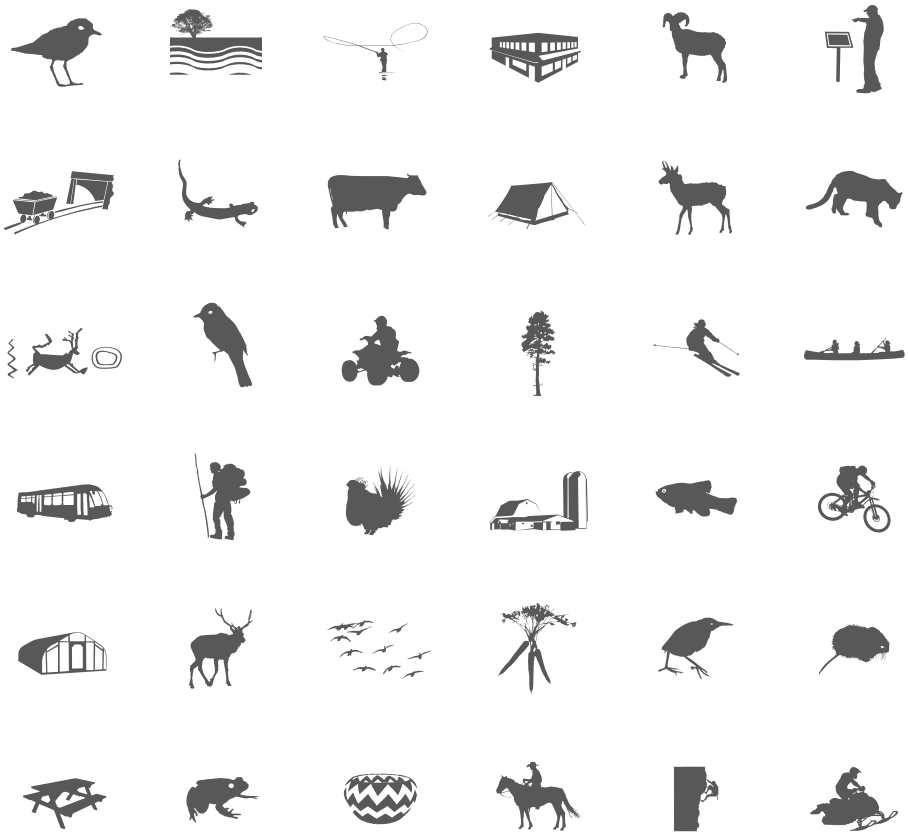
WATERSHED WHISPERERS

Exploring Potential for Water Use, Infrastructure, and Environmental Justice in the Owens Valley and Mono Basin [SUMMARY REPORT]



California State Polytechnic University, Pomona
Department of Landscape Architecture
Sponsor: Metabolic Studio
Principal Investigator: Professor Barry Lehrman

606 Studio Team: Tiernan Doyle, Eric Haley, James Powell, and Devon Santy
Spring 2013

AQUEDUCT FUTURES
The Lifeline of Los Angeles

Figure 1. Grant Lake from the Dam
Photo: Eric Haley 2012

WATERSHED WHISPERERS SUMMARY REPORT

Introduction

The Los Angeles Aqueduct has been a source of urban growth, wealth, and prosperity, as well as intense animosity, environmental degradation, and extensive legal action for over one hundred years. Since before the Aqueduct's completion in 1913, the multi-faceted relationship between the Eastern Sierra and the City of Los Angeles has perpetuated continued discussion over resource extraction and water usage that extends outward into the greater United States (Libecap 2004). While complex, the issues that demand reexamination of this subject and of the regional impacts of the Aqueduct on its watershed are not new. Groundwater pumping, stream diversions, habitat loss, and economic stasis can be seen as the side effects of large-scale urban water projects across the globe (Glennon 2002). In 1913, Los Angeles was ahead of its time in establishing one of its main water supplies over 200 miles away from the city center (Libecap 2004), but this story has become increasingly familiar as urban areas transform into megalopolises enabled by ever increasing control and regulation over distant water sources (Birch and Wachter 2011). As the 100 year anniversary of the Aqueduct passes, Los Angeles and the Eastern Sierra have the potential to become leaders and curators of sustainable water sourcing and supply that will be an example for other cities throughout the world.

Aqueduct Futures

In response to the centennial anniversary of the Los Angeles Aqueduct's completion, Professor Barry Lehrman of the California State Polytechnic University of Pomona created the Aqueduct Futures Project to explore the next 100 years of water use and development in Southern California. This project took the form of interdisciplinary courses that included community engagement, and developed an exhibit and website aimed at the general public and K-12 schools. The overall goal of these efforts was to advance policy and practices related to the adaptability, resiliency, and

Figure 2. Independence Wellfield Erosion
Photo: James Powell 2013

sustainability of the water infrastructure in Southern California; raise awareness about the water/energy nexus; and explore the cultural and ecological impacts of the Aqueduct.

606 Studio

As part of this larger effort, Professor Lehrman sponsored a team of graduate students from the Masters of Landscape Architecture program at the California State Polytechnic University of Pomona to develop regional strategies for sustainable land use and watershed planning along the northern half of the Aqueduct. Working as part of the program's capstone 606 Studio, this team developed a vision plan for the Owens Valley and Mono Basin watersheds that explores land planning possibilities and alternative futures of the Eastern Sierra region. Recognizing that Los Angeles and the Owens Valley now have the tremendous opportunity to become leaders in the realm of sustainable water supply, cooperative land stewardship, and resource resiliency, this vision plan examines different ways in which these possibilities may be realized and expanded into the future.

Goal

The overall goal of the project is to create a vision plan for the Owens Valley and Mono Basin watersheds that balances human and ecological needs through environmental stewardship and the development of resilient infrastructures.

Objectives

The objectives for this project were developed from a combination of rigorous background research and discussions with the client. They were reexamined and refined after extensive meetings with key stakeholders and local residents.

- Identify land with the greatest potential for hydrologic regeneration.
- Protect areas of crucial habitat and locate opportunities to increase or enhance habitat connections.
- Propose sustainable and ecologically sensitive recreation enhancements that encourage stewardship and increase tourism.
- Create guidelines for economic development that utilize local resources and promote the area's cultural heritage.
- Develop guidelines for agriculture that support ecosystem health while providing increased food security for local residents.
- Identify areas of potential land use conflicts and propose management guidelines for their resolution.
- Create suggestions to prepare residents and local infrastructure to better absorb fluctuations in resource availability.

