oxygen is less soluble in water as the water temperatures rises, and this is evident in the declining trend in DO at the Intake as the water warmed (Figure 5). During June and July, however, Tinemaha Reservoir releases were ramped up quickly and remained elevated (Figure 6). DO at the Intake was depressed by approximately 1 mg/L below the trend observed in data collected before and after the high flow releases. Higher river stage between Tinemaha and the Intake may have entrained organic matter from the floodplain causing a decline in DO in the channel and/or water returning to the river from the floodplain may have had depressed DO. Regardless of the cause, water released to the LORP in June and July in 2017 started at a slightly lower DO than would have been expected due to temperature alone.

Relatively well aerated water entering the top of the LORP is a favorable condition, but it was not known how far downstream the elevated DO persisted. ICWD collected a few manual measurements between the Intake and Mazourka Canyon during the peak flows to determine if water quality was a concern in the previously dry reach of the LORP. Minimum DO near the Blackrock return ditch, five river miles downstream of the Intake, was 1.3 mg/L in June and July during the peak flows (Table 2). This was approximately 3 mg/L lower than at the Intake. The flow transit time between these two location was

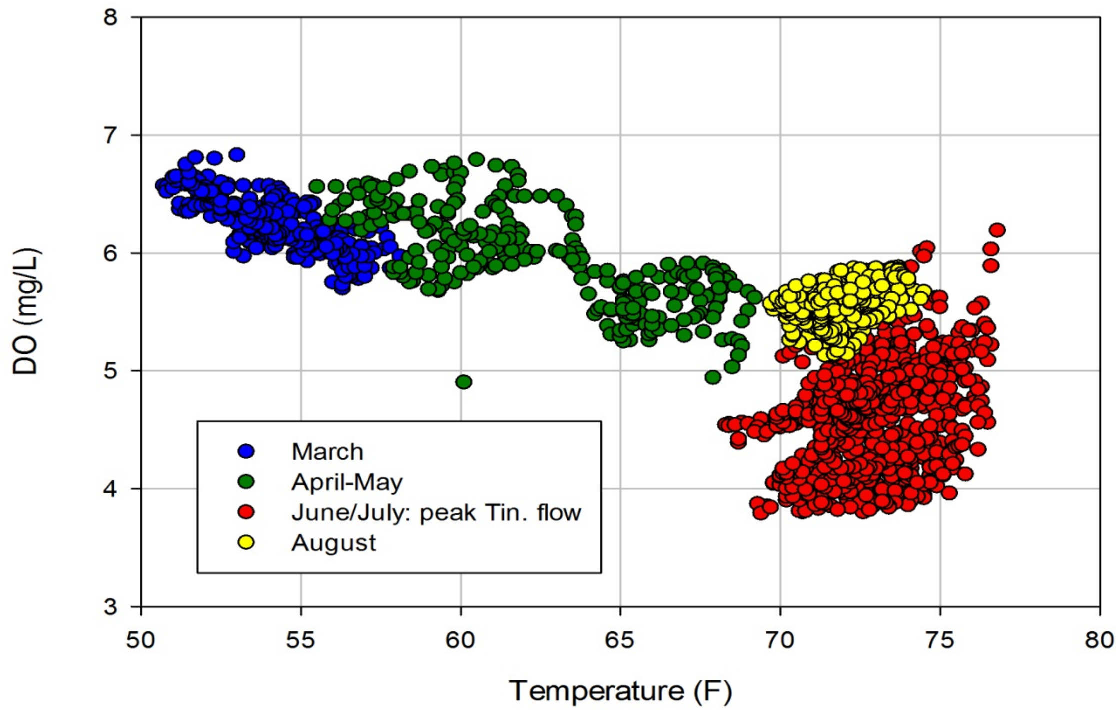


Figure 5. Intake DO as a function of temperature segregated by date showing the depressed DO during the peak Tinemaha releases in June and July.

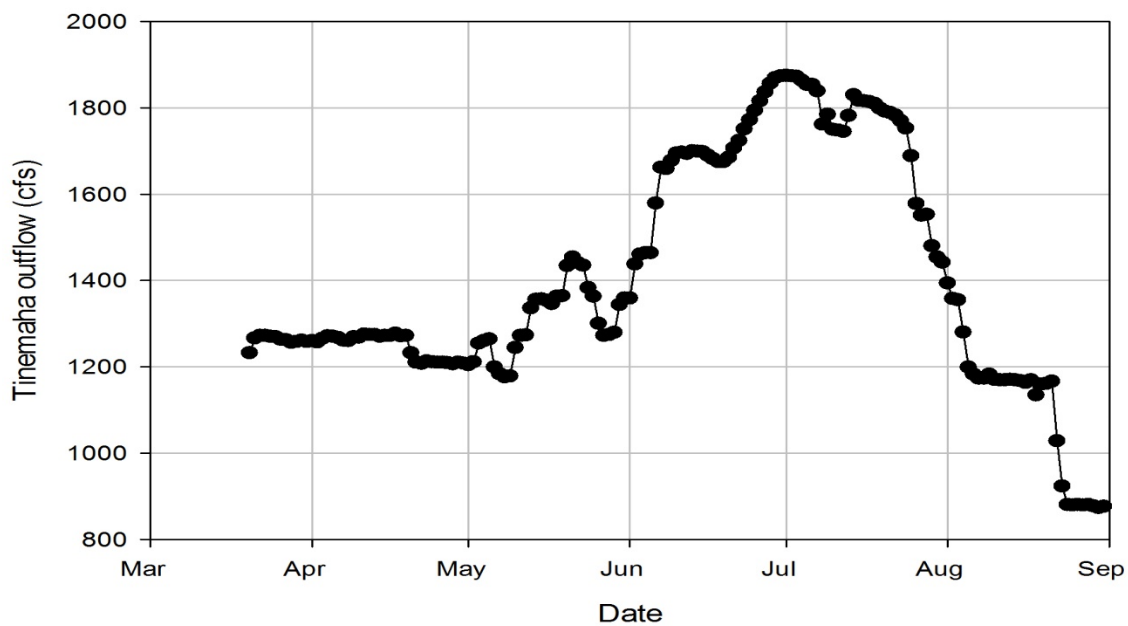


Figure 6. Tinemaha daily outflow in 2017 for the period that overlaps with LORP water quality monitoring. Data are from the Northern District Daily Report and have not been subject to LADWP internal quality control procedures. The data are subject to change.

Table 2. ICWD temperature and DO measurements at locations other than the permanent flow monitoring stations.

	Below Blackrock return			Above Goose L. return			Two Culverts			Billy Lake @ outflow			Narrow Gauge Rd.			Keeler Bridge		
Date	Time	Temp (F)	DO (mg/L)	Time	Temp (F)	DO (mg/L)	Time	Temp (F)	DO (mg/L)	Time	Temp (F)	DO (mg/L)	Time	Temp (F)	DO (mg/L)	Time	Temp (F)	DO (mg/L)
3/22													14:25	52.2	6.2	14:05	52.0	5.9
3/31													15:00	47.1	7.3	14:40	48.2	6.4
4/5																		
4/7													13:40	52.5	8.1	13:25	52.5	5.9
4/12													13:30	52.2	6.2	12:55	52.7	4.7
4/14													9:40	51.8	4.8	10:00	52.2	5.9
4/24													13:20	58.1	3.0	13:40	59.4	3.7
4/28													11:00	54.5	4.4	11:20	55.8	4.4
5/23													13:35	65.1	4.0	14:00	66.7	4.1
5/29													11:45	67.5	2.4	12:05	67.8	3.1
6/6													12:40	69.1	2.0	13:00	70.5	2.1
6/19													9:50	71.1	1.4	10:30	71.8	2.8
6/20							12:00	77.9	0.3	11:45	74.5	1.0						
6/22	14:30	77.4	1.8	12:30	77.4	0.3							9:10	75.0	0.5			
6/23	13:00	76.5	1.3										14:15	78.1	0.3	13:50	78.3	0.5
6/28	9:50	69.4	1.3				10:20	74.3	0.3				11:15	73.8	0.3	11:30	75.0	0.3
7/7	9:45	71.2	1.8	10:00	71.6	0.4	8:50	74.5	0.4	8:40	72.3	0.5	12:15	74.3	0.2	11:50	75.7	0.3
7/13				9:05	72.9	1.0	12:45	76.1	0.8	12:25	75.6	0.5	14:15	75.9	0.5	13:55	76.8	0.4
7/21				13:00	76.3	4.2	12:20	74.7	1.2	12:10	73.9	0.9	14:10	73.2	1.1	13:50	74.1	1.5
8/10	10:45	72.1	2.8				10:15	71.6	2.1	11:10	74.3	2.0	12:45	67.8	2.8	12:15	71.8	3.1
8/30				10:25	70.9	4.2	12:00	77.9	0.3	11:55	74.5	3.4	12:20	67.8	2.7	12:40	69.3	3.5
9/7													13:15	66.0	2.3			

Table 3. Effect of the spring pulse flow on dissolved oxygen levels for stations south of the Intake. All data in Table 3 were collected using the DataSondes except Keeler Bridge.

Station	DO preceding pulse flow (mg/L)	Peak Flow (cfs)	Peak Flow Date	Minimum DO (mg/L)	DO Decline (mg/L)	Temp. (F)
Mazourka	3.9	180	4/10/17	2.2	1.7†	55.9
Reinhackle	3.9	156	4/14/17	2.1	1.8††	58.1
Keeler Br.	5.9	NA	4/18/17 (est.)	3.7	2.2	59.4
PBS	4.6	134	4/19/17	1.5	3.1	63.0

Footnotes: "DO preceding the flow" was the DO measurement one day before the pulse flow began to arrive at the station taken at same time of day as minimum DO after the peak flow passed. Temperature shown is the maximum on the day preceding minimum DO to account for the diurnal pattern. †: DO declined 1.3 mg/L based on LADWP spot measurements on dates near the peak flow. ††: DO declined 1.1 and 1.8 mg/L based on LADWP and ICWD spot measurements on dates near the peak flow.

estimated to be one day. Temperature at the Intake and Blackrock return only differed by $\pm$ 2 ^{o}F which cannot account for the decline in DO. DO values of less than 1mg/L were measured at Lower Goose Lake return (river mile 12) and at Two Culverts (river mile 16) suggesting that the lower half of this reach experienced severely depressed DO levels in summer of 2017. Very low DO values in water exiting Billy Lake (Table 2) suggested that north of Mazourka Canyon, water from extensive spreading operations may have been a small contributor to low DO in the LORP channel.

The April pulse flow resulted in a depression in DO at all three stations downstream of the Intake. At Mazourka and Reinhackle, DO ranged between 2-5 mg/L in March and April when flows were low and temperatures below 60 ^{o}F. At the PBS, DO varied between 4.5-7 mg/L and temperatures were below 65 ^{o}F at the PBS (Figures 2-3). During the spring pulse flow, DO did not drop below the 1mg/L threshold associated with fish stress. The decline in DO ranged from 1.7 to 3.1 mg/L depending on location and water temperature (Table 3, Figures 2-4). The magnitude of the decline increased progressively downstream from Mazourka to the PBS probably due to warmer water as residence time in the channel increased. The observed decline in DO suggested that the spring pulse had its intended effect. Flow rates and temperatures were sufficient for microbial activity in the water column to consume entrained organic matter and/or muck from the channel without endangering the fishery. Unfortunately, it is not possible to examine whether the spring pulse flow would have had a positive effect on water quality during a subsequent seasonal habitat flow as previously proposed by Inyo and Los Angeles. Operational releases to the LORP in June and July to accommodate the exceptional runoff far exceeded the amount prescribed for seasonal habitat flows, and the releases occurred when water temperatures were much warmer than has been the practice under normal runoff conditions .

At all sites downstream from the Intake, DO declined below the 1 mg/L threshold, and H_2S and fish kills were observed during site visits (Figures 2-4). DO in the LORP was effectively exhausted ($\leq$0.3 mg/L) from Goose Lake to the PBS from June 16-20 to approximately July 13-21 (ICWD) or August 10 (LADWP, Mazourka and Reinhackle). Unfortunately, the continuous dataset was often fragmentary as the pulses of water arrived at the monitoring stations preventing precise estimation of flow/temperature thresholds. Flows were also changing rapidly, and the rate coinciding with exceeding the DO threshold can only be estimated within relatively wide ranges. DO dropped below 1mg/L at Mazourka when flows increased from approximately 115 to 164 cfs. DO dropped at Reinhackle when flows increased from 120 to 185 cfs. DO dropped at the PBS when flows increased from 75 to 106 cfs. At all three sites water temperatures were above 70-75 ^{o}F.

Flows at the stations ramped down beginning in late July and DO began to recover slowly. The ICWD data at Mazourka and Reinhackle show an unexplained earlier and greater recovery in DO than LADWP manual reads or the DataSonde. In all datasets, however, DO barely improved above 1-2 mg/L by mid-August. When monitoring was discontinued at the end of August, DO was generally above the 1 mg/L threshold, but DO had not fully recovered at any site in large part due to water temperatures remaining above 65^{o}F.

Other Parameters

Conductivity at the Intake varied between 0.6 and 0.2 mS/cm and appeared to steadily decline in March thru May, but the number of manual reads to confirm if this trend was real were sparse (Figure 7). Mazourka Canyon may also exhibit a similar declining trend in conductivity (Figure 8). The apparent spike in April at Mazourka occurred three days after the peak of the spring pulse had passed. Data before the spring flow are insufficient to determine if it is a spike was associated with the pulse or evidence of a declining trend similar to that observed at the Intake. No trend in conductivity over time was observed in 2015 at the Intake or Mazourka Canyon stations (SpC= 0.3-0.5 mS/cm).

At the Reinhackle and PBS locations, conductivity was higher than in 2015 by more than 0.2 mS/cm, and clearly responded to flow pulses (Figures 9 and 10). The spikes in conductivity above 0.8 mS/cm at Reinhackle and 1.0 mS/cm at the PBS in April, June, and July coincided with flow pulses. Similar spikes related to flow pulses were observed in 2015 at stations below the Islands reach.

Previous monitoring suggested pH varied little in the LORP. The record for pH in 2017was incomplete at all sites and the manual reads were infrequent making data interpretation difficult (Figures 7-10). Intake pH varied between 6.2 - 7.7, lower than the range measured in 2015 (7.4 - 8.2). Similar pH values were recorded at Mazourka Canyon, 6.7 - 7.4, which were also lower than in 2015 (7.4 - 8.0). At Reinhackle pH was between 7.2 - 7.8. The early record for pH at the Pumpback Station was relatively stable between 7.7 - 8.0 slightly higher than in 2015. During June and July, pH declined to 6.2 - 6.7 and recovered to 7.0 as peak flows subsided in August (Figure 10). The DataSonde and manual read data are fragmentary and the step changes in pH correspond with periods of missing data. Except for a single manual pH read in July, it is difficult to conclude that the decline in pH at the PBS was real.

For all monitoring stations, turbidity measurements from the DataSonde were highly variable and often of questionable accuracy similar to previous monitoring results. The data presented in Figures 11-14 only include measurements when turbidity <100 NTU. The 100 NTU threshold is an arbitrary threshold for graphing purposes to remove the visual clutter from numerous reads greater than several hundred NTU. No manual turbidity measurement was greater than 100 NTU in 2017. A higher threshold was chosen in 2017 than in 2015 to avoid filtering turbidity values that may be associated with the much higher flows in the LORP in 2017. Short-lived spikes in turbidity were common and may reflect aquatic life or other obstructions temporarily occluding the sensor. Extended periods when turbidity was obviously exaggerated probably represent complete occlusion of the sensor. The Intake turbidity data were particularly unreliable and apparently the sensor failed in early May. Manual reads suggest turbidity fluctuated between 10-60 NTU (the single value >60 precedes the spring pulse by a week). The turbidity data recorded by the DataSonde at Mazourka Canyon were too sparse to make meaningful interpretations. Before May 18, the sensor reads were always greater than 100 NTU; after that date missing data were the result of sensor failure and not the filtering procedure. Manual turbidity reads were usually less than 7 NTU. No data were available for when peak flows were above 200 cfs in July, but there was no relationship between manual turbidity measurements and flow between 56 and 189 cfs. The data record from the DataSonde at Reinhackle was more complete, but noisy. Data were unavailable for the peak flow in early July, but the DataSonde turbidity data tracked the decline in flow after the peak. It is suspicious that turbidity exceeded 80 NTU and with no manual measurements during the peak flow, it cannot be ruled out that the correspondence with declining flows was coincidental. There was no relationship between manual turbidity measurements and flow (54-167 cfs). All manual reads at the PBS were between 1 and 2.2 NTU. One instance of an increase in DataSonde turbidity can be associated with flow management. The spike near July 17 at Pumpback Station coincides with Alabama Gates releases for several days (maximum Al. gates release, 57 cfs). Turbidity data at PBS were not available during the June/July high flow preventing comparisons of the relative effects of Alabama Gates releases and high LORP flows.

Conclusions

In anticipation of high flow releases to the LORP in 2017, continuous recording instruments were operated by LADWP to measure five water quality parameters at four locations from March thru August. Numerous manual measurements were also collected by ICWD and LADWP staff. The data analysis concentrated on DO and temperature as the parameters most indicative of a threat to the fishery.

LADWP released a pulse of water in early April similar to that proposed by Inyo and Los Angeles in 2015. DO declined 2-3 mg/L in response to the spring pulse suggesting the organic matter was mobilized and temperatures were sufficient for microbial respiration. DO remained above the threshold for the onset of fish stress, suggesting that the spring pulse had the desired effect.

Operational releases from Tinemaha Reservoir diverted into the Intake in June and July resulted in the highest flows in the river since the LORP was initiated. Water arriving at the Intake in July had slightly depressed DO beyond that due to warmer temperatures alone. High flows in the LORP occurred when water temperatures were above that desired to avoid impacts to the fishery based on anecdotal experience from previous seasonal habitat flows. The combination of slightly depressed DO in the Owens River at the Intake, high water temperatures, and high flows caused DO to drop well below the 1 mg/L threshold from near Goose Lake to the PBS for approximately 4-5 weeks. The drop in DO was accompanied by a noticeable release of H_2S and fish kills observed at numerous locations along the channel. The LORP above Goose Lake did not experience a fish kill, and may act as a source of surviving fish to recolonize the lower river reaches.

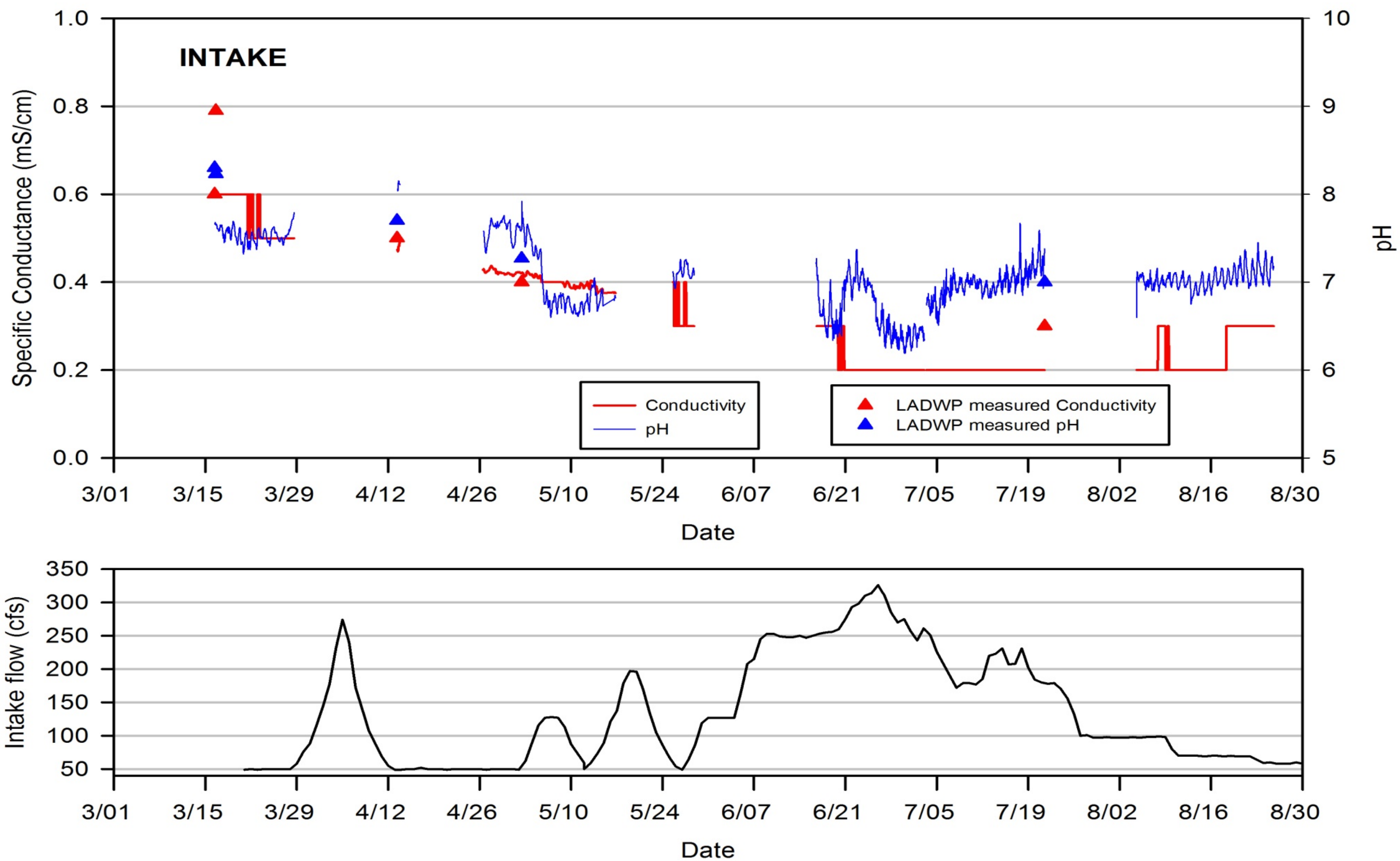


Figure 7. Specific Conductance and pH (top graph) and daily flow measured (bottom graph) at the Intake measuring station.

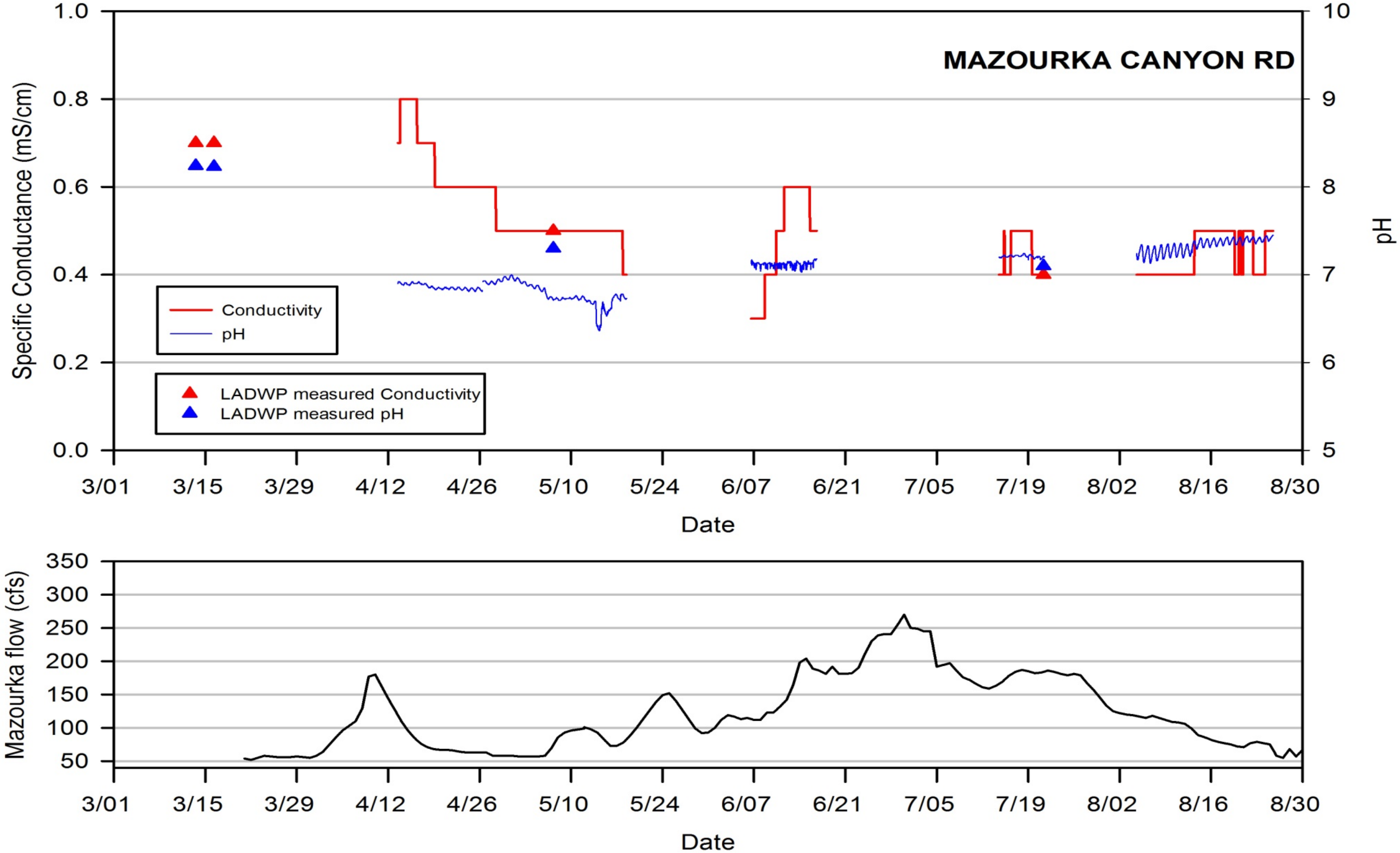


Figure 8. Specific Conductance and pH (top graph) and daily flow measured (bottom graph) at Mazourka Canyon Rd.

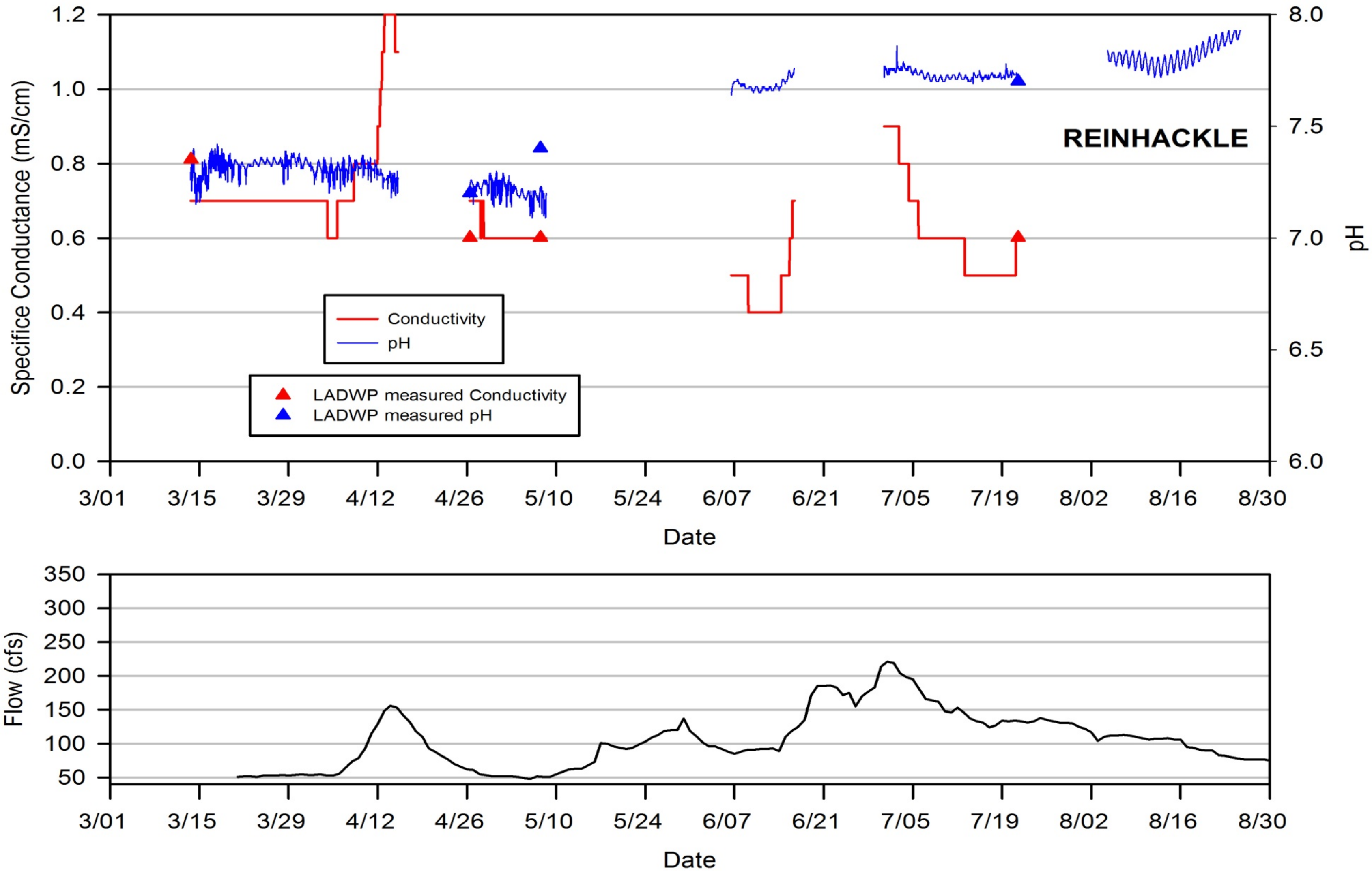


Figure 9. Specific Conductance and pH (top graph) and daily flow (bottom graph) measured at Reinhackle station.

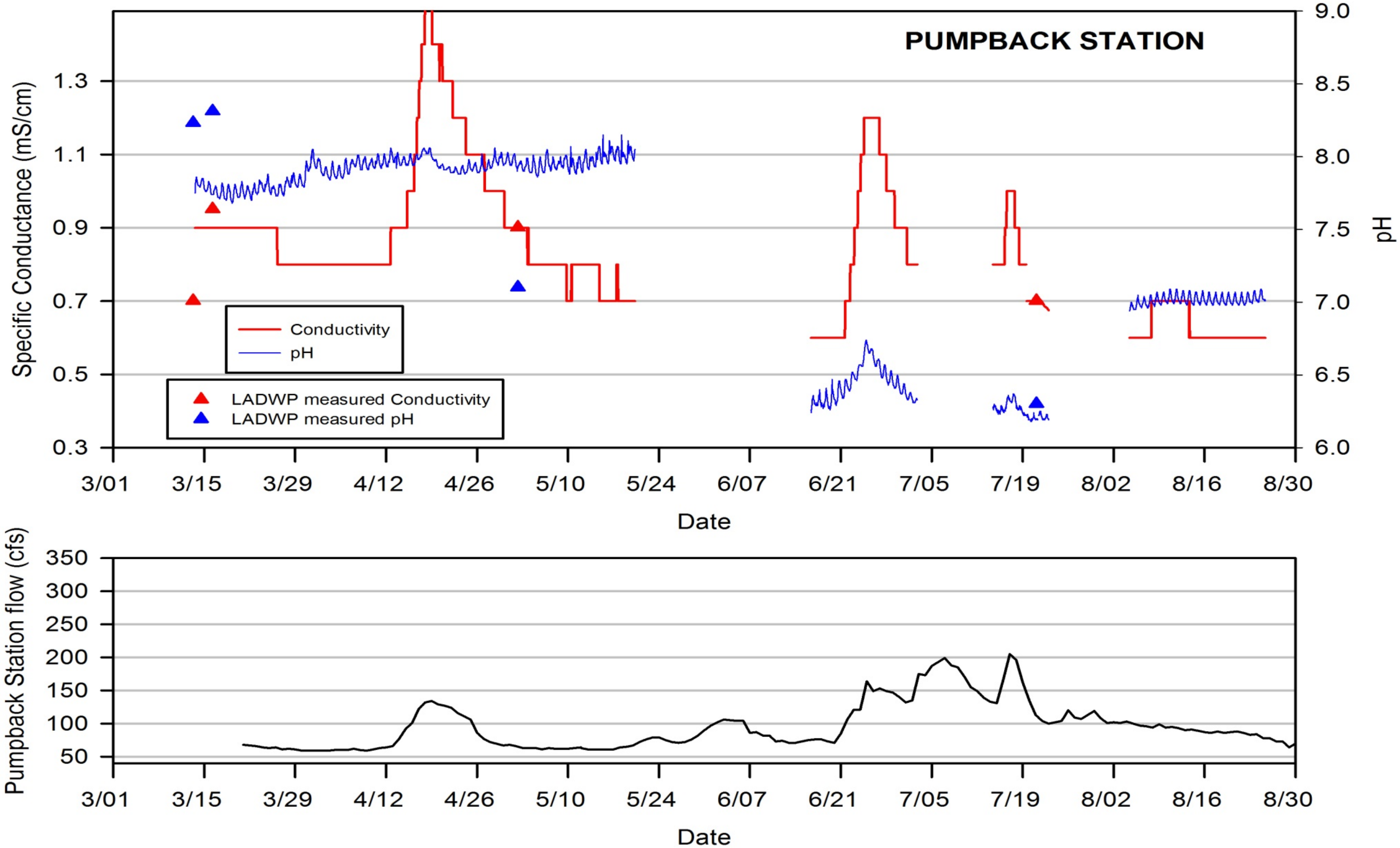


Figure 10. Specific Conductance and pH (top graph) and estimated daily flow (bottom graph) arriving at the Pumpback Station.

