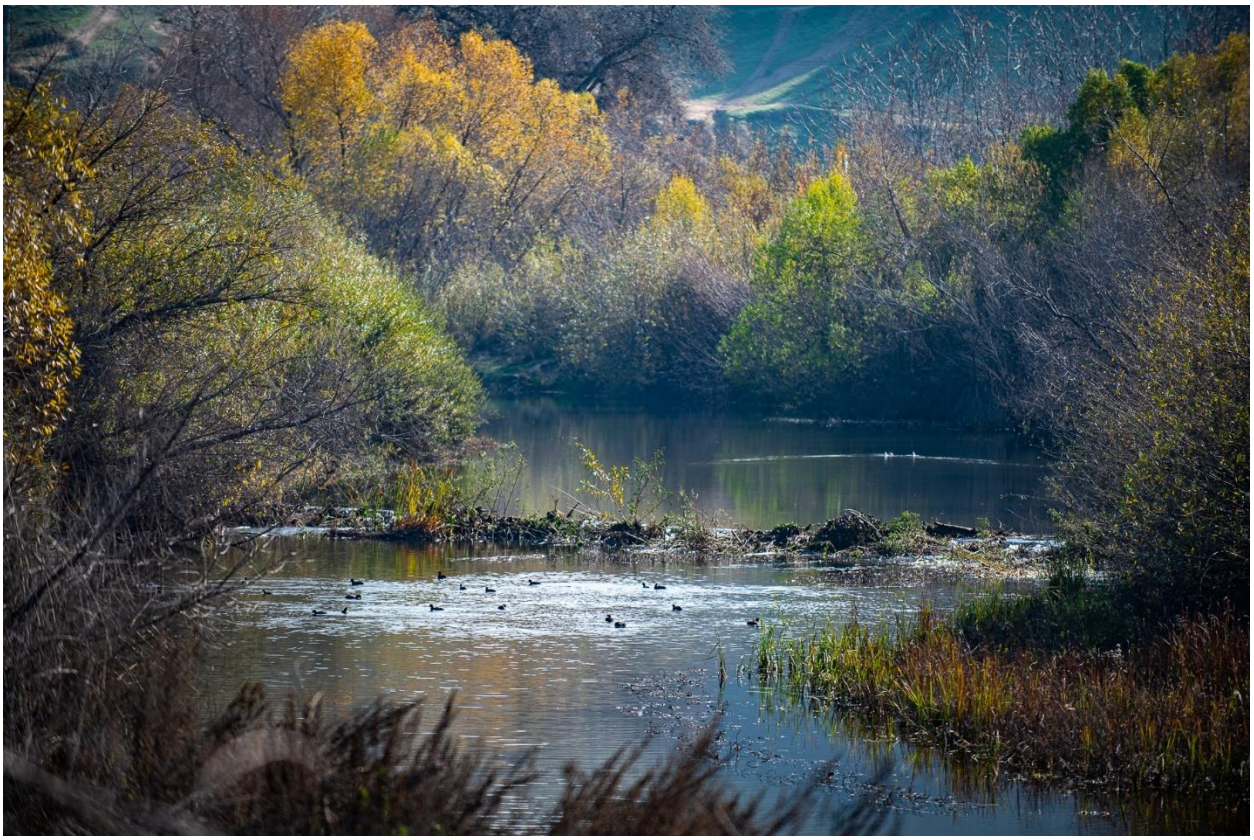
Beavers in the San Joaquin Valley



July 18, 2024

Sustainable Conservation

Cover Photo: Beaver dam at Panorama Vista Preserve in Kern County. Photo courtesy of Carolyn Belli.

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Acronyms and Abbreviations

AR	Accelerating Restoration
BCP	Budget Change Proposal
BDA	Beaver dam analog
BRP	Beaver Restoration Program
CalPBR Network	California Process Based Restoration Network
CCR	California Code of Regulations
CDFW	California Department of Fish and Wildlife
FGC	Fish and Game Code
FY	Fiscal Year
LTPBR	Low-tech process-based restoration
OAEC	Occidental Arts and Ecology Center
PALS	post-assisted log structures
PBR	process-based restoration
Refuge	National Wildlife Refuge
SGMA	Sustainable Groundwater Management Act
TEK	Traditional Ecological Knowledge

1.0 Introduction

Sustainable Conservation's mission is to advance the collaborative stewardship of California's land, air, and water for the benefit of nature and people. As a keystone species and ecosystem engineer, the North American beaver (*Castor canadensis*) could be a valuable asset in achieving our organizational goals, which include accelerating the restoration of aquatic, riparian, and nearby terrestrial habitats; and supporting local implementation of sustainable groundwater management. Over the course of 2022, the organization explored the role of beavers in advancing restoration and sustainable groundwater management and what role, if any, Sustainable Conservation could play in supporting beavers in California and specifically in the San Joaquin Valley regarding groundwater recharge. The organization is making its investigation available to others interested in beavers.

Sustainable Conservation is working to accelerate the pace and scale of aquatic restoration across California by creating alternative and expedited pathways for permitting restoration projects. As a result, the organization has relationships with restoration implementers across California and agencies like the California Department of Fish and Wildlife that could be leveraged to support beaver restoration efforts. Sustainable Conservation also has strong working relationships with private landowners, particularly farmers and irrigation districts in the San Joaquin Valley due to ongoing work on groundwater recharge and soil health.

The objectives of this paper are:

- Provide context:
    - Give a brief overview of beavers in California, their current legal status, their role in low-tech process-based restoration, and how beaver restoration is defined.
- Describe the policy landscape, including:
    - Current actions that the California Department of Fish and Wildlife (CDFW) is taking regarding beaver management.
- Summarize data from personal interviews conducted between January 2022 – September 2022:
    - Describe interviewees' perceptions of beavers, including their thoughts on the positive and negative aspects of beavers, the potential for beaver-based restoration in the San Joaquin Valley, and ways that people can adapt to beaver activities.
    - Map locations of beavers in the San Joaquin River watershed and Tulare Lake Basin based on information from personal interviews.
- Describe how Sustainable Conservation's current work is connected to beaver restoration and recommend potential actions to take related to beaver-based restoration in California.