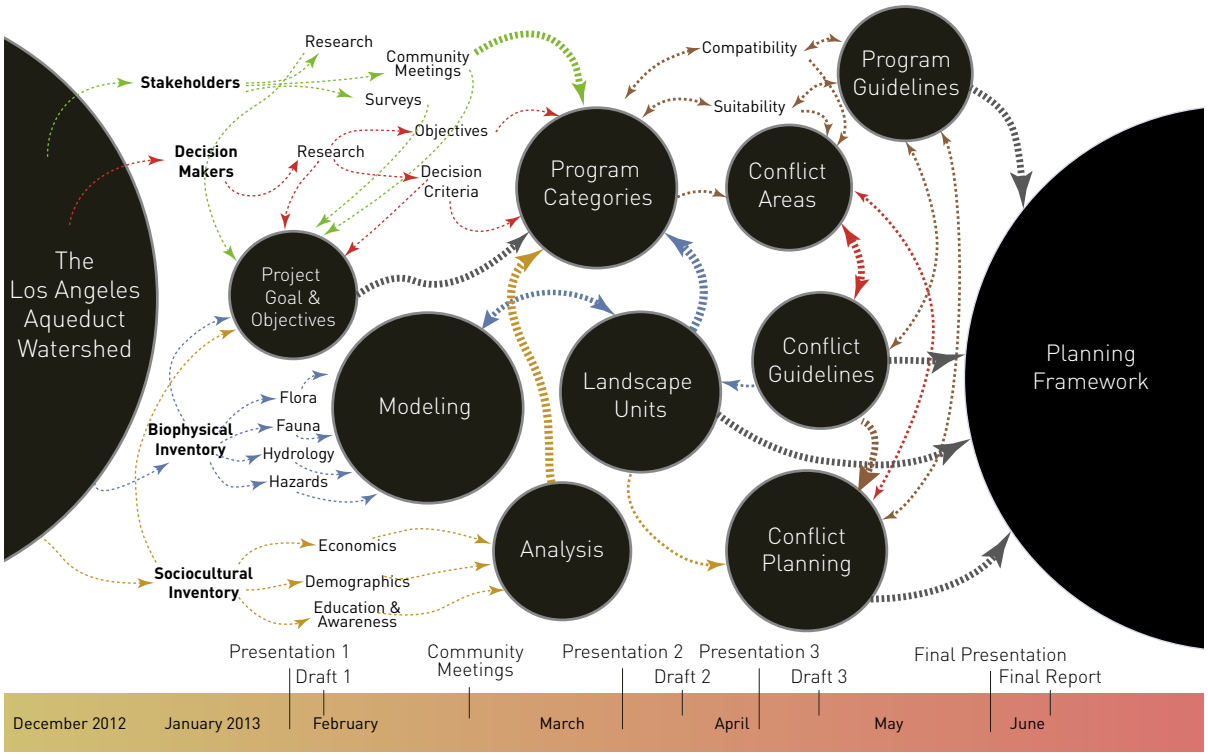


Figure 3. Project Timeline and Process Diagram

Project Timeline and Processes

Due to the study area's size of 4,188 square miles (10,847 sq km), the complex interactions of its interlocking ecological, social, and political systems, and the open-ended nature of the original project, a range of design processes and methods were employed to create the necessary structure and a cohesive working environment for the study. As the project developed, different methods became more applicable and it was suitable for the project to incorporate elements from Carl Steinitz's *A Framework for Geodesign* (2012), John Lyle's *Design for Human Ecosystems* (1985), and Margaret Carr and Paul Zwick's *Smart Land-use Analysis: The LUCIS Model Land-use Conflict Identification Strategy* (2007). Each method has informed the overall project organization, the types and methods of data collection, the analysis of that data, the selection of target audiences, and the definition of land use guidelines. The project was undertaken between November 2012 and June 2013, and followed the timeline shown in Figure 3.

The project was finalized in June 2013, with a final presentation of the vision plan materials and creation of this document. Documentation of the final study is offered for stakeholders and decision makers who have requested copies in digital or printed format. Results of the study are also available online, for decision makers, planners, and community groups who have expressed interest in implementing changes and recommendations made by the 606 team.

Figure 4. Project State Context
Data Sources: USGS NHD 2010, ESRI 2010, US Census 2010

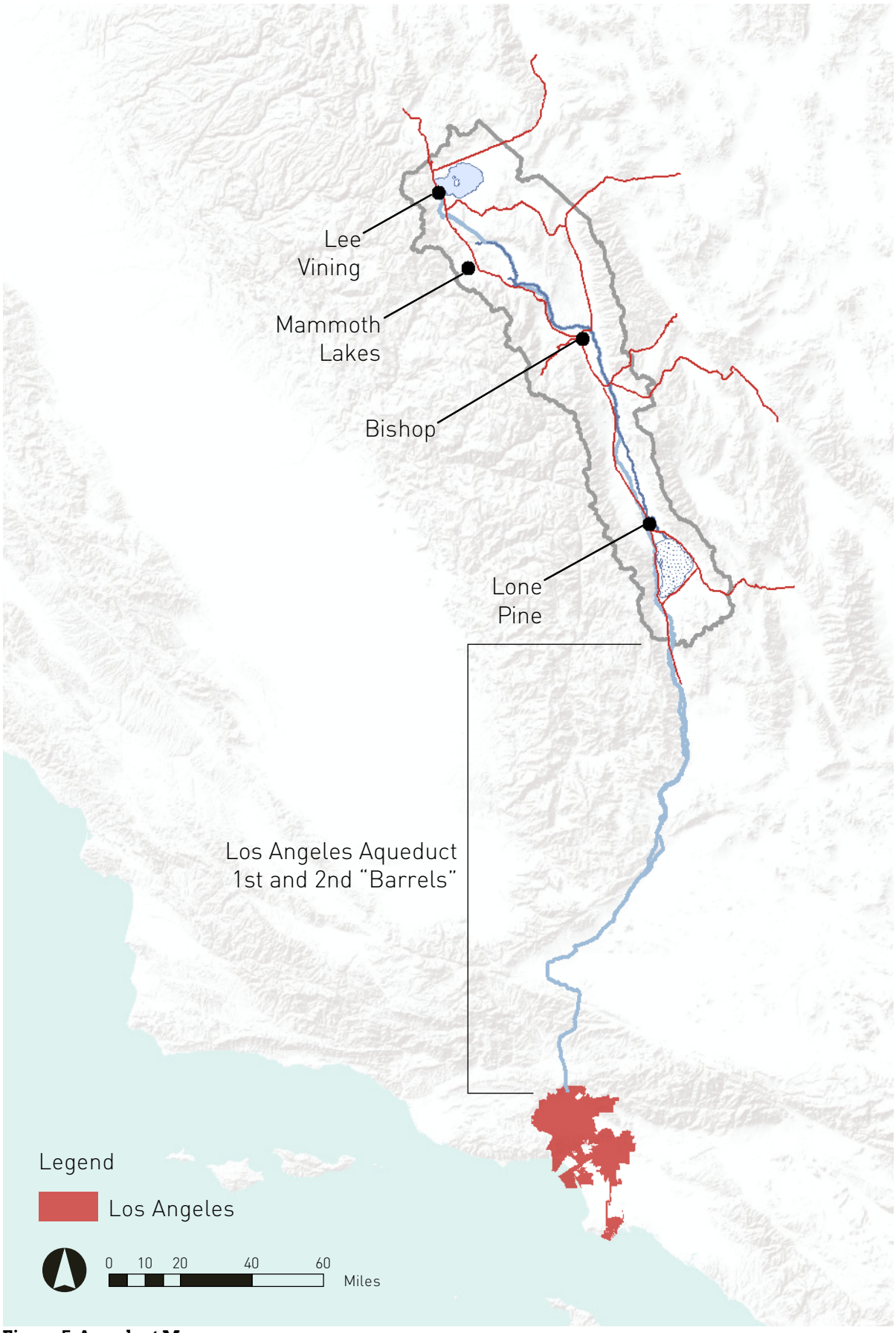


Figure 5. Aqueduct Map
Data Sources: NHD 2010, ESRI 2010

Figure 6. Los Angeles Water Sources, 20-Year Ranges 1984-2004
Data Sources: ESRI 2010, National Hydrology Data Set 2010, LADWP 2010, Zetland 2008

Study Area Context

Setting the Stage

The project area is located approximately 233 miles northeast of the City of Los Angeles (see Figure 4). Bounded on the western side by the peaks of the Sierra Nevada and by the White and Inyo Mountains to the east, the Owens Valley is the deepest valley in the United States (see Figure 5). Together with the creeks that drain into Mono Lake, these areas make up the watershed for the Los Angeles Aqueduct. Though the Eastern Sierra provides over half of the water supply of Los Angeles (Figure 6), the local population is sparse, and scattered mainly in small, unincorporated towns that are situated near Highway 395, which runs north-south through the entire area. In total, the study area comprises 4,188 square miles (10,847 sq km) with a population of 34,000 in 2013. This can be compared with the City of Los Angeles, which had a population of 3.82 million in 2011, and occupied 503 square miles (1,302 sq km).