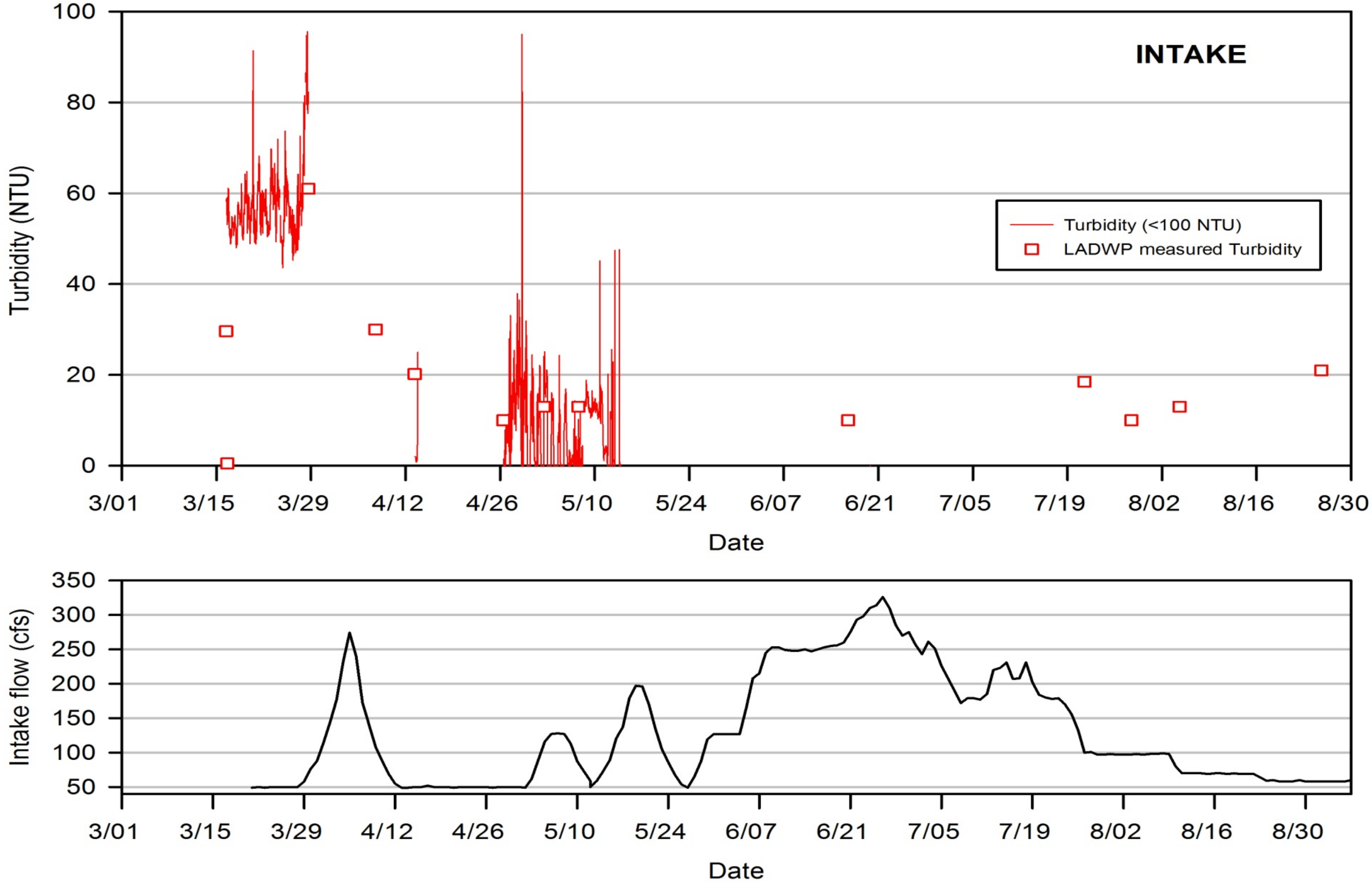


Figure 11. Turbidity (top graph) and daily flow measured (bottom graph) at the Intake measuring station.

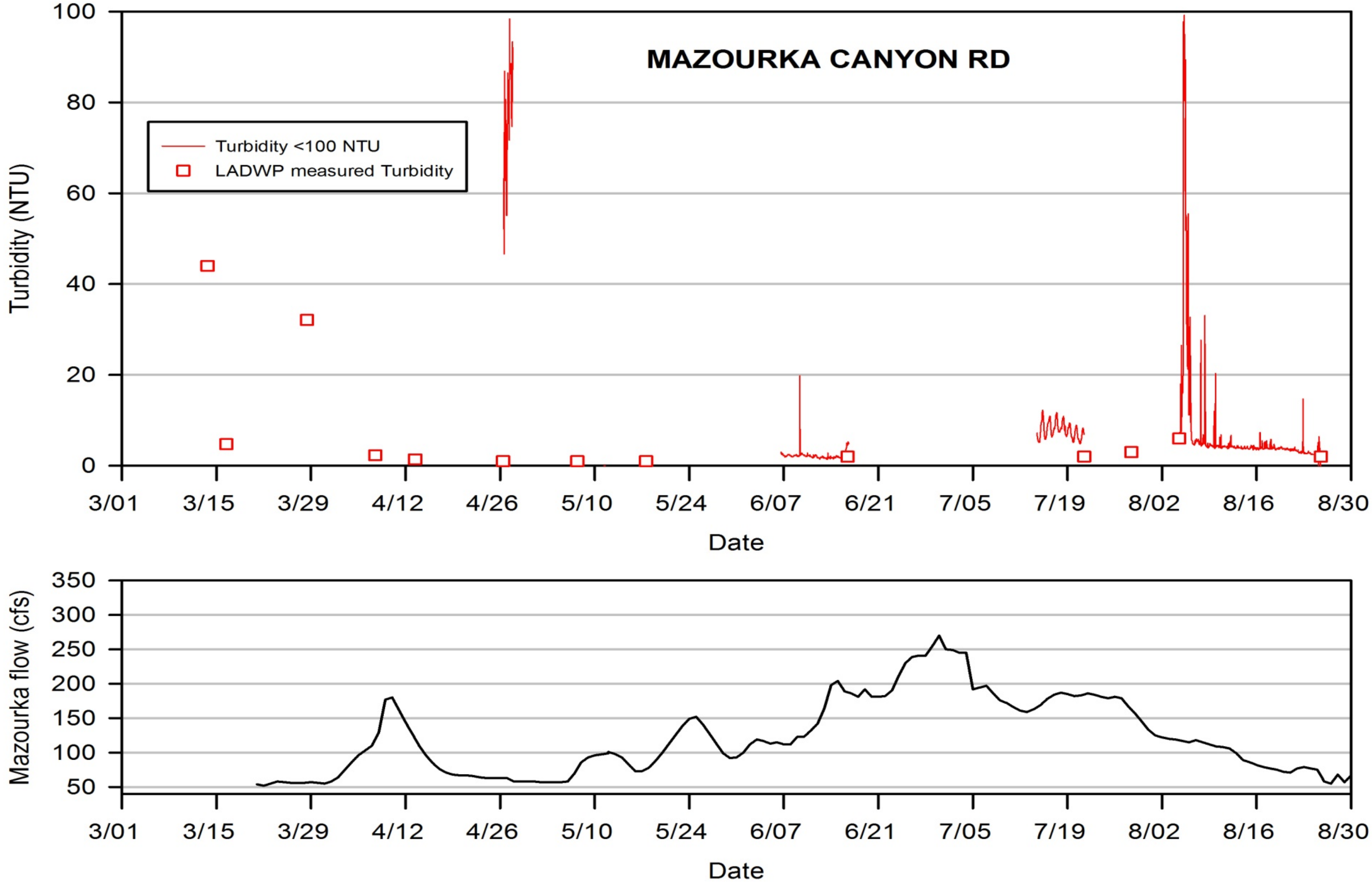


Figure 12. Turbidity (top graph) and daily flow measured (bottom graph) at Mazourka Canyon Rd.

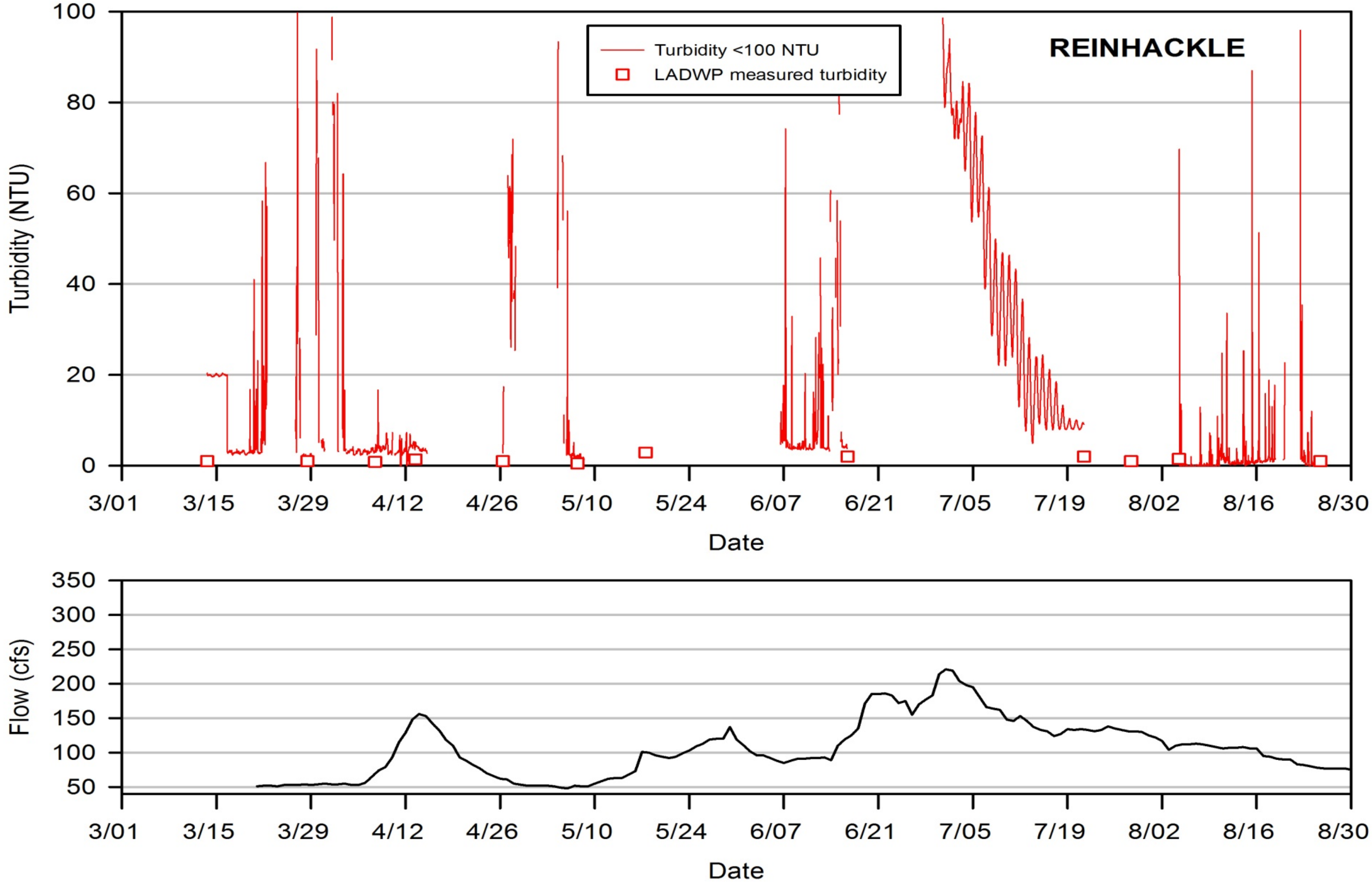


Figure 13. Turbidity (top graph) and daily flow (bottom graph) measured at Reinhackle station.

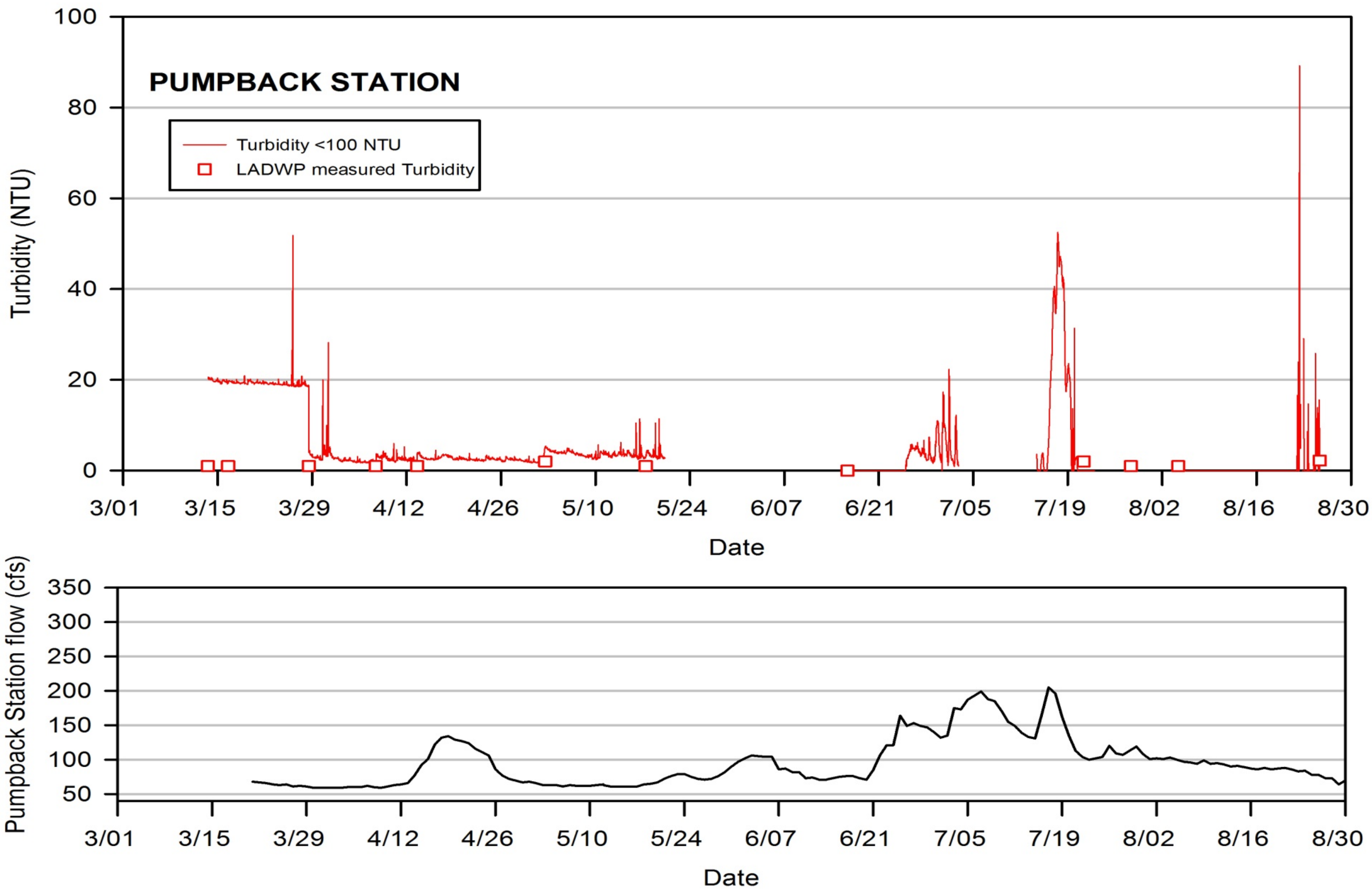
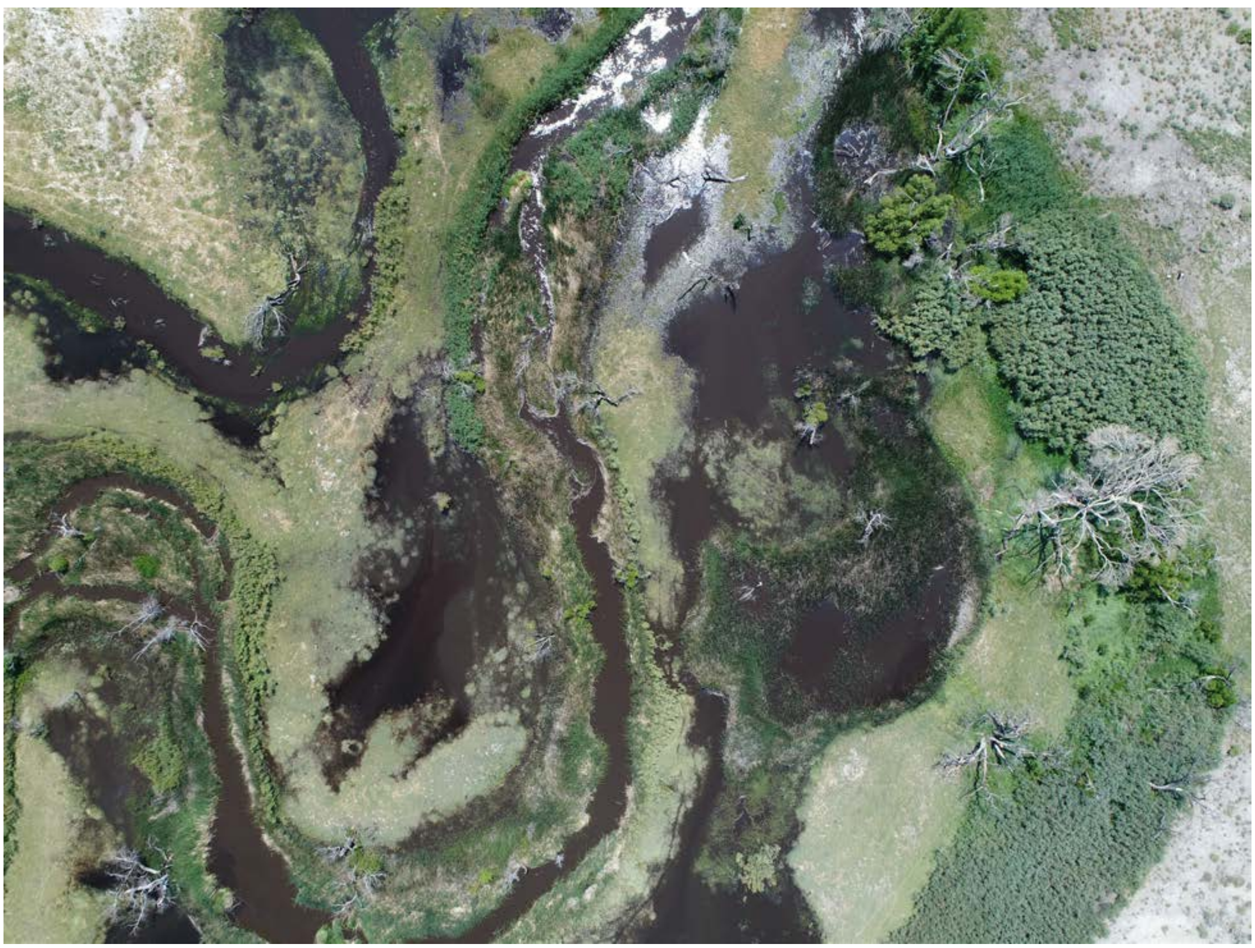


Figure 14. Turbidity (top graph) and estimated daily flow (bottom graph) arriving at the Pumpback Station.

7.0 LORP 2017 RAPID ASSESSMENT SURVEY

Lower Owens River Project
2017 Rapid Assessment Survey

Observations



The Lower Owens River at flood stage (appx. 200cfs) near Lone Pine, CA on July 7, 2017.

Lower Owens River Project
Summary of Rapid Assessment Survey Observations

A survey of the Lower Owens River Project (LORP) area, referred to as the Rapid Assessment Survey or RAS, is conducted annually beginning in August. The survey this year was conducted August 1 through August 9. Inyo County staff with a representative from LADWP surveyed along the wetted edges of the water features in the LORP, including the Lower Owens River, Blackrock Waterfowl Management Area (BWMA), Off-River Lakes and Ponds (OLP), and the Delta Habitat Area (DHA). The 401 observations recorded during this exercise are presented in this report.

The primary purpose of the RAS is to detect and record the locations of problems that can negatively affect the LORP. These are impacts that require physical maintenance such as repairing a damaged or cut fences, trash pickup, tamarisk slash pile removal, and herbicide treatment of noxious weeds.

Project managers and scientists also use RAS data as rough indicators of basic trends in the ecological development of the riparian and riverine environments, especially when RAS data is compiled with information gathered from other LORP studies. For example, RAS observations of woody recruitment can be considered along with river-edge belt transects, which are intended to look in greater detail at woody recruitment. The combined observations can help project managers understand how and where woody recruitment is taking place and if it is persisting.

Confounding factors affecting the 2017 RAS

The historically high Sierra snowpack in the winter of 2016-17 resulted in a runoff forecast that was 2-2.5% greater than would be experienced in a normal runoff year. To avoid overwhelming the Los Angeles Aqueduct, LADWP was forced to spread water throughout the Owens Valley including the LORP BWMA area. However, spreading alone could not absorb the volume of water coming off the mountains, and LADWP was forced to put excess water down the Lower Owens River as a last resort. Peak flows in the river topped 300 cfs, with flows above 200 cfs for 40 days (between 4/4-7/19/2017). During the RAS, flows ranged from 98-125 cfs, which is at least twice the flow experience during all previous years' surveys. These high flows pushed water into secondary channels and inundated the floodplain in many areas. Because of these unusual conditions, the tracks taken during the 2017 survey were in many cases outside the area surveyed in previous years. About 44% of the revisit sites were underwater or inaccessible due to flooding.

We have not analyzed how high flows might have affected this year's RAS, but a number of possible hypotheses might be offered. These include; low numbers of Tamarisk observed could result from a track that's further from the water; higher then average recruitment might be explained in part by observers exploring secondary channels where vegetative competition is reduced and open soil is more common; higher than normal numbers of dead fish likely resulted from high flows in June and July that caused a decline in water quality; and higher than normal records of Slash could be the result of a track further out from the river where debris might be relocated to avoid the waterway.

The observations recorded during the RAS are categorized by type and observation code in Table 1. The number of observations by impact type and LORP area are presented in Table 2.

Table 1. Catalog of impacts recorded by the RAS

Observation Code	Observation Type	Description
WDY	Woody recruitment	This year's cohort of willow and cottonwood seedlings
TARA	Saltcedar	*Tamarisk* spp. seedlings, resprouts from previously treated plants and mature trees.
ELAN	Russian olive	*Elaeagnus angustifolia*, seedlings and juveniles (height <1m).
NOX	Noxious weeds	Any of twenty-one species of locally invasive plants, mainly perennial pepperweed
BEA	Beaver	Sightings or evidence of beaver in the LORP
ELK	Elk	*Cervus canadensis* ssp. *nannodes*, sightings or evidence of tule elk
FEN	Fence	Reports of damaged riparian or exclosure fencing
GRZ	Grazing	Evidence of (off-season) grazing in the floodplain.
REC	Recreational impacts	Evidence of recreational activity and any adverse associated impacts
ROAD	Road	Previously unidentified roads, road building activities, or roads causing impacts
TRASH	Trash	Large refuse or dumping
DEADFISH	Dead fish	Dead fish in the water, on the bank, or in the floodplain
SLASH	Slash	New piles of recently cut saltcedar slash
OBSTR	Obstructions	Obstructions to river flow
Other	Other	Other impacts

Table 2. Summary of observations collected by category and area; including Blackrock Waterfowl Management Area (BWMA); Off-River Lakes and Ponds (OLP); and the Delta Habitat Area (DHA).

Code	Observation Type	Map	Reach 1	Reach 2	Reach 3	Reach 4	Reach 5	Reach 6	BWMA	OLP	DHA	Total Obs.
WDY	Woody recruitment (non-clonal)	Map 2	2	15	13	1	0	0	0	1	0	32
TARA	Saltcedar plants (Tamarisk)	Map 3	0	12	16	4	8	10	61	54	10	175
ELAN	Russian olive recruitment	Map 4	0	0	0	0	0	0	6	14	0	20
NOX	Noxious weeds (Lepidium)	Map 5	4	2	1	0	0	0	29	0	0	36
BEA	Beaver	Map 6	0	0	0	4	0	0	0	0	0	4
ELK	Elk	Map 6	0	0	1	3	3	12	1	0	0	20
FEN	Fence	Map 7	0	1	3	0	0	1	0	0	0	5
GRZ	Grazing	Map 7	1	0	3	1	0	1	0	1	0	7
REC	Recreation impacts & use	Map 8	0	0	6	0	1	9	0	4	0	20
ROAD	Road	Map 7	1	1	0	5	6	5	0	0	2	20
TRASH	Trash	Map 7	0	1	2	0	2	3	0	2	0	10
DEADFISH	Dead fish	Map 7	2	2	1	0	0	0	0	0	1	6
SLASH	Slash	Map 7	0	0	3	0	0	0	0	9	0	10
OTHER	Other	Map 7	0	1	1	0	0	0	0	0	1	3

[1] 30 of the 65 recruits discovered were clone derived narrowleaf willow (SAEX).

River-reaches and LORP units--Table 3

The Lower Owens River is divided up in to six river-reaches, which are defined by channel/ floodplain morphology, and hydrologic variables (Table 3, and "River-reaches and river-miles map"). For the RAS summary these reaches offer a convenient way to describe a position on the river and they serve as a common reference for RAS observations taken year to year. Individual observations in the river-riparian corridor are often referenced to the nearest tenth of a river-mile (RM). The Lower Owens River Intake is river-mile 0.0, the pump station is at river-mile 53.1, the Delta Habitat Area begins at river-mile 53.7, and the river recedes into the Owens Lake playa near river-mile 62.0.

When comparing the number of observations found per river-reach it is important to note that the lengths of the reaches are unequal, and that the number of observations by reach for the various categories has not been normalized to account for the different lengths of the reaches. For example, most of the woody recruitment observed in 2017 along the river was recorded in river-reaches 1, 2, 3, which together total just about half of river-miles in the entire river-riparian corridor. No tree willow or cottonwood recruitment was recorded below the Islands (Reach 3).

Table 3. River reaches: comparisons of reach length, and river type.

	Percent of river length	Total River-miles (RM)	Mile Markers	Description
Reach 1	7%	4.2	0 to 4.2 RM	Wet Incised Floodplain
Reach 2	25%	15.6	4.2 to 19.8 RM	Dry Incised Floodplain
Reach 3	24%	15.1	19.8 to 34.9 RM	Wet Incised Floodplain
Reach 4	6%	3.9	35.0-38.8 RM	Aggraded Wet Floodplain
Reach 5	7%	4.2	38.8 to 43.0 RM	Wet Incised Floodplain
Reach 6	17%	10.7	43.0 to 53.7 RM	Graded Wet Floodplain
Delta Habitat Area (DHA)	13%	8.3	53.7 to 62.0 RM	Delta

Map 1. Lower Owens River Reaches/Off-River Management Units

Summary of Observations by Category

Woody Recruitment (WDY)--*Tables 4-6; Map 2; Figure 1*

Willows and cottonwood provide the vertical structural and diverse natural habitats that are essential to attracting many of the riverine/riparian avian habitat indicator species. These species are key measure of the LORP's success. A focus of the RAS has been to identify areas where trees are establishing in newly wetted areas. RAS field staff is trained to locate, identify, and record willow and cottonwood recruits that are part of the current year's cohort. It's important to note that the recording and reporting of woody recruitment was often not consistent prior to 2011. The definition of a "woody recruit" for purposes of the RAS was not consistently handled until 2012. Prior to 2010, clonal reproduction of shrub willow (SAEX) by root sprouting was not differentiated from seed derived recruitment of tree willow, resulting in an over reporting of recruitment. In 2011, criteria were established to distinguish sexual from asexual SAEX development (SAEX recruitment ≥ 5 meters from a mature SAEX plant or stand would be considered non-clonal).

The RAS is conducted in August to be able to detect seedlings that may have germinated as the result of the annual LORP seasonal habitat flow (SHF), which is generally timed to accompanying willow seed-fly. Typically higher flows are released from the intake in mid-summer to offset downstream losses due to evapotranspiration. This is necessary in order to maintain a minimum 40 cfs flow throughout the river.

In 2017, unplanned high flows, up to 308 cfs, began in April and continued into August. These higher flows inundated low landforms for months. The increase in recruitment observed this year might be attributed to seed falling on moist soils in less vegetated areas. Competition is thought to be a factor in the lack of recruitment observed in recent years. How this year's recruitment, generated in part from an elevated water table, will fare over time is unknown. If the seedling were able to generate roots that grew deep enough to reach a normal-year water table they might persist.

Although the higher flows seemed to encourage recruitment this year, it's unknown how these flooding flows affected previous year's recruitment. Many juvenile plants were in standing water for months. Considerable numbers could have been lost. As well, mature trees were also inundated. Another all-years recruitment study, which would also survey mature trees, might be called for. This could help inform the effects that higher flows proposed in a new river hydrograph could have on past and future recruitment, as well as provide insight into the effects of flooding on mature trees.

Notes:

- In 2017, observers located 35 tree willow recruits, no cottonwood recruits and 30 clonal SAEX. This is 333% greater then observed in the previous year, and more total tree recruitment than had been observed in the preceding three years. However, this level of recruitment is less than that observed when high flows were let in earlier years.
- The majority of SAEX was found in the ORLP area mostly along recently maintained ditches.
- Tree willow recruitment sites were divided almost evenly between riverbank and floodplain landforms.

- No recruitment was found in the lower 27 miles of the river. All recruitment was found above RM 35.2

Figure 1. Seasonal habitat flow and woody recruitment observed 2007-2017

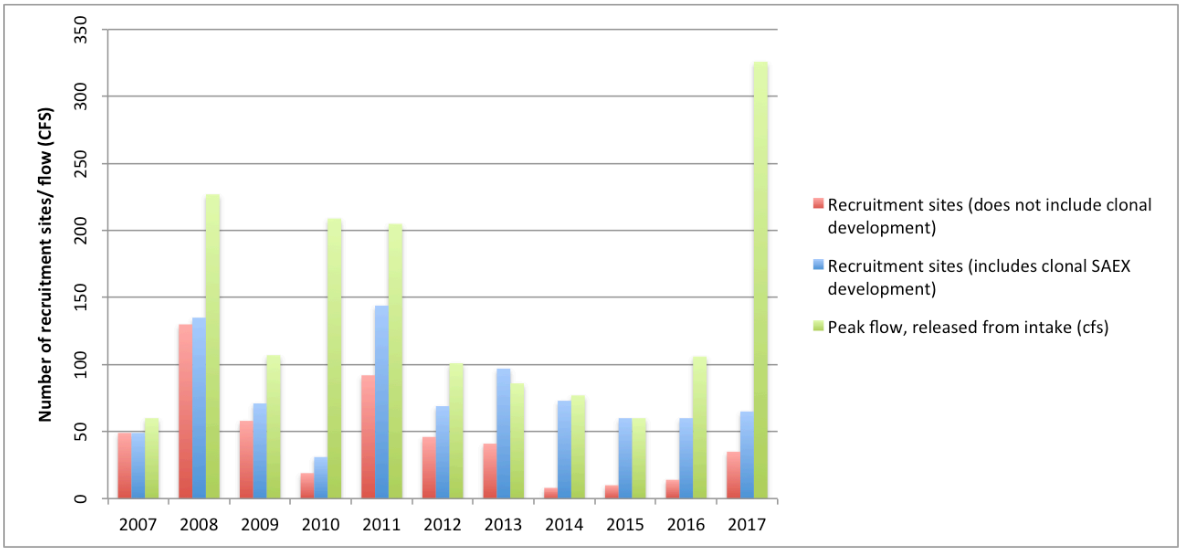


Table for Figure 1

Year	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Recruitment sites (does not include clonal development)	49	130	58	19	92	46	41	8	10	14	35
Recruitment sites (includes clonal SAEX development)	49	135	71	31	144	69	97	73	60	60	65
Peak flow, released from intake (cfs)	60	227	107	209	205	101	86	77	60	106	326

There was no SHF in 2007, 2014, or 2015. The 2008 SHF was released in February. Flows shown 2013-2015 represent maximum flows released from the Intake in the mid-summer to compensate for ET losses and maintain a >40cfs flow throughout the river. An extraordinarily high runoff forecast led to an above normal, and extended, high flow in 2017. Many secondary channels were flooded, as were large areas of floodplain in the lower river reaches.

Table 4. Number of distinct non-clonal recruitment sites by species and reach

Species Code	Common/ Scientific Name	Reach 1	Reach 2	Reach 3	Reach 4	Reach 5	Reach 6	DHA	BWMA	OLP	Total
SAEX	Narrowleaf willow/ *Salix exigua*	0	0	0	0	0	0	0	0	3	**3**
SAGO	Black willow/ *Salix goodingii*	2	15	12	0	0	0	0	1	0	**30**
SALA3	Red willow/ *Salix laevigata*	0	0	2	0	0	0	0	0	0	**2**
SALIX	Hybrid, or unknown	0	0	0	0	0	0	0	0	0	**0**
POFR2	Fremont Cottonwood/*P opulus fremontii*	0	0	0	0	0	0	0	0	0	**0**
Total number of Observations		**2**	**15**	**14**	**0**	**0**	**0**	**0**	**1**	**3**	**35**

Table 5. Plant abundance at recruitment sites

Species Code	Common Name	Abundance (number of plants per site)			
		1 to 5	6 to 25	26 to 100	>100
SAEX Seedling	Narrow leaf willow	2	1	0	0
SAGO	Black willow	1	6	12	11
SALA3	Red willow	0	1	0	1
SALIX	Hybrid or unknown	0	0	0	0
POFR2	Fremont Cottonwood	0	0	0	0

Table 6. Distribution of woody recruitment relative to landforms

Species Code	Common Name	Channel	Channel to Bank	Bank	Channel to Floodplain	Floodplain	Upland
SAEX Seedling	Narrow leaf willow	0	0	3	0	0	0
SAGO	Black willow	0	1	12	0	17	0
SALA3	Red willow	0	0	2	0	0	0
POFR2	Cottonwood	0	0	0	0	0	0

Sites Revisited--*Map 9*

Field crews returned to specific sites where woody recruitment, new roads, and evidence of beaver were recorded in the previous year. They noted the presence or absence of the subject. A total of 91 sites were identified for revisiting; however this year, due to flooding flows, many of the target subjects were inaccessible. The results from these revisits are found in this report in corresponding category sections.

Woody Recruitment Revisits--*Table 7*

Woody recruitment sites found in 2016 were revisited in 2017. Of the 10 sites revisited 7 of last year's cohort were relocated; where accessible.

Table 7. Revisit sites: persistence of woody recruitment identified in 2016 and revisited in 2017

Reach/Area	1	2	3	4	5	6	BWMA	OLP	DHA	Total
Present	-	1	4	-	-	-	-	-	-	5
Absent	-	-	2	-	-	-	-	-	-	2
Inaccessible	-	2	1	-	-	-	-	-	-	3

Note: A survey of all recorded tree recruitment sites from 2007 to 2015 was presented in the 2105 LORP Annual Report.

Saltcedar (TARA)--Tables 8, 9, 10; Map 3

Saltcedar (*Tamarix* spp.) is found throughout the LORP. It is the most abundant noxious weed in the project area. In 2017, 175 TARA populations were found at 51 discrete locations on the river, 60 locations in the BWMA and 54 in off-river sites. Ten were found in the Delta. Compared to last year, 49% fewer populations of TARA were observed.

Notes:

- The decrease in the number of TARA observed was likely due to an eradication program in 2016-2017 that spent less time in the spreading basins and focused primarily on the river, BWMA, and the OLPs.
- In the BWMA, Drew Winterton saw an increase in the number of high density populations. In the OLP, both Goose and Twin Lakes saw an increase in the number of high abundance populations.
- The Saltcedar control program, operated out of the Inyo County Water Department, has lost its manager and the program is no longer receiving third-party funding. The program will not be operating in 2017-2018.