2.0 Background and Policy Context

The importance of beavers as an ecosystem engineer that provides benefits for water quality, water quantity, flood attenuation, groundwater recharge, biodiversity, habitat complexity, climate change mitigation and resilience, and wildfire resilience has been documented in many studies and in the Beaver Restoration Guidebook (Pollock, Lewallen, Woodruff, Jordan, & Castro, 2023). The 2022 paper, Beaver: The North American freshwater climate action plan (Jordan & Fairfax, 2022), summarizes much of that research. They conclude that:

> *…Beaver managed floodplains are biodiversity hotspots because beaver ponds and wetlands serve as sinks for carbon, processing centers for nitrogen and phosphorus, reservoirs for the storage and cooling of water, and mitigation sites for both drought and flooding. Thus, it is imperative that we foster beaver-dominated areas for the many services they provide.* (Jordan & Fairfax, 2022)

2.1 History of Beavers in California and Current Legal Status

Commercial beaver trapping in California may have begun as early as the 1790s on the coast by Russian, American, and European fur traders. There were so many beavers trapped and killed inland and across the state in the mid-1800s, that by the early 1900s there were an estimated 1,000 beavers left in California (Lundquist & Dolman, Beaver in California: Creating a Culture of Stewardship (Version 4.0), 2020). Because beavers were extirpated from much of California before their full range was documented, their historic extent was understood to be just the Central Valley, the Klamath basin, and the Colorado River basin, until research showed that their historic range was likely all of California (Lanman, et al., 2013), including the Sierra Nevada (Lanman, Perryman, Dolman, & James, 2012)., except for the Mojave Basin (Lanman, et al., 2013)

A law was passed in 1911 to protect the remaining beaver, and as their numbers rose again, landowners were allowed to depredate (kill) beavers starting in the mid-1930s (Lundquist & Dolman, Beaver in California: Creating a Culture of Stewardship (Version 4.0), 2020).

Currently, the management of beavers falls under the jurisdiction of the California Department of Fish and Wildlife (CDFW). Commercial and recreational fur trapping was banned in California in 2019, but landowners can apply for a depredation permit from CDFW if their property is being damaged or destroyed, or in danger of being damaged or destroyed, by beavers (FGC § 4181.). Under current statute, CDFW cannot issue permits for the public to possess, transport, or release beaver, primarily because beavers are on the list of restricted species in the Fish and Game Code, as animals in the Order Rodentia, are typically considered "detrimental animals" (FGC 14 CCR § 671).

2.2 Beaver Restoration

The Beaver Restoration Guidebook describes three general beaver restoration approaches that are often used together:

- Passive actions such as trapping restrictions or changes in grazing regimes
- Active habitat manipulation to entice beaver to build dams and establish colonies
- Actively relocating beaver to areas with the intent that they will establish colonies. (Pollock, Lewallen, Woodruff, Jordan, & Castro, 2023, p. 46)

2.3 Low-Tech Process-Based Restoration

Beaver restoration is a form of low-tech process-based restoration (LTPBR), which is a suite of simple, low-cost practices focused on floodplain reconnection (Jordan & Fairfax, 2022). LTPBR is described in more detail by the California Process-Based Restoration Network (CalPBR), which was formed in 2022 to promote process-based restoration approaches:

> Process-based restoration is partnering with nature to recover degraded river and stream catchments by removing impediments to physical and biological processes and harnessing the system's fluvial and biological energy to do most of the restoration "work." Practitioners use low-risk approaches that minimize the use of fossil fuels.
>
> Heavy machinery is primarily reserved to address source problems such as levees, roads, and legacy mine tailings that confine the fluvial landscape. Additional treatments are designed to replace missing or altered functional ecosystem components that maintain floodplain connectivity and complexity.
>
> Treatments may include adding woody features such as post-assisted log structures (PALS) and beaver dam analogs (BDAs)[1], and large wood augmentation. Partnered restoration actions may include recruiting ecosystem engineers such as beaver, managing livestock, applying controlled burns, conifer thinning, and supplemental riparian and meadow vegetation planting. Interventions are guided by a stewardship mentality whereby they are adaptive over time in response to environmental feedback with a goal of encouraging a self-sustaining, dynamic ecosystem. (CalPBR Network, 2022)

Utah State University's Restoration Consortium is a key source of information about low-tech process-based restoration of riverscapes.

- Low-Tech Process-Based Restoration of Riverscapes Pocket Field Guide, (Wheaton, Bennett, Bouwes, Maestas, & Shahveridan, Pocket Guide, 2019)
- Low-Tech Process-Based Restoration of Riverscapes Design Manual, (Wheaton, Bennett, Bouwes, Maestas, & Shahverdian, Design Manual, 2019)

[1] "Beaver dam analogs (BDAs) are channel-spanning structures that mimic or reinforce natural beaver dams" (Pollock, Lewallen, Woodruff, Jordan, & Castro, 2023)

Another important paper on this topic is Design Criteria for Process-Based Restoration of Fluvial Systems (Ciotti, McKee, Pope, Kondolf, & Pollock, 2021), which features Doty Ravine, a site owned by Placer Land Trust where beavers had previously been depredated, but now coexist with cattle ranching.

LTPBR can be implemented in areas where there may or may not be beavers at the site or close enough for them to get to the site on their own. In many cases, LTPBR actions such as changing the grazing regime or installing BDAs (Anabranch Solutions, 2022) are necessary to prepare a site to be able to support beavers where the riverscape has been degraded and the channel incised.

Without deep enough pools to hide in, beavers are susceptible to predation, so installing BDAs makes a site more attractive for beavers to colonize naturally or makes it a more viable site for active beaver translocation. BDAs can be built stronger than beaver dams to withstand high flows in incised channels that would likely blow out natural beaver dams (Pollock, Lewallen, Woodruff, Jordan, & Castro, 2023). Examples of this include Bridge Creek (Weber, et al., 2017) in Oregon and Scott River Watershed Council's French Creek BDAs (See **Figure 1**) (Scott River Watershed Council, n.d.) and Sugar Creek BDAs (Scott River Watershed Council, n.d.) in Siskiyou County, California. The Sugar Creek BDAs (Goldfarb, 2018) were installed in 2014 and are now home to a robust population of beavers that were attracted to the restoration site after the BDAs were installed.

Figure 1. BDAs on French Creek. Photo credit: Scott River Watershed Council.

3.0 Recent Changes in California

3.1 CDFW Human-Wildlife Conflicts Program

The California Department of Fish and Wildlife (CDFW) is the lead agency in the state responsible for helping to resolve human-wildlife conflicts. CDFW's Human-Wildlife Conflict Program was established to address human-wildlife interactions for species across the state, including bears, wolves, backyard wildlife, and more (CDFW, n.d.). CDFW now has a minimum of two wildlife conflict specialists in each CDFW region to provide dedicated support responding to human-wildlife conflict incidents reported to CDFW, which includes conflicts with beavers (CDFW, n.d.).