As it looks today, the Eastern Sierra is a sparsely inhabited area between two massive mountain ranges. Only a handful of towns provide homes for the bulk of the local residents, with miles of open land in between. In the past few decades, hydrologic extractions and diversions have caused a flurry of litigation revolving around the environmental effects of water export. While issues such as drawdowns from Mono Lake and air quality remediation around Owens Lake have established important precedents for the State of California (James 2005, LADWP 2006a), legal battles fought over ecological effects of the water exports from the area have also made changes on the local scale. Severe environmental degradation such as habitat destruction, dried up springs, and significant river channelization are slowly being addressed by mandated mitigation projects (LADWP and ICWD 1991). Though many of the conditions agreed to in legal settlements have not yet been fulfilled, there is some ongoing work to preserve remaining ecosystems, and efforts have been made to rehabilitate other natural processes that had been destroyed. However, as mitigation projects are undertaken only after evidence of environmental harm has appeared, the area is still experiencing degradation and there is much work yet to do.

Figure 7. Walker Creek Diversion Impoundment
Photo: Eric Haley 2013

Characters

Land ownership within the study area is concentrated within the hands of three major agencies: the Los Angeles Department of Water and Power (LADWP), which exports the water resources of the area to supply the City of Los Angeles; the United States Department of Interior Bureau of Land Management (BLM), a federal agency which oversees mineral resources and energy production on government land; and the United States Department of Agriculture Forest Service (USFS), which manages timber, water, and recreation resources within the Inyo National Forest. Though they have major impacts on the lands and resources in the area, the decision making and planning processes of these agencies are often disparate and made at a scale that does not reflect the needs of the watershed as a whole.

Current Planning Context

Due to the multifaceted demands of land planning for human and ecological needs, it has been difficult to establish a management protocol that retains enough water within the Eastern Sierra while still providing adequate supply for the City of Los Angeles. Lawsuits involving decision makers and stakeholders have been a way of life since the 1920s, when disputes over land ownership between farmers and the City of Los Angeles became more intense (Libecap 2005).

Mono Lake Legal Battles and Decisions

The Los Angeles Department of Water and Power began exporting water from Mono Basin in 1941 (LADWP 2002). Four streams that drain the southwest portion of Mono Basin were diverted into the Los Angeles Aqueduct system: Lee Vining Creek, Rush Creek, and its two tributaries Parker Creek and Walker Creek (Hart 1996, Koehler and Anderson 1995) (Figure 7). The water from these creeks is diverted to Mono Craters Tunnel, part of the expansion of

the Los Angeles Aqueduct completed in 1940 to tap the Mono Basin (Smith et al. 2000).

Though the water levels of the lake have fluctuated somewhat throughout its history, the Aqueduct diversions created a 40-foot (12-meter) drop in the surface before action was taken to curtail water withdrawals (Herbst 1991). Though this process was gradual, it exposed 12,355 acres (5000 hectares) of previously covered lake bottom and created a land bridge to the islands in the middle of the lake that threatened to destroy the gull rookeries there.

In 1983, the State Supreme Court ordered the State Water Resources Control Board (SWRCB) to reevaluate the water rights granted to LADWP in order to restore some balance between the Public Trust resources of Mono Lake and the beneficial use of the water by LADWP (Loomis 1995). This was not completed until 1994 when the SWRCB issued an order (Decision 1631) establishing a maximum annual export of 30,800 acre-feet of water from the Mono Basin (Loomis 1995). Additionally, the order stated that a flow of at least 50 cubic feet per second must be maintained in the four creeks diverted by the LADWP. Meanwhile California Trout had filed suit against the LADWP and won other important decisions that influenced Mono Lake; most notably, the State Superior Court required LADWP to modify or even cease diversions as necessary to maintain a minimum lake level of 6,377 feet (1,943 meters) above sea level (Koehler 1995, Loomis 1995).

The 1994 Decision 1631 established a target lake level of 6,392 feet (1,948 meters) above sea level (Jellison, Romero, and Melack 1998); a goal that would be reached by a tiered set of regulations for creek diversion. As defined by the order, minimum diversions would be mandated until the lake recovered to an intermediate level.

Owens Valley Legal Issues and Plans

Owens Valley has been the subject of significant legal mandates and planning efforts since environmental issues were

Figure 8. Owens Lake
Photo: Sandy Redding 2010

first linked to LADWP water diversions in the 1970s. In 1972 Inyo County filed the first of many lawsuits against LADWP claiming that increased groundwater pumping to fill the new Second Los Angeles Aqueduct was harming the environment (James 2005). This action took advantage of the newly passed National Environmental Protection Act, which required that an environmental impact report (EIR) be completed for the construction of the second Aqueduct. As this had not been done, the LADWP was subject to court penalty.

One of the most significant effects of the legal settlements was the creation of the Long Term Water Agreement (LTWA) established in 1991 between Inyo County and LADWP (LADWP and ICWD 1991). The agreement addresses the health of vegetation in the Owens Valley, groundwater pumping, and the relationship between the two. A critical management strategy provided by the LTWA is the evaluation of water availability for the Owens Valley based on the precipitation for each water year. Each year, the snowpack and runoff available by April 1st is evaluated in order to judge how much water can be pumped from the aquifers in the valley without significant environmental impact (LADWP 2012a).

The LTWA also provides guidelines for groundwater monitoring. Monitoring must determine on July 1 and October 1 of each year whether the groundwater available at each well is enough to sustain the vegetation for the remainder of the growing season. If not, the well must be shut off. Groundwater pumping regulations are set in the Green Book, a technical document prepared by Inyo County Water Department (ICWD) and LADWP as an amendment to the LTWA (ICWD 1990). The Green Book provides guidelines for monitoring vegetation health, and provides goals for vegetation quality that must be met by maintaining a sufficient water supply to the area (ICWD 1997). The ICWD began revising the Green Book in 2006, and was joined in this effort by the LADWP. While the document

is undergoing this update, a groundwater pumping policy called the Interim Management Policy (IMP) sets the guidelines for monitoring groundwater levels, establishing pumping limits or turning wells on and off (ICWD 2013).

In 1997, a Memorandum of Understanding (MOU) between LADWP, the County of Inyo, the California Department of Fish and Game, the California State Lands Commission, the Sierra Club, and the Owens Valley Committee was established to further govern reporting of water management activities in the Owens Valley (LADWP and ICWD 1997). The 1997 MOU requires LADWP and Inyo County to prepare annual reports describing environmental conditions in the Owens Valley and the progress of associated studies, projects and activities conducted under the LTWA. Most notably, the 1997 MOU established the Lower Owens River Project, which has returned surface water flows to the Owens River downstream of the Los Angeles Aqueduct diversion near Aberdeen.

The Lower Owens River Project (LORP) is a multifaceted project meant to restore in-stream and riparian habitat for flora and fauna, and provide land management plans for LADWP leases in the area. The land management plans focus on enhancing native habitat diversity while allowing for sustainable grazing, with directed focus on riparian areas, irrigated pastures, and areas with sensitive species or habitats. As presented in the Action Plan prepared by Hill and Platts (1997), the LORP seeks to maintain healthy habitat for both native and exotic flora and fauna since such species may compete for space and much riparian habitat was compromised by water withdrawals. Plans prepared by the Berkeley and Oregon branches of the firm MIG, Inc. utilize the enhanced ecological resources of the project area to incorporate new recreational opportunities including boating and a trail system for hiking and/or biking (MIG 2013).

As the Lower Owens River became waterless as a result of diversions to the Aqueduct, its terminal point of Owens Lake also dried up. Historically the final sink for the waters of the river, a few spring-fed wetlands around the edge, are now the only naturally irrigated portions of the lake (Tyler et al. 1997) (see Figure 8). The result was one of the largest human-made sources of particulate air pollution in the world. Due to the interaction of high seasonal winds and the fine-grained lake sediments, Owens Lake is now responsible for 6% of all airborne pollutants in the United States (Reheis 2002). A series of legal mandates including a 1999 Memorandum of Agreement with the Great Basin Unified Air Pollution Control District (GBUAPCD), a 2003 State Implementation Plan, and an additional agreement between GBUAPCD and LADWP in 2006 require LADWP to construct dust control projects on the lake to meet federal air quality standards (LADWP 2006).