Table 8. Total number of observation sites and age class of saltcedar by location in 2017

Age Class	Reach 1	Reach 2	Reach 3	Reach 4	Reach 5	Reach 6	DHA	BWMA	OLP	Total
Seedlings	0	1	1	0	0	0	1	6	2	**11**
Resprouts	0	3	9	4	6	8	6	15	17	**68**
Mature	0	8	6	0	2	2	3	40	35	**96**
Totals	0	12	16	4	8	10	10	61	54	**175**

Table 9. Saltcedar abundance by river-reach or LORP unit in 2017

	Abundance (number of plants per site)				
Location	**1 to 5**	**6 to 25**	**26 to 100**	**>100**	**Total no. of sites**
BWMA-Drew	16	6	0	3	**25**
BWMA- Waggoner	6	6	3	0	**15**
BWMA-Winterton	18	2	0	0	**20**
Delta Habitat Area	8	2	0	0	**10**
Off River – Goose	19	1	1	2	**23**
Off River – Twin	19	7	4	1	**31**
Reach 1	0	0	0	0	**0**
Reach 2	10	2	0	0	**12**
Reach 3	11	4	0	0	**15**
Reach 4	4	0	0	0	**4**
Reach 5	8	0	0	0	**8**
Reach 6	12	0	0	0	**12**
Frequency of abundance	**131**	**30**	**8**	**6**	

Table 10. Saltcedar Observations by River Reach in years 2010-2017

Year	Reach 1	Reach 2	Reach 3	Reach 4	Reach 5	Reach 6	River Total
2010	1	46	45	18	34	89	**233**
2011	12	88	119	57	34	40	**350**
2012	15	84	80	49	27	56	**311**
2013	11	152	88	13	17	55	**336**
2014	6	106	64	39	44	46	**305**
2015	10	95	55	20	8	16	**204**
2016	9	88	55	18	10	12	**192**
2017	0	12	15	4	8	12	**51**

Russian Olive (ELAN)--*Table 11; Map 4*

Although Russian olive (*Elaeagnus angustifolia*) is not listed as a noxious weed in California, the California Invasive Plant Council considers this species highly invasive in riparian systems. All mature ELAN plants along the river and adjacent management units of the LORP have been recorded in prior years. Documenting seedling or juvenile ELAN is the current focus (height less than 1 m). Most of the current recruitment is occurring in off-river sites, e.g., Drew Slough, Thibaut Ponds, Billy, Goose and Twin Lakes.

Table 11. Russian Olive (ELAN) abundance at observation sites, by LORP unit or river reach

Location	Abundance (number of plants per site)				
	1 to 5	6 to 25	26 to 100	>100	Total no. of sites
BWMA-Drew	6	0	0	0	**6**
BWMA- Waggoner	0	0	0	0	**0**
BWMA-Winterton	0	0	0	0	**0**
Delta Habitat Area	0	0	0	0	**0**
Off River – Billy Lake	1	0	0	0	**1**
Off River—Twin Lake	1	2	0	0	**3**
Off River—Goose Lake	10	0	0	0	**10**
Reach 2	0	0	0	0	**0**
Reach 3	0	0	0	0	**0**
	18	**2**	**0**	**0**	**20**

*Abundance not recorded in one observation

As shown on Map 4, ELAN is concentrating primarily in the Blackrock management area, rather than spreading throughout the LORP or along the river.

Noxious Weeds (NOX)--*Table 12; Map 5*

Perennial pepperweed, *Lepidium latifolium* (LELA2) continues to be found within the LORP.

Notes:

- Thirty six distinct populations of LELA2 were recorded in 2017, compared to 40 in 2016.
- Fifteen of the 36 sites appeared to have been treated.

- LELA2 is concentrated in the northern part of the LORP with the majority of the populations found in the Drew and Winterton units of the Blackrock Waterfowl Management area and river reaches 1 and 2.
- LELA2 populations at Winterton are up 400% over 2016
- Populations present along the Owens River north of the Intake that might serve as a seed source are still a concern.
- More than half of the populations were found growing on or adjacent to the riverbank.
- Thirteen of the 61 LELA2 sites recorded in 2016 that were scheduled for revisits in 2017 were inaccessible due to flooding. Of the 48 sites that were accessible, 16 populations were persisting.
- The spread of Perennial Pepperweed, from 2007-08 to 2014-15, is found in Map 5a in the LORP RAS Report section of the 2015 LORP Annual Report.

Table 12. *Lepidium latifolium* (LELA2) abundance at observation sites, by LORP unit or river reach

	Abundance categories (number of plants/location)				
Location	**1 to 5**	**6 to 25**	**26 to 100**	**> 100**	**Total**
BWMA – Winterton	1	9	8	1	19
BWMA-Drew	5	5	0	0	10
Reach 1	3	0	0	1	4
Reach 2	2	0	0	0	2
Reach 3	0	1	0	0	1
Reach 4	0	0	0	0	0
Reach 5	0	0	0	0	0
Reach 6	0	0	0	0	0
Totals	11	15	8	2	36

Beaver Activity (BEA)--*Map 6*

Beaver activity and evidence was noted at four locations, down considerably from 2016. The decline might be attributed to flooding that prevented access to certain parts of the river.

Notes:

- Evidence of beaver was seen in four locations; all in Reach 2. One beaver carcass was found.
- Twelve sites where beaver were found in previous years were revisited. Of these four sites were inaccessible, seven had no beaver sign, and at one site there was evidence of an active animal.

Dead Fish (DFISH)--*Map 6*

Note:

- Six records dead fish were made. One was found in the Delta, the rest were on the riverbank or floodplain.

Elk--*Map 6*

Notes:

- Evidence of elk, or direct sightings, were noted at 20 locations; the majority in between the Islands and the Highway 136.
- Of note, on individual was sighted just south of Mazourka Canyon Road.
- The majority of observations were indirect browse or antler rub or both, but seven animals were observed.

LORP Riparian Fence (Observation Code: FEN)--*Map 7*

Staff surveyed enclosure fencing as well as riparian pasture fences.

Note:

- Five records were made of damaged fences in the LORP.

Grazing Management (GRZ)--*Map 7*

Notes:

- A cattle feed stations was found in the floodplain in Reach 3.
- Observers found only one or two cows per location.

Recreation (REC)--*Map 8*

Twenty discrete impacts were associated with recreation. Evidence includes general litter, clay pigeons, pallets, tackle box, clothes, BBQ fire remains, and shell casings. Recreation evidence was most abundant near roads, and in the Lone Pine area.

Roads (ROAD)--*Map 7*

All roads, or vehicle trails that were not present in 2005, or changes in roads were recorded. There were 20 observations—about the same as last year, and almost three times more than in 2014.

- 15 roads were characterized as "New" roads, and five were considered existing.
- Most of the roads (70%) were infrequently or rarely used.
- Of the nine roads found in 2015, all but one was receiving some use.

Trash--*Map 7*

Observers were asked to record large trash items. These were found in 10 locations; similar to number of sites in previous years. A washing machine, oil drums, plastic sheeting, foam board, and tires were some of the items found.

Tamarisk Slash (SLASH) --*Map 7*

Note:

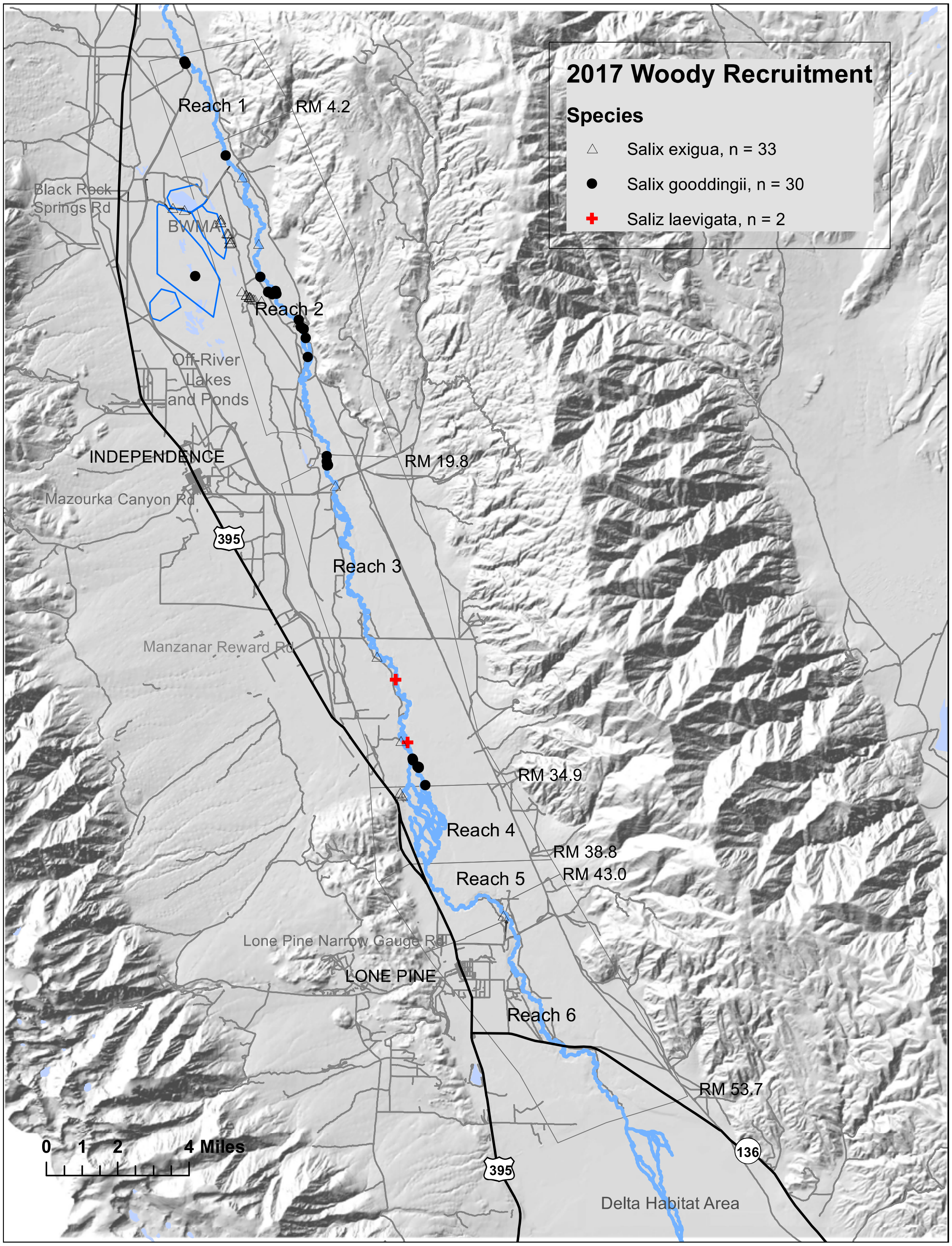
- All but one pile of newly cut slash were found at Twin Lake. Many of the piles were composed of ELAN.

Other--*Map 7*

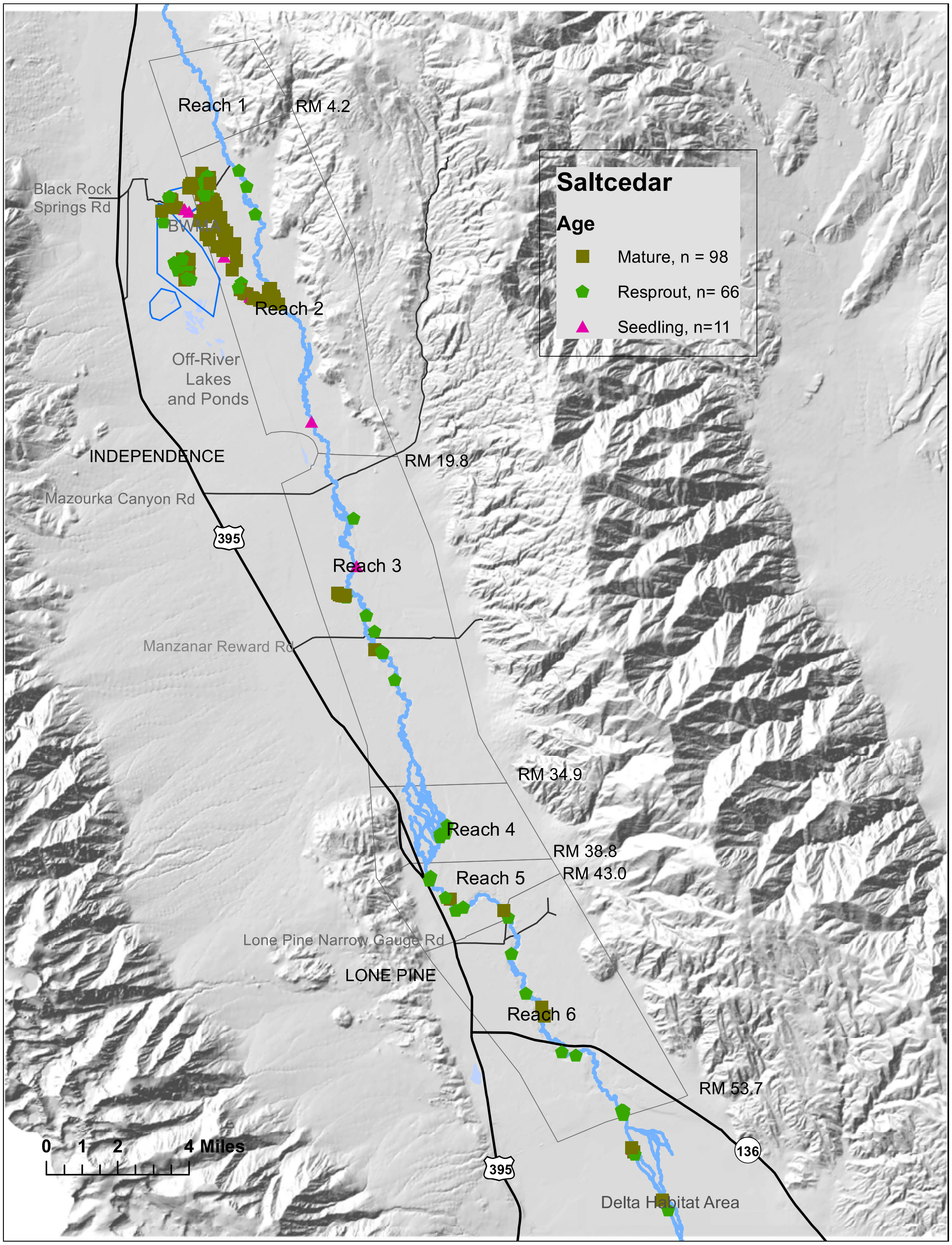
Note:

- Willows apparently drowning due to flooding.

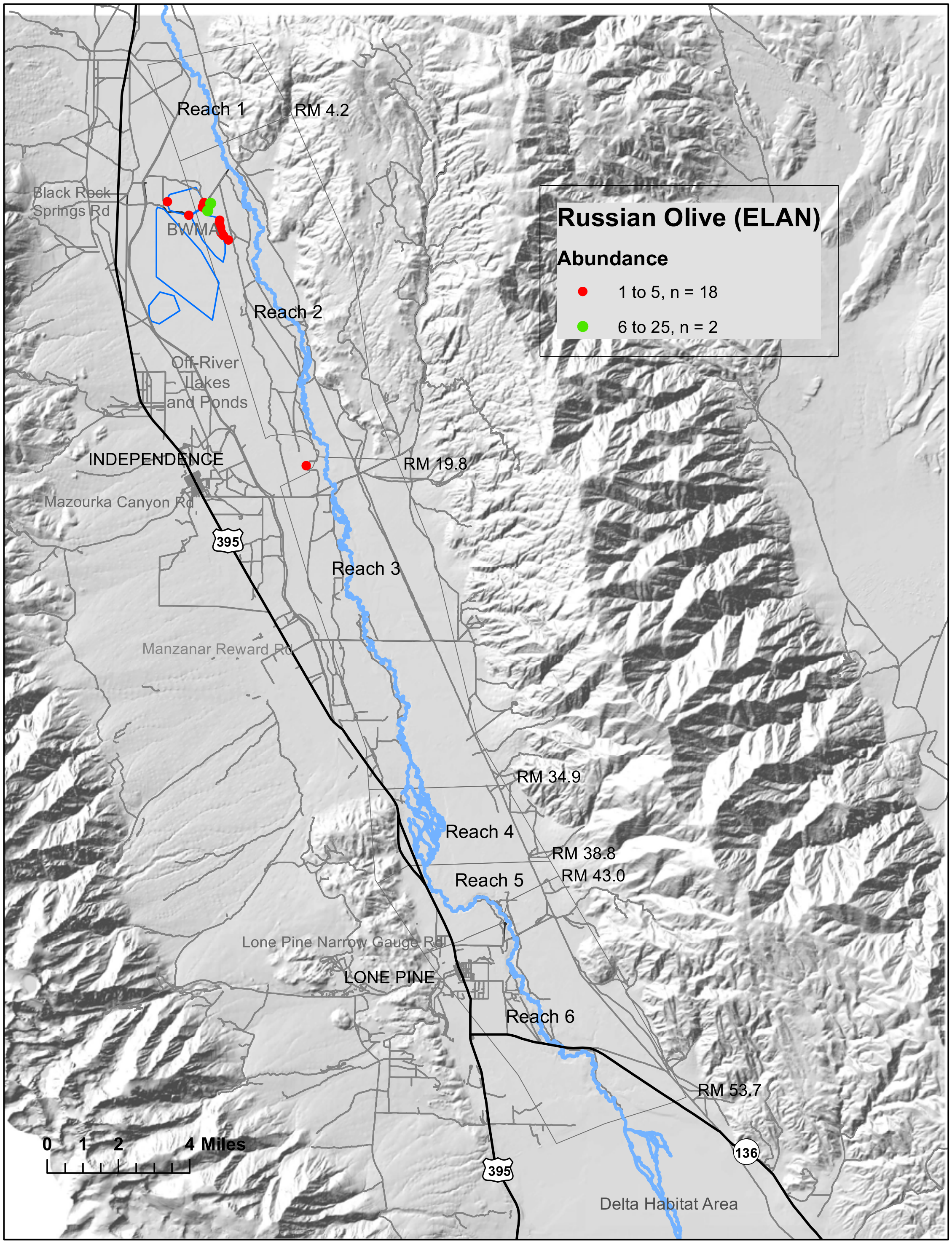
Map 2. Woody Recruitment



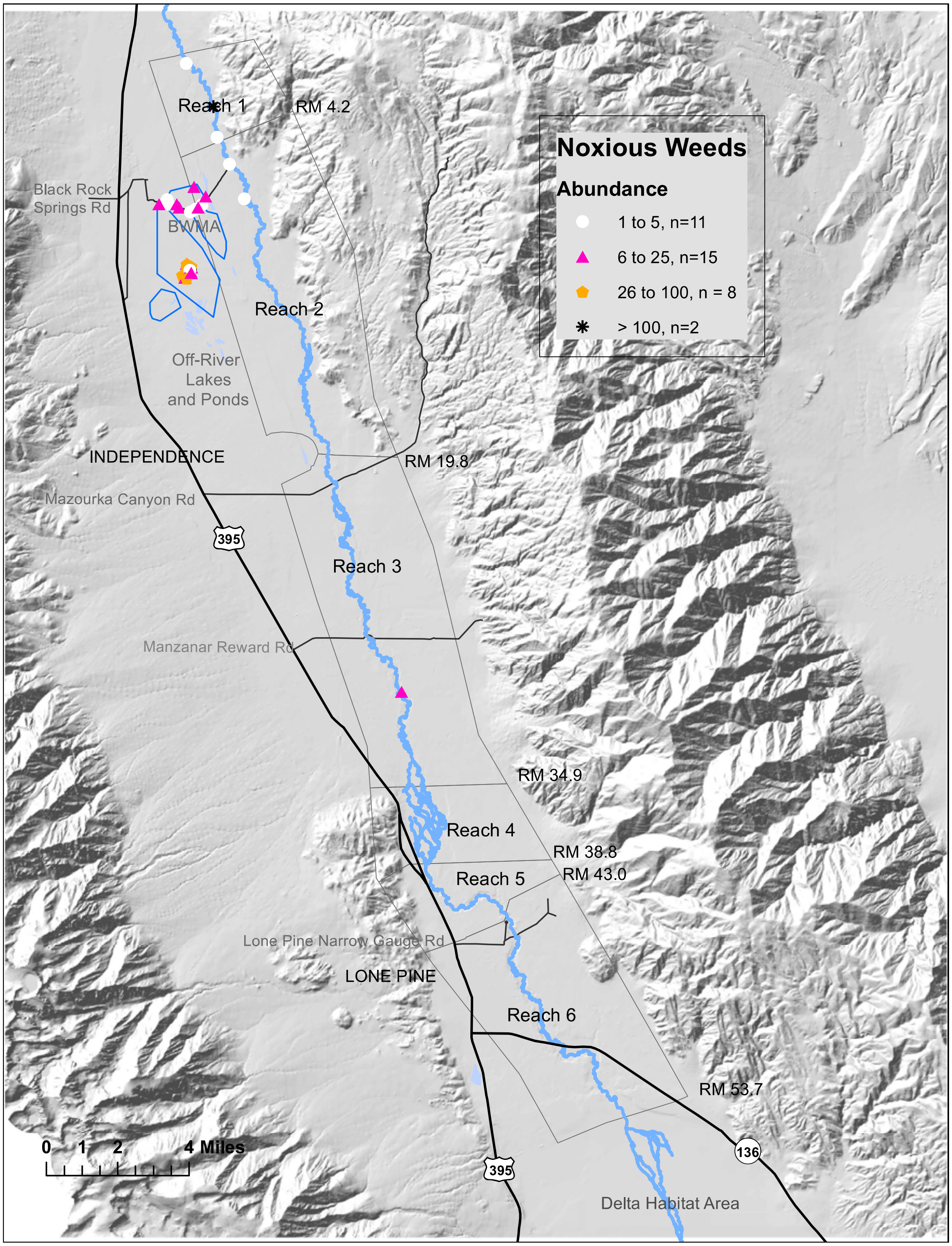
Map 3: Saltcedar



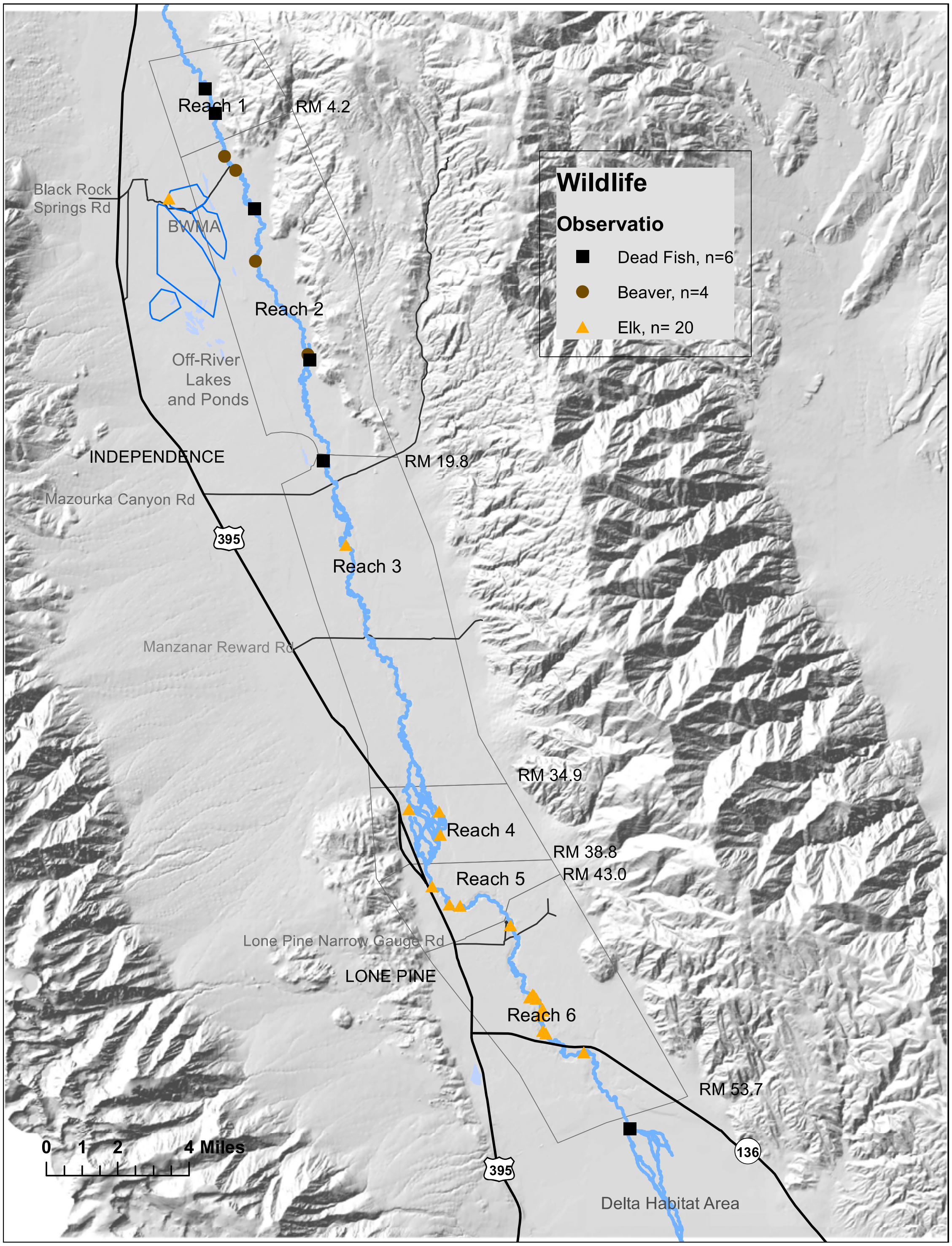
Map 4: Russian Olive Recruitment, *Elaeagnus angustifolia* (ELAN)



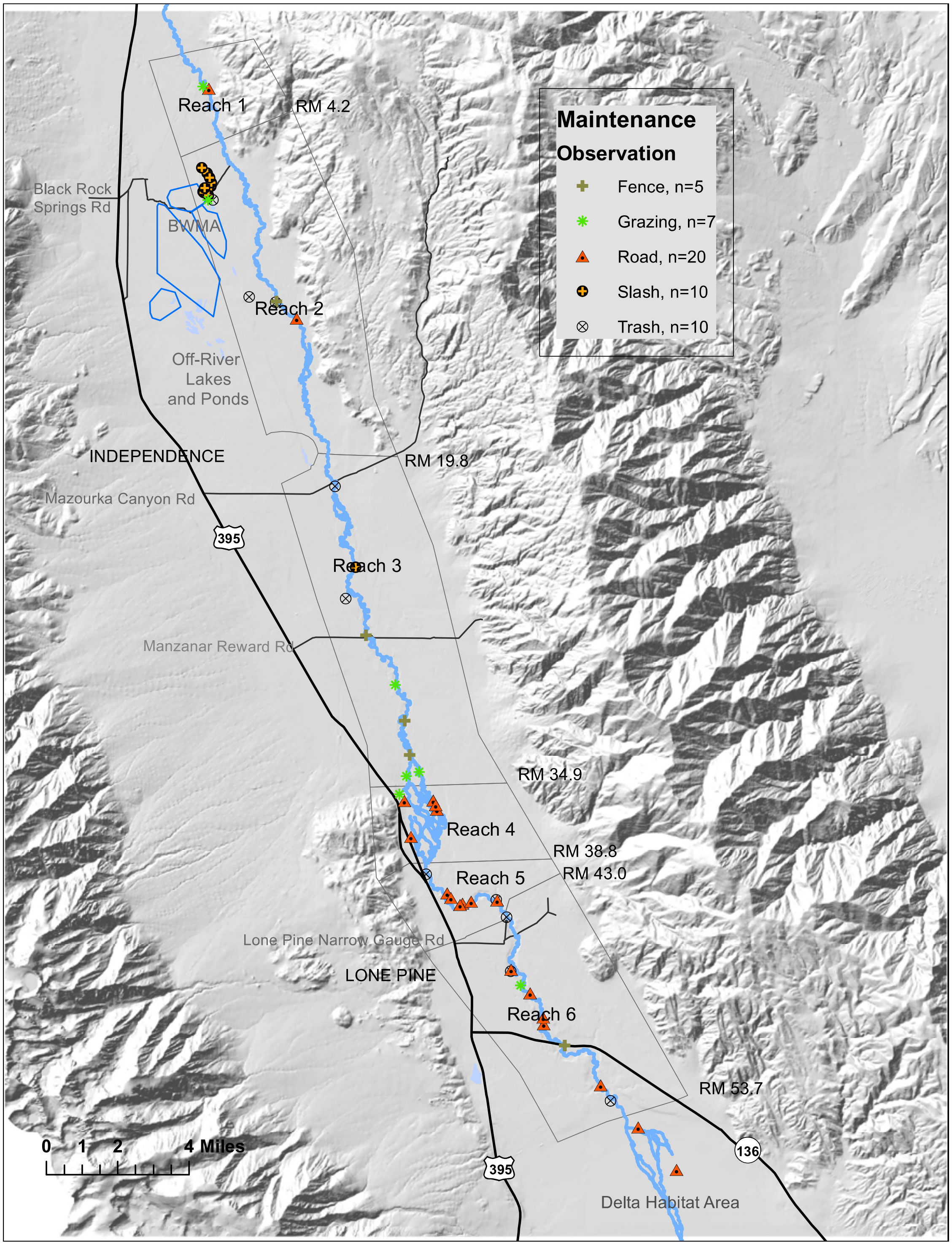
Map 5: Perennial Pepperweed, *Lepidium latifolium* (LELA2)



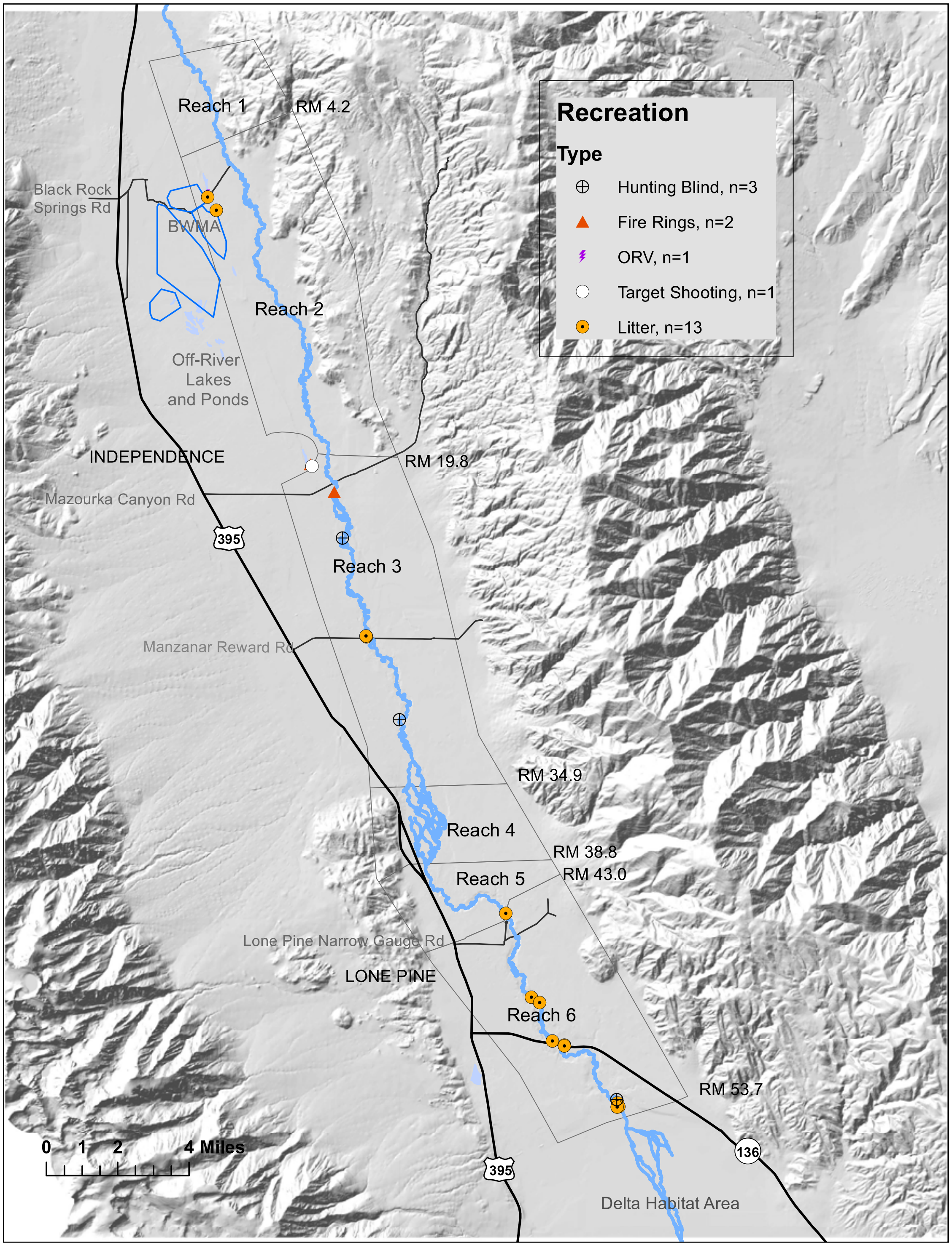
Map 6: Wildlife



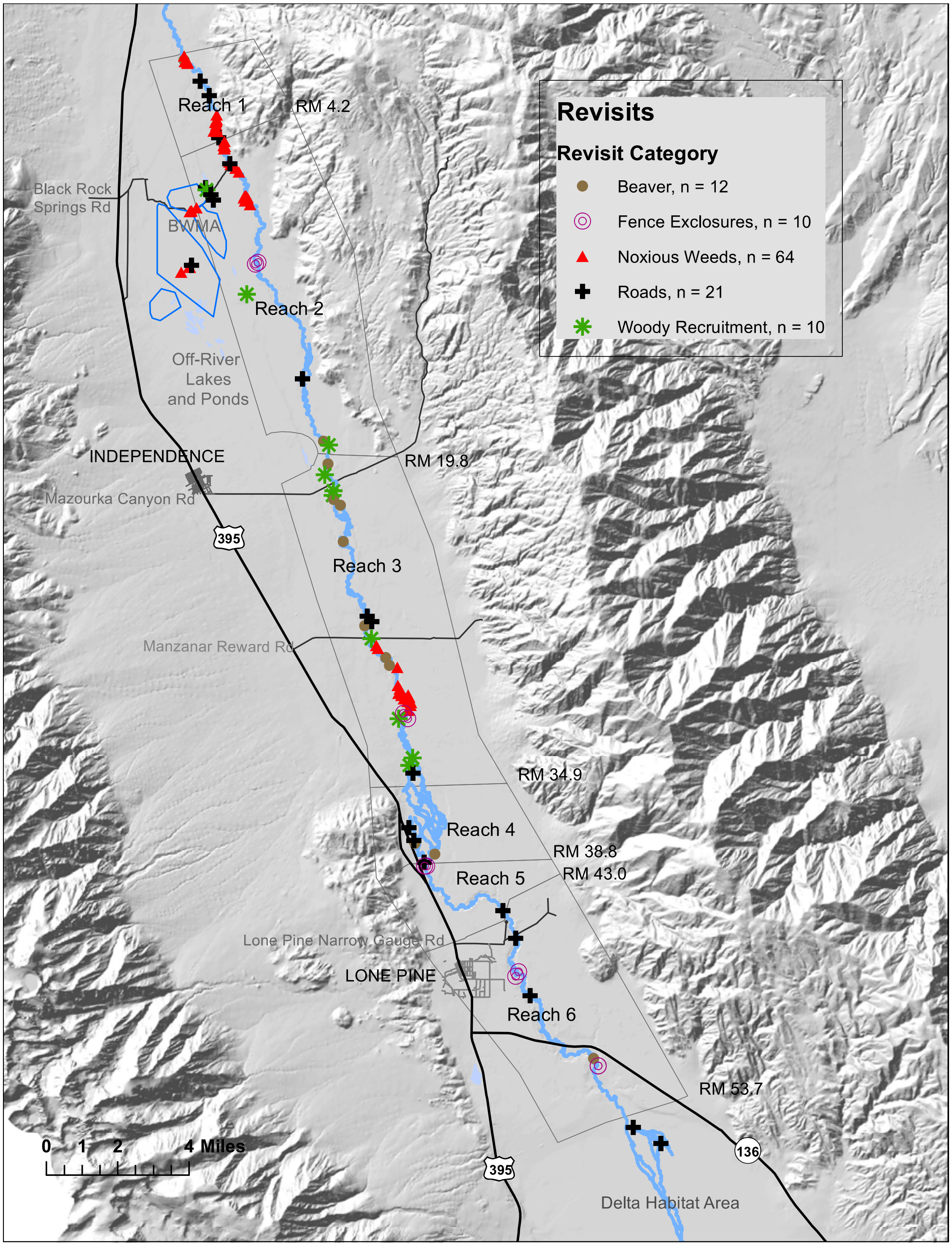
Map 7: Maintenance – Fences, Grazing, Roads, Slash and Trash,



Map 8: Recreation Impacts



Map 9: Revisit of 2015 Observations – Woody Recruitment, Beaver, and Roads



8.0 ADAPTIVE MANAGEMENT - POLE PLANTING OF TREE WILLOW AND COTTONWOOD

LORP ADAPTIVE MANAGEMENT

Pole planting of tree willow and cottonwood

Tree willow and Cottonwood planted along the Lower Owens River near Keeler Bridge, March 23, 2017.