3.2 CDFW Beaver Restoration Program

Kate Lundquist and Brock Dolman, Directors of the WATER Institute at the Occidental Arts & Ecology Center (OAEC), have been conducting research about the historical range of beavers, promoting coexistence techniques, and advocating for beavers with CDFW through their Bring Back the Beaver Campaign since 2009 (OAEC, n.d.). 2022 was a momentous year for this campaign.

The 2022-2023 California state budget included a Budget Change Proposal (BCP) to launch a new Beaver Restoration Program at CDFW (State of California, 2022). According to the Governor's proposal, the BCP includes $1.67 million in FY (fiscal year) 2022-23 and $1.44 million FY 2023-24 and ongoing, five new environmental scientists will work to "revise beaver policies and guidelines in development of a comprehensive beaver management plan" (State of California, 2022). This team "will develop an integrated and proactive approach to mitigate human-beaver conflict specific to reported damage due to known beaver activity" (State of California, 2022). The team will coordinate with other agencies and departments to prioritize beaver restoration projects.

The Beaver Restoration Program "strives to partner with tribes, non-governmental organizations, private landowners, and other state, federal, and local agencies to implement beaver-assisted restoration projects to support ecosystem conservation, habitat restoration, species conservation, and improve climate change, drought, and wildfire resilience throughout California." (CDFW, 2023)

3.3 California Beaver Policy Working Group

This group was organized by the OAEC and is being facilitated by Jennifer Fearing of Fearless Advocacy, Inc. Their first meeting was in October of 2022, and they have met monthly since. The agendas typically include beaver news, updates from CDFW, policy updates, and sometimes educational presentations about beaver topics that working group members requested.

3.4 Beaver Restoration Program Updates

Even more beaver-related activities occurred in 2023-24. See the timeline below (**Figure 2**) with additional information below.

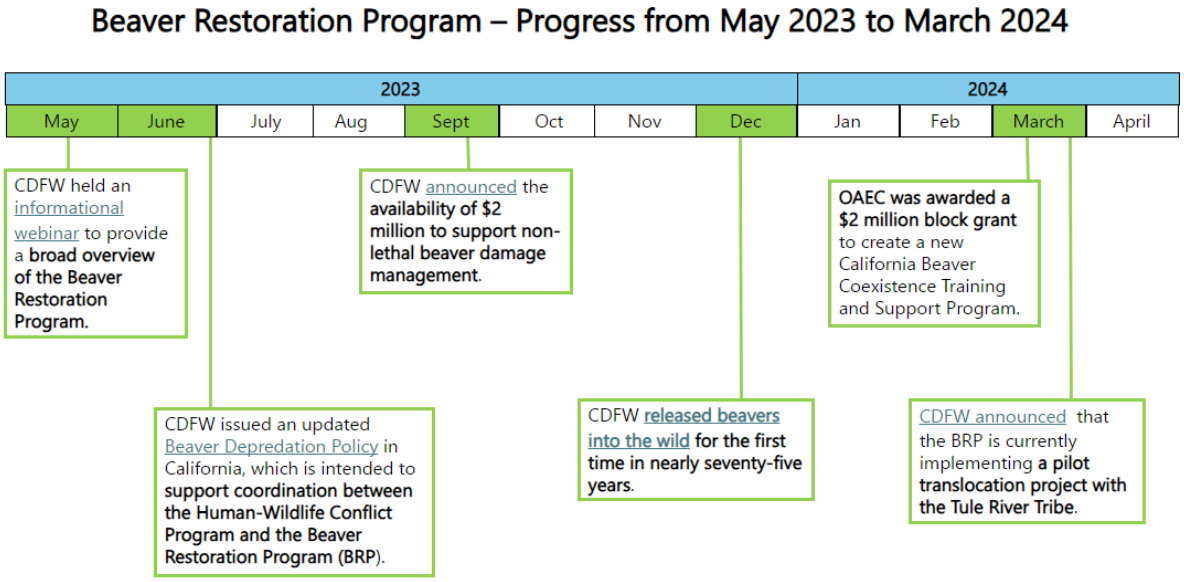

Figure 2. Progress from May 2023 to March 2024

Informational Webinar – May 2023

CDFW held an informational webinar to provide a **broad overview of the Beaver Restoration Program**, including its purpose, objectives, tasks, and timelines (CDFW, 2023). Additionally, the meeting highlighted the implementation of pilot and future beaver translocation projects, development of a beaver co-existence toolkit, and policy updates, and concluded with a public question and answer session.

Updated Beaver Depredation Policy – June 2023

CDFW issued an updated Beaver Depredation Policy stating that "The Policy outlined in this document is intended to implement a deliberative, tiered approach when responding to reported beaver depredation. The Department will promote the use of various nonlethal beaver damage deterrent techniques to resolve depredation conflicts where feasible" (CDFW, 2023). The policy is intended to support coordination between the Human-Wildlife Conflict Program and the Beaver Restoration Program (BRP), where the BRP will seek to utilize depredation beavers in its beaver conservation translocations when and where opportunities exist. The OAEC identified key take-aways on their website (OAEC, June). The BRP web page includes a section about Potential Conflict and Depredation with information and links to resources for preventing potential conflicts with beavers (CDFW, 2023).

Funding for Non-lethal Beaver Management – September 2023

CDFW announced the availability of **$2 million to support non-lethal beaver damage management** (CDFW, 2023)**.** The funding is intended for technical assistance as well as for direct implementation (installation and maintenance) of non-lethal management techniques. CDFW launched a new online application portal to receive applications for this grant funding (CDFW, n.d.). Eligible entities include Tribes, non-governmental organizations, and public agencies.

Beavers Released into the Wild – December 2023

CDFW released beavers into the wild **for the first time in nearly seventy-five years** (CDFW, 2023)**.** A family of seven beavers was released into Plumas County through work with the **Maidu Summit Consortium at a location known to the tribal community as Tásmam Koyóm** (see **Figure 3**)**.** Years of work to prepare the site for beavers through Maidu Summit Consortium's collaboration with the U.S. Fish and Wildlife Service, Occidental Arts & Ecology Center's WATER Institute (OAEC, n.d.), Lassen National Forest, Plumas Corporation, Swift Water Design, Symbiotic Restoration, Feather River Land Trust, The Sierra Fund, CalPBR Network and several others led up to this release. CDFW published a video commemorating this historic event (CDFW, 2023).