LADWP has implemented several different forms of dust mitigation projects ranging from sprinklers and bubblers irrigating the lakebed, berms that minimize the effects of the wind, and gravel spread on the lakebed that holds particulates down, to aquatic vegetation projects that flood away dust. Seeking innovative solutions to this problem, LADWP has also subcontracted three landscape architecture and planning firms: AHBE, Mia Lehrer and Associates, and Nuvis, to design strategies for dust control while integrating habitat and public use. Each of these three firms has designed small sample plots in the southeast portion of the dry lake to test techniques and effectiveness.

Figure 9. Alabama Hills Arch
Photo: Eric Haley 2012

Processes

The effects of the geography of the Eastern Sierra are not limited to striking scenery alone (Figure 9). Topography and terrestrial processes have created intricate patterns of weather, hydrologic resources, and geologic activity. Specialized plant communities and wildlife species developed to take advantage of the resulting landscapes. Because of the relative isolation of the area, and the specialized conditions, the Eastern Sierra is home to a multitude of rare and endangered plant and animal species that are scarce throughout the rest of California. Though much of the area is kept undeveloped because of federal ownership, a long history of resource extraction that includes mining, water withdrawals, and electricity generation has taken a toll on the land, the effects of which are especially visible in the desiccated springs in the Owens Valley. Resource extraction has affected ecologies of the area by degrading wildlife habitat and causing widespread conversion of vegetation types, but it has also taken a toll on the local communities.

Because of the large amount of federal and municipal land ownership in the area, the economy has remained stagnant, privately owned land is virtually non-existent, and the employment sector is dependent on government jobs and a highly seasonal tourism base.

Figure 10. Lone Pine Community Workshop
Photo: Eric Haley 2013

Community Outreach

Community outreach was a vital component that helped to shape the final goal, objectives, and deliverables of the project. Outreach was conducted through two community workshops, 12 stakeholder interviews, and an online survey, which was open to residents of the Eastern Sierra for two months. The information gained from these meetings confirmed a great deal of information that had already been obtained through background research, but it also introduced new topics that were of great importance to local communities. After analyzing the content from the community meetings, it became clear that the main areas of planning importance within the Eastern Sierra involved agriculture, town development, wildlife habitat, water resources, and recreation.

Focus Group Results

To understand the concerns of the study area residents, the team facilitated two community workshops: one in Lone Pine, California on February 16, 2013 (Figure 10), the other one in June Lake, California on February 17, 2013. In both workshops, participants expressed a desire to bolster the local economy by refining and focusing on the recreation-based tourism in the area.

In addition to concerns about the local economy, residents also expressed a desire for local food sovereignty. Many of the participants at the Lone Pine workshop were passionate about building a network of local agriculture production to provide more locally sourced food. Workshop participants made it clear that a movement had already begun and expansion of such a local food network would be well within their means.

Cooperation and communication was introduced through a variety of suggestions ranging from internet connectivity and information technology; to increasing participation and cooperation from LADWP in local planning efforts; to developing education programs in the Los Angeles area to inform end users about the source of their water and the implications of extracting it from the Eastern Sierra.

Participants at both meetings individually expressed the desire to see elements of cultural heritage and historical significance preserved. Concern for cultural heritage was reflected in the importance placed on the opinions, values, and traditions of local people, while the wish to preserve historic structures and places underscored the importance of the area's unique character.

Many individuals at both meetings expressed that they valued the dark night skies and the unobstructed views of the mountains. While the objectives do not directly address the visual aesthetics of the area, the team carefully considered this desire when formulating planning guidelines and recommendations to ensure that they do not detract from the impressive vistas of the Eastern Sierra.

Survey Results

The team posted a survey on watershedwranglers.com to obtain local opinions about various topics from political decision-making to ecological health in the Eastern Sierra.

Land ownership is a frequently addressed topic within the Eastern Sierra, as there are few parcels available for private purchase and an overwhelming majority of land in the Eastern Sierra is owned by government agencies. Results of the survey question addressing land ownership suggested that area residents are mostly satisfied with the current situation, though there is some feeling that more land should be privately owned. Despite the few stated preferences for more individual ownership, responses also showed that local citizens would be in favor of more protected public lands.

To better understand local opinions about economy and recreation, several survey questions addressed tourism. Nearly all respondents suggested that tourism is important to their local economy. With so much land accessible for public use, the tourism industry is almost entirely based on outdoor active recreation. Local opinions of recreation activities suggested that the dominant forms of recreation include winter sports, camping, fishing, and hiking.

Looking for more nuanced data on the status of local economies, the survey addressed potential new development, the current job market, and new businesses. Responses showed that while most would be opposed to a great deal of new development, they also saw benefit in attracting new businesses to their communities. In regards to employment, survey respondents generally agreed that there were enough jobs for the residents, though several rated the opportunities as inadequate or severely deficient. This may reflect the situation identified by the workshop participants (Figure 10), where although there were enough jobs, they were low-paying.

Meeting Results

In order to develop a better understanding of specific aspects of planning within the Eastern Sierra, the team met with 14 individuals representing different agencies and interest groups.

Several important themes were expressed by these contacts, some of which were addressed by several individuals. The most common theme was the lack of constructive cooperation between LADWP and local governments, agencies, interest groups and residents. As with many of the concerns expressed in the public outreach, this issue is beyond the scope of the project, but recommendations for future policy change attempt to show how further openness could be mutually beneficial for the residents and agencies operating within the study area. Recreation was brought up in several different forms, and it became clear that the planning tools within this document needed to address how to maintain and improve upon the current recreation system that brings so many people to the area. Environmental quality related to the water extraction practices also came up in several of the meetings, and became a constant component in the development of planning guidelines and implementation activities.

Program Development

After compiling all the data from the various types of community outreach, this information was compared with the project scope as determined by the boundaries of the Aqueduct Futures Project; by research into recent and historical project precedents; and by consideration of how the vision planning document could best address the needs of the communities within the Eastern Sierra.

After the objectives were solidified, the community data was again cross-referenced with the tenets of the Aqueduct Futures Project, demands of the 606 studio, and the results of preliminary research and biophysical inventory data. Combining the objectives with these other inputs created five broad land use categories that took into account community needs, Aqueduct Futures goals, and the biophysical and human needs of the area. These categories also provided a blueprint for interagency land use and resource management planning and allowed the creation of guidelines to aid community planning and development throughout the study area. The five categories were: Agriculture, Development, Habitat Rehabilitation, Hydrologic Regeneration, and Recreation.

Agriculture

Agriculture was one of the most frequently discussed topics at the community workshops as individuals expressed the desire to achieve local food sustainability. It is also a major planning concern for the Owens Valley in particular because of the historic importance of farming for the area, and the ranching leases that are currently operated by the LADWP. Comparison of the cost of water with the market value of crops shows that large-scale farming would never be profitable for the valley, but the number of small community gardens has increased in communities throughout the Eastern Sierra and there is a groundswell of enthusiasm for tribal and local food sovereignty.

Development

Development became an interesting point of discussion for community members and stakeholders. There was a general agreement that a stronger economy and more jobs would be beneficial for the area, but at the same time individuals expressed a great deal of concern for maintaining the wide-open spaces and historic aesthetic that characterizes the area. Vision-planning for this area is well situated to establish guidelines that will maintain the rich character and cultural values of the place, while suggesting economic diversity and sustainable development opportunities.