The managed flow regime of the Lower Owens River is largely inadequate to provide fluvial disturbance such as scouring and deposition necessary for robust natural recruitment of cottonwood and tree willow. Flood-susceptible infrastructure, such as road crossings, Owens Lake flow restrictions, a desire for water-neutrality, and legal constraints of the MOU, don't allow the release of flooding flows of the magnitude needed for recruitment, and ultimately for persistence of stands of trees on the LORP.

Given constraints, it is unlikely that a principal goal of the LORP, to increase riparian woodland to attract and support tree-obligate avian species will not met. Without large-scale flood events, active intervention to expand riparian woodland appears to be the only viable route to meet avian LORP goals.

CHALLENGES TO NATURAL RECRUITMENT

Recruitment of tree species is recorded during the annual Rapid Assessment Survey (RAS). Seedlings of black and red willow, along with an occasional cottonwood are observed, but in low numbers (Figure 1). This year's results are found in this LORP Annual Report.

Low levels of recruitment are in part due to direct competition with other floodplain vegetation that developed prior to implementation of the LORP and has since prospered from the newly elevated water table. In a free-flowing river, floodplain vegetation would be affected by seasonal floods that would scour river banks and deposit sediment over floodplain meadows. The flood process builds surfaces on which wind and water-dispersed willow and cottonwood seed can establish. In the LORP, the thick rhizomatous root masses of saltgrass (*Distichlis spicata*) forms a significant barrier to the establishment of tree seedlings.

The other major impediment to recruitment is lack of bank access for water transported seed. During the peak of seed fly (dispersal) the river carries rafts of cottonwood and willow seed on the water (the natural timing of dispersal has evolutionarily coincided with the timing of spring floods). In an unregulated river, seed would be effectively transported by water during spring floods and deposited on the disturbed floodplain terraces to take root as the waters receded. Under current flows, streambanks host dense tule stands which entrain water-dispersed seed from the channel and limit dispersal to the bank and wet fertile soil (assuming microsites may be available for establishment).

Where most recruitment has been found is near or under mature trees. These established trees drop seed beneath onto soil enriched with organic matter from decades of leaf matter accumulation. Cattle, deer, and Elk congregate and conceal under established trees where they functionally till the soil and contribute organic matter. It seems the concentrated seed source and animal activity in combination with elevated Seasonal Habitat Flows encourage seedling establishment. Hundreds of seedlings are often found under larger trees.

However, even under nearly ideal conditions, many seedlings do not establish. Some germinate, but likely cannot extend their roots fast enough to keep pace with the retreating water table as the river drops after the brief passage of high water, some are eaten or trampled, and some are shaded out. Recruitment sites found during the RAS are revisited the following year to check success. Seedling success after one year has ranged from 35-74%.

Given the challenges to natural recruitment, essential to meet key LORP goals there are two options, 1) accept current conditions and reset LORP goals; 2) attempt active intervention to create an advantage for recruitment.

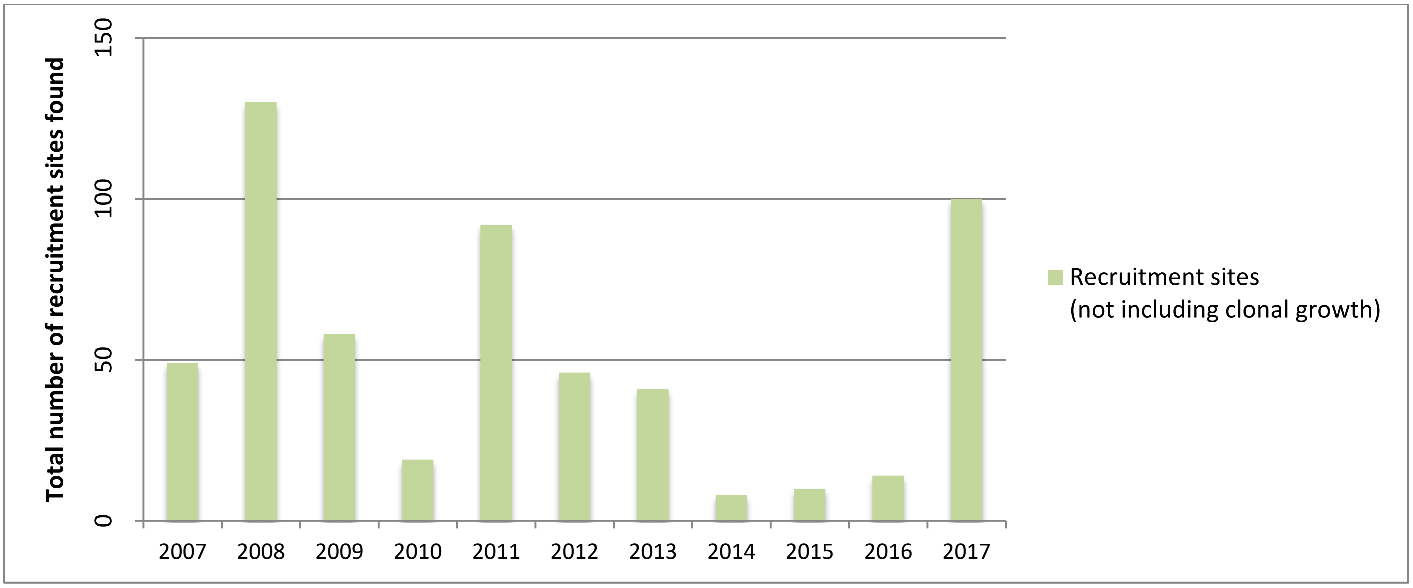


Figure 1. Tree willow and cottonwood recruitment 2007-2017

ADAPTIVE MANAGEMENT

The LORP is managed through Adaptive Management. The Project relies primarily on the concept of natural self-design. Active intervention is considered only if it is determined that natural processes are not fulfilling LORP goals, and the cost of not intervening is that ephemeral windows of opportunity may be lost and project goals not realized.

Since LORP goals are so closely tied to the development of riparian forest, it seemed to project managers that an attempt to jumpstart tree recruitment was an experiment worth trying. Methods considered included "poop-and-stomp," where cattle are concentrated along a section of river bank to eat and trample competing vegetation and open seed receptive soil; mechanically plowing receptive soils and planting seed in the exposed dirt; planting greenhouse propagated juvenile willow starts; or installing willow cuttings from mature trees. The experiment we chose in 2017 was the latter; the technique is referred to as pole planting.

POLE PLANTING

A proven method for establishing riparian trees is through planting dormant tree cuttings. In our case, this technique involves removing larger diameter branches in the early spring from cottonwood and willows, mostly from secondary growth on mature trees or adjacent clonal sprouts, and trimming off any secondary branches. The poles are then submerging in water until they were planted. Planting involves trimming 3-4" off the end of the pole to expose fresh cambium, then positioning the pole in a hold drilled at least 1 foot below the water table, with 3-5 feet of the pole above ground. Willow is preferentially planted in the shallowest groundwater locations. The trees are to establish through the proliferation of adventitious roots in the capillary fringe above the water table.

Figure 2. Dormant willow and cottonwood pole stock

THE POLE PLANTING PROJECT

In the 2016-2017 LORP Work Plan, Inyo County and LADWP agreed to a pilot project to assess the feasibility of intervening to actively develop stands of tree willow and cottonwood along the Lower Owens River. The goal of this small scale effort was to assess the effectiveness of planting groves of trees to augment existing seed sources and boost natural recruitment. If this pilot project proved successful, then third-party funding would be sought to develop a larger tree planting program to be conducted under adaptive management.

The area chosen for the experiment was a section of floodplain just north of Highway 136. The planting site was chosen for its ease of access, favorable soils, and a variety of topographic and hydrologic features. The area was heavily forested, but an intense range fire swept the area in 2013 destroying most of the mature trees. Some of the affected trees are reestablishing through vegetation sprouting from basal buds, but their tree form has been lost and their ability to contribute seed is diminished.

METHODS

To implement the project, a landscape contractor (The Landscape Center, Riverside, CA) was hired. Locations where trees were to be planted were pin-flagged by Inyo County staff and access routes to and from the planting areas were staked. Groves were located along the riverbank, as well as in and around old oxbow depressions, and adjacent to secondary channels. The Red willow pole stock was harvested in the Big Pine area, and the Cottonwood that was collected near the Bishop airport. A description of the methods and specifications for planting can be found in Appendix A and seen in Figures 2 and 3. Black willow was to be a component of the planting, but suitable stock was not available.

Figure 3. Drilling planting holes.

The planting took four days to complete. Pole stock was harvested over two days and preserved in water, and the drilling of holes, installing tree protectors with stakes, and the planting of trees took another two days. A construction monitor was on site for the majority of the effort to confirming that the trees were cut and planted to specification, and that equipment avoided sensitive habitat in the floodplain.

The contractors' work was well planned and efficient, and in four days a total of 576 trees were planted in 12 groves with a combined area of 1.58 acres. After installation, the perimeters of the individual groves were documented by GPS and each plant assigned an alphanumeric identification code, which was written on the plant protector. To aid follow-up monitoring, at least two photopoints were established at each grove (Appendix C, Figures 7-16).

UNFORTUNATE CIRCUMSTANCES

Despite the successful installation the project was compromised by wind and water. First, fierce dry-wind swept the planting area the week after the plants were installed. About 10% of the plant tubes and stakes were damaged by sustained 48 mph winds and 65mph gusts. These high wind and low moisture conditions lasted days. The broken supports and bent plant protectors were replaced, but another bout of extreme wind followed and more stakes were broken and tubes bent. The six foot polyethylene plastic plant tubes, which were buried a few inches below ground, helped maintain moisture and moderated the effect of the drying wind, but the vegetation exposed above the tubes appeared battered and desiccated.

Once the winds abated most plants recovered as evidenced by new leaf growth. The recovery was short-lived. Abnormally high runoff, resulting from a historically high snowpack, necessitated releasing record high flows into the Lower Owens River. As a result, much of the planting sites were underwater for weeks (Appendix C, Figure 6). For 47 days, from April 14-April 26, from May 30 to June 8, and from June 20 to August 15, the plantings experienced flooding greater than would be expected in this area during a normal-year seasonal habitat flow release (photo Appendix C, Figure 6). Although newly-planted pole roots can accommodate some fluctuation in height of the capillary fringe, they need about three feet of aerated soil above the top of the emerging roots to survive.

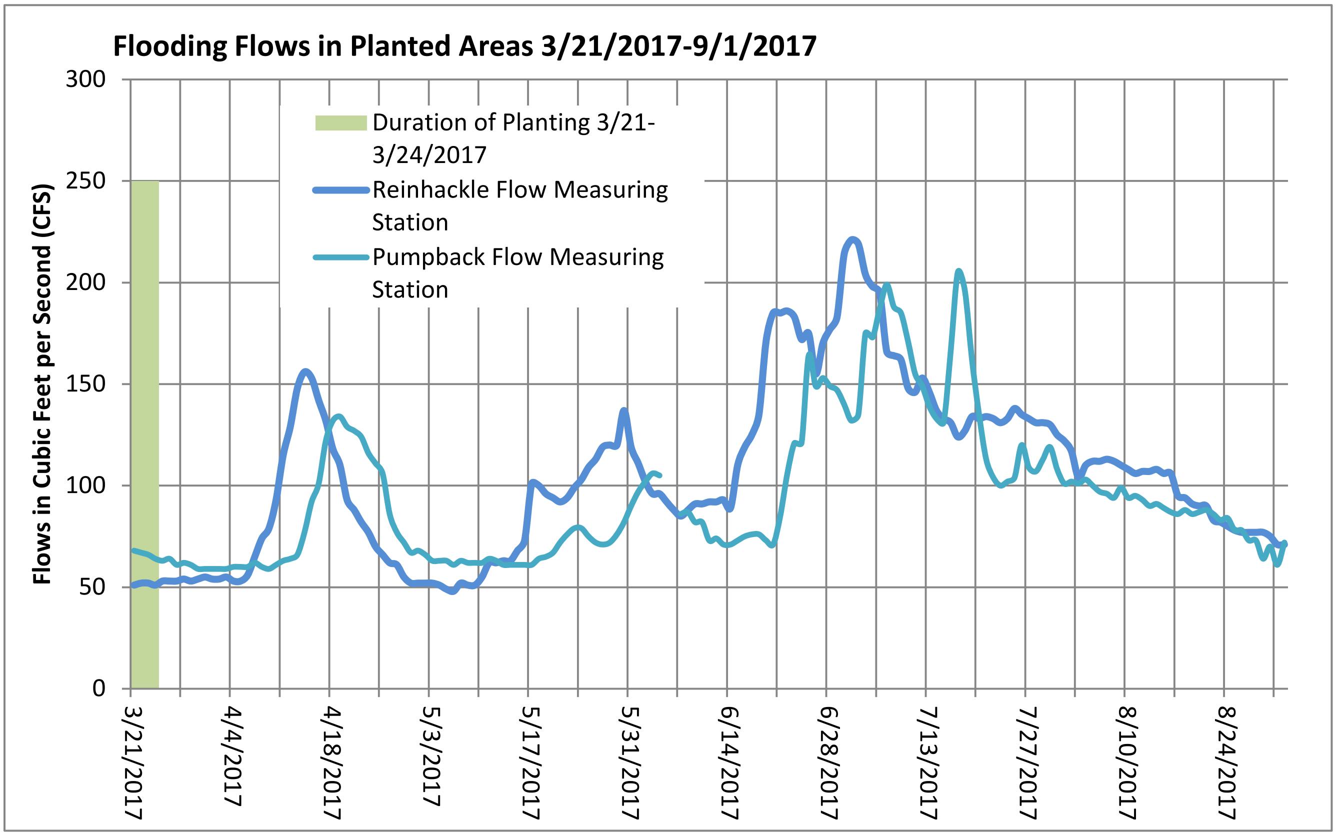


Figure 4. River flow above and below planting site. In a normal year the area would experience up to 90 cfs flow for a few days.

High winds stressed the plants, and then flooding drowned the majority of the trees. As of an August 16, 2017 survey, only 24 trees were persisting, and most of these were in poor condition (Appendix B, Figure 5).

The loss of trees after such a great effort was unfortunate and disappointing, but the experience yielded useful information. We established that large scale planting can be accomplished efficiently with minimal effort by a skilled contractor. Long pin-flags worked well for directing the contractor to drilling locations, and drilling was accurate. The equipment used by the contractor, and the strategy used to plant worked exceptionally well. Holes 6 inches wide and 6-8 feet deep were dug in less than 90 seconds and multiple holes 10 feet apart could be drilled without relocating equipment. The spoil from the drilling created a neat mound around the mouth of the hole allowing easy access to dirt to backfill and pack the holes. The rubber tracked mini tractor and lightweight all-terrain vehicles and trailers used in the floodplain left no long-term evidence of their having been in the area (fig. 1). Pole cutting locations have been identified that can be used in future. As to timing, we found that many of the poles began to sprout soon after being cut; and concluded that we were likely cutting too late in the growing season. Plant growth was well underway a few days after cutting. Ideally the poles should be emplaced when completely dormant—suggesting that a winter cutting and mid-

February to early March planting might be desirable (fig. 2). Alternatively, others using the pole planting technique have allowed the poles to sprout and roots develop before planting. We could experiment with this method in the future.

Based on the success of others using pole planting as a method of floodplain restoration, in a normal year, a similar planting would likely result in 50-80% survival after five years. This was not a normal year.

Appendix A

Scope of Work from Request for Proposals

Overview

Work will involve securing Fremont cottonwood (*Populus fremonti*) and native willow species: Red willow (*Salix laevagata*), Black willow (*Salix goodingii*), pole cuttings from identified and approved local sources on City of Los Angeles (City) lands in Inyo County. Cutting and preparation of the poles will be the responsibility of the vendor. Poles will be inserted to a depth of six feet unless water table is reached at a shallower depth. A ventilated tree shelter will be installed over the pole and secured in place with a wooden stake.

Specifications

Harvest poles of Fremont cottonwood (*Populus fremonti*), Red willow (*Salix laevagata*), and Black willow (*Salix goodingii*) when dormant. Live wood at least one year old must be used. (Note: Breakdown by percentage - 70 percent of poles are to be a combination of willow species and 30 percent of poles will be Fremont cottonwood. Trim branches from pole as close as possible. Poles must be a minimum of six feet in length. Identify top and bottom of cutting by an angle cut on butt end and a square cut on top. Diluted latex paint or other suitable vapor barrier material will be used to seal top and bottom cuts to prevent desiccation prior to storage. Poles must be cut when dormant and stored in a cool dark place. Poles are to be cut and stored a maximum of one month prior to installation.

Stock must have originated from the Owens Valley on City lands (a total of approximately 250,000 acres) in areas authorized and delineated for cutting by the Los Angeles Department of Water and Power (LADWP). If another local source (City of Bishop, County of Inyo) is used, any cutting must be pre-approved in writing by the Inyo County Water Department Director.

Install poles approximately between February 15 and March 21, weather permitting. Poles must be inserted to a depth of six feet, unless water table is reached at shallower depth. Where water table is less than six feet, poles are to be inserted at least one foot into the water table. Poles are to be soaked in water onsite a minimum of one day prior to installation and installed within six hours of being removed from water. Poles are to be cut at a 90 degree angle on top just below node and 45 degree angle just below the bottom most nodes on the trunk side before inserting in hole to remove protective latex. The top of any pole is to extend a minimum of one foot above backfilled ground surface.
A hole is to be created, to the prescribed depth, using a narrow auger, stinger jet, probe, or other means, to create minimum disturbance to the surface but still allow pole to be inserted to the prescribed depth. Once the pole is inserted, the hole will be backfilled and packed with a wooden implement to minimize desiccation. Poles for willow species to be installed approximately one per every 36 square feet. Poles for Fremont cottonwood species to be installed approximately one per every 81 square feet. Exact spacing will vary slightly from site to site based on soil conditions.

Install 72 inch white vented Miracle Tube Tree Shelters (VTS) http://www.treepro.com/products/miracle-tube-tree-shelters.html. If other brand name or equal vented tree shelter (VTS) is proposed, it must be approved by Inyo County Water Department Director, prior to installation. Shelters must be installed within one day of pole planting and preferably at time of planting. Place VTS directly over pole and bury to a minimum depth of six inches. Install 2” by 2” by 72” wooden stake adjacent to VTS to a depth of two feet. Secure VTS to stake with two or more releasable plastic zip tie.

Work Schedule

Poles to be installed in mid-February to the third week of March, allowing for holes to be created before leaf out of poles. All work to be completed by March 31, 2017. Upon receipt and approval, a partial payment for the first half of the contract may be made after the planting of one-half of the poles in 2017. Upon receipt and approval of invoice, the final payment for the second one-half will be made after planting remainder of poles in 2017.

Site Conditions and Access

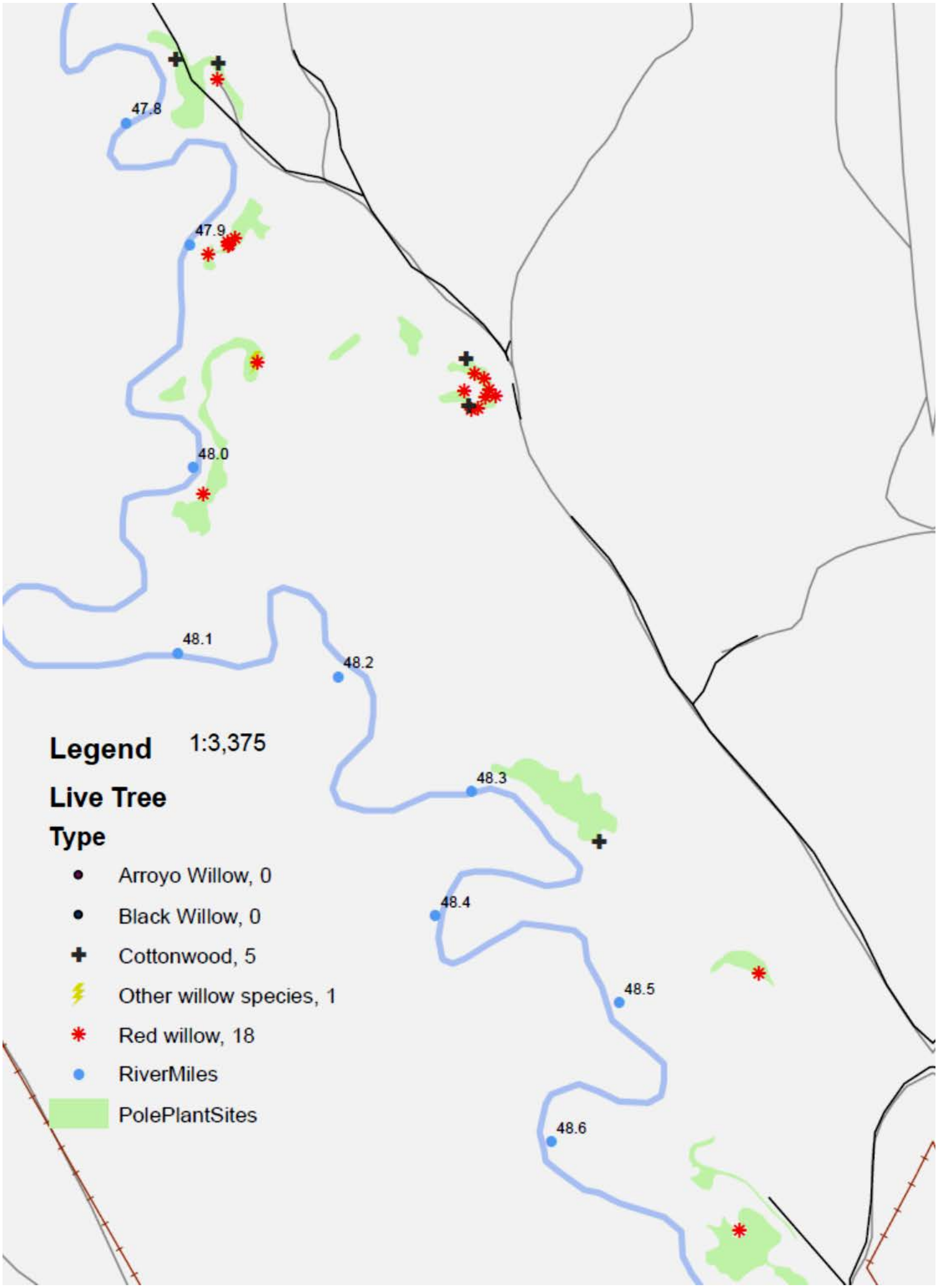
All installation sites are located on the Lower Owens River floodplain, on City land in Inyo County. Soils are typically unconsolidated alluvium. Historic river channels are located on the lower terrace where work is to be completed. Soils vary widely including loams, clays, sand, gravel, and cobbles. Soils can vary both horizontally and vertically as a result of historic deposition from river channel movement over time. Groundwater varies through the season, but can be found within six feet of the surface in suitable locations for pole plantings. Access for augers and moving materials into the site will be allowed and designated by LADWP staff in order to facilitate installation. Inyo County and LADWP staff will identify sites and access at time of installation. A minimum of five installation sites will be identified.

Access to water to soak trees is from irrigation ditch and pond near Independence, CA. Equipment and supplies can be stockpiled at the County Road Department site in Independence, CA.

Appendix B

Instructions to Staff Conducting Follow-up Assessment

1. Using the map and the Juno, find the individual polygons (tree groves).
2. Once at a polygon, note any living trees, all trees have a 3 character identifier written on the tube.
3. In the Juno select the 'Woody Recruitment' category and fill in the details, take a GPS point for living plants only using the identifier as the point name, not the traditional RAS ID.
4. State whether it is a willow or cottonwood.
5. Survey one polygon at a time; when you're done with a polygon proceed to the next polygon. The polygons are various shapes, some roundish and others long and string-like.
6. All living plants have green leaves.



Appendix B, Figure 5. Pole planting revisit results

APPENDIX C
Photos

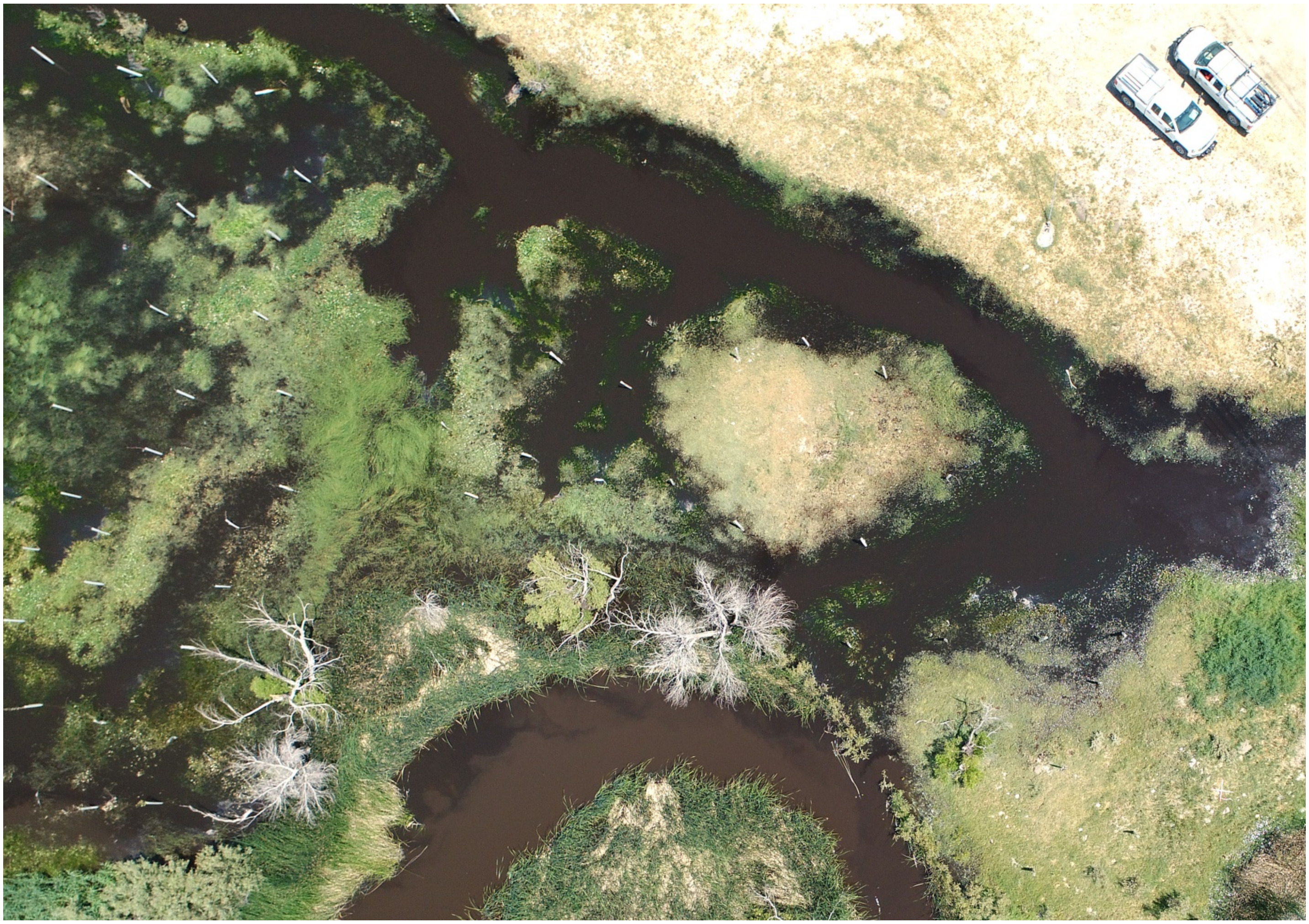


Figure 6. Poles in standing water at 190 cfs flow near Keeler Bridge.

Figure 7. Grove A

Figure 8. Grove G

Figure 9. Grove K

Figure 10. Grove M

Figure 11. Grove L

Figure 12. Grove LP

Figure 13. Grove SW

Figure 14. Grove ZH


Figure 6. Grove ZF


Figure 16. Grove B

9.0 SALTCEDAR CONTROL PROGRAM

9.0 SALTCEDAR CONTROL PROGRAM

The goal of Saltcedar Control Program is to eliminate existing saltcedar stands, to prevent the spread of saltcedar throughout the Lower Owens River and associated wetland environments, and to sustain the ecological restoration that is now occurring in the LORP.

PROGRAM BACKGROUND

Saltcedar (Tamarix ramosissima) is an invasive non-native shrub or tree that can grow to 25 feet and live up to 100 years. Given favorable conditions, a tree can grow 10 to 12 feet in one season. Saltcedar can compete with native vegetation and degrade wildlife habitat. Its presence in the southern Owens Valley has the potential to interfere with the LORP goals of establishing a healthy, functioning Lower Owens River riverine-riparian ecosystem.

References to the importance of managing saltcedar can be found in documents that guide the saltcedar program and govern the LORP:

- The LORP Monitoring, Adaptive Management, and Reporting Plan (MAMP), notes that saltcedar may increase in some areas of the river because of seed distribution with stream flows. The MAMP states that the potential risk of infecting new areas with saltcedar is considered a significant threat in all management areas

- The 1997 Memorandum of Understanding (MOU), between Inyo County, City of Los Angeles, Sierra Club, Owens Valley Committee, CA Dept. of Fish and Game and California State Lands Commission, expresses that saltcedar reinfestation in the LORP area would compromise the goal of controlling deleterious species whose "presence within the Planning Area interferes with the achievement of the goals of the LORP" (1997 MOU B. 4)

- Parties to the Long-Term Water Agreement (LTWA) recognized that even with annual control efforts saltcedar might never be fully eradicated, but that ongoing and aggressive efforts to remove saltcedar will be required. (Sec. XIV. A)

PROJECT MANAGEMENT AND STAFF

The Saltcedar Control Program is administered by the Inyo County Water Department, and was managed by a Saltcedar Program Manager in 2016-17. The work crew included eight seasonally employed employees and one shared county employee. In 2016-2017, the field season began in mid-October and concluded in mid-March.

CESSATION OF ACTIVITY IN 2017

A WCB grant that supported the Saltcedar Program was exhausted in 2016. Some reserve funds allowed the program to operate with full effort through March 2017; however no additional grant funding has been identified. Lack of funds, combined with the retirement of the Saltcedar Manager, has led to the temporary cessation of saltcedar work based out of the Water Department. No work is planned for the 2017-18 season. It is not clear when the County sponsored program will begin again.

WORK ACCOMPLISHED (Figure 1)

From October 2016-March 2017 Inyo County Water Department saltcedar field crews cut and retreated with herbicide saltcedar resprouts in the water spreading basins (Figure 2), in the Blackrock Waterfowl

Management Area, and on the Lower Owens River. Crews also cut and treated tamarisk and some Russian olive near LORP Off-River Lakes and Ponds, and the ditches that connect them. Special effort was put into the floodplain surrounding Upper Twin Lake, Blackrock Ditch East, and the Upper Twin Lake crossover road ditch. A significant amount of Russian olive was cut in the Twin Lakes area. Approximately 50 acres of tamarisk in the Goose Lake area was cut, piled, and burned (Figure 1).

The crew spent considerable time along the Lower Owens River, treating resprouts, pull seedlings, and removing mature plants. Crews were guided to the new growth and regrowth by information obtained in the previous year’s Rapid Assessment Survey (RAS). Of the 192 sites from the 2016 RAS, they treated (pulled, cut, or sprayed) 102 sites, 9 sites were inaccessible or not found. The crews did not get to the remaining 81 sites.

A total of 85 piles of saltcedar were burned.

FUNDING

The annual contribution provided by LADWP to the County is sufficient to fund one full time employee. At this time, no other funds are available to support the County’s tamarisk eradication program. The cost per year for a fully resourced program is approximately $350,000. Until additional funds are secured the County’s work will be limited to recording the location and characteristics of infestation during the Rapid Assessment Survey, if that monitoring continues.