Funding for California beaver Coexistence Training and Support Program – March 2024

As part of $50 million in grants for a diverse set of habitat restoration projects, the **OAEC was awarded a $2 million block grant** to create a new California Beaver Coexistence Training and Support Program (Governor Gavin Newsom, 2024). In the OAEC's announcement about the grant, WATER-Institute Co-Director Kate Lundquist said, "A first in the state, this program will provide **accessible coexistence information, trainings for installers, and technical and financial assistance** to landowners to facilitate the best possible outcome for beavers and humans alike" (OAEC, 2024).

CDFW Now Accepting Beaver Restoration Project Proposals – March 2024

CDFW announced that the BRP is currently implementing a **pilot translocation project with the Tule River Tribe** and created a process for requesting the translocation of beavers onto public and private lands outside of CDFW lands (CDFW, 2024). More information and links to the **Beaver Restoration Project Proposal form** can be found under the Beaver Translocation Projects section of CDFW's Beaver web page (CDFW, 2023).

Beavers are Back on Tule River Tribe Lands in the Southern Sierra Nevada – June 2024

From a CDFW news release:

> After years of work by the Tule River Tribe, a family of seven beavers has been released into the South Fork Tule River watershed on the Tule River Indian Reservation as part of a multi-year beaver reintroduction effort done in partnership with the California Department of Fish and Wildlife (CDFW). (CDFW, 2024)

A video of the release is available to view (CDFW, 2024), and more information about the Tule River Beaver Project can be found on their website (Tule River Indian Tribe of California, 2024).

Submit Your Beaver Observations to CDFW

CDFW is currently working to improve their understanding of the current range of beavers in California and is requesting submissions of additional beaver observation data. If you would like to submit a beaver observation (including their dams and lodges) and contribute to this mapping effort, you can report your observation through CDFW's California Beaver Observation Survey (CDFW, n.d.).

Figure 3. Release of beavers at Tásmam Koyóm. Photo credit: CDFW.

4.0 Personal Interviews

As part of this investigation into the potential for beaver restoration to support our organizational goals, Sustainable Conservation interviewed various people to determine where beavers are located in the San Joaquin Valley and what role, if any, beavers can play in restoration and water sustainability goals in that region. We produced maps of first-person sightings of beavers and collected a range of perspectives and opinions about beavers and their potential to advance restoration and groundwater resiliency objectives. The following section shows the scope, methods, and results of these interviews.

NOTE: This is NOT a scientific study. The results in this section of the paper are anecdotal only.

4.1 Study Area

The northern section of our study area for this project is the San Joaquin River watershed, with the Cosumnes River as the northernmost river and the San Joaquin River as the southernmost limit. To the east our study area ends below the rim dams. See **Figure 4.**

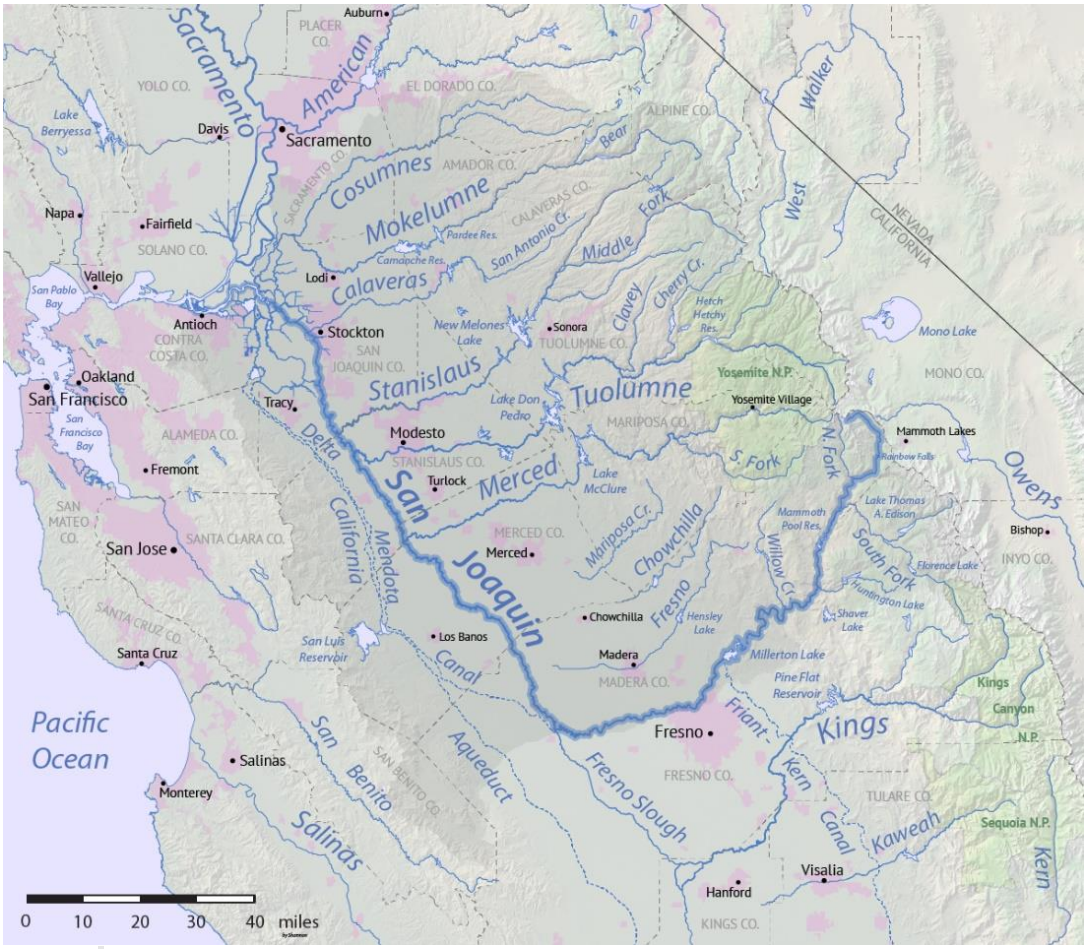

Figure 4. San Joaquin River watershed map.

Source: https://upload.wikimedia.org/wikipedia/commons/c/ce/San_Joaquin_River_watershed.png

The southern section of our study area is the Tulare Basin, with the San Joaquin River bounding the area to the north and the Kern River as the southernmost limit. To the east our study area ends below the rim dams. See **Figure 5**.