Habitat Rehabilitation

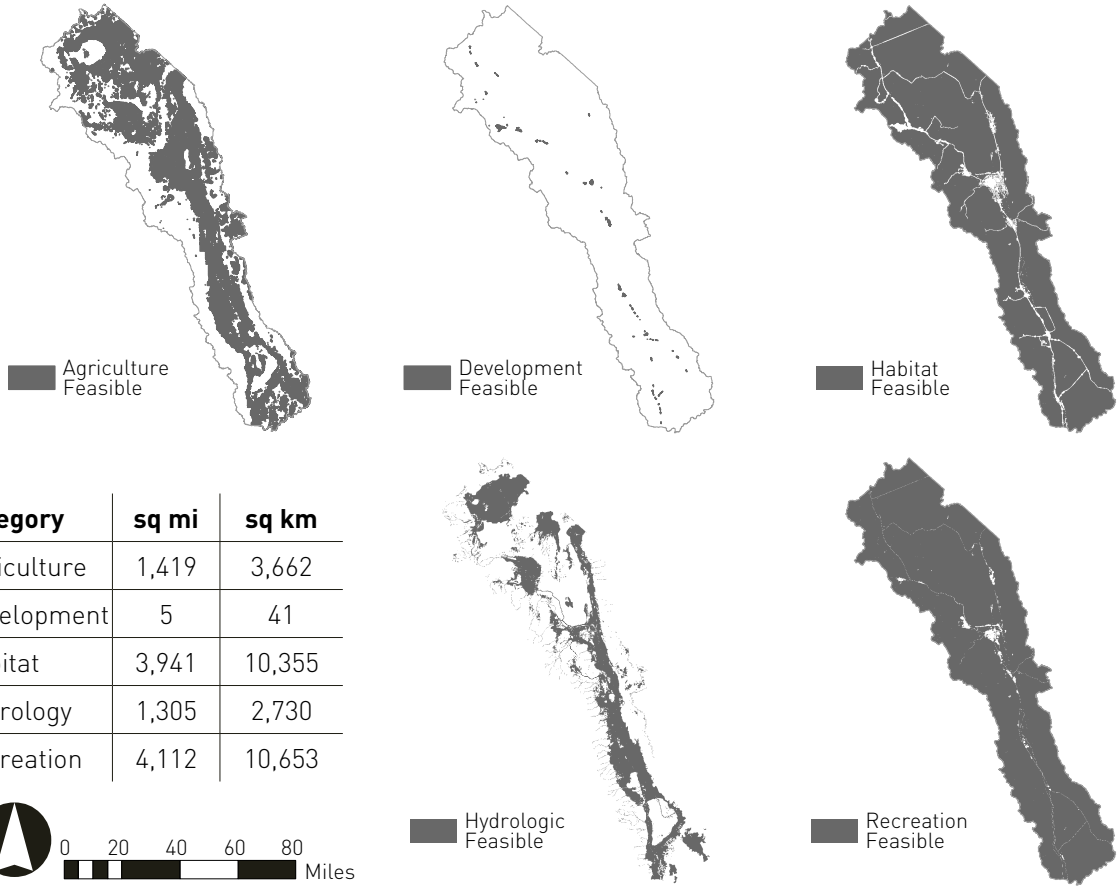
As the vast majority of the lands within the study area are governmentally owned and protected from development, the Eastern Sierra has been able to provide habitat for a wide variety of species. Despite this, habitat corridors and connectivity have been destroyed for many rare and endangered animals because of fenced ranching lands; resource extraction; recreation and urban development; and the intensive alteration of hydrologic patterns around Mono Lake and the Owens Valley floor. Habitat availability for certain species such as the pupfish was expressed several times as a concern during the community meetings. The USFS and BLM also plan for specific habitats, as does the LADWP within the newly established Lower Owens River Project (LORP). These plans are not necessarily connected or cohesive, so management guidelines for the entire watershed area will allow better understanding of the possibilities for habitat connectivity and restoration.

Hydrologic Regeneration

Reflecting its importance to both the history and current state of the Eastern Sierra, the topic of water was brought up many times during community outreach activities. Identifying areas for improving hydrologic function will help with the overall goal of the project by improving the health of the watershed. This will be accomplished by reconnecting areas of surface or groundwater table disruption and create more stabilized patterns of water supply for both human and wildlife communities in the face of climate change.

Recreation

Recreation is a vital component of the Eastern Sierra's economy. It is, however, highly seasonally dependent and is focused in a few key areas such as Mammoth Mountain. The topic of recreation was very important at the community meetings, especially in relation to keeping governmentally owned lands open for public access. This is also an important component of the vision-planning document since this will help to create stronger connections between Los Angeles and the Eastern Sierra while fostering local stewardship efforts.



Category	sq mi	sq km
Agriculture	1,419	3,662
Development	5	41
Habitat	3,941	10,355
Hydrology	1,305	2,730
Recreation	4,112	10,653

Figure 11. Land Use Categories Overview

Analysis

After the categories of planning importance had been derived from research and community workshops, the first step in creating this toolbox was analysis of the existing landscape. Using GIS data from a variety of sources, the landscape was broken down into units based on the similarity or differences of their physical attributes. The planning categories of agriculture, town development, wildlife habitat, water resources, and recreation were each assigned generalized physical attributes that defined areas in which the activities could take place. These physical attributes were matched with the landscape units that had been created to map out where these land use types could take place on the ground.

Once the program feasibility categories had been mapped onto the landscape, it became clear that there were areas where more than one program category could take place. These sites of overlap became opportunities to create areas of nuanced design, where planning projects could increase both cooperation among agencies and ecological health throughout the area.

Landscape Units

Development was restricted to areas in or directly adjacent to existing development, as the preservation of open space and overall character of the region were identified as high priorities among all stakeholders in the area.

Not all landscape units correlated to a program category. These units were considered beyond the scope of the project, and included areas such as freeways, the Los Angeles Aqueduct channel, and airports. These areas were excluded due to security concerns, lack of public access, and overall maintenance and operations of these features. Were the operational status of these features to change, so too could the rules of exclusion and possibility for reuse.

Figure 12. Mono Lake Tufa
Photo: Eric Haley 2012

GUIDELINES

Introduction

The final section of the report presents suggestions for how to conduct future planning efforts in the Eastern Sierra. Five general land use categories were identified by extensive work with the community, and GIS modeling of the physical landscape allowed the designation of areas where the program categories could feasibly be placed. In order to promote cooperation between both project planners and land use types, guidelines were developed to aid in planning for each of these categories.

In addition to areas of program feasibility, the GIS modeling process revealed numerous areas of overlap, as many of the categories are feasible in similar geographies. Seeing this as an opportunity for nuanced planning efforts, guidelines were also developed specifically for these overlaps and are available in the unabridged version of the report. Finally, site-scale interventions are presented as Sample Implementations in the full report. Guidelines are presented with these sample implementations so they may be executed in a manner that maximizes local stewardship and contributes to a secure and sustainable future for the Eastern Sierra.

Agriculture

General Guidelines

- Due to limited land and water resources, produce crops for the health and food security of valley residents, not for large-scale export.
- Prioritize sites containing prime farmland, as identified by SSURGO.
- Prioritize areas where the average low temperature during winter is above freezing.
- Promote community health by expanding existing farmers markets to providing fresh food for each community at least once per week (McCormack et al. 2010).
- Grow low-water crops where possible, including specialty crops for dry environments (Creswell and Martin 1993).
- Minimize evapotranspiration through crop selection, greenhouses, and covered crops.
- Retain or treat irrigation runoff on-site to prevent contamination of streams and wetlands (Creswell and Martin 1993).
- Mulch with crop residues to minimize runoff to maximize the benefit of irrigation and rainfall (Ethan and Umar 2001).
- Minimize the use of fertilizers, pesticides, herbicides, and fungicides to prevent contamination of habitat and hydrologic areas, and for the safety of farm workers and residents (Kassie, Zikhali, Manjur and Edwards 2009).
- Plant shelter belts of native trees and shrubs to minimize soil and moisture loss to wind (Creswell and Martin 1993).
- Implement low- and no-tillage methods to minimize loss of topsoil and maximize soil moisture retention (Van Wie, Adam, and Ullman 2013).
- Concentrate agricultural areas near existing disturbed or developed sites, minimizing intrusion into habitat.
- Expand existing Future Farmers of America programs in public schools to include Paiute techniques, low-water crops, and moisture conservation methods. Build on momentum from the existing program at Lone Pine High School.
- Explore the feasibility of both new and old ranching techniques, such as fenceless technologies and actively managed grazing.
- Where alfalfa is grown, rotate with edible crops for sale at local markets.