Figure 1. Saltcedar OLP area treated in 2016-2017 (approximate)

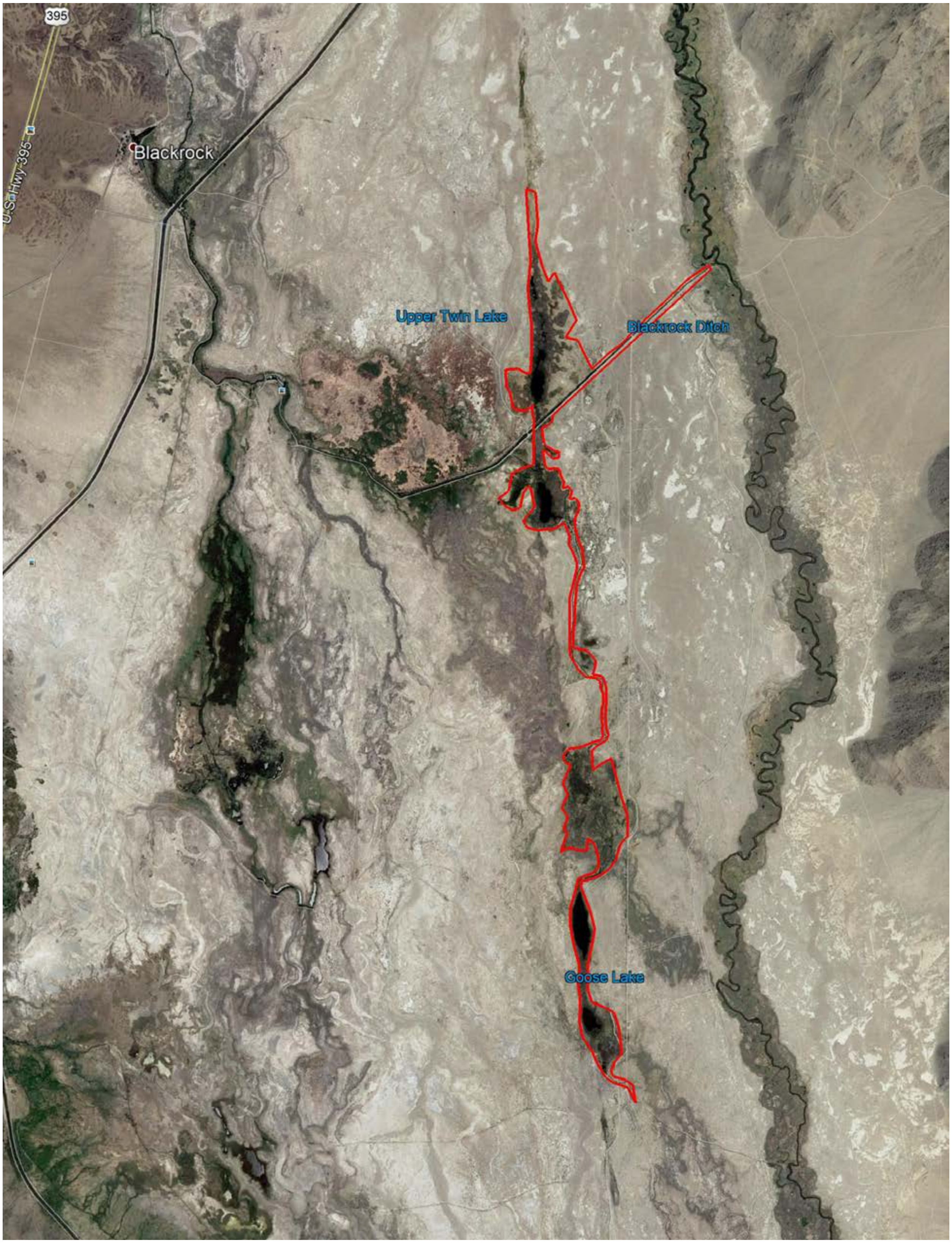
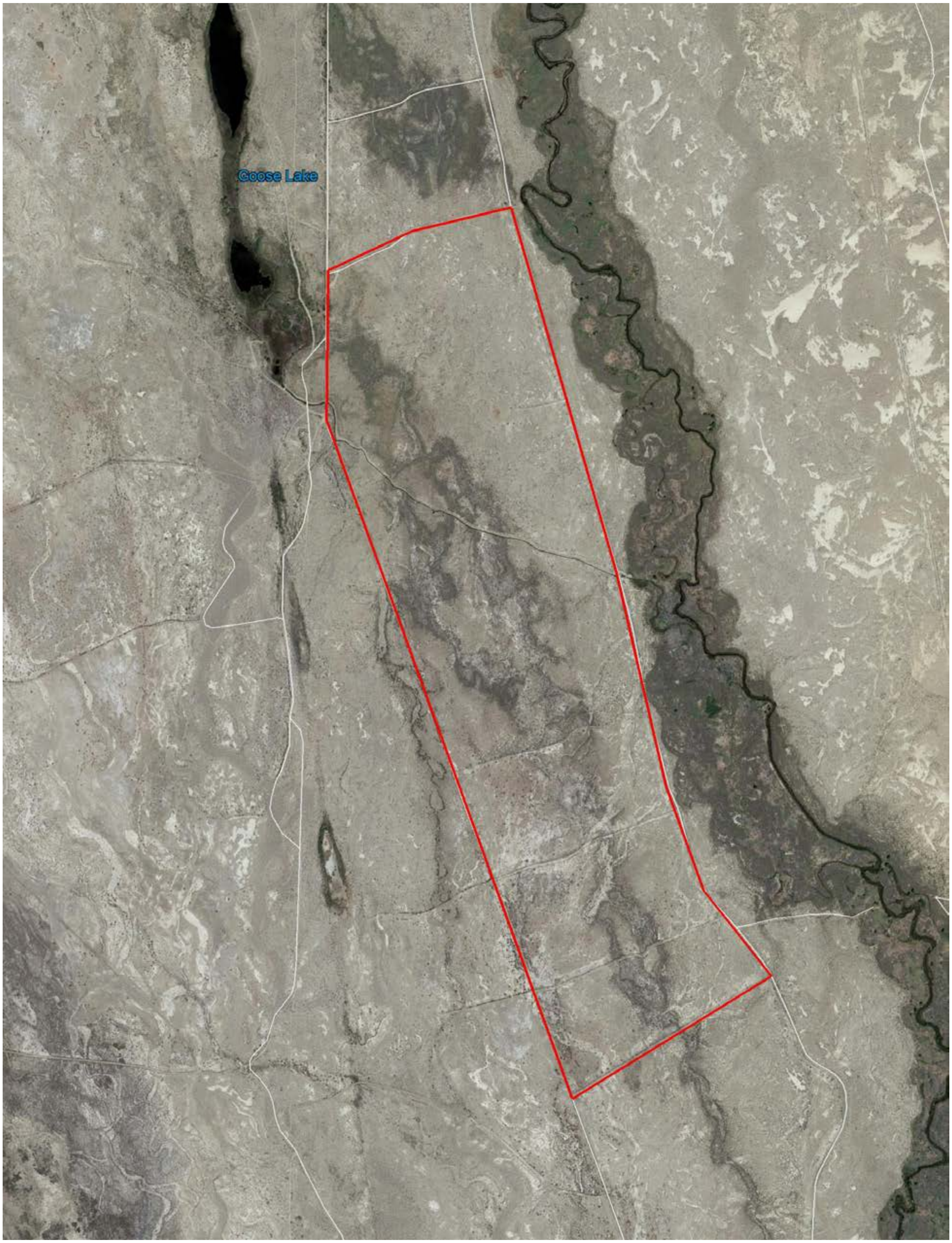


Figure 2. Saltcedar spreading basins treated in 2016-2017 (approximate)


Goose Lake

10.0 LORP WEED REPORT INYO/MONO COUNTIES AGRICULTURAL COMMISSIONER'S OFFICE

2017 LORP Weed Report
Inyo/Mono Counties Agricultural Commissioner's Office

Introduction:

The Inyo and Mono Counties Agricultural Commissioner's Office (CAC) manages certain invasive weed infestations within the LORP project area in conjunction with The City of Los Angeles Department of Water and Power (LADWP). Target weeds for CAC management and control include California Department of Food and Agriculture (CDFA) designated weeds with a significant focus on Lepidium latifolium. Management of Lepidium latifolium is accomplished both by efforts to eradicate known weed populations within the LORP area, as well as through monitoring for pioneer populations. This program has successfully managed to prevent the widespread establishment of invasive weed populations throughout tens of thousands of acres.

While eradication of all known populations is the long-term goal, new populations will continue to establish so long as a seed source exists upstream. Thus, the detection component of the program is critical to the protection of the LORP as this region is a recovering habitat with many disturbed areas, and also because eliminating these threats early is far less costly than attempting to do so once established. Disturbed conditions make this area more conducive to weed establishment, as does increasing recreation use. In addition to the LORP area, the CAC is working on Lepidium latifolium eradication efforts along the middle Owens River from Pleasant Valley dam to Warm Springs road and the LADWP is managing invasive weeds on city owned lands including along the Owens River from Warm Springs road to the LA aqueduct intake.

While protecting native habitat is the paramount goal of this project, there are many other positive consequences resulting from this work. A healthy native plant habitat will support wildlife (including some threatened and endangered species), help to reduce stream bank erosion and dust, maintain healthy fire regimes, preserve the viability of open-space agriculture, and conserve recreational opportunities.

Summary of LORP Weed Management Activities in 2017

2017 was a challenging year for invasive weed treatments within the LORP. The record runoff from the 2016-17 winter had a significant impact on treatment activity and plant growth and likely will result in still unforeseen impacts for many years to come.

Crews began field treatments in May, however, access to much of the project area was impossible due to high water through most of the growing season. In addition to weed sites being submerged, roads were washed out or impassible throughout the project area. Attempts were made to visit all known Lepidium latifolium sites, however some sites along the mainstem of the river, particularly along the eastern bank, and some sites within the Winterton management unit were impossible to reach until very late in the season. Large areas of the project area were permanently flooded through most of the growing season, this appears to have significantly suppressed Lepidium growth. While the standing water successfully suppressed Lepidium this season, we anticipate that under normal runoff conditions, the populations will be return next season. Due to the access difficulties and suppressed growth in some of the largest populations, particularly the Winterton management unit, the total acreage treated within the project area was only .02 acres, however, the treatment reduction is expected to be an anomaly and populations should rebound to at least 2016 levels (1.05 net acres treated) next season. All of the treated sites were considered small, or less than 100 plants. Most treated sites consisted of a single plant or less than 5 plants. Treatments will continue into October as access is granted and growing conditions allow.

Individual sites totaled 48 in 2016, 3 new sites were discovered. Of the 48 known sites, 31 sites had no plants present or were inaccessible and thus total sites with no growth is unknown for the 2017 season. After five continuous years of no growth, sites may be considered eradicated, no sites were considered eradicated in 2017. The Rapid Assessment Survey (RAS) reported 36 new sites, however all but 4 of the sites were already within known treatment areas.

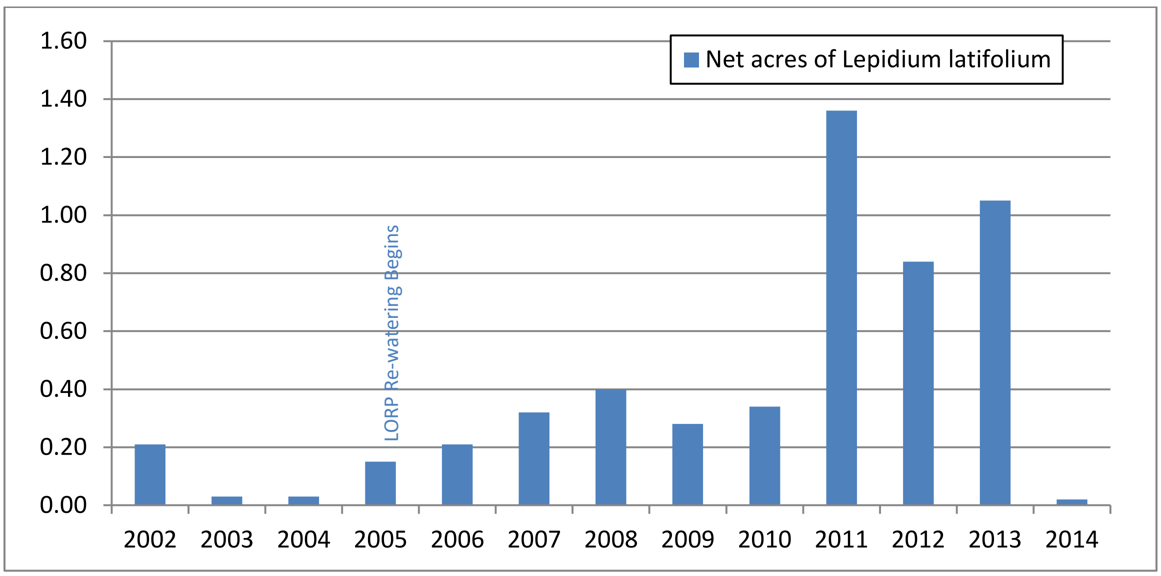
Table 1 – Count of LORP Invasive Weed Sites

Year	Total Number of Sites	New Sites Discovered	Sites with No Growth
2002	2	0	0
2003	2	0	1
2004	3	1	1
2005	4	1	1
2006	4	0	1
2007	4	0	1
2008	12	8	1
2009	17	5	4
2010	32	15	5
2011	35	3	19
2012	38	3	19
2013	39	1	29
2014	46	7	22
2015	51	5	21
2016	45	5	19
2017	**48**	**4**	**unknown**

Survey efforts utilized two employees and included areas of known infestations and several surveys into other areas to ensure early detection of new populations. Surveys were based on preliminary information from agricultural operators, and survey data produced by the 2017 rapid assessment surveys (RAS).

Treatment methods utilized low-volume, directed spot treatments using selective herbicides. These applications were made on foot using backpack sprayers to mitigate damage to native plant communities within the LORP. CAC will continue to employ these methods as long as these results continue and staffing levels permit.

Chart 1 – Net Acreage of Weed Population on LORP



Management Difficulties

In addition to the difficulties presented by the record runoff and detailed in the activity narrative, the most significant management difficulty continues to be maintaining adequate staffing for effective management of such a large site. The CAC was able to commit one employee to work on the LORP area during the winter/survey season and two seasonal employees during the summer growing/treatment/survey season.

Next season's activities should include expanded survey efforts. The long term effects of the 2017 floodwaters are unknown, however more than likely the record breaking runoff event has done little to suppress such an aggressive plant as Lepidium. The high waters also likely have distributed weeds across the project area to many new locations that have not seen flooding in many years. Finally, the significantly increased activity from vehicles and heavy machinery managing water, cleaning ditches and canals and repairing damaged infrastructure within the project area likely has resulted in additional spread of weeds into new areas.

Detecting small invasive plant populations in the vast LORP project area early in the colonization cycle is a challenging but important task as treatment activities are most effective when plant populations are discovered early, saving resources long-term and reducing the threat of future seed dispersal.

11.0 ADAPTIVE MANAGEMENT RECOMMENDATIONS

2017 LOWER OWENS RIVER PROJECT ANNUAL REPORT

ADAPTIVE MANAGEMENT RECOMMENDATIONS

Prepared by:

MOU Consultants

Dr. William Platts

Mark Hill

Contents

EXECUTIVE SUMMARY

The singular responsibility of the MOU Consultants is to provide LORP managers (LADWP and ICWD), the Stranding Committee, and MOU Parties with adaptive management recommendations each year. We review and evaluate the monitoring results along with staff conclusions and suggestions, combined with an annual on-sight examination of the LORP environmental components (river, wetlands, off-channel lakes and ponds, delta, and range). As described in the project guiding documents (MOU 1997; EMP 2002; FEIR 2004; MAMP 2008), adaptive management recommendations will be the cornerstone of LORP management. The MOU states "*Should the reported information reveal that adaptive modifications to the LORP management are necessary to ensure the successful implementation of the project, or the attainment of the LORP goals, such adaptive modifications will be made".* In practice, the MOU Consultants make their recommendations for modifications, actions or changes then consultant with LADWP and ICWD staff. The Technical Committee then makes its recommendations to the Standing Committee.

The MOU Consultant's adaptive management recommendations are presented at the end of each section in this chapter and summarized below.

- MOU Consultants recommend all present (2017) and future City-County Annual Report Executive Summaries include a summary of the Adaptive Management Chapter of the report.
- MOU Consultants recommend the LORP Scientific Team, during the winter of 2017-2018, develop a "Draft River Rehabilitation Status Report." A report that describes and documents the present environmental status of the Lower Owens River.
- MOU Consultants recommend the City and County complete a preliminary <u>ballpark only</u> estimate, of infrastructure modification needed and the cost to complete these modifications (within the Lower Owens River flood-plain) in order to safely pass river flows up to 800 cfs without damaging infrastructure or cause safety concerns.
- MOU Consultants recommend no active restoration be implemented in the future without first developing a sufficient justification, testing, monitoring, and evaluation plan.
- MOU Consultants recommend the Scientific Team conduct an initial evaluation of those feasible active rehabilitation interventions that could be tested for success in the future.
- MOU Consultants recommend the LORP Scientific Team develop a scientific based testing, monitoring, and evaluation plan to evaluate all future flushing flow effects. This methodology should be capable of determining success, failure, no effect, or any needed flow modifications.
- MOU Consultants recommend the MOU Parties hold a "Working-Decision Meeting" during the winter of 2017-2018. Meeting purpose is to determine those river flows, if any, the "Parties" would agree to test and evaluate.

- MOU Consultants recommend the LORP Scientific Team "draft" a series of feasible flushing-augmentation flow scenarios along with a predicted effect analysis. The team produced "draft" report would then be submitted to the County and City for review and then forwarded to the MOU Parties prior to their Working-Decision Meeting.
- MOU Consultants recommend that the County, in their 2018 Annual Report, be in position to provide the evidence they believe is missing that does not allow them to evaluate proposed seasonal habitat and flushing flow effectiveness.
- MOU Consultants recommend the 2018 seasonal habitat flow be augmented from the Alabama Gates. The volume and duration of the augmentation flow will be recommended by the Consultants to the City and County when Owens Basin run-off conditions become available to the Consultants.
- MOU Consultants recommend the LORP Scientific Team test, monitor, and evaluate the Consultants recommended 2018 flushing flows to determine their success, failure, non-effect, or any flow modifications needed.
- MOU Consultants recommend that the Scientific Team "draft" report their flushing flow test and evaluation findings to the County and City for their review. The "draft" report will then be sent to the MOU Parties for their information and necessary action.
- MOU Consultants recommend the LORP Scientific Team be given the responsibility to properly evaluate all future fish kills. This would be accomplished via reliable data collection, documentation, analysis and report submission. Using the findings, the Scientific Team will develop information for the MOU Parties to better understand what is causing fish kills.
- MOU Consultants recommend the County and the City conduct a recreational fishery survey in 2018. Results, with suggestions for methodology improvement should be documented in the 2018 LORP Annual Report.
- MOU Consultants again recommend the County develop a "draft" recreational fishing evaluation methodology that meets their expectations. The County will then send this "draft" to the LORP Scientific Team for review and evaluation.
- In 2016, the MOU Consultants recommended employing a remote sensing approach to improve accuracy and reduce the labor effort associated with walking the perimeter of units. While both LADWP and ICWD agreed to give this recommendation consideration, it has not been adopted. The inability to walk the units this last spring and summer adds weight to the recommendation to rely upon remote imagery for this monitoring.
- MOU Consultants concur that American Coot as an indicator species in the BWMA and Thibaut Units is counterproductive and recommend removing it from the indicator species list. As in 2015 and 2016, we recommend that LADWP and ICWD work together to refine the indicator species list to better reflect the actual presence and usage of targeted animals.
- In the response to the MOU Consultants' recommendation in previous years to develop and initiate a plan for the BWMA to seasonally wet and dry management units, LADWP

and ICWD agreed to pursue such a plan in cooperation with CDW. We again urge the managing entities to address the legal and operational constraints and establish a more beneficial management plan that would be agreeable to the MOU Parties. The avian survey results clearly indicate that seasonal flooding and drying similar to the Thibaut Unit management will result in far greater bird use.

- Effects of the high flows this year on the DHA should be evaluated using remote imagery taken during the flood periods to identify the location (east and west channels) and extent of open-water since this type of habitat has been shown to have greater value to some indicator species. Then initiate a study to determine the most suitable flow pattern for the DHA for the three periods recommended previously.
- MOU Consultants recommend that if LADWP is interested in increasing utilization standards in riparian pastures, that they design a rigorous scientific experiment to test the effects of increased grazing on key LORP goals such as woody riparian recruitment and indicator species habitat.
- MOU Consultants have wavered back and forth on the advisability of continuing the RAS beyond next year when it is programmed to terminate. Our recommendation is to continue part of the RAS beyond next year and that is just observing and counting riparian recruitment and conditions.
- MOU Consultants recommend that before more pole plantings are attempted, a detailed experimental plan be developed and vetted through the Scientific Committee and the adaptive management process.
- MOU Consultants recommend refunding the salt cedar control program for at least this coming year because of the risk of substantial increase in noxious weeds and salt cedar. We further recommend that eradication effort be focused on the river corridor and the flooding basins be a secondary priority as funding permits.
- MOU Consultants recommend increasing the CAC funding and staffing in 2017-18 to address the expected increase in lepidium and other noxious weeds throughout the LORP.
- MOU Consultants recommend that LADWP and ICWD development a contingency monitoring plan to account for extreme flood conditions such as this year. Monitoring should focus on discharge throughout the river, flood extent and water quality.

INTRODUCTION

2016-17 Annual Report

The roles and responsibilities of the County, City and MOU Consultants for collecting, analyzing and reporting monitoring data are described in the 2008 LORP Monitoring, Adaptive Management and Reporting Plan (MAMP). The County and the City submit annually to the MOU Parties and the public an Annual Report that displays LORP data and management activities. The MOU Consultants reviewed LADWP's and ICWD's 2017 Annual Monitoring Draft Report and developed adaptive management recommendations needed to ensure LORP goals are met in the four Lower Owens River management areas: the Riverine-Riparian Area, Blackrock Waterfowl Management Area, Delta Habitat Area, and Off-River Lakes and Ponds.

Flood Event Observations

The MOU Consultants performed a field review of flooding, water spreading, and in channel flows throughout the LORP on July 17 and 18, 2017, following the highest releases from the Intake (Figure 1). Consequently, the Consultants could assess conditions under the greatest flows ever experienced in the LORP. Of particular concern to this review was flood extent, out-of-channel reaches, bank and landform stability; impact on infrastructure, forage, riparian vegetation, water quality and organic/sediment movement.

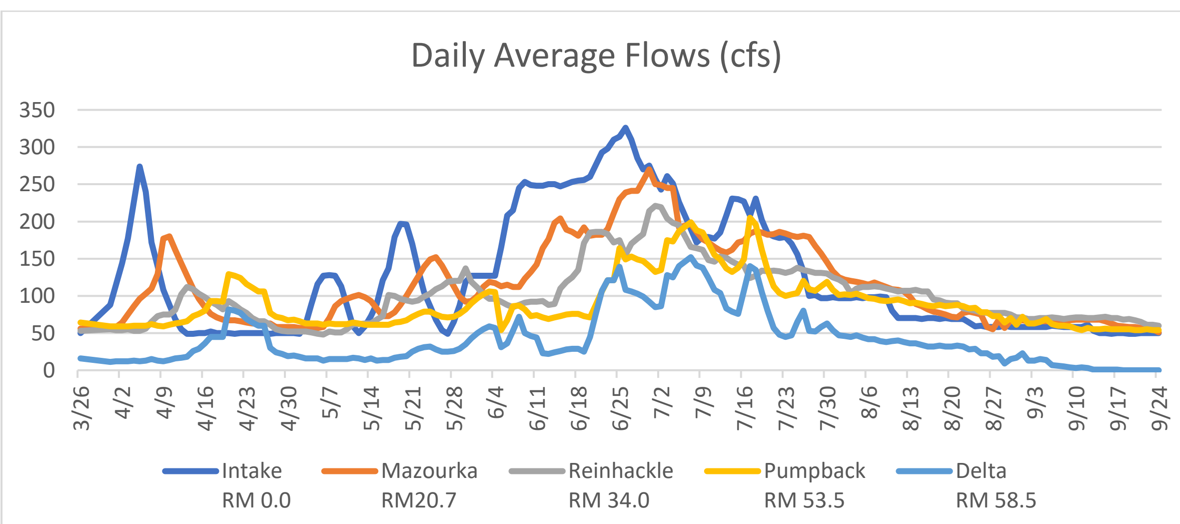


Figure 1. Average daily flows (cfs) at LORP stations and river mile (RM) throughout high flow period.

High flows caused substantial deterioration of water quality especially dissolved oxygen, temperature and suspended solids. Taken together the poor water quality resulted in fish kills throughout the river. At the time of the site visit, the Intake was receiving very turbid water from upstream. Out-of-channel flooding above the Intake to Tinnemaha assimilated cattle waste from overland flows and sediments from bank sloughing. Poor water quality entering the LORP at the Intake was exacerbated as flows throughout the lower river inundated anaerobic substrates on landforms and accumulated resuspended organic material. Dissolved oxygen throughout the river may have been below tolerance thresholds leaving little opportunity for fish to escape the conditions. The lower river below Billy Lake is the area of greatest concentration of vegetation biomass and decomposing organic material, which would likely mean dissolved oxygen was at 0 mg/l in this reach throughout most of the high-flow period.

The organic loading was compounded by the input of cattle waste from flooded grazing lands. This was unavoidable because of the need to spread water and there was no way to prevent some return of water off adjacent land. The effect of water spreading out of the channel can be seen in Figure 1. Peak flows from one measuring site to another diminished as flood waters spread across landforms between reaches.

During the field review no infrastructure damage was noted. Diversion of flows through the McIver Canal and East Side Ditch were critical to moving flows around road crossings and other sensitive areas, particularly preventing flooding and damage to infrastructure components in Owens Lake. It was interesting to note that water released from Alabama Gates followed the alignment of an old diversion canal to below the Island reach. This was the diversion the MOU Consultants recommended to be used to bypass anaerobic soil conditions when releasing Alabama Gate flows. The diversion is adequate with minor adjustments to carry flows to below the Island. Also, all of the spillgates were employed and were able to handle flows after some cleaning and debris removal. This shows that that spillgates and Alabama Gates can be used for future water management in the LORP to augment flows if required.

The dominant process in the LORP is erosion and aggradation. While no data was taken, the visible volume of sediment carried in the flood waters would indicate these processes were accelerated. While dissolved oxygen depletion can be attributed to suspension of flocculants and excessive BOD, the heavy sediment loading will further reduce channel capacity and perhaps adversely affect riparian vegetation and riparian pastures.

In addition to water quality impacts, the loss of riparian vegetation was of concern. The out-of-channel conditions continued throughout most of the summer. Because of the extreme duration of flooding, it is possible that willow seedlings established in previous years could have been lost. On the other hand, flooding of higher landforms could result in recruitment of new colonies of woody riparian vegetation.

Sediment deposition apparently did not impact forage areas by laying down or covering some grass species. It was noted that stands of Nevada saltbush appeared to die-out under standing water conditions. While this is a salutary effect of flooding, it is likely that water spreading will spur the reestablishment and growth of salt cedar and other noxious weeds throughout the LORP, especially on floodplains and water spreading basins.

The Blackrock Waterfowl Management Area (BWMA) was also used to spread flood waters. The Drew Unit was reflooded to some extent as was Winterton and Waggoner, but Thibault was used more extensively because of its configuration to accommodate spreading. Given the emergency nature and need to use wetland units, wetted areas were not measured during the flood period.

The Delta received such heavy flows that water spilled over the west and east channels, which were underwater for many weeks. Presumably vegetation will recover and tules will probably expand. However, the principle concern will be the invasion of non-native species and weeds, especially salt cedar, on the landforms that have supported salt grass.

The 2017 water year was a learning a experience in many ways for future river management. Moderately high flows of over 300 cfs did not “scour” the channel. Rather, these high flows mobilized flocculants and organic sediments that exacerbated the BOD and caused dissolved oxygen to plummet resulting in extreme fish mortality throughout the river. These flows also did nothing to suppress tule growth and may have contributed to tule spreading, especially in oxbows. Riparian vegetation suffered from out-of-channel flooding for a prolonged period. Noxious weeds and salt cedar resurgences will be a concern on flooded landforms. In ecological terms a flood like this should have created a much needed “disturbance regime”; however, the in-channel and out-of-channel flows were of insufficient magnitude to overcome the accumulation of organics and tule growth since project inception, and, consequently, the river’s ecological trajectory was not reset. While much higher flows may have caused more disturbance, its clear that simply relying upon rare high flow events above the 200 cfs minimum seasonal habitat flow will not be adequate. The MOU Consultants address each of these problems in the following sections and make adaptive management recommendations.

A RIVER REHABILITATION STATUS REPORT
(Where Are We)

Background

The California Department of Fish and Wildlife (CDFW), in their 2016 LORP Annual Report review comments, stated that Lower Owens River flows, as now being released, will not achieve LORP goals. CDFW emphasized that no progress has been made to date to improve bulrush and cattail management. Consultants for the Sierra Club and OVC continually point out that some segments of LORP management are failing. The Sierra Club (2014), in their Annual Report review, listed the present poor water quality conditions in the Lower Owens River as the highest priority for solution, after the need to meet water quality requirements.

MOU Consultants pointed out in past Adaptive Management Reports that the rehabilitation of the once dry Lower Owens River has already and will continue to produce many benefits. Where the river is in its rehabilitation status, however, has not been adequately defined in Annual Reports. A “River Rehabilitation Recovery Status Report” would help guide future management decisions. The following sections describes a few environmental conditions that should be addressed and evaluated “status wise” as the recommended “Status Report” is being developed.

“Muck” Buildup

The County (during the pre-LORP planning period) estimated the average “muck” depth in the “wetted reach” of the Lower Owens River channel was 0.42 feet. This expands to 123,000 cubic yards of “muck” stored in the “wetted channel” at that time. Today “muck” stored in the channel far exceeds this pre-LORP volume based on Jensen’s (2014) findings. Jensen found that river channel aggradation is occurring annually from the constant accumulation of muck, debris, and other sediments.

Early in the LORP planning process, MOU Consultants, based on HEC-6 model predictions, suggested that “muck” and other organics would be cleaned out of the channel over-time. Consultants errored in accepting HEC-6 predictions that flows to be applied would distribute “muck” and other organic debris out and on surrounding banks, floodplains, and terraces. This sediment distribution over-time, the HEC Model predicted, did not happen in any significant quantities. The Consultants did, however, predict that many years would be needed to reach sediment transport equilibrium (MOU 1997 Appendix 2). Experience now demonstrates that “muck” influences are not going to go away as long as present river flow regimes are implemented.

Consultants now list obtaining proper functional channel condition and its future maintenance as the top LORP management priority for the MOU Parties to consider at this time. If actions are not taken to decrease BOD influences during future high summer flow releases, fish kills will occur and it may be more difficult to meet future water quality regulations.

The LORP management plan recommended river flows that were supposed to, over-time, minimize the amount of “muck” and other organics deposited in the channel. Experience has demonstrated and Jensen (2014) supports that extreme low river power, in combination with increasing tule-cattail abundance, is not going to allow minimization to happen under flows implemented to date.   The mandated year-around uniform base flows, now implemented for 14 years, are the main contributor to the channel build- up of “muck” and other organics.

Annually accumulated organic channel sediment needs to be removed, sidelined, or buffered each year to maintain favorable water quality conditions. Consultants suggest, at this time, the best feasible method available to the Parties for removing these materials or make them harmless, is via high flushing flow releases with coordinated augmentation. If organic channel sediment build-up cannot be managed, river water quality condition cannot be managed. The status of present channel conditions should be a priority issue in the Status Report.

Cattails and Tules

Consultants list controlling cattail-tule channel domination as the second management priority for solution. MOU Parties should also move this issue up in priority. Because annually produced tule-cattail biomass and its subsequent decomposition contributes most of the stored “muck” and fine organic sediment, this problem needs higher management priority. Managing tules and cattails will be a challenging part of future river management. Tules and cattails are needed for habitat diversity, water cleansing, and wildlife-fish habitat. Maintaining the most productive mix and amount in the right places in the channel over-time may not be possible. Improving present conditions, however, may be possible.

The pre-LORP applied Inyo County tule model accurately predicted that in some river reaches, cattail-tule abundance and encroachment would not be controlled by releasing flows less than 200 cfs. The model, however, greatly underestimated future encroachment by predicting that in other river reaches, flows of only 30 to 50 cfs would adequately control tule abundance and encroachment. In 2010, river landscape mapping showed 1,085 acres of marsh and only 263 acres of open water. A ratio of only about 1 acre of open surface water to 4 acres of marsh. Far from a more ideal ratio of 1 to 1. Today’s water to cover ratio is probably even worse than 2010 conditions. MOU Consultants in 2007, early in the LORP management process, cautioned that future tule and cattail expansion would detrimentally affect some LORP resources. Consultants also predicted that the increase in tule-cattail abundance would benefit some other LORP resources.

The numerous model runs (the best models available at that time and are still inadequate today) led Consultants and decision makers (MOU Parties) into underestimating the power of tules and cattails to dominate river habitat. One of the many confounding cause and effect unknowns that fortunately led the MOU Parties to mandate that the LORP be progressively Adaptively Managed over time. A very wise decision by the MOU Parties.

Consultants stressed in the LORP Action Plan that, in the future, management will need to be constantly modified as more experience and understanding are gained. The “status” of cattail-tule domination and encroachment needs to be better evaluated and documented to help guide future decisions. The MOU Consultants in 2012 recommended a "work meeting" of MOU Party members to consider actions to manage tules and cattails, including modification of the current flow regime to increase LORP resources and values. The Consultants have never received any information from this meeting, if it took place.

Tree Recruitment

To date, insufficient woody plant (trees) recruitment along with a poor survival rate is the result of the LORP management practices that have been implemented. Active management, previously and presently applied by the MOU Parties (such as willow-cottonwood pole plantings; small rooted willow plantings, heavy soil bank disturbance through forced increased livestock grazing; artificial disturbance of banks and terraces; and seeding banks, terraces, and bare soils with tree seeds) has provided no successes to date. These rehabilitation activities were so low in success they have not even been adequately reported on or documented in Annual Reports.

Consultants place tree recruitment and survival as the third priority in the development of the "Status Report". Consultants annually emphasize that tree recruitment is an important part of river rehabilitation. But, because some trees already occur and minor tree recruitment is taking place, Consultants recommend limited management emphasis at this time because active interventions are not working. Active interventions, to date, have not been well planned, not well implemented, and have not been adequately processed through the Adaptive Management process.

Passive or Active Approach

The Status Report should identify gains made by passive and active management. The report should also provide more information to help MOU Parties address passive and active management needs in the future. In evaluating, adapting, or applying passive or active management there is direction to do this in the guiding documents of the LORP.

For each of the four physical features of the LORP (Lower Owens River, Delta Habitat Area, Off River Lakes and Ponds, and the Blackrock Waterfowl Habitat Area) the MOU goal is, to the extent feasible, create and maintain diverse natural habitats consistent with the needs of the respective habitat indicator species (MOU 1997). These habitats will be as self-sustaining as possible (MOU 1997). The qualifiers underlined for emphasis suggest that LORP rehabilitation management practices will mainly depend on passive and natural forces. Forces that, hopefully, result in the best habitats feasible. Based on years of experience, Consultants have found that passive management usually provides the bulk of the favorable rehabilitation. Active management, much costlier and time-consuming, fits in best during the later fine-tuning process. Future active rehabilitation approaches should be much better planned, more thought out, more properly implemented, and authorized through the Adaptive Management and Standing Committee processes.

Recommendation

The MOU Consultants recommend the LORP Scientific Team, during the winter of 2017-2018, develop a "Draft River Rehabilitation Status Report." A report that describes and documents the present environmental status of the Lower Owens River. The "draft" will then be submitted to the County and the City for their review. The final report would be sent to the MOU Parties for their information and action as necessary.

MODIFYING INFRASTRUCTURE TO PASS HIGHER FLOWS

(Location, Description and Costs)

The much higher than normal flows released into the Lower Owens River (resulting in flows up to 325 cfs) during the spring and summer of 2017 tested valley infrastructure (Table 1). Especially vehicle transportation systems. Some culverts, bridges, water diversions, and road sections showed they are not in condition to pass higher flows than this without damage. The MOU Consultants, as have the OVC and Sierra Club Consultants, consistently stressed the need to apply much higher and more frequent river flows.

River flow levels recommended by the Consultants may never be agreed on or implemented by the MOU Parties. It would still be very helpful, however, to know what infrastructure changes are needed and costs required to pass these much higher flows than the river has received during LORP management to date. Decision makers (MOU Parties) need to know beforehand the cost required to ensure no significant damage or safety concerns would occur should future river flow management actually release the needed higher flows. This information would also be valuable in the future to evaluate coming natural high flood events.

Table 1. Lower Owens River peak flow and number of days over 100, 200, and 300 cfs during April 1 and August 16, 2017.

			Days Over		
Site	Peak Flow	Date	Over 100 cfs	Over 200 cfs	Over 300 cfs
Intake	326	June 26	81	40	4
Mazurka	270	June 30	91	12	0
Reinhackle	221	July 1	77	4	0
Pump Back	206	July 6	54	1	0
Delta Habitat Area	127	July 8	20	0	0

Recommendation

MOU Consultants recommend the City and County complete a preliminary ballpark only estimate, of infrastructure modification needed and the cost to complete these modifications (within the Lower Owens River flood-plain) in order to safely pass river flows up to 800 cfs without damaging infrastructure or cause safety concerns.