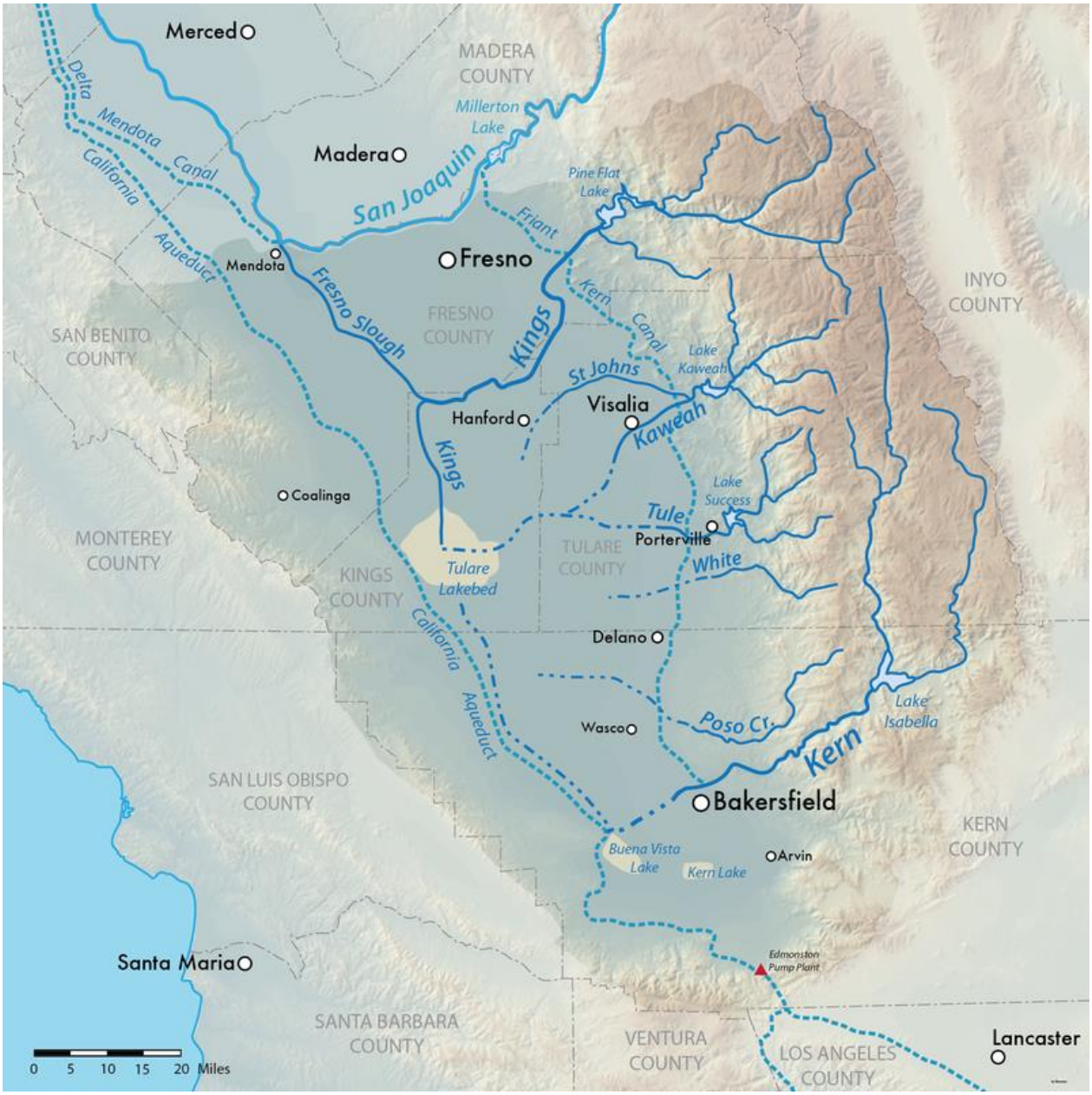

Figure 5. Tulare Basin Map.

Source: https://en.wikipedia.org/wiki/Tule_River#/media/File:Tularebasinmapnew-01.png

4.2 Interview and Mapping Methods

Interviews were conducted between January 7, 2022, and September 20, 2022.

To form our interviewee list, we began with people that we knew in the study area. Two of our interview questions helped us to find additional people to interview. These questions were:

- Do you know people who have beavers on their land? (get contact info)
- Do you know people who are likely to know where beavers are in the area? (get contact info)

After interviewing several people along with their contacts, we organized our interviewee list by location, looked for gaps in our geographical coverage and reached out to more people. Our interviewees are not meant to provide any statistically significant information or to be a representative sample of people in the San Joaquin Valley.

For each interview, we used a template list of questions (see Appendix. Interview Questions), but not every question was asked of every interviewee because not every question was relevant to each person.

4.3 Interviewees

Total number of interviewees: 36

Note: The total numbers below of interviewees by river (**Figure 6**) and interviewees by affiliation type (**Figure 7**), respectively, may add up to more than the total number of interviewees, as interviewees may have spoken about and provided beaver locations for more than one river, and may have more than one affiliation type.