Requisite Policy Changes

- Allow the use of water on irrigated LADWP leases for growing non-forage crops.
- Instigate a Los Angeles city charter vote to create a new agricultural water rate, lower than the residential water rate, with this rate available to residents of Los Angeles and the study area.
- Offset lost LADWP revenue with higher outdoor irrigation rates for non-agriculture water use.
- Use higher rates to encourage agriculture and gardening in both Los Angeles and the Eastern Sierra.
- Allow community gardens on LADWP lots until the lot sells for 'acceptable market value.'
- Allow interim agriculture use on vacant, non-LADWP lands within communities.
- Instigate a Los Angeles city charter vote to grant LADWP lands within Eastern Sierra towns to the towns or counties, rather than placing it up for auction.
- Create sublease arrangements with LADWP lessees to allow temporary growing areas on leased land.
- Partner with existing FFA programs to educate students about the benefits of local growing and modern small-scale farming techniques.
- Develop agreements with the LADWP to borrow equipment to move planters when necessary.
- Ensure full water allotments are available to reservations, even if that requires the construction of new infrastructure to allow storage and application.

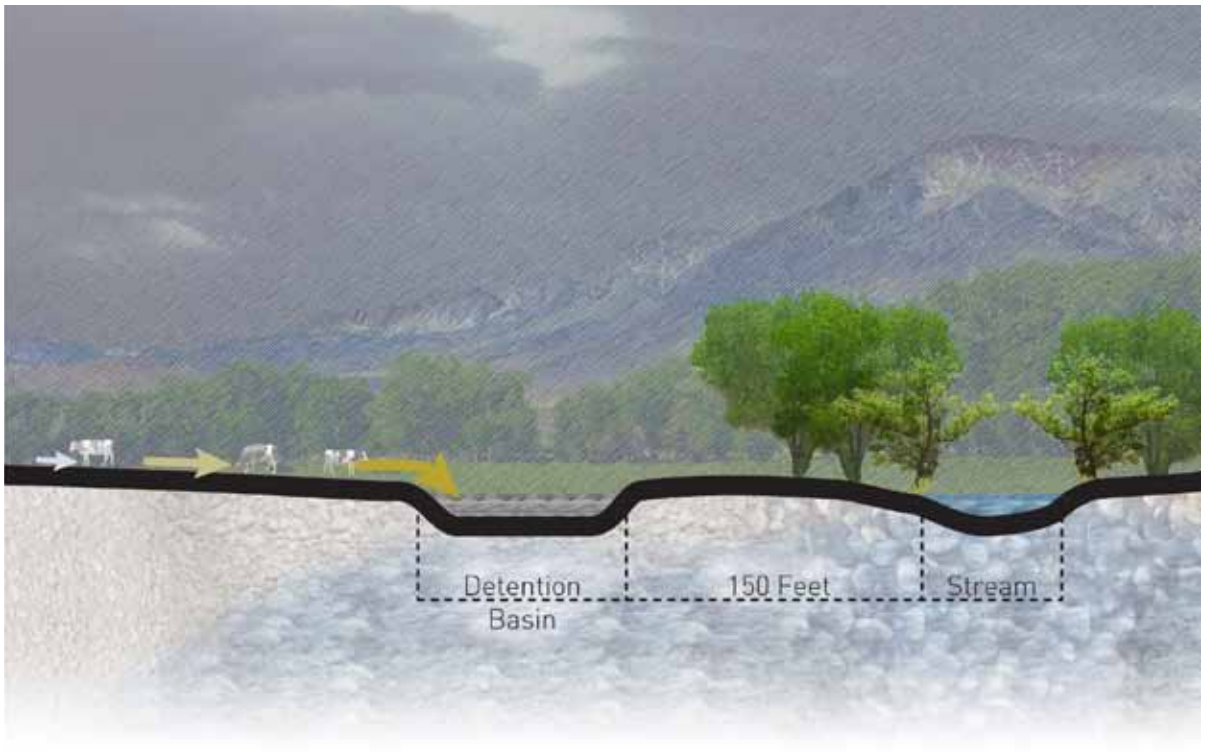


Figure 13. Agriculture and Hydrology Integration Strategies

Development

General Guidelines

- Reuse previously disturbed lands where possible (USGBC 2013).
- Renovate existing buildings instead of developing completely new construction where possible (USGBC 2013).
- Incorporate site-scale energy production such as solar power generation on south-facing surfaces and wind turbines when visually appropriate.
- Use locally sourced and recycled building materials (USGBC 2013).
- Capture and treat stormwater on-site through the use of bioswales, detention basins, and constructed wetlands.
- Preserve and highlight views during building footprint, structural, and façade design.
- Ensure that community input is part of the design and construction process.
- Improve connections to the new Digital 395 fiber optic spine (Sierra Business Council 2012).
- Encourage active and public transportation modes.
- Ensure that new and existing facilities meet ADA standards for accessibility.
- New development shall not increase point source air and water pollution.
- Incorporate public art into design of structures and their premises.

Requisite Policy Changes

- Incorporate public art-making into the construction process, and into later stewardship activities.
- Update electricity metering systems to allow reselling of excess electricity generated on-site to be credited towards electricity bills (Sierra Business Council 2012).
- Create incentives for the growth of small and locally-owned business and restrict development of "big box stores" (Sierra Business Council 2012).
- Allow for mixed use (commercial and residential) development along main streets.
- Include community outreach and participation in the design and construction of parks.
- In multiple-unit housing, allow for mixed income rents and ownership.
- Develop onsite educational programs for all age groups at community centers and visitor centers. Tailor these programs to specific demographics based on availability of schedules.
- Make visitor centers available as community gathering spaces for public meetings and committees.
- Create pedestrian and bicycling programs to increase visibility of non-motorized transportation, increase safety, and improve public health.
- Allow water sales to LADWP parcels in developed areas.
- Allow public activities and temporary parks on LADWP lots until the lot sells for 'acceptable market value.'
- Subsidize affordable housing near job centers (e.g. Mammoth Lakes) to minimize commuting time and high costs.
- Create transient housing overlays for high second home ownership areas with accompanying tax revenue generation programs (Town of Mammoth Lakes n.d.).
- Allow smart metering to encourage sustainable energy generation onsite
- Provide financial and program support for groups such as Mammoth Lakes Housing in their efforts to provide affordable housing close to job centers (Mammoth Lakes Housing Inc. 2005).
- Create park stewardship programs to improve upkeep, prevent vandalism, and increase educational opportunities in developed areas (Cranz and Boland 2004).
- Include curriculum on transportation network use and safety in local schools.
- Create partnerships, community college programs, and internship programs that connect local jobs with the local workforce (Sierra Business Council 2012).
- Create programs to fill local habitat and hydrologic restoration jobs with Eastern Sierra residents.
- Create ranger-led activities for all ages and abilities and families.
- Take advantage of solar power incentive programs.

Figure 14. Development, Agriculture, and Recreation Strategies

Habitat Rehabilitation

General Guidelines

- The current causes of habitat degradation shall be identified and reduced or eliminated.
- The habitat planning area shall be analyzed for connections to external habitat patches and those areas will be prioritized for preservation (Swenson and Franklin 2000).
- The current carrying capacity of vegetation and range for target species habitat will be determined and compared with future population goals.
- Goals for target species population will be determined along with the management intensity necessary to achieve those goals.
- Stewardship for habitat areas should be created through keystone species identification, community outreach, education programs and signs.
- Ecologically sensitive habitat areas will be off limits for development, agriculture, and high-impact recreation.
- Plan for seasonal migrations of species and provide habitats for different life phases of animals from birth to maturity (Corry and Nassauer 2005).
- Introduced species such as sport fish should be removed from areas of habitat suitable for endangered species (Andren 1994).
- Historic fire regimes for different vegetation areas should be mimicked with the use of controlled burns (Fuhlendorf and Engle 2001).
- Arrays of patch, edge, and linear habitats should be planned within the planning area in order to bolster biodiversity and foster species health (Andren 1994).