PASSIVE-ACTIVE MANAGEMENT
(Which Where and When)

Passive Management

Background

Twenty years have elapsed, and this does not include five years of pre-LORP negotiations, since the County (Petitioner) and the City (Respondent) submitted their 1997 MOU to the Superior Court for approval to guide the implementation of the LORP. This MOU required that all future management implemented use holistic management principles, whatever that means. 27 years have passed since the first LORP EIR was submitted. The Technical Committee has been in existence for 35 years. Therefore, more than adequate time and experience has passed to allow an evaluation of passive management successes and failures. The 2004 EIR predicted that in 2019, the Lower Owens River will be approaching a "steady state" condition. The EIR guessed correctly because we now have the river "we are evidently going to get."

Under past and present management, passive management applied by the Parties has produced many LORP successes. These include many benefits for many wildlife-fish species. Passive management by itself, however, may not completely meet all benefits required in the 1997 MOU.

Tule and cattail dominance and expansion throughout the Lower Owens River was very rapid. This is a natural passive response to a flow management that required a steady uniform 40 cfs base flow through all river reaches year-around with no or insignificant seasonal habitat flows. Under these conditions, tule and cattail dominance will maintain the same river conditions in the future that we have today. Tules will continue to expand, but the big expansion phase is over.

Controlling tules by applying very high erosive flushing flows, very low summer drying out channel flows, low flows to allow winter channel substrate root freezing, creating large increases in channel depth, or a combination of all so far have been unacceptable to the MOU Parties. Base flows built the river, base flows maintain the river, and base flows now control the river. If the Parties are not going to manage tules and cattails differently, then there is an immediate need for the Parties to learn how to best get along with them.

Different Interpretations of Success

MOU Consultants constantly point out that the passive management options applied to date by the MOU Parties have greatly benefited many resources; especially many wildlife-fish species. Success and failure, however, is often defined and determined in the "eye of the beholder." This is evidenced by the many different types of interpretations of LORP success floating around.

Patton (2015), always maintained that many wildlife-fish indicator species in the Lower Owens River ecosystem have not benefited from LORP management. Patton also pointed out that the lack of established appropriate habitat (especially woody riparian plants) has not occurred. CDFW continues to voice their concerns that the current river flow regime applied will not achieve LORP goals. CDFW calls for applying <u>active</u> intervention to meet LORP goals. CDFW justifies this conclusion because to obtain needed changes in the distribution, abundance, and encroachment of bulrush and cattail active intervention will likely be required (CDFW 2015). CDFW again supported active intervention to create sites for tree establishment in 2010 (CDFW 2016).

The OVC sees management accomplishments to date in a very different light as will be discussed later. Also, in past Annual Report information meetings, a member of the Bishop

Paiute Tribe expressed, “There is a lot of life going on down there (riverine-riparian area).” He went on to state that, “Life is abundant, plants are abundant, and other animals are abundant also.” He also emphasized that, “There is value in the density and occurrence of cattails.” Consultants agree with his conclusion that, “There is a lot of life going on down there and there is value in the density and occurrence of cattails.”

Consultants constantly argued that tules and cattails are necessary to support a high quality warm water recreational fishery and needed to support other wildlife needs. Tules and cattails accomplish this support by filtration and deposition of transported sediments which improves the constant poor-quality water diverted into the Lower Owens River from the Middle Owens River. Tules and cattails are also necessary to support nesting and brooding for waterfowl and many other wildlife species.

Tules and cattails will always be the major controlling influence governing the health of this desert river system; especially in effecting water quality condition. Consultants maintain that the river should be managed, under the dominating impact of tules and cattails, in a manner that provides the best mix of resulting resources. As stated before, Managers must not only learn how to better manage tules, they must learn how to get along with them.

MOU Party Positions

The OVC, analyzing data in the 2014 Annual Report, suggested a condition of present general stability in the LORP, as opposed to a looming significant impact (OVC 2014). OVC points out the abundance of life in wetland and riparian areas, fish and birds that appear to be thriving, woody species are germinating and surviving, and tules in the long-term may be out competed (by more favorable plants).

OVC calls for patience to allow tules to “live out their life-time” because they may be successional to the next wave of dominant vegetation. OVC also points out that fish data presented in the 2014 Annual Report show a general increase in fish numbers and fish species diversity. Trends pointed out by the OVC corroborate the County’s findings (Jackson 2014) of static or improved water quality observations. They point out that data presented do not suggest a degradation of water quality as far as warm water fish are concerned. OVC notes that the 50 cfs pump-out limit restriction at the Pumpback Station does not provide any handicap for managing the Lower Owens River.

Consultants mainly agree with the OVC remarks and to date, many valuable resources have been developed by releasing flows into a once dry river. Consultants do, however, maintain that the MOU Parities need to determine what can to be done, if any, to improve water quality conditions quickly.

The Serra Club (2013) takes a much different look at past and present LORP management. The Sierra Club stresses that managing tules will require active intervention in their Annual Report review comments. The City (Jensen 2014) noted that lack of force (energy) by the river precludes any uprooting of tules. The dense and well established tule stands effectively dissipate much of the erosive force of flows and thereby minimize their ability to erode and transport sediment. In simpler words, the present river function and condition (aggrading) is here to stay as long as presently applied flow management continues.

The Sierra Club is also concerned that the passive restoration approach applied so far, which dominated project implementation, has not achieved LORP goals. They recommend active restoration approaches be studied. The Sierra Club supports active management to solve the problem of tule establishment and encroachment on terraces, banks, and in the channel.

The Serra Club (2013) also points out that 2012 Annual Report data shows adequate recruitment of riparian tree species is not occurring. Annual RASS data backs up their concern because very little new forested habitat is being developed. The County magnifies these concerns when they emphasize that more than half of the riverine-riparian habitat indicator bird species need a riparian forest. The MOU Consultants predict that because of the many differing views supported by the Parities, it is going to be very difficult, if not impossible, to apply successful passive or active management actions in the future.

Passive or Active

Passive rehabilitation, providing the casual problem has been eliminated or buffered, is usually the most logical, inexpensive and successful approach once rivers have been greatly altered. Ecological potential, available funding, management direction, and legal restraints, however, may not allow the passive approach by itself to meet all required LORP goals and objectives. Consultants pushed for passive management to be emphasized first and then through testing, monitoring, and evaluation through Adaptive Management determine needed management changes for required success. This same process would also apply to active management approaches.

Moving from a passive to a more active management rehabilitation process means considering the 1997 MOU direction of building a self-sustaining and self-organizing natural system. Changing the rehabilitation approach from mainly passive restoration actions to active applied management will greatly increase monies spent, resources used, and time expended. Studies and experiences needed to determine if an active approach would even be successful has yet to start. For the best feasible final success of the LORP, some degree of mixture between passive and active management may be required. So far, active management actions implemented to date have provided no significant benefits. Results were so unsuccessful they have not even been adequately reported on.

The City has been very successful in meeting required daily LORP management direction dictated by the MOU Parties as outlined in their 1997 MOU and the 2004 EIR. The City has well demonstrated that it can implement management requirements very successfully if they can be properly identified and justified.

If river flow implementation and changes in land management do not create a proper functioning Lower Owens River, then feasible and sensible active management approaches should be considered. Before this happens, however, the LORP Scientific Team needs to identify, justify, and detail the possible approaches for the MOU Parties to consider. As stated before, the different active management approaches applied to date have not been well developed, thought out, and as a result unsuccessful. A result because they did not go through the proper Adaptive Management process.

A more academic discussion of passive and active management is taken from the 2014 Annual Report and presented again in the Appendix.

Recommendations

MOU Consultants recommend no active restoration be implemented in the future without first developing a sufficient justification, testing, monitoring, and evaluation plan. This process has not been followed by the Parties to date.

MOU Consultants recommend the Scientific Team conduct an initial evaluation of those feasible active rehabilitation interventions that could be tested for success in the future. This evaluation should be reported on in a manner it would give the MOU Parties solid information for their decision making.

TESTING RIVER FLOWS SCENARIOS

(Test, Monitor, Evaluate and Improve)

Historic

The Owens Valley was taken over by Europeans in the 1860's (Brothers 1981). Up to this time the Owens River was flowing in its long-term natural geomorphic-hydrological condition. Settlement, with drastic changes in land management, changed all this dramatically. Even prior to the City diverting water from the Owens River, flows could fluctuate dramatically daily and seasonally; especially during the agriculture irrigation period. The river would be flowing over 2000 cfs in July and a month later in August, the flow could approach 0 cfs in some reaches. These man-made early hydrological conditions, as with the previous hydrological pre-Columbian natural conditions made it impossible for tules and cattails to dominate the Lower

Owens River. These very large flow fluctuations, however, must have been very devastating to many forms of fish and wildlife.

The City's successful implementation of the MOU Party controlled river hydrology has developed a healthy warm water recreational fishery and created habitat for native fish. Flows have benefited many wildlife species, produced some habitat for trees, and greatly increased ecological diversity. MOU Consultants usually ignore the many LORP successes in their Adaptive Management and reporting process because emphasis is placed mainly on attempting to solve conditions that could detrimentally influence LORP success. The many benefits gained by MOU Party actions also need to be considered as ecological problems are identified and the push made for solutions, so it is not all one-sided.

MOU required base flows were initiated 14 years ago. LORP monitoring initiated 11 years ago. Seasonal habitat flows were initiated 10 years ago (Table 2). The environmental results are now discernable. LORP Technical Memorandum #7, the Consultants 2007 letter to the Court and MOU Parties, and the 2004 EIR, all predicted early in the process that the uniform 40 cfs over-all river reach base flow requirement, in combination with insufficient low or no seasonal habitat flows, would result in future water quality problems. DO levels were predicted to

Table 2. Lower Owens River Flows released from the Intake Control Station from 2008 to 2017

Year	SHF Peak(cfs)	Maximum Base Flow (cfs) Released
2008	220*	77
2009	110	84
2010	209	81
2011	208	85
2012	92	101 (base flow higher than SHF peak)
2013	58	91 (base flow higher than SHF peak)
2014	0 (no SHF released)	86
2015	0 (no SJF released)	78
2016	106	85
2017	197	325 (base flow higher than SHF peak)

- a flushing flow

decline to levels of concern (at or below 1/mg) as the peak of habitat flows pass the lower reaches of the Lower Owens River.

Early in LORP management, DO conditions were believed by some that they may improve with time as fines (sediment) are entrained in the lower river reaches (LADWP 2009 Annual Report), but this did not happen. MOU Consultants in their 2013 Adaptive Management Recommendations stated that nothing is more unnatural than a now human modified snow melt controlled river that is now having higher summer flows than during spring time snow melt flows. The continuous tule-cattail expansion, influencing detrimental water quality conditions, is the most serious threat to Lower Owens River resources at this time.

County Responsibilities

MOU Consultants, early in the LORP management process, recommended the LORP Scientific Team develop a thorough detailed analysis of different flow scenarios that may have the opportunity to improve Lower Owens River resources. The Team was to submit their evaluation report to the MOU Parties for consideration and necessary action. This Adaptive Management recommendation has never been accepted. The County also emphasized in recent Adaptive Management Recommendation responses, that knowing the physical and biological effects of past flows (base, seasonal habitat flows, and flushing) are necessary in setting new flow regimes. The County stated that a proposal on how this analysis could be developed will be developed by the Scientific Team and released in 2014. Consultants have not seen this report if it was ever released. In the 2013 Annual Report the County agreed to work with LADWP and other MOU Parties in 2014 to derive a new flow management regime.

Consultants also continually recommended base flow volume be altered, high flushing flows be applied, augmentation flows applied as needed, and seasonal habitat flow peaks greatly increased. The County, however, in their 2013 Annual Report response, cautions that no evidence exists supporting the increase of base flows from 40 to 55 cfs. Consultants recommended an average 55 cfs base flow spread out at different volumes over the year. This average 55 cfs base flow would have allowed the City to implement their proposed 2013 annual river flow hydrograph. Thus, flushing and augmentation flows would be released, tested, and evaluated for the first time.

The County believed the evidence was not there that the increase to 55 cfs base flow would better accomplish any of the LORP related management objectives than what present management (uniform 40 cfs) is doing. The County is correct in their statement that evidence is lacking. The only way to get this evidence, however, is that someone has to do something to get it.

The County and the City are the sole entities responsible for providing the evidence that is missing. MOU Consultants are not allowed to collect, develop, analyze, or provide any data unless it appears in Annual Reports. The County should now make sure this necessary evidence is now available, so their decision making is on solid ground.

The County also documented in their 2013 Annual Report that their Scientific Team will meet and evaluate different river flow scenarios. This is a very high priority effort and the County needs to report the results. It's likely, however, the team meeting never took place. The County also made a very important conclusion when they stated that, "They must know the physical and biological effects of past flows prior to their approval of developing and implementing new flows recommended by the Consultants." The County said they would provide a proposal on how this analysis should be conducted by the Scientific Team and proposed its release in the 2014 Annual Report. Consultants agree with the County on this need and the County should follow through with this. The County should document the results of their Scientific Team's efforts by including it in the County-City 2017 LORP Annual Report.

Flushing Flows

The first pre-planned flushing flow released into the lower river, since LORP implementation, occurred in February 2008. The 2008 February flushing flow was an anomaly from 1997 MOU direction. A second pre-planned flushing flow was applied by the City in 2017. A 300 cfs spring peak flushing flow was recommended by the Consultants for the 2014 and the 2015 seasonal habitat flows. As CDFW stated in their 2012, 2013, 2014, and 2015 Annual Report comments, they strongly support using higher magnitude flushing and seasonal habitat flows.

Prior to this year (2017) a large spring-summer flushing flow effect moving through the Lower Owens River was outside our experience. Past river modeling alerted that a significant risk exists for fish kills if large flushing flows were released during high summer river temperature conditions. How much river flow (flushing flows) and how often this flushing flow is to be applied that would transport "muck" from the river channel and, in turn, improve summer dissolved oxygen condition is not known. We do know, however, based on past and recent experience, that major fish kills will be a common occurrence in the future if some type of flow management cannot be implemented to buffer the present seasonal low available dissolved oxygen conditions.

Jensen (2014) predicted the river will become more encroached on by tules and cattails in the future. Jensen predicted the amount of river open surface water will continue to decrease. Surface water area will be replaced by cattail and tule cover. A major problem because the river will then produce larger amounts of organic biomass. Stored biomass that will become activated at critical times ensuring even bigger fish kills. The river needs flows that will increase sediment transport, will result in channel substrate dryness, causes channel bottom substrate freezing, and provide much more additional water column depth. Preferably a combination of all may be needed to correct the problem.

This year (2017) a April flushing flow released by LADWP showed promising results. The pulse flow peak (276 cfs), was very close to that flow peak previously recommended by the

Consultants (300 cfs). The pulse flow resulted in a dissolved oxygen decline of 2 to 3 my/l in response to a mobilized organic matter that increased BOD. Dissolved oxygen remained favorable because river temperatures were still low. Dissolved oxygen remained above the threshold for the onset of fish stress, suggesting the spring pulse had the desired effect (2017 Annual Report). Consultants encourage the MOU Parties to increase the testing of flushing flows to determine if future water quality conditions in the Lower Owens River can be improved.

The immediate testing and evaluation of high volume flushing flows is a good place to start. Their implementation and effectiveness should be determined to see if they can be part of the solution. The County recommended a cool water flushing flow be implemented as an experiment to determine if it would improve water quality. The Scientific Team was to discuss this recommendation. The team was to design appropriate monitoring methods to determine if a late winter- early spring pulse flow mobilizes organic material in the river channel and what effect that might have on water quality (2013 Annual Report). Consultants have never seen this report, if it was ever completed. Consultants will continue to push for the testing and evaluation of high flushing flows through their adaptive management responsibilities.

Seasonal Habitat Flows

Patton (2012) advised the MOU Parties to give serious consideration for applying and investigating larger seasonal habitat flows; especially flows exceeding 200 cfs. Hill (2004), 14 years ago, very early in the LORP planning process (memo to the MOU Parties) alerted MOU Parties that a 200 cfs flow release from the Intake Station would not scour the river channel. Hill expressed that “muck” and other accumulated organic channel sediments would not be sufficiently exported from the river without flow management changes.

Between 2012 and 2015, the Lower Owens River did not receive a viable or effective seasonal habitat flow. An aggrading river, annually storing large amounts of biological waste, could develop future problems. Continuing to function in the future in this manner could result in a future tipping point (initiate a chaotic condition). A tipping point that could collapse river health making it difficult in the future to correct and compensate for river conditions from many years of low habitat flows. Consultants recommended in 2012 that during any annual “water year” that is 75% of normal or more, a seasonal habitat flow peak of at least 200 cfs should always be released. We now believe this recommendation was too low in habitat peak flow volume.

Annual seasonal habitat flow recommendations to the County and City by the MOU Consultants are not submitted until first being informed in April of the water-runoff percent of normal prediction by the City. Regardless of the City’s 2017-2018 Owens Basin runoff predictions, the

2018 seasonal habitat flow and all future seasonal habitat flows should be augmented at down-river sites.

Augmentation Flows

Background

The first applied flushing flow (220 cfs peak) released in 2008, was successfully augmented via Alabama gate release flows. A 220 cfs peak flow release from the Intake resulted in a 171 cfs peak flow reaching the Alabama Gate river reach. A 78 cfs augmentation flow released from the Alabama Gate resulted in a 227 cfs peak flow reaching the Pump Back Station. The 227 cfs released peak flow caused no observed detrimental effect on aquatic life. The river today reacts to flow releases much differently now that the channel has become so dominated by tules and cattails. In 2008, a peak flow release from the Intake resulted in a peak flow influence reaching the Pump Back Station in 8 days. An Intake released peak flow now takes about two weeks to show effects at the Pump Back Station.

The MOU (1997) and the Monitoring Plan (2008) called for applying down-river flow augmentation if plants (i.e., trees) are not sufficiently recruited the first three years of project implementation. The Monitoring Plan, in the event environmental expectations are not met, called for seasonal habitat flows to be augmented at down-river spill gates to produce much higher peak flow effects. The MOU (1997) requires habitat flows with a sufficient volume that their implementation will maintain favorable water quality conditions. The Sierra Club agreed with the MOU Consultants proposal to augment base flow in the winter to improve water quality conditions.

The Ecosystem Management Plan calls for modifying the magnitude, duration, and timing of all flows, if needed. The experience record developed to date, justifies the need to be test and evaluate flow augmentation to determine what beneficial effects can be gained, if any.

Consultants continue to recommend that all habitat flows be flow augmented at down-river sites, so effects will occur all the way through the system. The MOU Consultants recommended the 2012 seasonal habitat flow be augmented at downriver sites as needed to obtain more wetted acreage along the river corridor to see if recruitment and maintenance of woody vegetation and other desirable riparian vegetation could not be improved. Consultants also recommended that the MOU Party conduct “work meetings” to consider actions to better manage tules. Application of flow augmentation is justified because all higher habitat or flushing flows released, soon lose much of their effect as they flow through lower river reaches. The sooner augmented flows are tested and evaluated the sooner the MOU Parties will know if augmentation has any opportunity to solve past, developing, and future habitat condition problems.

Is There a Solution

The Serra Club (2010) recommended that all seasonal habitat flows released be at least long enough in duration that a 140 cfs peak flow reaches the Pump Back Station. The most efficient way to accomplish this recommendation is via down-river flow augmentation. The Serra Club also recommended that sufficient flow augmentation releases, from down-river spill gates, be high enough in magnitude to result in at least a 200 cfs flow passing each spill gate release. As described in most previous annual reports, Consultants agree with these recommendations. Consultants first recommended (back in 2010) that flow augmentation always occur when Owens Basin Runoff is predicted to be 100% of normal or over. Consultants now recommend down-river flow augmentation should occur each year regardless of Owens Basin runoff predictions.

The MOU Consultants continuous series of recommendations to test and evaluate down-river flow augmentation is now in its 7th year. Patton (2014) recommended controlling tule abundance by releasing scouring flows of over 500 cfs. To accomplish this size of effect through down-river reaches would require flow augmentation.

The large unplanned augmentation flow releases this summer could provide the MOU Parties with some future information on what summer augmentation can do. The 2017 summer augmented flows, however, will not determine water quality benefits that may be gained if these flows were released during winter-spring periods. During this cooler period, biological impacts to the river would be much less. Future beneficial biological effects from the 2017 unplanned augmented flows, however, may occur. Current monitoring methods may not be capable however of teasing out any present or future interpretations of the abnormal 2017 spring-summer flow effects.

Recommendations

MOU Consultants recommend the LORP Scientific Team develop a scientific based testing, monitoring, and evaluation plan to evaluate all future flushing flow effects. This methodology should be capable of determining success, failure, no effect, or any needed flow modifications. Based on the Scientific Team's testing and evaluation findings, the team should then design improved flushing flow scenarios for further testing. Results will be reported on and submitted to the County and the City for review and follow-up submission to the MOU Parties for information and any necessary action.

Consultants recommend the MOU Parties hold a "Working-Decision Meeting" during the winter of 2017-2018. Meeting purpose is to determine those river flows, if any, the "Parties" would agree to test and evaluate. Potential flow scenarios would be evaluated to determine which ones may improve river water quality conditions and lessen the impact of coming fish kills.

Consultants recommend the LORP Scientific Team "draft" a series of <u>feasible</u> flushing-augmentation flow scenarios along with a predicted effect analysis. The team produced "draft" report would then be submitted to the County and City for review and then forwarded to the MOU Parties prior to their "Working Group Meeting."

Consultants recommend that the County, in their 2018 Annual Report, be in position to provide the evidence they believe is missing that does not allow them to evaluate proposed seasonal habitat and flushing flow effectiveness. This additional evidence acquired should be of sufficient quality to alleviate their concerns about the lack of evidence hampering their decision-making ability. The County should lay out the process for accomplishing this task in the 2018 Annual Report.

Table 3. Recommended March and April 2018 flushing and augmentation flow peaks.

Day Augment	Normal Spring Average Base Flow	Intake Release Including Base Flow	Alabama Gate
1	46	46	0
2	46	200	0
3	46	400	0
4	46	200	0
5	46	46	0
6	46	46	0
7	46	46	0
8*	46	46	100
9*	46	46	300
10*	46	46	100
11	46	46	0
12	46	46	0

* Actual days of flow release will be determined when flow travel timing is known.

Consultants recommend the 2018 seasonal habitat flow be augmented from the Alabama Gates. The volume and duration of the augmentation flow will be recommended by the

Consultants to the City and County when Owens Basin run-off conditions become available to the Consultants. LADWP Water volume neutrality would be maintained by taking the same amount of additional augmented water from the coming summer-winter base flows as recommended by the LORP Scientific Team.

FISH KILLS

(Past, Present and Future)

Past

In 1969, the Inyo County Register reported 200,000 dead fish were observed over a 20-mile reach of the Lower Owens River below the Alabama Gate release site. Numerous fish kills, especially through the Bishop area river reach, were reported much earlier than 1969. In 1993, river flows as low as 30 cfs resulted in significant dissolved oxygen declines causing large fish kills through the Manzanar Station to Pump Back Station river reach. In 1994, at least 1,000-dead fish were observed through the Manzanar to the Pump Back Station reach (Jackson 2016). In 2010 another fish kill occurred through the Manzanar Station to Reinhackle Station reach consisting of several hundred, observed fish. In 2013, several hundred-dead fish were observed from Lone Pine Bridge to the Pump Back Station river reach. The over-all kill numbers were in the thousands. Numerous fish kills were again observed during the summer of 2017 (2017 Annual Report).

Concerns

Fish kills emphasize how critical summer river water quality conditions are in the Lower Owens River. Kill occurrences and numbers justifying the need to try and find some way to improve future water quality conditions. MOU Consultants become very concerned when the 2013 fish kill was first observed when only a 15 cfs flow increase reduced dissolved oxygen to dangerous levels. The fish kill could have possibly started when river flow through the reach had only received an 8 cfs increase. If so, this small variance puts up a red flag for the need to predict future expectations. MOU Parties need to test and evaluate management techniques that may have a chance to better buffer Biological Oxygen Demand influences. Summer flow volume changes that can occur at any time should not have such a strong influence in reducing available dissolved oxygen and inducing other unknown toxic water quality conditions.

Water Quality Effects

The Owens River, over at least the past 5 decades and probably longer, has continually experienced poor water quality conditions and resulting fish kills. Fish kills are nothing new. Poor seasonal water quality condition is now a built in environmental factor because of past and present water management. Summer periods with poor water quality condition will be an annual occurrence unless changes in river management can be found that lessens impacts. In 2007, early in LORP planning, MOU Consultants alerted MOU Parties that dissolved oxygen was becoming and would cause serious problems in the future. Just because fish kills have been a continuous part of river history does not mean there is not the opportunity to prevent or lessen the amount of fish kills in the future. Improved river management may offer this opportunity.

The County shares the City's contention that based on water quality data collected to date, river water quality condition trend is not declining. The County is not convinced that the problem and its biological effects are worsening over-time. Consultants still maintain and predict that water quality condition will worsen over-time under present flow management. Regardless of whether the condition trend is down, up, neutral, or no trend at all, the Lower Owens River has a temperature-dissolved oxygen problem that deserves consideration.

Consultants in their 2015 Adaptive Management Report, predicted it could be difficult to meet all applicable water quality regulations in the future. Experience has already proven it will be very difficult to minimize the amount of accumulated muck and other organics to prevent future fish kills. Little can be done, if anything at all, about controlling river temperatures. It may be possible, however, to improve summer dissolved oxygen conditions if the MOU Parties test, evaluate and apply improved flow management.

Future

Natural storm events, accidental and required flow releases, sudden incoming flood flows from surrounding areas, infrastructure accidents, channel aggradation, and future water management will provide some very challenging events in the future. Maximum average monthly summer air temperature over the Lower Owens River averages about 96 F. Ambient air temperature will always hamper and depress the ability of the Lower Owens River to take care of itself and its aquatic resources. The river channel and water column are so heavily colonized by tules and cattails that the river can no longer scour, dissolve, move, or export all the annually accumulated biomass. The river does not have the power to maintain favorable water quality conditions (Jensen 2013). Therefore, fish kills in this desert river will be a continuous part of the future LORP.

The Qual-2 model runs used in LORP planning predicted future Lower Owens River dissolved oxygen would range between 2.5 and 6.1 mg/l. Thus, the model errored badly and again errored when the model predicted dissolved oxygen conditions would improve over time and be no problem in the future. The model predicted summer river temperature would range between 71F to 80F. Experience now informs us that future river dissolved oxygen conditions will meet or approach 0 mg/l in some river reaches during certain future events and conditions (Table 4). During the 2017 unplanned flow augmentation releases, from the last half of June and the first part of July, dissolved oxygen readings approached 0 mg/l at some measuring sites for 21 to 28 days.

Table 4. Number of days dissolved oxygen approached 0 mg/l at measuring sites in the Lower Owens River during the last half of June and the first half of July in 2017.

Site	Days Approaching 0 mg/l
Mazurka Bridge	21
Manzanar Bridge	21
Reinhackle Spring Site	28
Lone Pine Narrow Gauge	28
Keeler Bridge	28

Recommendations

MOU Consultants recommend the LORP Scientific Team test, monitor, and evaluate the Consultants recommended 2018 flushing flows to determine their success, failure, non-effect, or any flow modifications needed (Table 3). One flushing flow would be released in March and the other in April from the Intake Station. A coordinated additional augmentation flow will be released from the Alabama Gates as displayed in Table 5.

The MOU Consultants recommend that the Scientific Team "draft" report their flushing flow test and evaluation findings to the County and City for their review. The "draft" report will then be sent to the MOU Parties for their information and necessary action. First, however, the

Scientific Team should develop a scientific monitoring method and evaluation plan for evaluating these flows. The "draft" plan would be submitted to the County and City for their review and the final released to the MOU Parties for information and any necessary action.

Table 5. Recommended March and April 2018 flushing and augmentation flows (cfs).

Day Augment	Normal Spring Average Base Flow	Intake Release Including Base Flow	Alabama Gate
1	46	46	0
2	46	200	0
3	46	400	0
4	46	200	0
5	46	46	0
6	46	46	0
7	46	46	0
8*	46	46	100
9*	46	46	300
10*	46	46	100
11	46	46	0
12	46	46	0

The actual release day will be determined when flow travel timing is known.

Consultants recommend the LORP Scientific Team be given the responsibility to properly evaluate all future fish kills. This would be accomplished via reliable data collection, documentation, analysis and report submission. Using the findings, the Scientific Team will develop information for the MOU Parties to better understand what is causing fish kills. To date, all fish kills have been very poorly evaluated and documented. Especially lacking is information related to magnitude, cause, effect and especially solution. Some fish kill data acquired by a MOU Party was refused to be accessed by the Consultants.

RECREATIONAL FISHING METHODOLOGY

(Sufficient or Insufficient)

Recreational fishing data and personal fish observation data are the only information currently available under LORP monitoring guidance to evaluate the health of the recreational fishery. To date, five (2003,2010,2013,2014, and 2015) recreational fishing surveys have been completed. The County, again in Annual Reports and 2017 personal communication, downgrades the ability of the recreational fishing survey to develop meaningful information. The County, however, still refuses to accept the Consultants recommendations in the 2016 Annual Report that the County develop and implement an improved recreational fishing monitoring-evaluation method that they are sure will develop meaningful information. Consultants are not allowed to study, develop, evaluate or apply new or improved monitoring methods unless this type of information should appear in Annual Reports. So far, Annual Reports have been lacking in this type of information. Therefore, under these restrictions, it's the County's responsibility to back up their concerns with some action.

MOU Consultants maintain the presently used recreational fishing survey method will provide useful information on evaluating the health of the recreational fishery.

Recommendations

MOU Consultants recommend the County and the City conduct a recreational fishery survey in 2018. Results, with suggestions for methodology improvement should be documented in the 2018 LORP Annual Report.

Consultants again recommend the County develop a "draft" recreational fishing evaluation methodology that meets their expectations. The County will then send this "draft" to the LORP Scientific Team for review and evaluation. After team review and any modifications needed, the team will then submit the methodology to the City and County for review and processing through Adaptive Management. The Standing Committee would then decide if the additional methods and resulting data collected is needed, sufficient, and is it worth the increased cost.

WETLANDS

Blackrock Waterfowl Management Area

The record runoff in 2017 resulted in total flooded area peak of 688 acres in the Winterton and Thibaut Units. Given the 197% of normal runoff, both units experienced more than 500 acres throughout the year, well above the MOU requirement. As in previous years both LADWP and ICWD staff walk the wetland perimeters and record water extent. This year, because of heavy flooding in the spring and summer, the units were only measured in the winter and fall.

Avian Census

Avian surveys were performed in the Winterton Unit in 2015-16, and the Thibaut Unit was surveyed this year. Census results reported in the annual report show that the most abundant species are waterfowl. With the exception of Least Bittern and Belted Kingfisher (wetland and open water indicator species), all other indicator species were present to one degree or another. The survey also showed that the sheer number of American Coots overwhelm the interpretation of use by other species.

Waterfowl appear to be the greatest beneficiary of wetland unit flooding in the spring and fall. Total numbers declined in the summer and then peaked in the fall. Because of the extraordinary water year, the Thibaut Unit remained flooded throughout the year, which provided an opportunity to observe avian response to seasonal flood conditions. Survey data showed a 500% increase in species use. The conclusion reached from these data is that productivity is best when units are flooded in spring and especially the fall, and concomitantly, drying units in the summer will provide a measure of tule control without causing harm to breeding habitat. As noted in the annual report, breeding populations are extremely limited in the region.

Recommendations

In 2016, the MOU Consultants recommended employing a remote sensing approach to improve accuracy and reduce the labor effort associated with walking the perimeter of units. While both LADWP and ICWD agreed to give this recommendation consideration, it has not been adopted. The inability to walk the units this last spring and summer adds weight to the recommendation to rely upon remote imagery for this monitoring.

The MOU Consultants concur that American Coot as an indicator species in the BWMA and Thibaut Units is counterproductive and recommend removing it from the indicator species list. As in 2015 and 2016, we recommend that LADWP and ICWD work together to refine the indicator species list to better reflect the actual presence and usage of targeted animals.

In the response to the MOU Consultants' recommendation in previous years to develop and initiate a plan for the BWMA to seasonally wet and dry management units, LADWP and ICWD agreed to pursue such a plan in cooperation with CDW. We again urge the managing entities to address the legal and operational constraints and establish a more beneficial management plan that would be agreeable to the MOU Parties. The avian survey results clearly indicate that seasonal flooding and drying similar to the Thibaut Unit management will result in far greater bird use.

Delta

As described in the annual report, the extreme water year caused unintended and very high flows over the weir and Langmann Gate. The highest flows into the Delta occurred between July 3 to July 10, with the peak 152 cfs on July 7. These continuous high flows caused the east channel to break out (widen) and the development of additional tule stands, salt grass and three-square. It appears that even these high flows did not put water over the center, elevated landform of the Delta but the brine pool was greatly expanded. Outside of the brine pool there was some open water area, very small, adjacent to the east channel. The west channel remained relatively unchanged.

Each year since 2011, the MOU Consultants have recommended that DHA habitat flows be released from the Intake rather than the Pumpback Station. The justification was to improve water quality conditions throughout the river using this moderate additional annual flushing flow, while meeting DHA goals with a flow pattern that also meets the needs of indicator species. We also recommended eliminating the present programmed habitat flow releases for the DHA, and implementing and evaluating three DHA habitat flows (Periods 1, 3, and 4) released from the Intake over a two-year period. Results should help determine if Lower Owens River water quality and other environmental conditions can be improved via flow management. Results will also allow better predictions of how these flows pass downriver and when and how much of the flushing flows arrive in downriver reaches. The three DHA habitat flow periods recommended for release at the Intake Control Station are Period 1 (March-April), Period 3 (September and add October), and Period 4 (November-December).

LADWP has objected to the recommendation to release DHA pulse flows from the Intake because they argue it would violate their position that flows in the LORP must be "water neutral". ICWD also has objected, arguing that 20-30 cfs pulses added to the base flows would have little impact on water quality. The MOU Consultants' recommended that LADWP meet their "water neutral" mandate by adjusting base flow levels as needed. Whether releasing DHA pulse flows from the Intake will improve water quality or not is untested. Water quality is no longer being measured year-round throughout the river, so the argument that additional flows will not be effective is speculative. However, it is clear that neither LADWP nor ICWD will adopt this recommendation.

Recommendations

Effects of the high flows this year on the DHA should be evaluated using remote imagery taken during the flood periods to identify the location (east and west channels) and extent of open-water since this type of habitat has been shown to have greater value to some indicator species. Then initiate a study to determine the most suitable flow pattern for the DHA for the three periods recommended previously.

LAND MANAGEMENT

The MOU Consultants have stated in past years that land management (grazing) is one of the LORP success stories. This continues to be the case. The MOU requires the project to allow for multiple uses, which has, for the most part, been focused on grazing as the principle land management activity. There are seven leases consisting of twelve riparian pastures and seventeen upland pastures, as well as exclosures for rare plants and monitoring throughout the LORP. At the beginning of the project, lease management plans were developed in concert with each leasee. Overtime the plans have been modified to improve both monitoring, grazing and environmental conditions.

Grazing management plans allow for a maximum use of 40% in riparian pastures and 65% in upland pastures during the dormant season (winter). These standards apply to the average use in a pasture based on forage species like salt grass, sacaton, and wild rye.

As described in the annual report, grazing is monitored with several techniques including utilization, range trend, and pasture scoring. While this monitoring is extensive, involving a great many transects measured seasonally; over time LADWP has developed a very reliable algorithm system that allows leasees to manage livestock use on the basis of stubble height. Stubble height has been a very easy measure for leasees to manage to.