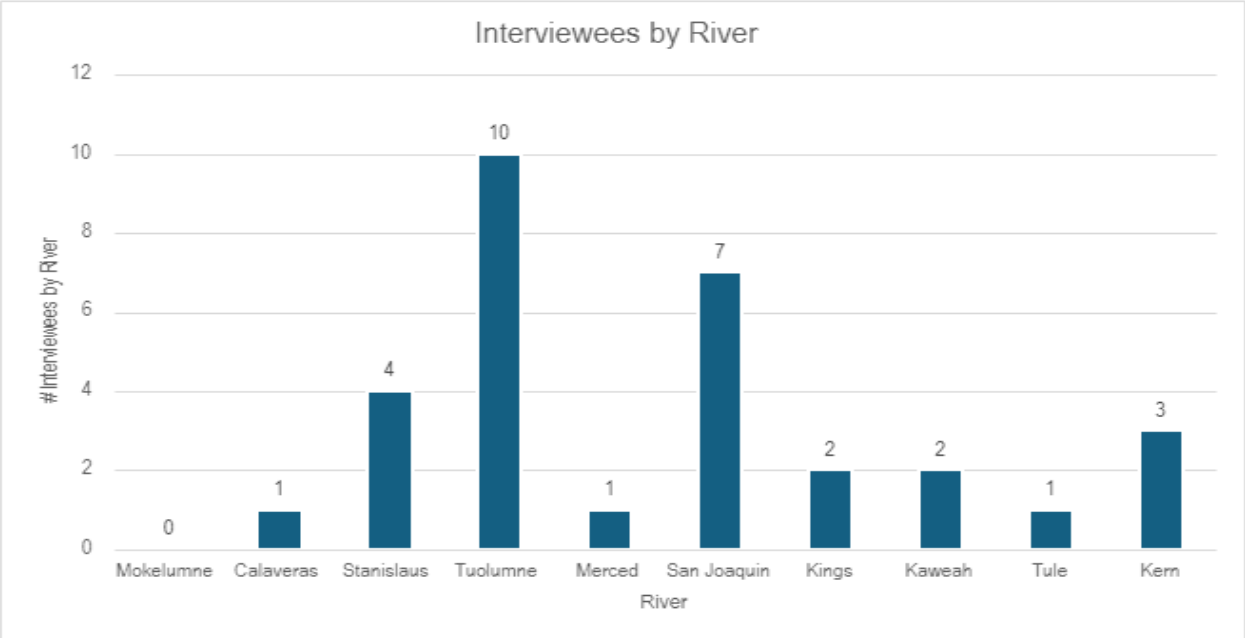

Figure 6. Interviewees by River.

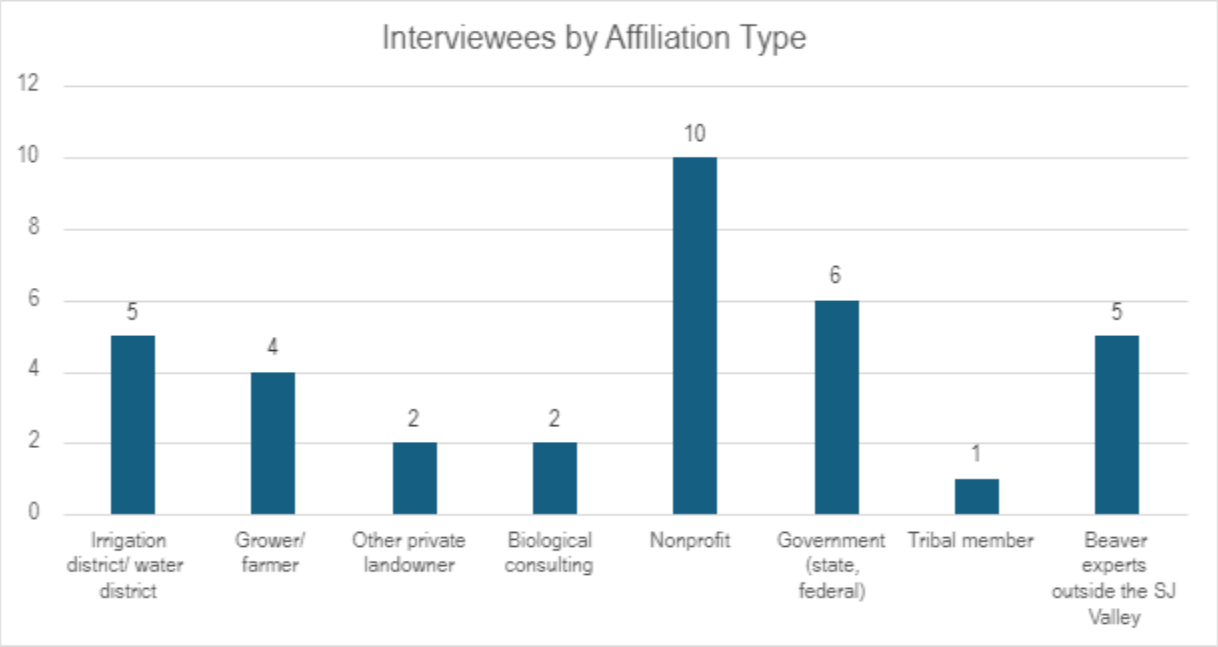

Figure 7. Interviewees by Affiliation Type

4.4 Interview Results

The information in this section is **based entirely on interview results** and does not necessarily reflect the opinions or knowledge of Sustainable Conservation staff. Where interviewees give input that is known to be inaccurate, or further description is needed to understand what the interviewee is stating, a footnote is included to give context.

Since the interviewee pool was quite limited and based on personal contacts, along with the fact that all interviewees were not asked the same set of questions due to limits on the length of time for each interview, a quantitative analysis of interviewee responses is not possible within the limits of our study. However, we do summarize general themes where more than one person gives similar answers, in addition to citing individual input to help paint a picture of interviewees' context and perspectives.

4.4.1 Beavers on the Land

Interviewee perceptions of positive effects

Many interviewees felt that beavers are very good at creating diverse habitats, noting that they widen the riparian corridor and develop more wetlands with a diversity of conditions. One implementer of large restoration projects in the San Joaquin Valley is generally happy about beavers and their effects on restoration projects. They mentioned that beavers create woody debris (such as dams and felled trees) that increases complexity in the river system, causing more food chain productivity in the shallow waters for invertebrates, which in turn enhances juvenile fish rearing habitat. Flooded conditions caused by dams help to support migratory birds and other species. Even beaver dens can support multiple species, including turtles and otters.

By virtue of harvesting trees like willows and cottonwoods, beavers help to keep riverbanks open for other wildlife, since otherwise the vegetation can get too dense. The stick weirs that beavers create trap sediment, which leads to regrowth of riparian vegetation. In sum, interviewees generally agree that beavers create pockets of stable biodiverse habitat that support many species.

Some interviewees stated that beavers help to slow down and retain water on the landscape, thereby recharging aquifers and helping to support tree growth. Drought resilience is another related benefit, with one person mentioning that areas with beavers remain wet throughout the year, whereas areas without beavers get dry by June. Beavers prevented a head cut from moving upstream on one interviewee's property, and others state that beavers can help to heal incised streams. A couple of people note that beavers create refugia from wildfires.

Finally, most people agree that beavers are fun, cute, and a great way to connect society to nature.

Interviewee perceptions of negative effects

Some interviewees described the negative effects of beavers on riparian vegetation. One person told how beavers cut down every one of the 60 willow and cottonwood trees they had planted as part of a restoration project and that had grown for 4 years. They also took down all the trees on another restoration site – 8 cottonwoods that were 5" in diameter – and 3 or 4 oak trees that were 2 feet in diameter. Another person mentioned how beavers girdled some alders and willows.