Requisite Policy Changes

- Provide budget for vegetation monitoring and overgrowth prevention.
- Prohibit non-native species from endangered native habitat.
- Require water flow and temperature monitoring in rehabilitation areas to ensure proper oxygenation and reproductive capability for aquatic species.
- Limit agriculture clear cutting and harvest at the edges of pastures so that habitat corridors are maintained along fence lines.
- Restore riparian banks and natural flow regimes to support tree establishment.
- Encourage placement of connected habitat areas not fragmented by roads or canals.
- Require diversified management of agricultural fields to allow for habitat preservation.
- Leave ranges unfenced except parallel to highways or major roads.

Figure 15. Habitat Rehabilitation and Hydrologic Regeneration

Hydrologic Regeneration

General Guidelines

- Establish a water budget for the area to ensure suitable distribution of resources and prevent destruction of vegetation coverage.
- Determine clear goals for hydrologic regeneration projects, deciding whether the focus of the activity is community/ recreation use, habitat, restoration, or some other purpose (Palmer et al. 2005).
- Include examination of upstream conditions that affect flow regimes and infiltration rates in analysis of the water systems (Kondolf et al. 2006).
- Restore historic flow regimes and water cycles to the fullest extent possible (Kondolf et al. 2006).
- Reconnect lateral streams to main channels to promote groundwater recharge.
- Connect recharge sources and aquifer inputs to stream channels with corridors of undeveloped land (Reckendorfer et al. 2006).
- Establish protected vegetative and undeveloped corridors to allow groundwater flow into the floodplain (Paillex et al. 2009).
- Restore riparian vegetation along river and stream banks and conduct pre- and post-occupancy evaluations for establishment success (Paillex et al. 2009).
- Base regeneration projects on similar sites in the area that are hydrologically healthier and aim to restore water system function to the same level (Kondolf et al. 2006).
- Use general river classification systems as a guide only after the nature and historic activities of the river have been understood and if there are no suitable comparanda in the area (Kondolf et al. 2006).
- Include before and after assessments of restoration activities in project planning processes and documents (Palmer et al. 2005).
- Conduct thorough geohydrological surveys of the area to understand the historical behavior and variations of the water system in question (Kondolf and Smeltzer 2001).
- Identify areas of high groundwater recharge and buffer by at least 165 to 330 feet (50 to 100 meters) from development and pollution sources (Foster et al. 2002).

Requisite Policy Changes

- Remove invasive beavers from the Owens River.
- Alter engineered infrastructure to allow more natural flow regimes.
- Place existing marshes and wetlands under protected status and restore degraded areas to sufficient patch size.
- Alter engineered infrastructure to allow more naturalized flow regimes.
- Disallow placement of septic tanks near wells or areas of high recharge.
- Manage wastewater treatment sources to comply with California Groundwater Recharge Guidelines.
- Create/purchase easements for floodplain buffers.
- Manage rivers and tributaries as connected systems.

Figure 16. Habitat, Hydrology, and Recreation Integration

Recreation

General Guidelines

- Plan recreation activities for highest compatibility with adjacent or shared land uses, with priority given to low impact forms of recreation (Van der Zee 1990).
- Subject high impact recreation activities to comprehensive environmental impact reports prepared by qualified environmental or ecological consultants.
- Plan recreation areas to create a cohesive recreation system that promotes participation in several forms of recreation during a visitor trip to the area (Sierra Business Council 2012).
- Prohibit recreation activities within areas with habitat or hydrological restoration projects until these projects attain acceptable ecological stability as determined by qualified ecological or environmental consultants (Van der Zee 1990).
- When designing new trails, follow guidelines set forth by the management agency with jurisdiction over the lands that the trail will travel (U.S. Forest Service 2013). In the event that the new trail traverses land without such extant design guidelines, the project should meet National Park Service standards (National Park Service 2006).

Requisite Policy Changes

- Develop a special wilderness permit for multi-night trips that utilize backcountry or dispersed camping. These outdoor recreation permits should govern campfire permission and authorization to stay overnight in various land management agency jurisdictions (U.S. Forest Service 2013).

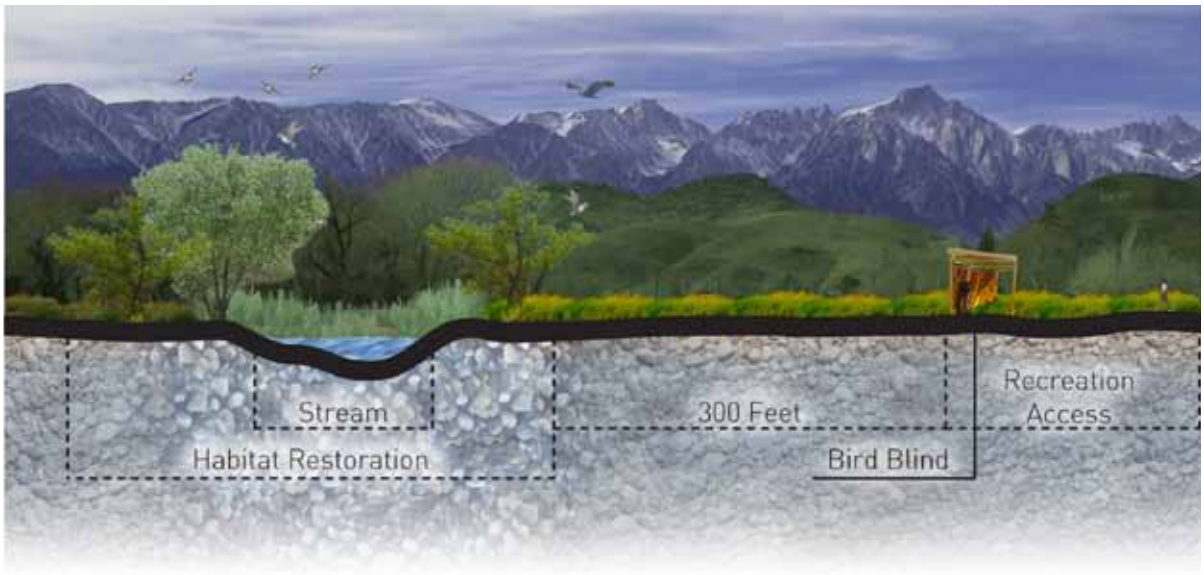


Figure 17. Habitat, Hydrology, and Recreation Integration Strategies

Figure 18. Dawn Near Rush Creek
Photo: Eric Haley 2013

THE FUTURE

Though almost a prerequisite for urban expansion, large water projects across the globe now balance between catastrophe and a precarious maintenance of the status quo. Within the United States, the water resources of the American southwest are severely over allocated, and the Colorado River, which supplies water to seven states in addition to Mexico, is projected to run dry by the year 2050 (Callison 2009). Growing populations, political manipulations, and mismanaged resources have created a demand for water that is, in many places, well over available supply. California is home to several of the largest water infrastructure projects in the United States, many of which will be stressed in the coming decades by the reduced precipitation caused by climate change (CDWR). As evidence of an already tenuous water supply, portions of the San Joaquin Valley have subsided over 29 feet (9 meters) from their original elevation due to groundwater extractions (Zektser, Loaiciga, and Wolf 2004). Against this backdrop of conflicting demand and supply throughout the state, both the issues and possibilities that exist in the relationship between Los Angeles and the Eastern Sierra have a loud resonance for the future of sustainable resource use.

Recommended Planning Areas

There are many possibilities for land use planning in the Eastern Sierra that will contribute to the future of the area. The vision planning document does not recommend specific sites or projects that should be undertaken. Rather, it is suggested that areas of high conflict should be prioritized for planning efforts and projects. With analysis of the physical characteristics of the sites as well as their surrounding context, planning projects will be more sensitive to the local and regional needs of both human and ecological systems. Suitable planning guidelines for the areas with the potential for multiple, possibly conflicting uses can then be chosen and used to guide future projects to successful completion.