The result has been relatively balanced grazing patterns such that upland pastures have experienced little change from initial conditions; plant diversity has not increased significantly nor has productivity declined as an impact of grazing. Precipitation had a greater effect on upland pastures than grazing.

Riparian pastures, on the other hand, because of in-channel and out-of-channel flows over time, have experienced considerable change in vegetation. The annual reports document these changes. LADWP's range conservation staff now suggest that since riparian vegetation has improved perhaps it's time to reexamine utilization standards; also, maybe use grazing to control undesirable plants like Nevada saltbush by trampling.

The MOU Consultants are not opposed to innovative ideas to improve range conditions such as using cattle to decrease unwanted plant species like Nevada saltbush. However, the grazing standards have worked very well in both upland and pasture leases. Unless there is a clear need to provide more forage for leasees, there is no real need to alter utilization. The current 40% utilization standard in the pastures has certainly increased the available forage, the standard has also created necessary habitat for indicator species. Without a rigorous scientific experiment, conducted through the adaptive management process, to test the hypothesis that riparian pasture utilization can be increased without harming other LORP values like woody riparian development and wildlife habitat, the MOU Consultants cannot support an increase in pasture utilization.

On the other hand, control of saltbush and bassia is encouraged, but using cattle to trample this vegetation is problematic requiring fencing and feeding to keep cattle on the unwanted vegetation; therefore, mowing may be the most feasible control option.

Recommendations

The MOU Consultants recommend that if LADWP is interested in increasing utilization standards in riparian pastures, that they design a rigorous scientific experiment to test the effects of increased grazing on key LORP goals such as woody riparian recruitment and indicator species habitat. Results of the study must then be presented to the Scientific Committee for consideration under adaptive management.

RAPID ASSESSMENT SURVEY

The RAS methodology has changed through time, its usefulness has been called into question, because it gathers information that has not been used to inform management decisions. Other monitoring efforts (e.g., site-scale mapping, and indicator species habitat analysis) have not been performed as mandated by the MAMP. Consequently, the information collected in the RAS, land management and hydrologic monitoring provide the most recent and pertinent data to make management decisions relating to woody species and habitat. Data from the RAS have been used successfully to locate invasive species, woody riparian recruitment, recreation impacts and tamarisk resprout and seedling sites. The RAS is a qualitative assessment; its results should not be used to categorize river conditions or be the basis for broad management decisions. Rather, the RAS should inform managers about river conditions and indicate where problems exist that require remedial action.

Willow Sustainability and Recruitment

The 2017 RAS was confounded by the high-water conditions throughout the river. Flooding of oxbows and floodplains hampered the usual track taken in previous years, thus it is not known if and to what degree sustained high water levels impacted previously set woody riparian species. As reported in the annual report, about 44% of revisit sites were underwater or inaccessible due to flooding. Nevertheless, the RAS found 35 tree willow recruits, 30 clonal willow, but not cottonwood recruits. All of the recruitment was confined to the upper river above RM 35.2. While there is no direct evidence, it's reasonable to conclude that the greater flood extent did influence willow recruitment. As noted in the RAS report, tree willow recruitment sites were distributed between floodplain and streambank landforms.

Water spreading was performed between the aqueduct and the river above Two Culverts and in the BWMA as well as diverted above the Islands reach through McIver Canal and the East Side Ditch, thus flooding in the lower 27 miles of river was limited and could explain the lack of woody recruitment.

Pole Planting

ICWD and LADWP initiated a pilot, pole planting project to test the feasibility of augmenting the natural development of tree willow in the LORP. A site just above the Keeler Bridge was selected and 576 trees were planted in 12 groves. As reported in the annual report, only 24 trees were alive as of August 16, 2017.

This level of mortality is not unusual and both the scientific literature and experience in other areas of the LORP would lead us to expect over 90% mortality of initial pole plantings. For example, LADWP performed an experimental pole planting further above the Keeler area several years ago and that resulted in 100% mortality. However, pole plantings in the Baker Creek area to enhance avian use was deemed successful but only after repeated plantings.

While it is feasible to augment natural, tree willow recruitment with pole planting, management must be committed to the effort and cost of repeated plantings until a desired survival goal is attained. However, before such an intensive effort is undertaken the causes of the failure of this pilot project need to be careful examined. While it could well be attributed to high, desiccating winds followed by prolonged flooding, this is speculation. As noted in other pole planting attempts the causes for high mortality could be several factors. A much more thorough and rigorous experimental design is needed to isolate those factors, which may be unique to the LORP, that ensure success and minimizes failure.

Recommendations

Each year we debate the value of the RAS and whether the data derived is sufficiently informative. The MOU Consultants have wavered back and forth on the advisability of continuing the RAS beyond next year when it is programmed to terminate. Our recommendation is to continue part of the RAS beyond next year and that is just observing and counting riparian recruitment and conditions. We recommend this because at this time there is no other monitoring effort that provides this data and knowing the condition of riverine-riparian habitat is important. The future RAS can eliminate the off-channel lakes and ponds and the BWMA as well as the other survey parameters so that the RAS team can collect and evaluate just riverine-riparian data at a reasonable cost.

The MOU Consultants recommend that before more pole plantings are attempted, a detailed experimental plan be developed and vetted through the Scientific Committee and the adaptive management process.

WEED MANAGEMENT

The greatest concern resulting from the 2017 flooding is the expansion of noxious weeds and, especially, salt cedar in the water spreading basins and on river landforms. Unfortunately, 2017 is the last year of grant funding for the salt cedar eradication program, and no work is planned for the 2017-18 season. Also, the Inyo and Mono Counties Agricultural Commissioner's Office (CAC), responsible for preventing the spread of noxious weeds throughout the LORP, continues to be understaffed and underfunded, while the risk of increased noxious seed spreading is extremely high following the 2017 runoff.

Recommendations

MOU Consultants recommend refunding the salt cedar control program for at least this coming year because of the risk of substantial increase in noxious weeds and salt cedar. We further recommend that eradication effort be focused on the river corridor and the flooding basins be a secondary priority as funding permits.

MOU Consultants recommend increasing the CAC funding and staffing in 2017-18 to address the expected increase in lepidium and other noxious weeds throughout the LORP.

MONITORING

Experience with the flooding conditions this year illustrated a need for monitoring improvements. In previous years flood extent was monitored during seasonal habitat flows. As described in the MAMP …" Monitoring of flooding extent, which is how much land area is inundated during seasonal habitat flows, is prescribed to inform managers about the effectiveness of seasonal habitat flows. Seasonal habitat flooding extent monitoring is more qualitative than quantitative, and its aim is to document that flooding is occurring and reveal which habitat communities are being affected by the flooding. Determining the extent and duration of the flooded area enables managers to identify which vegetation communities are inundated and are being affected by the seasonal habitat flow".

In the event annual runoff predictions indicate another extreme water year, monitoring of water quality should be implemented similar to what has been done in previous years during seasonal habitat flows . As described in the MAMP…"LORP water quality monitoring provides an early warning of declines in water quality during and after initiation of flow releases and during seasonal habitat flows; this allows LADWP to modify flow releases to improve water quality in limited areas around spillgate returns designated as fish refuges. Water quality monitoring also allows LADWP and others the ability to track the gradual, expected improvement of water quality conditions over time".

Stream flow monitoring as performed this year appears adequate to evaluate flows at strategic points throughout the river. This monitoring should be a component of a contingency monitoring plan for extreme water years.

Recommendations

MOU Consultants recommend that LADWP and ICWD development a contingency monitoring plan to account for extreme flood conditions such as this year. Monitoring should focus on discharge throughout the river, flood extent and water quality.

ANNUAL REPORT EXECUTIVE SUMMARIES
(More Inclusion)

Annual Report Executive Summaries need to better display each years LORP environmental conditions as required by the 1997 MOU. A 2013 letter, in Response to the 2013 Annual Report from the Sierra Club and the OVC, stated that a clear assessment and analysis of progress towards meeting the 1997 MOU goals cannot be easily discerned from the draft Annual Report. A clear assessment and analysis of progress towards these MOU goals and objectives and whether the goals and objectives are sustainable is lacking in the Annual Report. Both of these MOU Party representatives believed the Annual Report Executive Summary is mostly a descriptive summary of what the different sections of the Annual Report covers and does not provide a summary overview and progress towards the LORP program goals and objectives.

Executive Summaries need to cover all important aspects of each subject appearing in the Annual Report. Annual Report Executive Summaries have not covered any Adaptive Management findings, recommendations, or responses (See the 2013 through 2017 Annual Report Executive Summaries). As a result, Adaptive Management information and recommendations are hidden along with the Glossary at the extreme end of a very large report.

The EIR (2004) plainly and emphatically states that the LORP is to be managed adaptively. LORP success in meeting MOU goals will depend on the decision makers (the MOU Parties) ability to implement successful Adaptive Management. The LORP can point out many successes, however, Adaptive Management is not among them (2011 Annual Report). To date, implementation of Adaptive Management has been one of the failures of the LORP (Duncan 2012). Vorster (OVC Consultant) also emphasized that implementing meaningful and specific Adaptive Management recommendations have been lacking and as a result is now inhibiting LORP progress. Adaptive Management implementation needs much more consideration in the MOU Party decision making process.

Recommendation

Consultants recommend all present (2017) and future City-County Annual Report Executive Summaries include a summary of the Adaptive Management Chapter of the report.

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APPENDIX

Active versus Passive Restoration: A Discussion

Some interested parties have inquired as to why more active restoration techniques are not being employed in the LORP. In particular, Inyo County Water Department has asked the MOU Consultants to research and appraise the efficacy of several alternative restoration techniques for use in the Lower Owens. This section discusses and analyzes the reasoning and feasibility of these suggested proposals and ideas.

The MOU Consultants recognize that there is both impatience and apprehension over lack of progress in the LORP; ranging from lack of habitat development and channels filling with tule/cattail to poor water quality conditions. Whether these issues are real or perceived, it is likely worth taking time to describe why certain restoration approaches are utilized and why many are not adequate or relevant to this project.

Regulators and interested parties who are monitoring and measuring restoration success often make the mistake of not allowing adequate time for natural self-designing processes to develop before passing judgment. Legal, political and economic human priorities too often demand unnatural and mechanistic interventions for "quick-fixes" that usually do not allow the time necessary for nature to find balance, and actually can often be undermining or even destructive to ecological restoration efforts.

LORP Restoration Philosophy

Since project inception it has been understood that to achieve success in the restoration of the Lower Owens River, there are three basic requirements: (1) to understand ecosystem function; (2) to give the system time; and (3) to appreciate self-design. The overarching goal expressed in the MOU is for the LORP to be a natural, self-sustaining ecosystem to the extent possible.

Self-design emphasizes the development of natural habitat. Scientific knowledge in the field of ecology verifies that natural forces do ultimately self-design around habitat by choosing the most appropriate species to fill niches and establish rates of recruitment, production and growth. Self-design allows the natural colonization of plant and animal species to attain balance and optimum biodiversity with minimal human manipulation of materials or processes. In other words, sustainable ecological restoration should not rely upon a human-built and artificially maintained ecosystem.

The LORP emphasizes instead, to the greatest extent possible within the constraints of continued multiple uses, to give nature back what it needs to function and then take a hands-off approach that adapts management interventions to what nature is teaching us about what it needs to achieve a healthy balance.

If monitoring results indicate that the changes in environmental conditions are inconsistent with the LORP objectives, LADWP and the County will implement feasible adaptive management measures… the effects of altered river flows, changed flooding patterns in wetland areas, and modified land management practices will be monitored on an ongoing basis to determine if the esired goals are being achieved, and if not, the adaptive management actions will be considered and implemented as necessary and to the extent consistent with the MOU. **This approach contrasts with alternative habitat restoration approaches that involve active planting of vegetation and/or introduction of wildlife species**. (LORP FEIR, 2004)

Unless natural conditions are continuously reset with excessive and proactive human interventions to attempt to force nature and the restoration process along an inappropriate path, nature can and will organize by way of natural ecological processes toward a functional condition.

LORP Restoration Reality

The trajectory of ecosystem recovery has come into line with river flow regime and land management conditions. The past and current flow management regime for the river is causing ecological stagnation and limiting the ability of the river to achieve original goals, expectations, improve overall health and develop a balanced ecological system. The flow regime for the Lower Owens River, as currently configured, is problematic yet it is the key to whether the LORP will succeed or fail. The current flow regime is managed to attain policy and compliance obligations first and foremost. If these prescribed river flows happen to benefit the riverine ecology it is secondary to the need to meet fixed legal obligations. As such the current river baseflow is confounding and recent seasonal habit flows are so small as to be completely ineffective. The Lower Owens River is degrading because it is fixed in place by legal stipulations dictating flow regimes that do not conform to any ecological or natural process. Compliance restrictions are inhibiting the LORP's potential and are affecting it negatively.

Discussion

There are three generalized approaches to restoring a disturbed riverine-riparian environment:

(1) rely completely on passive (spontaneous succession)
(2) exclusively adopt active, technical measures
(3) or a combination of both passive and active techniques toward a target goal (Hobbs and Prach 2008). Passively restored sites exhibit robust biota better adapted to site conditions with increased natural value and wildlife habitat than do actively restored sites alone (Hobbs and Prach 2008)

Ecological restoration involves assisting the recovery of an ecosystem that has been degraded, damaged, or destroyed, typically as a result of human activities (Sala et al., 2000). Ecological restoration is based on the view of ecosystems as biological communities established on a geophysical substrate that can develop into alternative stable states rather than into a single climax state (Lewontin 1969). As a consequence, the idea of the balance of nature has been replaced with the flux of nature (Wu & Loucks, 1995; Pickett & Ostfield, 1995; Wallington et al., 2005), and ecosystems are thought to be mostly in non-equilibrium. Their dynamics are not only complex but also dependent on the spatial context and the history of natural disturbance and human influence (Hobbs & Cramer, 2008). The main implication of this conceptual model is that ecosystems that have been altered by human activity may not revert back to its original state if left alone. On the contrary, these altered ecosystems could reach a different stable state defined by the actions of human management on them (i.e. soil alteration and erosion, invasive species, loss of native species, changes in hydrological regime, etc.). The goal of ecological restoration is therefore the reestablishment of the characteristics of an ecosystem, such as biodiversity and ecological function that were prevalent before degradation (Jordan et al., 1987), and that will not be reached (or if so, in very long time scales) by the ecosystems if left alone.

The persistence of undesirable functional states is an indication that the system may be stuck and will require active intervention to move it to a more desirable state (Hobbs and Prach 2008). Understanding when passive versus active restoration approaches are warranted can increase chances of success and reduced project costs.

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12.0 RESPONSE TO ADAPTIVE MANAGEMENT RECOMMENDATIONS

12.1 LADWP's Response to the 2017 LORP Adaptive Management Recommendations

LADWP's Response to Comments on Mark Hill and Bill Platts'

2017 Lower Owens River Project Annual Report
Adaptive Management Recommendations

A RIVER REHABILITATION STATUS REPORT

The MOU Consultants recommend the LORP Scientific Team, during the winter of 2017-2018, develop a "Draft River Rehabilitation Status Report. A report that describes and documents the present environmental status of the Lower Owens River. The "draft" will then be submitted to the County and the City for their review. The final report would be sent to the MOU Parties for their information and action as necessary.

The 2017 annual report and previous reports provide ample documentation for the status of the river. If there is a specific gap in information/data, it should be articulated by the Consultants with the rationale of how it will assist in achieving the LORP goals sooner.

MODIFYING INFRASTRUCTURE TO PASS HIGHER FLOWS

MOU Consultants recommend the City and County complete a preliminary ballpark only estimate, of infrastructure modification needed and the cost to complete these modifications (within the Lower Owens River flood-plain) in order to safely pass river flows up to 800 cfs without damaging infrastructure or cause safety concerns.

This is not a feasible recommendation. First, how is the 800 cfs derived? Secondly, the cost of modification to the pumpback station would be greater than the cost of the current facility. And lastly, none of the road crossings could handle a flow this magnitude without extensive (*i.e.* expensive) modifications.

PASSIVE-ACTIVE MANAGEMENT

MOU Consultants recommend no active restoration be implemented in the future without first developing a sufficient justification, testing, monitoring, and evaluation plan. This process has not been followed by the Parties to date.

LADWP concurs. There is benefit in restoring natural processes (floods, droughts, natural willow recruitment etc.) as these physical and ecological drivers, over time, will be more efficient and effective in restoring the river.

MOU Consultants recommend the Scientific Team conduct an initial evaluation of those feasible active rehabilitation interventions that could be tested for success in the future. This evaluation *should be reported on in a manner it would give the MOU Parties solid information for their decision making.*

Any potential active interventions would need to be extensively analyzed for feasibility, costs, and short and long term benefits.

TESTING RIVER FLOWS SCENARIOS

MOU Consultants recommend the LORP Scientific Team develop a scientific based testing, monitoring, and evaluation plan to evaluate all future flushing flow effects. This methodology should be capable of determining success, failure, no effect, or any needed flow modifications. Based on the Scientific Team's testing and evaluation findings, the team should then design improved flushing flow scenarios for further testing. Results will be reported on and submitted to the County and the City for review and follow-up submission to the MOU Parties for information and any necessary action.

This is mostly redundant, in that the annual report provides results of monitoring along with analysis. However, it would be beneficial to monitor suspended sediment during high flows to quantify the amount of "muck" being transported.

FISH KILLS

MOU Consultants recommend the LORP Scientific Team test, monitor, and evaluate the Consultants recommended 2018 flushing flows to determine their success, failure, non-effect, or any flow modifications needed. One flushing flow would be released in March and the other in April from the Intake Station. A coordinated additional augmentation flow will be released from the Alabama Gates displayed in Table 5.

The MOU Consultants recommend that the Scientific Team "draft" report their flushing flow test and evaluation findings to the County and City for their review. The "draft" report will then be sent to the MOU Parties for their information and necessary action. First, however, the Scientific Team should develop a scientific monitoring method and evaluation plan for evaluating these flows. The "draft" plan would be submitted to the County and City for their review and the final released to the MOU Parties for information and any necessary action.

It warrants consideration to move the SHF earlier in the year for water quality considerations. However, any augmentation from the Alabama Gates must be consistent with the *2007 Stipulation and Order* and the 2010 Revised Addendum for Augmentation of Seasonal Habitat Flows.

RECREATIONAL FISHING METHODOLOGY

MOU Consultants recommend the County and the City conduct a recreational fishery survey in 2018. Results, with suggestions for methodology improvement should be documented in the 2018 LORP Annual Report.

Consultants again recommend the County develop a "draft" recreational fishing evaluation methodology that meets their expectations. The County will then send this "draft" to the LORP

Scientific Team for review and evaluation. After team review and any modifications needed, the team will then submit the methodology to the City and County for review and processing through Adaptive Management. The Standing Committee would then decide if the additional methods and resulting data collected is needed, sufficient, and is it worth the increased cost.

Current assessment of the condition of the LORP fishery is adequate.

WETLANDS- BLACKROCK WATERFOWL MANAGEMENT AREA

In 2016, the MOU Consultants recommended employing a remote sensing approach to improve accuracy and reduce the labor effort associated with walking the perimeter of units. While both LADWP and ICWD agreed to give this recommendation consideration, it has not been adopted. The inability to walk the units this last spring and summer adds weight to the recommendation to rely upon remote imagery for this monitoring.

LADWP agrees that this approach should be explored for its utility in documenting the wetted extent.

The MOU Consultants concur that American Coot as an indicator species in the BWMA and Thibaut Units is counterproductive and recommend removing it from the indicator species list. As in 2015 and 2016, we recommend that LADWP and ICWD work together to refine the indicator species list to better reflect the actual presence and usage of targeted animals.

LADWP concurs with this recommendation that the Habitat Indicator Species list should be reevaluated and refined based on existing habitat conditions, as conditions are unlikely to change in the foreseeable future.

In the response to the MOU Consultants' recommendation in previous years to develop and initiate a plan for the BWMA to seasonally wet and dry management units, LADWP and ICWD agreed to pursue such a plan in cooperation with CDW. We again urge the managing entities to address the legal and operational constraints and establish a more beneficial management plan that would be agreeable to the MOU Parties. The avian survey results clearly indicate that seasonal flooding and drying similar to the Thibaut Unit management will result in far greater bird use.

Any potential changes would need to be extensively analyzed for feasibility, costs, and short and long term benefits.

WETLANDS- DELTA HABITAT AREA

Effects of the high flows this year on the DHA should be evaluated using remote imagery taken during the flood periods to identify the location (east and west channels) and extent of open-water since this type of habitat has been shown to have greater value to some indicator species. Then initiate a study to determine the most suitable flow pattern for the DHA for the three periods recommended previously.

LADWP concurs. Remote sensing technology can be a useful tool in monitoring wetlands and could be beneficial in analyzing conditions in the Delta Habitat Area this past runoff year.

LAND MANAGEMENT

The MOU Consultants recommend that if LADWP is interested in increasing utilization standards in riparian pastures that they design a rigorous scientific experiment to test the effects of increased grazing on key LORP goals such as woody riparian recruitment and indicator species habitat. Results of the study must then be presented to the Scientific Committee for consideration under adaptive management.

LADWP's lessees, in general, have successfully met utilization standards associated with the LORP. Meeting LORP requirements was no small feat and has required operators to make significant changes in stocking rates, use patterns, and timing of use. Operators maintained their businesses during an unprecedented drought without negatively impacting riparian and upland areas in the LORP. One lesson learned from the drought is that irrigated pasture condition and production will decline and that traditional summer grazing areas in Long Valley and on the Kern Plateau may not be available. All of the LORP lessees rely upon summer grazing on irrigated pastures in Long Valley or on the Kern Plateau. If the summer forage base becomes less reliable then LORP land managers need to plan for requests by operators to increase grazing pressure and change season of use towards more summer grazing. LADWP agrees that simply increasing utilization without evidence to support an increase is not acceptable. Over the course of the last 10 years there have been examples of localized utilization exceeding 40% with no subsequent negative impacts in plant communities.

RAPID ASSESSMENT SURVEY

Each year we debate the value of the RAS and whether the data derived is sufficiently informative. The MOU Consultants have wavered back and forth on the advisability of continuing the RAS beyond next year when it is programmed to terminate. Our recommendation is to continue part of the RAS beyond next year and that is just observing and counting riparian recruitment and conditions. We recommend this because at this time there is no other monitoring effort that provides this data and knowing the condition of riverine-riparian habitat is important. The future RAS can eliminate the off-channel lakes and ponds and the BWMA as well as the other survey parameters so that the RAS team can collect and evaluate just riverine-riparian data at a reasonable cost.

LADWP is not in support continuing Rapid Assessment Surveys, as no management changes have been made as a result of this annual monitoring since the implementation of the project.

The MOU Consultants recommend that before more pole plantings are attempted, a detailed experimental plan be developed and vetted through the Scientific Committee and the adaptive management process.

LADWP is not in support of additional pole planting in the LORP, as previous efforts have proved unsuccessful time and time again.

WEED MANAGEMENT

MOU Consultants recommend refunding the salt cedar control program for at least this coming year because of the risk of substantial increase in noxious weeds and salt cedar. We further *recommend that eradication effort be focused on the river corridor and the flooding basins be a secondary priority as funding permits.*

MOU Consultants recommend increasing the CAC funding and staffing in 2017-18 to address the expected increase in lepidium and other noxious weeds throughout the LORP.

LADWP has launched a significant salt cedar eradication program during the fall of 2017 in the wake of significant water spreading in the Owens Valley and limited remaining funding for the Inyo County Salt Cedar Program. LADWP continues to fund Inyo County's program annually per the Inyo/Los Angeles Water Agreement, but fulfilled all supplemental funding for the program required in the LORP EIR in 2015.

LADWP also continues to treat noxious weeds in the LORP area and adjacent spreading basins. There is no justification for funding the County Agricultural Commissioner's Office to duplicate this work.

MONITORING

MOU Consultants recommend that LADWP and ICWD development a contingency monitoring plan to account for extreme flood conditions such as this year. Monitoring should focus on discharge throughout the river, flood extent and water quality.

Recommendation noted. This past year, the County and LADWP performed remote sensing, stream gaging and continuous water quality monitoring during record runoff conditions. Monitoring of suspended sediment, however, could be implemented in the future.

ANNUAL REPORT EXECUTIVE SUMMARIES

Consultants recommend all present (2017) and future City-County Annual Report Executive Summaries include a summary of the Adaptive Management Chapter of the report.

Recommendation noted.

12.2 Inyo County Water Department Response to MOU Consultants 2017 LORP Adaptive Management Recommendations

Inyo County Response to MOU Consultants 2017 Adaptive Management Recommendations

GENERAL COMMENTS ADDRESSING THE CONSULTANTS OBSERVATIONS

General concerns regarding flooding

In reference to the exceptional flows that occurred in the Lower Owens River in 2016-2017; Consultants state:

> *"Of particular concern to this review was flood extent, out- of-channel reaches, bank and landform stability; impact on infrastructure, forage, riparian vegetation, water quality and organic/sediment movement."*

Although they lightly touch upon some of these topics, nowhere in their report, other then in the opening, do they identify specific concerns or suggest action to address concerns about bank and landform stability.

Alabama Gates

Consultants note the Alabama Gates diversion:

> *"…is adequate with minor adjustments to carry flows to below the Island."*

We assume they are referring to the diversion below the Alabama Gates and west of the Islands; a map would have been helpful. We are not sure what "minor adjustments" the Consultants recommend. They promote the idea of water management through the Alabama Gates, but do not offer specific recommendations for adjusting the channel; which would seem a prerequisite.

Fluvial Processes

Without any data to back their claim, the Consultants intuit that, "The dominant process in the LORP is erosion and aggradation." We assume they are referring to river processes. The claim is based on visible observation, but they then refer to what could only be made by measurement, that "these processes were accelerated." CDFW took a number of water samples during the height of the flood and found little evidence of sediment transport. The Water Department inspected the Keeler Bridge and Mazourka Canyon measuring station concrete aprons and floors and found algal buildup, but little if any deposition of inorganic material after the high flows, indicating that little mineral sediment was mobilized. Water Department staff did not discern riverbank or benthic erosion. Perhaps elevated levels of organics in the water fueled the notable algal buildup, but this is speculative. The consults claims could be tested by experiment, but they make no recommendation to further investigate.

Flooding effect on vegetation

Potential loss of riparian vegetation due to flooding-out concerned the Consultants, however they didn't specifically recommend a study to assess effects on previous year's recruitment, or determine if seedlings recruited on the higher landforms persisted. It seems appropriate to employ the RAS to answer these questions as well determine if high water led to the spread of invasive and exotic species, but oddly this wasn't discussed or recommended.

River rehabilitation

Consultants recommend a "River Rehabilitation Recovery Status Report," to guide management decision-making be produced by the City and County. This is first time the Consultants have implied that they view rehabilitation as a LORP goal. Nowhere in their LORP Monitoring, Adaptive Management and Reporting Plan, the MOU [check], or LORP EIR [check] is there reference to rehabilitation.

They recommend a "Status Report," which seems a reasonable request, but gauging project status against the new and undefined benchmark "rehabilitation" is confusing. It might be useful, as has been done in the past, to include a section in the Annual Report that assesses LORP conditions against goals. The Consultants have offered this in the past.

Tules

Consultants list controlling tules as the second management priority behind water quality improvement needs. They bemoan the inadequacy of models to predict the extent of emergent vegetation intrusion into open water. They accurately blame muck accumulation and mobilization as contributing to poor water quality and offer that as experience and understanding are gained these can be applied to future adaptive management.

<u>Active recruitment efforts</u>

The Consultants note insufficient tree recruitment and survival then go on to denigrate and minimize attempts to establish tree willow and cottonwood. They are correct that small-scale poorly documented efforts have been attempted, but they are incorrect in stating that these efforts had no success. We are not aware of any recent experiments to install small rooted willow plantings, or implement heavy soil bank disturbance through forced increased livestock grazing, referred to by the Consultants, but we do know that pole planting of cottonwood by LADWP was somewhat successful in the upper reached of the river.

Contrary to the Consultants' claims, the recent small-scale experiment in pole planting in the area of Keeler Bridge was carefully planned, with every planting location individually selected to establish levels of success on differing landforms, soils and depths to water. The poles were professionally installed using best management practices, each tree was identified, and a monitoring plan was in place. This was a proof-of-concept project that would be scaled-up with third-party funding if successful.

The project predictably failed, not due to design, but because the newly planted poles were flooded for weeks during a critical establishment period. Given the mitigating circumstances surrounding the pole-planting experiment, it is misleading for the Consultants to say that active interventions are not working.

<u>Active vs. passive management</u>

In regard to choosing passive/active management, the Consultants favor passive management, as does the County, however the Consultants believe the LORP as it is now, is the LORP that we will get—and the LORP is not meeting objectives. Based on current conditions, which the Consultants portend is likely the long-term condition of the project, many of the goals of the LORP will not be realized. In their report they place emphasis on the adjectives that modify the project goals, rather than seek out indicators of success, such as <u>creating</u> and maintaining diverse habitat for habitat indicator species. We expect some improvement in the project over time--especially given disturbances such as last year's flooding--but if the LORP is locked-in, then barring the ability to create periodic large-scale natural disturbances, active intervention is appropriate.

What adaptive management is feasible, or not, is largely related to the ability to fund intervention. The Technical Group and Standing Committee approved the pole planting experiment. It was a low-cost effort to establish a proof-of-concept on which to demonstrate to third-party funders that pole planting was a reasonable investment. The ORWT is another effort at adaptive management that if successful could attract additional outside funding.

Infrastructure improvements to handle larger flows

The Consultants ask for a rough estimate of the cost to modify infrastructure. It is unlikely that a flow of 800 cfs could be established given the intake structure and hydraulic resistance. Even if such a flow could be established the cost of rebuilding infrastructure would certainly be high. Even with flows less than 250 cfs we saw roadbed saturated and road surfaces compromised. Although flows above 200 cfs have not been modeled, it is obvious that an 800 cfs flow would sheet water across the floodplain and inundate considerable stretches of cross-river road. Levee roads would need to be constructed along with elevated bridges—at considerable expense beyond the County's means.

COMMENTS ADDRESSING THE CONSULTANTS SPECIFIC RECOMMENDATIONS

MOU Consultants recommend all present (2017) and future City-County Annual Report Executive Summaries include a summary of the Adaptive Management Chapter of the report.

- This is a good idea that can be accommodated. The Consultants should produce a short (1-3 paragraphs) summary of their chapter to be included with their AMR report.

MOU Consultants recommend the LORP Scientific Team, during the winter of 2017-2018, develop a "Draft River Rehabilitation Status Report." A report that describes and documents the present environmental status of the Lower Owens River.

- This task is redundant. The LORP Annual Report already serves this purpose. If the task is to compare current conditions to desired conditions, that analysis might be helpful; however the "status" of the river is generally well known: We have a low gradient desert river with low dissolved oxygen levels. Dissolved oxygen falls to hazardous level for fish and invertebrates when flows are above about 70-80 cfs and temps are above 60-65F. Poor water quality zones are expanding upstream. We have a channel infested with tules and insufficient tree recruitment and canopy. Aggradation is occurring, exacerbated by tule growth. We would rather spend time seeking expertise on possible solutions and seeking funding to implement them then spend time documenting known challenges.

MOU Consultants recommend the City and County complete a preliminary ballpark only estimate, of infrastructure modification needed and the cost to complete these modifications (within the Lower Owens River flood-plain) in order to safely pass river flows up to 800 cfs without damaging infrastructure or cause safety concerns.

- The budget for such modifications would certainly be well above the County's entire LORP budget. Such an investigation would require an engineering study, which in itself would be prohibitively expensive.

MOU Consultants recommend no active restoration be implemented in the future without first developing a sufficient justification, testing, monitoring, and evaluation plan.

- It is unclear what observation, or compounding environmental factors would reach the threshold of "sufficient justification". We would, in part, look to the Consultants to come up with criteria, related to goals, that would justify adaptive management. Any adaptive management undertaken would be guided by a plan, with monitoring, reporting, and evaluation.

MOU Consultants recommend the Scientific Team conduct an initial evaluation of those feasible active rehabilitation interventions that could be tested for success in the future.

- Agreed.

MOU Consultants recommend the LORP Scientific Team develop a scientific based testing, monitoring, and evaluation plan to evaluate all future flushing flow effects. This methodology should be capable of determining success, failure, no effect, or any needed flow modifications.

- Agreed.

MOU Consultants recommend the MOU Parties hold a "Working-Decision Meeting" during the winter of 2017-2018. Meeting purpose is to determine those river flows, if any, the "Parties" would agree to test and evaluate.

- The Parties have made it clear that they want to see flow experiments, and are willing to modify the MOU to allow tests. However LADWP and the Owens Valley Committee have conflicting views on whether the pumpback station capacity needs to be increased in order to test high flows. The County will organize a meeting to revisit the MOU Parties needs and see if the impasse can be overcome.

MOU Consultants recommend the LORP Scientific Team "draft" a series of feasible flushing-augmentation flow scenarios along with a predicted effect analysis. The team produced "draft" report would then be submitted to the County and City for review and then forwarded to the MOU Parties prior to their Working-Decision Meeting.

- Developing such a scenario would be a prerequisite to holding such a meeting.

MOU Consultants recommend that the County, in their 2018 Annual Report, be in position to provide the evidence they believe is missing that does not allow them to evaluate proposed seasonal habitat and flushing flow effectiveness.

- Consultant's recommendation that the County provide the missing evidence to allow evaluation of changes in the flow regime misrepresents the County's concerns. The County raised concerns over the lack of biologic or hydrologic information supporting Consultant's previous recommendations to revise flow releases. Consultant's rationale was largely based on whether the revised flows were "water neutral". The County agrees and has advocated for revised flow regimes, but prefers that before the time and effort to acquire agreements to alter flows are undertaken, that the revised flow be designed to accomplish specified environmental benefits or test specific hypotheses so that appropriate monitoring may be designed.

MOU Consultants recommend the 2018 seasonal habitat flow be augmented from the Alabama Gates. The volume and duration of the augmentation flow will be recommended by the Consultants to the City and County when Owens Basin run-off conditions become available to the Consultants.

- The County agrees that augmentation from the Alabama Gates, to bring flow in the lower river up to the levels found above the Islands, is desirable. Augmentation must not lead to nutrient entrainment that could put the fishery in jeopardy. Augmentation should absolutely occur with a cool weather pulse, and conditionally occur with warm weather pulses—if the augmentation channel is clear.

MOU Consultants recommend the LORP Scientific Team test, monitor, and evaluate the Consultants recommended 2018 flushing flows to determine their success, failure, non-effect, or any flow modifications needed.

- Infrastructure in the LORP will not pass the Consultants' recommended flow without incurring damage.

MOU Consultants recommend that the Scientific Team "draft" report their flushing flow *test and evaluation findings to the County and City for their review. The "draft" report will then be sent to the MOU Parties for their information and necessary action.*

- As stated above, developing such a scenario would be a prerequisite to holding such a meeting.

MOU Consultants recommend the LORP Scientific Team be given the responsibility to properly evaluate all future fish kills. This would be accomplished via reliable data collection, documentation, analysis and report submission. Using the findings, the Scientific Team will develop information for the MOU Parties to better understand what is causing fish kills.

- We will consult with CDFW to get their suggestions as to how to better monitor fish-kills. We will employ these methods, to the extent man-power is available, when another kill occurs or is likely.