Beaver impacts on tree crops vary. One grower occasionally sees evidence of gnawing on a tree – but has only lost 2 trees over the last 6 years, out of 10,000 trees that are readily accessible to the beavers. He relayed a story he heard about how one weekend beavers took out 19 pistachio trees and hauled them up over the bank 4-5 ft above the river. Another grower near the confluence of the San Joaquin and Tuolumne Rivers has seen tens of thousands of beavers during his time on the land since 1968. In the winter of 1993-94, one of his "river bottom" fields stayed flooded for 100 days with about 18 inches of water. It was perfect for the beavers – they could stand on their hind legs in the water and eat - and they ate 2.5 acres of the 5 acres that had Asian Pears. The same grower noted that beavers eat almond trees when they are under ¾ inch thick. They chew them down, take them to the riverbank and chew the bark off and then leave the remains strewn.

As part of their habit of slowing down water and pooling it up, beavers often block conveyance structures like culverts, ditches and weirs. This can lead to headaches for their human neighbors, like flooding of roads or buildings and restricting people's ability to move water in irrigation canals and onto fields. Even National Wildlife Refuge (refuge) managers can struggle with trying to move water into managed wetlands, while the beavers are trying to keep it in the channel where they live. Generally, beavers can create a lot of extra work for land and water managers, with one person noting it can take 1-2 hours a day to unplug conveyance structures. According

to one person, it is backbreaking and dangerous work to get into these structures, and public agencies like wildlife refuges in particular tend to be too understaffed to handle the extra workload.

Beavers could also have major impacts on infrastructure. According to some interviewees, beavers in the valley usually burrow into riverbanks or levees and don't make the traditional lodge. They generally live in a burrow and dig it right at the current water level. This means that a car or a tractor on a nearby road could cave in the beaver den, without ever knowing it was there. Additionally, walking trails can and do cave in. A few interviewees think that this isn't a huge problem outside of the Delta and east of Highway 99 (areas that are not leveed) but when beavers burrow into levees the consequences could potentially be severe due to the heightened flood risk. As one interviewee notes, levees and beavers are not a good combination.

Additionally, periodic dams are sometimes blown out by winter storms, which can cause flooding issues downstream. Other impacts mentioned by interviewees include sharp sticks on the bottom of the creeks that can be a hazard, potential water quality issues due to beaver feces in ponds, and the tendency of beavers to migrate and expand their territory into areas where they are unwanted. One person notes that past concerns about beaver dams blocking fish passage have generally been proven wrong, although a different person did bring up that dams could potentially interfere with boat navigation.

Resolving conflicts

There are some key strategies interviewees mentioned that could potentially resolve conflicts with beavers.

Protecting vegetation may be one of the easier issues to tackle, by installing fencing around trees, wrapping trees with plastic, painting tree trunks up to 3 feet with fine grit paint sometimes mixed with olfactory repellant, and/or spraying trees with cayenne hot sauce. To protect orchards, some suggest planting tree crops further away from waterways (100 feet is an oft-cited boundary), employing a dog to keep the beavers away, and providing alternative riparian vegetation for their food source. On this latter point, one person planted sycamores and cottonwoods on the edge of a slough and got them established, noting that if alternative environments are created for the beavers, they will go to it. This same interviewee also relayed a story where beavers were trained over the course of 30 days to eat riparian vegetation instead of pistachio trees by bringing all pistachio clippings to the beavers, then bringing pistachio clippings mixed with willow clippings, then finally just bringing willow clippings to retrain them back to willows. For restoration projects, one interviewee stated that they overplant to prepare for beavers and replant as needed when beavers move in.[2]

[2] Planning for Beavers Manual: Anticipating Beavers When Designing Restoration Projects, published in 2022 by the King County Water and Land Resources Division Department of Natural Resources and Parks, is intended as a planning tool for restoration projects, especially when tree and shrub planting is involved (King County, 2022).

Water conveyance issues are harder to solve. There are devices like trapezoidal culvert protection fences and flexible pond levelers[3] that multiple interviewees have used, with mixed success. According to one refuge manager, they seem to work pretty well where the water levels are stable and the intake pipe remains submerged or flooded. However, when the water level gets too low, beavers can get through or around the screen to the intake pipe that moves water from one area to the other. He stated that screens in front of water control structures will keep the beavers from carrying limbs and things up into the structure, but people still have to clean the debris away from the screen. Even so, it is easier to clean the area around the screen than in the pipe. According to him, beaver deceivers are not deceiving them at all – rather they are just a barrier to beaver activities.

Another person from an irrigation district tried a number of different technologies about a decade ago to try to fool beavers. Unfortunately, he could not find anything that was successful. According to him, initially it worked but beavers are smart creatures, and the structures were harder to maintain than having a simple pipe, where someone can go in to remove branches. The newer, more innovative structures are even harder to maintain since they have to excavate them, pull them apart to clean them, and then put them back together.

Given the additional work associated with traditional "beaver deceiver" devices, as well as the difficult work managing constant beaver activities, one interviewee talked about a newer technology that is now available called the "beaver back saver"[4] that seems to be very effective for beaver issues associated with twin track weirs.[5] According to the interviewee, the beaver back saver cut down maintenance of a managed wetland area in the Sacramento Valley from once a day to once a year and significantly reduced risk of back injuries. Proponents of this technology have published a video demonstrating how to install the device and details on how to make and install it.

Interviewees mentioned other ways to reduce conveyance issues with beavers, such as setting diversion pipes deep enough so that beavers don't mess with them and giving rivers more room to be rivers so that beavers stay on the river and don't go up irrigation ditches in the first place.

Multiple people brought up getting depredation permits and hiring trappers to kill beavers as one solution to manage general beaver conflicts. However, an interviewee noted that he has shot and trapped over 100 beavers on his land but then realized there were 300 to 400 more.

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[3] The culvert protection fence is constructed so that beavers can dam against it, but it excludes them from the culvert so it remains unobstructed. After the fence is installed, a Flexible Pond Leveler™ is installed through the fence and the pipe outlet is set at the desired pond level (Beaver Solutions, 2023).

[4] The "beaver back saver" is a device designed to prevent beavers from blocking twin track weirs. It was developed by US Fish and Wildlife Service staff at the Sutter National Wildlife Refuge and is being promoted by the OAEC WATER Institute (https://oaec.org/projects/beaver-back-saver-device/).

[5] A twin track weir is a concrete structure laid across the horizontal width of a water current in order to alter its flow characteristics (Briggs MFG, Inc).
See link for an example (https://www.briggsconcrete.com/collections/twin-track-weirs-1)

So, he eventually gave up and sold his right to farm that ground in exchange for a conservation easement. Some people mentioned that California should allow beavers to be relocated to areas where they could provide ecosystem services.