Recommendations for Future Actions

The recommendations listed below fell outside of the study area and/or the project scope:

Create an interagency cooperation plan.

This plan would function as a guiding protocol for initiating, coordinating, and facilitating projects that cross jurisdictional boundaries, both physically and through policy. Ideally, this plan should be tailored to the specific needs of all involved agencies and have flexible components that can be adapted to new intra-agency policy and structure changes, as well as be able to accommodate additional inputs from stakeholder organizations. This suggestion is related to the community concern for transparency and cooperation between agencies and with the public, as well as to the complexity of existing overlapping plans and land ownership in the area. Identifying common goals and strategies for addressing those goals should help to streamline their implementation, while avoiding potential interagency conflicts. An example of similar cooperation on a large socio-environmental scale is the Coastal America Partnership (Coastal America 2013).

Create new guidelines for balanced water withdrawals, use, and related issues.

Water withdrawals from the valley, both surface and groundwater, have been a defining political and environmental factor for the last century. These withdrawals are controlled almost entirely by the LADWP, as is data regarding the amount and timing of withdrawals. While these items are addressed to some extent in Green Book updates (Inyo County 2008), and in the annual groundwater plan that LADWP submits to Inyo County, these processes take many years to happen and are perceived as lacking transparency. Additionally, the limits to these planned withdrawals are based on thresholds below which environmental mitigation projects are not required by law, rather than on the programs presented herein or on possible conservation practices in Los Angeles City. Most of the issues that drive this project could be addressed in part or in full by a reduction of water withdrawals from the study area.

Increase ecological stewardship through outreach and tourism.

Much of the economy of the study area relies on tourism. Many of those tourists are repeat visitors that live in Southern California. Connecting the end users of the Eastern Sierra water to its source through outreach, education, and interpretation, is a goal that is attainable because many Southern Californians already recreate in and around the Eastern Sierra. This sort of connection could increase water conservation efforts in Los Angeles, and generate the political will to make changes that will benefit the sustainability of their most crucial water source and political cohesion with other regions.

Include Native American communities in planning processes.

A more concerted effort needs to be made by agencies in the Eastern Sierra to include Native American communities in their decision making process. This increased outreach process should include education on opportunities for involvement, transparency of decision making, and follow through on promises.

Create local planning commissions.

While many of the settlements in the Eastern Sierra are not incorporated, they still have the ability to participate in planning commissions. These commissions can make informed recommendations based on local needs. Creating this level of planning will help to bridge the gaps that are created by long distances between settlements and the decision makers, as well as the current technological divide.

Suggest new ownership strategies for LADWP land.

Community inventory and stakeholder interviews almost unanimously called for the LADWP to release some of their land for economic development in existing town centers. While the Long-Term Water Agreement outlines properties in the Owens Valley to be sold at auction by the LADWP, these auctions are criticized for not meeting realistic market rates. A shift towards private land ownership in the towns along with adequate water supplies could improve economic conditions in the Eastern Sierra. A stable and locally derived tax base could stimulate investment in developing main streets, and in turn improve tourist revenue. This type of shift in ownership would also relieve LADWP of their obligations to maintain appearances on lots in the towns, as well reduce maintenance and administrative costs.

Increase self-sufficiency through local access to food, health care, public transportation, and technology.

The Owens Valley and Mono Basin are remote areas in comparison to much of California, but share many of the same populations through seasonal tourism. However, the facilities that much of the rest of California enjoys are not abundant in the study area. Community input demonstrated a desire for self-sufficiency in the region, both from Native American populations and town residents. Their primary desires are for food security and health care. Local food movements are present in the Owens Valley and Mono Basin, but face the challenge of securing water rights and adequate land for growing and selling food. The climate can also be challenging for growing crops at a scale that enables self-sufficiency. While this report provides the tools for planning the locations of these types of food security projects, complete implementation and maintenance plans would be appropriate for future studies. Additional infrastructure is also needed in the form of public transportation and information technology to support self-sufficiency across the study area.

Develop a water-oriented education program for Los Angeles residents to improve awareness and political will.

As the consumers of Eastern Sierra water, the residents of the City of Los Angeles largely dictate the amount of water that is exported from the study area. However, many Angelenos are unaware of where their water comes from or the social and environmental side-effects that water exports have caused. Adding curriculum to Los Angeles schools to inform families about the source of their water and the impacts of its consumption should improve conservation efforts, and increase the political capacity in Los Angeles to make changes in the water export schedule and LADWP land holdings.

Develop contingency plans for disruption in transportation, food, and water supplies.

The remoteness of the Eastern Sierra means that severance of external inputs to the study area is possible. Few transportation routes connect the area to the rest of the region, and internal resources are lacking. In addition to planning for self-sufficiency, it is important to plan redundant external supply systems in the case of natural and man-made disasters.

Plan for cohesive social and ecologic networks.

Extant conditions in the Eastern Sierra include fragmented habitat and hydrological systems as a result of resource extraction and development. The Eastern Sierra presents an encouraging opportunity to plan for cohesive ecological, social, and economic networks. This document has laid a framework for such network-based planning by identifying areas appropriate for different general land use categories. If used appropriately, the program categories in this document can guide future planning efforts to benefit local food security, recreation-based tourism, local economies, hydrologic systems, animal migration, plant communities, and many other systems that operate simultaneously in the Eastern Sierra.

Planning Need

The importance of planning for the future of the Eastern Sierra, and of management for its continued vitality, cannot be overstated. Not only does Los Angeles depend on the Eastern Sierra for a great deal of its water supply, but the local communities also rely on the area's environmental integrity and attraction for their own livelihoods. Evidence for the importance of land and resource planning can be seen in current efforts by the major decision makers to update all of the management plans for the area.

Planning for watershed health can be conducted at various scales, but the core concepts of hydrologic connections and holistic environmental health have been designated as a planning priority for California (SWRCB 2011). This type of planning is especially appropriate for the Mono Basin and Owens Valley, as these watersheds are greatly affected by connections to the larger region of Los Angeles. Only by recognizing and planning for this connection can resources and local communities maintain their health. By focusing on watershed-scale management and programming, the vision plan hopes to contribute to an Eastern Sierra that is stronger, more secure, and resilient in the face of whatever the future brings.

Possibilities for Implementation

In order to maximize the effectiveness of the document, the geospatial information showing program categories and overlap areas have been made available as Google Earth™ layers at http://aqueductfutures.com. Necessary steps for using the tools within the document are outlined in beginning of the document as part of the How to Use This Document section. Actual implementation of the plans and guidelines within the document are beyond the scope of the project, but it is hoped that the information will be of benefit to decision makers and stakeholders within the project area. To that end, the guidelines and program mapping have been created at a level that will create specific contributions to watershed health, but are still general enough to be implemented by any agency within the project area. This generality also allows for, and encourages, the creation of partnerships and cooperative planning between agencies that will enhance overall watershed health.

Figure 19. Trail Camp Lake
Photo: Eric Haley 2010

Future of the Eastern Sierra

The Eastern Sierra has already experienced a tumultuous and litigious past, and the future of the area promises to be affected by many external factors, including the large-scale effects of climate change and continued population growth in Los Angeles. Despite all uncertainties of what is to come, the striking environment and strong communities of the Eastern Sierra will continue to create one of the most unique places in the United States. As one of the first major water infrastructure projects in the country, the Los Angeles Aqueduct had a strong impact on the history of the area. Early water use by indigenous tribes, miners, and farmers was quickly surpassed by the needs of the large urban center of Los Angeles. Though entangled in legal battles and hampered by environmental degradation, the Eastern Sierra area and its resources provide a foundation for the rapid growth of the of the largest cities in the United States.

As rising populations continue to place pressure on resource availability and supply, Los Angeles and the Eastern Sierra are poised to become leaders in sustainable water management achieve truly cooperative resource use. It is the ultimate goal of this project that the planning resources presented here will help the Eastern Sierra achieve a future that is sustainable, healthy, and sufficiently resilient to thrive through the next 100 years.