MOU Consultants recommend the County and the City conduct a recreational fishery survey in 2018. Results, with suggestions for methodology improvement should be documented in the 2018 LORP Annual Report.

- For the reasons articulated in previous reports, the County does not support the effort of a month-long recreation fishing survey. These reasons include: lack of open water in which to fish; lack of fishermen willing to participate; varying levels of fishing expertise of the volunteer anglers; fishing technique, including choice of bait/lure, preference collection of certain species over others; weather interfering with weekends available to fishermen; difficulty tracking down fishermen to collect census sheets; creel census' track catchable classes, not young of year.

MOU Consultants again recommend the County develop a "draft" recreational fishing evaluation methodology that meets their expectations. The County will then send this "draft" to the LORP Scientific Team for review and evaluation.

- The County rejects a creel census, but encourages electro-fishing each reach as an unbiased and useful method of sampling.

In 2016, the MOU Consultants recommended employing a remote sensing approach to improve accuracy and reduce the labor effort associated with walking the perimeter of *units. While both LADWP and ICWD agreed to give this recommendation consideration, it has not been adopted. The inability to walk the units this last spring and summer adds weight to the recommendation to rely upon remote imagery for this monitoring.*

- Agreed.

MOU Consultants concur that American Coot as an indicator species in the BWMA and Thibaut Units is counterproductive and recommend removing it from the indicator species list. As in 2015 and 2016, we recommend that LADWP and ICWD work together to refine the indicator species list to better reflect the actual presence and usage of targeted animals.

- Agreed.

In the response to the MOU Consultants' recommendation in previous years to develop and initiate a plan for the BWMA to seasonally wet and dry management units, LADWP and ICWD agreed to pursue such a plan in cooperation with CDW. We again urge the managing entities to address the legal and operational constraints and establish a more beneficial management plan that would be agreeable to the MOU Parties. The avian survey results clearly indicate that seasonal flooding and drying similar to the Thibaut Unit management will result in far greater bird use.

- Agreed. The County has suggested a cooperative effort to develop a revised management plan for the BWMA. The County will again suggest a cooperative approach, including CDFW, to develop a plan to improve management of the BWMA.

Effects of the high flows this year on the DHA should be evaluated using remote imagery taken during the flood periods to identify the location (east and west channels) and extent of open-water since this type of habitat has been shown to have greater value to some indicator species. Then initiate a study to determine the most suitable flow pattern for the DHA for the three periods recommended previously.

- Agreed, if such imagery is available.

MOU Consultants recommend that if LADWP is interested in increasing utilization standards in riparian pastures, that they design a rigorous scientific experiment to test the effects of increased grazing on key LORP goals such as woody riparian recruitment *and indicator species habitat.*

- Agreed.

MOU Consultants have wavered back and forth on the advisability of continuing the RAS beyond next year when it is programmed to terminate. Our recommendation is to continue part of the RAS beyond next year and that is just observing and counting riparian recruitment and conditions.

- The RAS provides surveillance of certain impacts that if not identified, contained, and eradicated, could lead to expensive intervention. Examples include monitoring of invasive and exotic species.

  The RAS is still helpful for monitoring woody recruitment and survivorship. This monitoring will help inform the relationship between flows and recruitment, and will be helpful for future planting experiments.

MOU Consultants recommend that before more pole plantings are attempted, a detailed experimental plan be developed and vetted through the Scientific Committee and the adaptive management process.

- Inyo and LADWP came up with a plan for pole-planting, which included stratifying landform choices, and plant monitoring of each individual planting. Planting methods where based on BMP. We are not sure what additional details the Consultants would recommend that would be helpful. They might reference an experimental plan that meets their expectations.

MOU Consultants recommend refunding the salt cedar control program for at least this coming year because of the risk of substantial increase in noxious weeds and salt cedar. We further recommend that eradication effort be focused on the river corridor and the flooding basins be a secondary priority as funding permits.

- Agreed. We would add BWMA as another priority treatment site.

MOU Consultants recommend increasing the CAC funding and staffing in 2017-18 to address the expected increase in lepidium and other noxious weeds throughout the LORP.

- Agreed.

MOU Consultants recommend that LADWP and ICWD development a contingency monitoring plan to account for extreme flood conditions such as this year. Monitoring should focus on discharge throughout the river, flood extent and water quality.

- Agreed; however flood management plans are the prevue of LADWP. Such a plan would consider the effect of flood control and containment on biological resources. The County would hope to review and comment on these plans.

13.0 PUBLIC MEETING AND COMMENTS

13.1 LORP Annual Public Meeting

The LORP 2017 Draft Annual Report public meeting was held on December 20, 2017, at the LADWP Bishop office. The following table lists those in attendance.

LORP ANNUAL PUBLIC MEETING

Wednesday, December 20, 2017 8:00am

Name	Affiliation	Email	Phone
Phil p [illegible]		Philipama@[illegible]	818 371 9624
Nick [illegible]	Other	Nick[illegible]@[illegible]	760 872 1110
Also in attendance:			
Dave Martin, Teri Koch, Jason Morgan, Greg Loveland, Mark Bagley,			
Richard Potashin, Deb Murphy			

13.2 Public Meeting

The audio recording of the LORP 2017 Draft Annual Report public meeting is available upon request.

13.3 LORP 2017 Draft Annual Report Comments

The comment period for the 2017 Draft LORP Report was from December 5, 2017 through January 3, 2018.

13.3.1 California Department of Water and Power Lower Owens River Project 2017 Draft Annual Report Comments

State of California – Natural Resources Agency
DEPARTMENT OF FISH AND WILDLIFE
Inland Deserts Region
3602 Inland Empire Boulevard, Suite C-220
Ontario, CA 91764
(909) 484-0167
www.wildlife.ca.gov

***EDMUND G. BROWN, Jr.**, Governor*
***CHARLTON H. BONHAM**, Director*

January 2, 2018

James Yannotta
Los Angeles Aqueduct Manager
Los Angeles Department of Water and Power
300 Mandich Street
Bishop, CA 93514

Dr. Robert Harrington
Director
Inyo County Water Department
P.O. Box 337
Independence, CA 93526-0337

Subject: LOWER OWENS RIVER PROJECT 2017 DRAFT ANNUAL REPORT COMMENTS

Dear Mr. Yannotta and Dr. Harrington:

The California Department of Fish and Wildlife (CDFW) appreciates the opportunity to provide comments on the Lower Owens River Project (LORP) 2017 Draft Annual Report. CDFW continues to support changes to the Lower Owens River flow regime, and continues to support changing wetland management practices in the Blackrock Waterfowl Management Area to improve conditions for waterfowl and shorebirds. In addition, CDFW is extremely concerned with the health of the warm water fishery throughout the LORP. The following comments aim to address the goals and challenges of the LORP as discussed in the 2017 Draft Report. Specific page number references from the 2017 Draft Report are provided in parenthesis throughout this letter.

LOWER OWENS RIVER FLOWS

CDFW continues to be concerned that the current flow regime on the Lower Owens River will not result in achievement of LORP goals. CDFW continues to support changes to the flow regime for a trial period in which comprehensive monitoring would further elucidate the impacts on various water quality parameters, riparian tree recruitment and survival. CDFW believes that the LORP Draft Annual Report includes a comprehensive synopsis of flow magnitude and associated water quality measurements during 2017.

Three high flow events occurred in the Lower Owens River during 2017: an April experimental pulse flow, peaking at 280 cubic feet per second (cfs); a May Seasonal Habitat Flow, peaking at 200 cfs; and June to August operational releases into the Owens River, peaking around 330 cfs. The differences in timing and magnitude should allow for certain inferences regarding future river management thresholds.

High flows during summer months cause hypoxic conditions in the Lower Owens River, as seen in June and July of 2017, resulting in fish and invertebrate mortality. There has been little effort to formally quantify this relationship, and thus establish thresholds for future flow releases as well as assess if the probability of fish kills is increasing; this information need is noted in the MOU Consultants Recommendations (Pages 18-19). Using a stream segment model and the information collected during the 2017 runoff year and in Inyo County and the Los Angeles Department of Water and Power's (LADWP) Hydrologic Model of the LORP, it is possible to quickly provide guideline recommendations. CDFW will present the preliminary model results in our 2018 Comment Letter on regarding the proposed Seasonal Habitat Flow, and encourages Inyo County and LADWP to continue to quantify this relationship.

The Adequacy of the Seasonal Habitat Flow
As stated in our May 2017 Comment Letter on the proposed seasonal habitat flow, the current seasonal habitat flow does not produce adequate sheer stress to meet the management objectives in the LORP Environmental Impact Report (LADWP 2004). The flushing flows in the LORP are intended to remove accumulated organic debris from the river, maintain channel width, (which creates scoured banks for riparian seedlings to germinate), and maintain topographic diversity (2004 EIR).

The effectiveness of flushing flows to meet these objectives was evaluated in part by measuring suspended organic and inorganic sediment mobilization and flux during April pulse flow in conjunction with evaluating changes to channel wetted width and profile. Assessment of sediment flux allows for an evaluation of the flow magnitude to entrain and transport accumulated organic material prior to shoreline deposition. Following established protocols, CDFW estimated suspended sediment load during the experimental April 2017 pulse flow, and provided the methods and results in the May 2017 comment letter on the Seasonal Habitat Flow (CDFW 2017). At its peak, the April 2018 flow measured 280 cfs, making it the largest controlled flow event in the Lower Owens River. During this flow event, CDFW did not record any significant increase in organic or inorganic sediment load. Daily organic sediment mobilization estimates during the pulse flow varied between 1.95 and 8.5 liters of sediment per day. The estimated daily suspended load during the April 2017 flow was less than the total amount of organic flocculent that has accumulated on one square foot of streambed (CDFW 2017).

It is clear that the river power generated by the existing seasonal flow regime is insufficient to scour the accumulated organic detritus or maintain the existing banks and channel. Continuation of the flow regime without extensive mechanical intervention will likely result in a failure to meet LORP goals. As stated in our January 2017 Lower Owens River Project 2016 Draft Annual Report comment letter, the specific timing and magnitude of flow changes warrant further discussion by all Memorandum of Understanding (MOU) Parties. CDFW agrees with the MOU Consultants recommendations that the 2018 Seasonal Habitat Flow peak at 400 cfs; additionally, CDFW recommends that the 2018 Seasonal Habitat Flow occur in April, when water temperatures (and thus biological oxygen demand) is lower. The 2018 Seasonal Habitat Flow should include appropriate monitoring to assess flow adequacy. This monitoring should include, at a minimum: collection of water quality data concurrent with the 2018 Seasonal Habitat Flow; an assessment of sediment mobilization during the 2018 Seasonal Habitat Flow; and collection of channel cross sections before and after the 2018 Seasonal Habitat Flow.

CDFW continues to be open to considering a modification the legal documents that set the base and peak flows on the Lower Owens River. At this time, CDFW supports a temporary lifting of pump back station restrictions in order to provide the flexibility to implement different flow recommendations.

Altering the flow regime of the Lower Owens River has been an adaptive management recommendation that CDFW has advocated and supported for several years (see Annual Report comment letters in 2013, 2013, 2014, 2015, 2016, and 2017). It is also evident that changes to Lower Owens River Flow regimes will require early consultation and planning with all MOU party representatives, and CDFW encourages Inyo County and LADWP to engage with the 1997 MOU parties regarding this, and other, topics. CDFW supports the MOU Consultants recommendation that an MOU party meeting occur during winter of 2017/2018 to discuss potential flow changes, and other, management recommendations on the LORP. It is apparent that failure to implement adaptive measures will result in a failure to meet LORP goals.

WARM WATER FISHERY AND FISH MORTALITY

Establishment of a healthy recreational warm water fishery is a goal of the LORP. CDFW supports an assessment of the fishery following the fish mortality that occurred in summer of 2017; however, as stated in our January 2015 comment letter, CDFW recommends LADWP and Inyo County complete this assessment using the appropriate methodology. As stated in our 2015 Comment Letter, Creel Census surveys (as proposed in the LORP Annual Report) should be avoided when assessing fish populations (Inland Fisheries Management in North America, 2010), and CDFW encourages both Inyo County and LADWP to consider augmenting or substituting the planned creel census with additional surveys utilizing more robust methodologies. The 2018 Annual Report should analyze and interpret all survey results within the limitations of their chosen study methods.

CDFW also recommends that a discussion of extent of the 2017 fish kill be included in the annual report. This discussion should include a table or map of all locations where fish mortality occurred, including off-channel lakes and ponds. CDFW is supportive of a comprehensive response to fish kills, and would like to make the following recommendations regarding investigations of future fish kills on the Lower Owens River:

- Lower Owen River inflow and measuring station readings for at least two weeks prior should be documented.

- Dissolved oxygen data and temperature data should be collected at each location where dead fish are observed in the morning and evening of the following day.

- Fish carcass retention in North American riparian habitats averages can be extremely short (*e.g.* Labay and Buzan 1998), and can average less than 24-hours. As a result, surveys for fish kills should be conducted as soon as possible following reported fish mortality events. CDFW recommends that preliminary surveys occur within 24-hours of a report.

- Information on species, size, eye clarity, gill color, and bloating should be collected carcass, and any live fish observed during the survey should be noted (Labay and Buzan 1998).

- If multiple surveys will be conducted, observed dead fish should be marked on each successive survey effort to estimate detectability.

BULRUSH AND CATTAIL GROWTH
Bulrush and cattail growth were identified as one of the main biological challenges in the LORP planning process (*e.g.* 2004 EIR), and again three years ago at the 2014 LORP Summit. Since 2014, there has been no progress on this topic; no endorsement or discussion of adaptive management actions by LADWP with MOU parties; and continuation of existing management practices, which support emergent vegetation encroachment into the channel. The LORP was intended to incorporate adaptive management actions into the design as the project progressed in order to address uncertainties in the restoration process.

CDFW believes that extensive mechanical removal of emergent vegetative growth in conjunction with flow modification provides the best option for a self-sustaining fluvial habitat, as described in the 1997 MOU. This challenge is increasingly important to address as the vegetation change analysis and aggrading state of the river indicate bulrush and cattail will likely increase along the Lower Owens River in the future. Methods to reduce or limit river aggradation should be investigated. Also, the potential for lower winter flows to allow bulrush and cattail encroachment on the channel should be investigated before winter flows are reduced.

BLACKROCK WATERFOWL MANAGEMENT AREA
CDFW concurs with LADWP's conclusion that wetland productivity and use by habitat indicator bird species at the Blackrock Waterfowl Management Area would be improved by more seasonal manipulation of certain habitat areas, including seasonal drying to control emergent vegetation (3-9 and 3-10). The best available science strongly

supports seasonal wetland management for migratory waterfowl and shorebirds (Ducks Unlimited 2007, Olsen 2013, Davis 2014); in addition to increased waterfowl and shorebird use, seasonal wetland habitat management (CWA 2015) has decreased water-use at U.S. Fish and Wildlife Service (USFWS) and CDFW-operated wetland areas and decreased maintenance costs at these locations. Data from California's Imperial and Central Valleys indicates that perennial-flood regimes result in decreased value to migratory waterfowl and shorebirds, increased maintenance costs, and increased water loss (CDFW 2014, Ducks Unlimited 2007, CWA 2015, Olsen 2013, Davis, 2014). Cost- and water- effective wetland management for waterfowl and shore birds has been implemented across California by CDFW, USFWS, and non-governmental organizations, and CDFW would like to encourage LADWP, Inyo County, and the MOU parties to implement similar management regimes.

CDFW supports LADWP and Inyo County's assessment of waterfowl use within the Blackrock Waterfowl Management Area. CDFW is encouraged to see that survey methods have been expanded to include aerial surveys, as well as additional intra-seasonal ground surveys.

CDFW would like to re-iterate our 2016 and 2017 recommendations for the Blackrock Waterfowl Management Area. Specifically, CDFW recommends the following actions to help Blackrock Waterfowl Management Area meet the goals of the 1997 MOU:

- Build a collaborative Blackrock Waterfowl Management Area team including CDFW, Inyo County, LADWP and the California Waterfowl Association to guide, fund, and implement significant adaptive management to switch largely from perennial to seasonal wetland.
- Implement science-based wetland management practices to maximize use by migratory and resident waterfowl, migratory shorebirds, and passerine birds.
- Arrange MOU party meeting to discuss changing regulations at Blackrock Waterfowl Management Area to allow a set amount of water to replace the regulatory standard of wetted acreage that currently exists.
- Develop alternative monitoring to replace current landscape vegetation mapping. Develop fine-scale topographic mapping of the Blackrock Waterfowl Management Area to determine flow direction and current topographic fall for assessing current management capabilities.
- Modify wetland unit infrastructure to allow for efficient flood-up and drawdown activities.
- Conduct systematic waterfowl surveys three times per year (peak fall migration, overwinter, spring breeding), in accordance with CDFW protocol and validated by follow-up ground surveys to evaluate the effect of seasonal wetland management.

CDFW understands that adaptive management will require early consultation and planning with all MOU party representatives, and CDFW encourages Inyo County and

LADWP to engage with the 1997 MOU parties regarding this. CDFW supports LADWP's recommendation that an MOU party meeting occur during spring or summer of 2018to discuss this.

LACK OF WOODY RECRUITMENT
Despite the high-flow-related mortality that operational releases caused within Inyo Counties' pole planting areas (Pages 8-1 to 8-6), CDFW continues to support active intervention to create sites for tree establishment. In coordination and cooperation with grazing leaseholders, CDFW supports further investigation on the potential for high density grazing in small restricted areas to create the disturbance needed to support riparian tree recruitment. In addition, current riparian trees are potentially threatened by aggradation and the sustained high flow events; interventions to maintain the river channel should be investigated and implemented in order to ensure the survival of existing riparian vegetation.

If you have any questions regarding this letter, please contact Nick Buckmaster at (760) 872-1110 or Nick.Buckmaster@wildlife.ca.gov.

Sincerely,

Heidi Calvert

Heidi Calvert
Senior Environmental Scientist (Supervisor)

cc: Chron
Nancee Murray (CDFW Office of General Counsel)
Nick Buckmaster, CDFW

Work Cited:

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13.3.2 Owens Valley Committee Comments on the Draft 2017 LORP Annual Report

the Owens Valley Committee

P.O. Box 77, Bishop, CA 93515
January 5, 2018

Owens Valley Committee Comments on the Draft 2017 LORP Annual Report

The Owens Valley Committee (OVC) thanks the Inyo County Water Department (ICWD) and the Los Angeles Department of Water and Power (LADWP) for the opportunity to comment on the 2017 LORP Annual Report.

LORP Flows

LADWP's 2017 emergency release of runoff down the LORP was not planned, and would not have occurred in an average precipitation year. Months of high flows created vast areas of inundation, which had a detrimental effect on LORP restoration efforts and project goals, and did nothing to "flush out" excessive vegetative buildup (i.e. tules) in the LORP. OVC cites these examples as results of the long-term high flow regime:

A. Promotion of more salt cedar recruitment
B. Negation of pole planting experiment
C. Negative impact regarding woody recruitment
D. Potential negative impact on tall, established willows that provide the habitat for key avian species
E. Recruitment and spread of weedy species like *bassia* and *lepidium*
F. Fish kills

OVC recommends that LADWP and ICWD monitor the impacts of last year's unprecedented flows down the LORP, and in turn evaluate and analyze the long-term impacts as a crucial part of the 2018 Annual Report. Questions that should be addressed include:

A. How much were the overall goals of the project set back?
B. Are there feasible alternatives to shunting that much water down the LORP (e.g. pulsing flows, etc.)?

OVC recommends that LADWP better plan for this type of future runoff event, and — with significant reference to monitoring efforts and analyses — thereby mitigate the negative impacts seen during the 2017 long-term emergency releases.

Recreation

A great shortcoming of the annual report is its lack of a recreational component, which is one of the stated goals of the 1997 MOU and LORP EIR. The goal of sustaining recreation is the responsibility of all parties to the LORP, not just Inyo County.

OVC believes the omission of the Owens River Water Trail (ORWT) from the 2017 Annual Report is one of the document's most glaring deficiencies. We urge its inclusion in the final report. LADWP considers the ORWT to be merely a county recreation project. Yet it has a strong potential to improve water quality and river habitat. Mechanical in-river excavation will clear 0.8 miles of river obstructions. Hand labor and specialized water craft will be used to open and maintain 1.75 miles of tule-constricted channel.

Tules are considered to be the second most pressing problem on the LORP. Fishermen, boaters, canoers, and others who wish to recreate on the river, as well as on Lone Pine and Billy Ponds, cannot access or have limited access because of excessive tule growth. Again, 2017's high flows did nothing to remove tules, and likely new areas of inundation have led to new recruitment of tules, further restricting access.

OVC supports the ORWT and the extensive mechanical removal of tules. This will provide the best opportunity for a self-sustaining fluvial habitat as dictated by the 1997 MOU. The MOU consultants support and recommend the ORWT. It was included in the 2016 report under adaptive management, and OVC demands that it be included under adaptive management in the 2017 final report.

Tamarisk Removal/ Exotic Vegetation

With huge amounts of water deposited in spreading basins along the LORP, tamarisk will re-establish itself with renewed vigor. ICWD has run out of funding for its tamarisk removal project, and only has resources to survey potential problem areas. OVC recommends that DWP, as a mitigation effort for its emergency releases, fund additional tamarisk/ invasive weed eradication efforts.

A recent discovery of tamarisk beetles on the LORP may provide another tool in the ongoing effort to eradicate tamarisk from the LORP. OVC recommends further study of this treatment method with an eye toward increasing introductions of the beetle if they prove a feasible option.

Reduced Dissolved Oxygen and Fish Kills

The high summer releases to the LORP resulted in significant fish and invertebrate mortality, yet quantifiable data accumulation appears to be lacking in this report. LADWP needs to review 2017 data, and establish thresholds for future runoff events of this nature in order to re-evaluate high flows and reduce the likelihood of fish kills like those seen this past summer. Not only do these kills affect the viability of the aquatic ecosystem, they also reduce the recreational viability of the river for anglers.

Warm Water Fishery

A major goal of the LORP is the establishment of a healthy recreational warm water fishery. OVC supports a detailed analysis and assessment of the extent of the 2017 fish kills and their overall impact on meeting this goal. This assessment should include impacts on the fisheries in off-channel lakes and ponds. This data should appear in the 2018 LORP Annual Report. We further support CDFW's recommendation that LADWP institute "more robust methodologies" than the current creel census to assess LORP fish populations and dynamics.

Seasonal Habitat Flows
The 2017Annual Report recommends raising the seasonal habitat flows to 400 cfs. The report further states that flows peaked at 380 cfs. If 380 cfs flows did little to remove organic detritus and affect bank dynamics, what greater impact will 400 cfs flows have? Without some form of mechanical intervention, a 400 cfs flow will do nothing and LORP goals will remain unmet. OVC supports the kind of mechanical intervention and adaptive management proposed by the Owens River Water Trail project, which seeks to clear and provide watercraft and angler access to over a 6 mile stretch of the LORP.

Rapid Assessment Survey (RAS)
Although it is scheduled to expire, OVC supports the continuation of the RAS as one of the more effective methods of monitoring the LORP. Not only does the RAS help assess woody recruitment and survivorship of seedlings it also tracks beaver populations and new infestations of invasive species.

Monitoring Equipment
During the recent (December 21, 2017) meeting regarding the LORP Annual Report, several references were made to monitoring equipment that is no longer working or in need of repair. Accurate readings of stream criteria may be affected. OVC supports the repair and/ or replacement of such equipment so we can continue to harvest quality data in a timely manner.

Agriculture
OVC seeks more discussion in the annual plan regarding sustainable agriculture on the LORP. Specifically, how the abundance of tules and last summer's flooding are negatively impacting floodplain forage.

Woody Recruitment
High summer flows down the LORP dealt a crushing blow to the pole planting project. OVC continues to support active efforts to establish tree sites along the riparian corridor. OVC urges DWP and ICWD to fund and implement another pole planting project in the coming season. OVC also urges real monitoring of established riparian vegetation, such as willows and cottonwoods, which likely were also impacted by root inundation for an extended period. We cannot afford to lose trees so vital to numerous avian species.

Public Engagement in the LORP
OVC urges the following steps be taken to enhance the quality of public engagement for the LORP Annual Report meeting:

1. Schedule meetings at hours convenient to the general public, i.e. in the evenings after the average work day. (Not at 8:00 A.M. on a Tuesday)
2. Rotate meeting locations to Lone Pine and/or Independence so residents of southern Inyo County, where most of the LORP is located, have a chance to provide input.
3. Provide the public with adequate advance notice of meetings through press releases, radio announcements, etc.
4. Contact the LORP consultants well in advance of the meeting to elicit their involvement in the process.
5. Have technical experts on hand at the meeting to answer specific technical questions.

6. Facilitate annual report meetings with an atmosphere of patience and jointly-sought clarity on these important issues.
7. OVC demands that future LORP comment periods not coincide with the holiday season. Schedule comment periods well before or well after the holidays.

The future of LORP

The LORP is now a decade old and OVC is concerned that many of its goals are not being met. OVC proposes a meeting of the MOU parties in the future to re-evaluate the goals of the project.

OVC is thankful for the additional time provided to submit these comments.

Sincerely,

Mary Roper
President, Owens Valley Committee

13.3.3 Sierra Club Comments on the Draft Lower Owens River Project 2017 Annual Report

VIA EMAIL

Date: January 5, 2018

From: Mark Bagley
Sierra Club 1997 Owens Valley MOU Representative
<markbagley02@gmail.com>

To: Bob Harrington,
Inyo County Water Department Director
<bharrington@inyocounty.us>

–and–

Jim Yannotta
Manager of the Los Angeles Aqueduct, LADWP
<James.Yannotta@water.ladwp.com>

Subject: DRAFT LOWER OWENS RIVER PROJECT 2017 ANNUAL REPORT COMMENTS

This memo is being submitted on behalf of Sierra Club, a party to the 1997 Owens Valley MOU. It represents Sierra Club comments on the "Draft 2017 Lower Owens River Project Annual Report" released by Inyo County and LADWP.

Comments on the LORP Annual Report Review Process

As previously noted multiple times by MOU parties and others, including the MOU Consultants, the process for the LORP Annual Report review and the opportunity to provide meaningful input on the draft report including the adaptive management recommendations is flawed and needs to be addressed by the MOU parties. The Annual Report release date (which is typically in mid-December, just before the holidays), annual public meeting, and total review time of 30-40 days do not allow for adequate public review of the 200-plus page Annual Report and constructive dialogue with the public, MOU parties and consultants on the monitoring program, adaptive management recommendations, and report presentation. Every year the MOU parties go through a perfunctory process that inhibits providing meaningful input and helping to make the necessary adaptations to achieve LORP objectives in a cost-efficient manner. DWP's budgeting process and the Stipulation and Order should be not be used as an excuse for the current irrational timetable particularly if there are opportunities to make the program more cost-effective and increase the possibility of meeting the LORP goals.

LORP Goals

The Lower Owens River Project (LORP) is, in addition to being a requirement of the Inyo-LA Long Term Water Agreement, a mitigation project in the Los Angeles Department of Water and Power (LADWP) 1991 EIR on water gathering activities to fill the Second Los Angeles Aqueduct. In that EIR it is presented as compensatory mitigation for numerous, diffuse and unquantified adverse environmental impacts due to groundwater pumping and surface water management practices of LADWP that occurred in Owens Valley from 1970, with the commencement of operation of the Second LA Aqueduct, to 1990.

It is important to note that the LORP is not a "restoration" to previous conditions pre-1913. That would be impossible given the export of so much water from the system to Los Angeles. Rather, as the result of the 1997 MOU, the river was designed to be managed to achieve goals set forth in the MOU (see below) using certain agreed upon flows. What was agreed on was not a certain volume of water for the project, but flow rates: a 40 cfs minimum base flow in the river, year-round and throughout the river, and a spring seasonal habitat flow (SHF) with a peak flow of 200 cfs in average or above average runoff years and lower peaks in less than average runoff years. The timing, duration and ramping of the SHF was left to the recommendation of the MOU Consultants in their LORP Ecosystem Management Plan and to later adaptive management as needed to meet the goals of the project.

The overall goal of the LORP is provided in Section II. B. of the 1997 MOU:

> "The goal of the LORP is the establishment of a healthy, functioning Lower Owens River riverine-riparian ecosystem, and the establishment of healthy, functioning ecosystems in the other physical features of the LORP, for the benefit of biodiversity and Threatened and Endangered Species, while providing for the continuation of sustainable uses including recreation, livestock grazing, agriculture and other activities."
>
> "The Goal of the LORP includes:
>
> 1. Establishment and maintenance of diverse riverine, riparian and wetland habitats in a healthy ecological condition. The LORP Action Plan identifies a list of "habitat indicator species" (Table 1, Attachment A) for each of the areas associated with the four physical features of the LORP. Within each of these areas, the goal is to create and maintain through flow and land management, to the extent feasible, diverse natural habitats consistent with the needs of the "habitat indicator species." These habitats will be as self-sustaining as possible.
> 2. Compliance with state and federal laws (including regulations adopted pursuant to such laws) that protect Threatened and Endangered Species.
> 3. Management consistent with applicable water quality laws, standards and objectives.
> 4. Control of deleterious species whose presence within the Planning Area interferes with the achievement of the goals of the LORP. These control measures will be implemented jointly with other responsible agency programs.
> 5. Management of livestock grazing and recreational use consistent with the other goals of the LORP."

Additionally, in Section II.C the MOU provides more specific goals for each of the four project areas:

1. "The goal for the Lower Owens River Riverine-Riparian System is to create and sustain healthy and diverse riparian and aquatic habitats, and a healthy warm water recreational fishery with healthy habitat for native fish species. Diverse natural habitats will be created and maintained through flow and land management, to the extent feasible, consistent with the needs of the 'habitat indicator species' for the riverine-riparian system. These habitats will be as self-sustaining as possible.

Management of flows in the riparian-riverine system will be consistent with the flow regime set forth below."

2. Delta Habitat Area. "The goal is to enhance and maintain approximately 325 acres of existing habitat consisting of riparian areas and ponds suitable for shorebirds, waterfowl and other animals and to establish and maintain new habitat consisting of riparian areas and ponds suitable for shorebirds, waterfowl and other animals within the Owens River Delta Habitat Area. Diverse natural habitats will be created and maintained through flow and land management, to the extent feasible, consistent with the needs of the 'habitat indicator species' for the Owens River Delta Habitat Area. These habitats will be as self-sustaining as possible."
3. Off-River Lakes and Ponds. "The goal is to maintain and/or establish these off-river lakes and ponds to sustain diverse habitat for fisheries, waterfowl, shorebirds and other animals as described in the EIR. Diverse natural habitats will be created and maintained through flow and land management, to the extent feasible, consistent with t h e needs of the 'habitat indicator species' for the Off-River Lakes and Ponds. These habitats will be as self-sustaining as possible."
4. Blackrock Waterfowl Habitat Area. "The goal is to maintain this waterfowl habitat area to provide the opportunity for the establishment of resident and migratory waterfowl populations as described in the EIR and to provide habitat for other native species. Diverse natural habitats will be created and maintained through flow and land management, to the extent feasible, consistent with the needs of the 'habitat indicator species' for the Blackrock Waterfowl Habitat Area. These habitats will be as self-sustaining as possible."

Comments on Progress Towards Achieving LORP Goals

The Annual Report represents a lengthy compilation and analysis of a tremendous amount of monitoring data but progress towards LORP goals and objectives over the life of the project cannot be easily discerned from the report. DWP and Inyo County as the LORP implementing agencies should use the Annual Report to inform the public and decision-makers whether LORP is achieving its goals and objectives and not merely as a check-the-box exercise in monitoring and flow compliance.

A clear assessment and analysis of progress towards project goals and objectives and whether the goals and objectives are sustainable should be included in the Annual Report and not relegated to the Adaptive Management Recommendations chapter. Taking the monitoring data and analyzing it to determine progress, or lack thereof, towards achieving project goals and objectives is a separate task from making adaptive management recommendations and one which is largely missing in the Annual Report. The management recommendations need to be based on the analysis of project outcomes determined from the monitoring data, i.e. the analysis of progress towards achieving project goals. In making adaptive management recommendations one needs to have some understanding why adequate progress is not being achieved, then suggesting actions to address that.

Sierra Club is concerned that project goals are not being met for at least several components. There has been loss of mature riparian trees in the project area and little recruitment of tree species. Additionally, there has been a huge expansion of marsh habitat in the riparian area. These developments have been good for the marsh dwelling habitat indicator species, but detrimental to the habitat indicator species that require riparian woodland habitat and to the enhancement of biodiversity in the LORP area. We also remain concerned about the health of the warm water fishery, the lack of completion of the Habitat Conservation Plan for the LORP and any efforts at recovery of Threatened and Endangered fish and bird species.

Comments On River Flows

Sierra Club has in the past expressed our concern that the current flow regime in the LORP is not and perhaps will not result in the achievement of LORP goals. We continue to have that concern and support changes to the flow regime, for a least a trial period, that were discussed by the MOU parties several years ago. We continue to support a temporary lifting of pump back station restrictions to provide LADWP with the flexibility to implement different flows.

It is clear the the very high Lower Owens River flows in the summer of 2017 were dictated by LADWP infrastructure needs given the record runoff and not with benefit to the LORP habitats in mind. The high flows created a large fish kill in the channel, killed the trees that were pole planted in early 2017, flooded large areas that potentially will greatly spread salt cedar and other weeds, and may have killed what trees have been recruited over the past few years. Monitioring in 2018 should look at just how the high flows affected LORP habitats, i.e. land forms, existing trees, weeds, and fish; and look at their affects on infrastructure, i.e. roads, flow measuring stations.

We concur with the MOU Consultants recommendation that the 2018 seasonal habitat flow be augmented from the Alabama Gates to provide additional flow in the lower reaches of the river. We have recommended this in the past, along with a recommendation that conveyance of water from the Gates to the river be improved. At our 2014 LORP summit meeting LA and Inyo agreed to study options for this improved conveyance, but we have seen nothing on this since then.

Comments On Tule (Bulrush and Cattail) Growth

Sierra Club continues to be very concerned with the spread of tules in the river channel and on the floodplain where wet meadows continue to be converted to tule marsh. This was discussedthe the 2014 LORP summit, but there does not appear to be an progress in addressing this issue through adaptive management since then. Adaptive management was intended as a major management tool for the LORP, but does not appear to be being used much.

Comments On the Owens River Water Trail Project

Why was this project not addressed in the annual report. We believe it should be included and that the project would provide a test of potential adaptive management measures for the control of tules. This project would not only provide a greatly needed recreational opportunity, but would have habitat benefits. The project includes some removal of tules that would potentially greatly improve flows in the water trail project area. This potentially would create more open water on the river to the benefit of waterfowl, and remove channel blockages that back up water and result in expanded tule growth onto flood plain meadows to the detriment of livestock grazing.

Comments On Blackrock Waterfowl Habitat Area

Sierra Club supports the assessment of waterfowl use here and the ideas for modifications to flow management in the area. A new management plan for this area should be prepared this winter for implementation this spring and the rest of the year. Such changes were discussed at our 2014 LORP summit, it is time for some adaptive management.

Comment On MOU Party Meeting

Sierra Club supports the idea of the 1997 MOU parties meeting to discuss adaptive management issues, particularly those that would require some changes to the legal documents.

Sincerely,

Mark Bagley

cc: Larry Freilich, ICWD
Larry Silver, Sierra Club