One interview suggested that California could learn from the East Coast and put together teams of people to handle problem beavers so when beaver dams flood roads and create other nuisances, there are resources available to go out and fix the issues.

4.4.2 Perceptions of Beavers

Interviewees were somewhat mixed in their impressions of beavers throughout the course of the interviews, and in some cases the same person can have two opinions on the matter especially if they have regular experience managing water in beaver-populated areas. However, even the more skeptical interviewees expressed admiration for beavers and acceptance of their presence in suitable locations.

Full support

Many people brought up how beavers are part of the landscape, were here before humans, and that humans just have to work around them. A few people were unequivocal in their support for beavers, in one case identifying as a "beaver believer" and another case saying that his grandchildren love the beavers on his land. One person observed that where beavers are in their natural area in the river, they are awesome at fulfilling their ecological function. He thinks that wetland management in the Central Valley is a necessary thing to continue to have flourishing populations of migratory waterbirds, but this is often in conflict with human infrastructure needs. Another person noted that if relocation of beavers were allowed, she would want them on her land. One individual relayed a story about how one man stopped cattle ranching to do ecosystem work on his property although he does do work for the cattle ranches surrounding him. This man says he is more profitable now than he was when he was cattle ranching. He has an event center on the property and wants to document how wildlife recover.

Mixed

A land manager said that he respects and admires beavers and doesn't take shooting them lightly (and he also notes that shooting them can take longer than just taking down their structures). An interviewee told a story of how a farmer found that beavers had destroyed 14 pistachio trees and called the farming company he worked for to tell them not to worry, he would get rid of the beavers. The company responded that they did not want him to kill the beavers and that as a company they were committed to having 30% of their lands in conservation. This farmer then started planting riparian trees that the beavers would like better.

Negative

While some of the interviewees had positive or mixed perceptions of beavers, others expressed more negative opinions. As mentioned in previous sections, beavers can cause headaches for land and water managers by plugging up waterways and felling trees. One person used to live in

the Great Lakes region where she had to fight through beaver flooded areas, so she admitted she has a negative impression from her past personal experience.

Interviewee impressions of how others view beavers

Multiple interviewees think that others don't like beavers, particularly farmers. One person made the observation that non-agricultural people are pleased to see beavers, whereas agricultural people have a less positive reaction. People have heard from farmers that beavers are totally destructive and will negatively impact crops, ruin water systems and generally add to their workload. One individual brought up beavers to his neighbors and heard nothing but negative comments about what rodents and pests they are, and even that beavers would steal water. A farming company reportedly has no desire to have species of any kind on their land because of the potential for endangered species to get established.

However, some interviewees note how certain communities do want beavers, and in particular that the Tule River Tribe is working to bring them back to their land. One tribal member described how agencies do not prioritize something unless there is a perceived economic value. He notes how agencies think that once a species is gone, then it is gone, and they are not willing to work to bring it back. He mentioned how in this way, the beaver is like the freshwater mussels that his Tribe used to harvest in the valley up until the 1990s.

Do beavers have a place in the San Joaquin Valley?

When asked if beavers have a place in the San Joaquin valley, many people responded in the affirmative, noting that this is their home and that beavers can help with restoring habitat and replenishing groundwater. However, some acknowledged that the water system has been so altered that the possibility to support beavers is marginal in many places, and undesirable when located near human infrastructure. As such, multiple interviewees divided the watershed into three different segments - upper, middle and lower – and commented on the various possibilities and effects of beavers in each of those regions (See **Figure 8** below).

<u>Upper watershed</u>

The upper watershed is generally acknowledged as the land above the major rim dams and is often regarded as separate from the valley, though the water draining this area definitely affects the valley. Some interviewees mentioned that the possibilities for beaver reintroduction are highest here due to a multitude of factors. First, there is an abundance of federal land, which reduces potential conflicts with private landowners and also offers a lot of possibilities for connected habitat. Some interviewees noted that the meadows in this area are degraded due to being drained long ago, resulting in incised streams with huge drop-offs at the bottom of the meadows. In addition, the meadows face new challenges with more cabins being built in the area, which leads to more pumping of groundwater. One person stated that current meadow conditions have little to no recharge potential due to granitic geology, so the water comes and leaves quickly like a bathtub. The possibilities to restore mountain meadows using beavers – particularly harnessing their ability to slow down water and build up soil - is generally acknowledged as a positive and important potential. One academic stated that the reduction in

snowpack predicted under climate change could be somewhat mitigated by beavers, since they would mimic a distributed reservoir system by shaping the landscape to hold water longer into the dry season.

Middle watershed

The middle watershed is often referred to as the foothills and can be generally thought of as the area between the rim dams and Highway 99. Some people think this is a potentially ripe area for beaver reintroduction, especially if beavers can help with retaining water on the landscape and reducing flood risk downstream. One person stated that the San Joaquin Valley middle watershed has about 10 million acres of oak, 80% of which is privately owned. According to him, these are watersheds that frequently have water year-round, and the landowners could be interested in hearing how beavers could keep water on their land longer. Also, he thinks the middle watershed region is promising because it has the highest diversity of species in California.

Lower watershed

The lower watershed is basically the valley floor, where the topography is pretty flat. One person defines this area as west of Highway 99 and east of Interstate Highway 5. Here, many people think that the options for reintroducing beavers are quite limited, and even where they currently live, they are nuisances to conveyance systems and potentially threats to infrastructure such as levees. One interviewee notes the valley is "ecologically devastated" and a difficult place to restore, especially in times of drought. Some are concerned that beavers would die when introduced to unsuitable areas.

Even though multiple people think that the ability of beavers to survive in the valley floor is quite limited, that may be a function of different types of conditions in the lower watershed due to water availability. For instance, healthy beaver populations live at multiple refuges that are in the lower watershed. As one interviewee states:

> *Beavers are everywhere on the Valley bottom where you have flowing water and trees; it's just that there are not many places where there is both flowing water and trees. Beavers will swim tens of miles away from where they were born so you could draw a circle 20-30 miles out from all the wildlife areas, which all have beavers, and if the conditions were right, there would be beavers.*

With this observation, beaver suitability in the lower watershed may be quite different when comparing the relatively dry Tulare Basin with the wetter San Joaquin River basin. Additionally, beavers in the Delta region might be viable from a habitat perspective but potentially damaging if beavers burrow into levees.

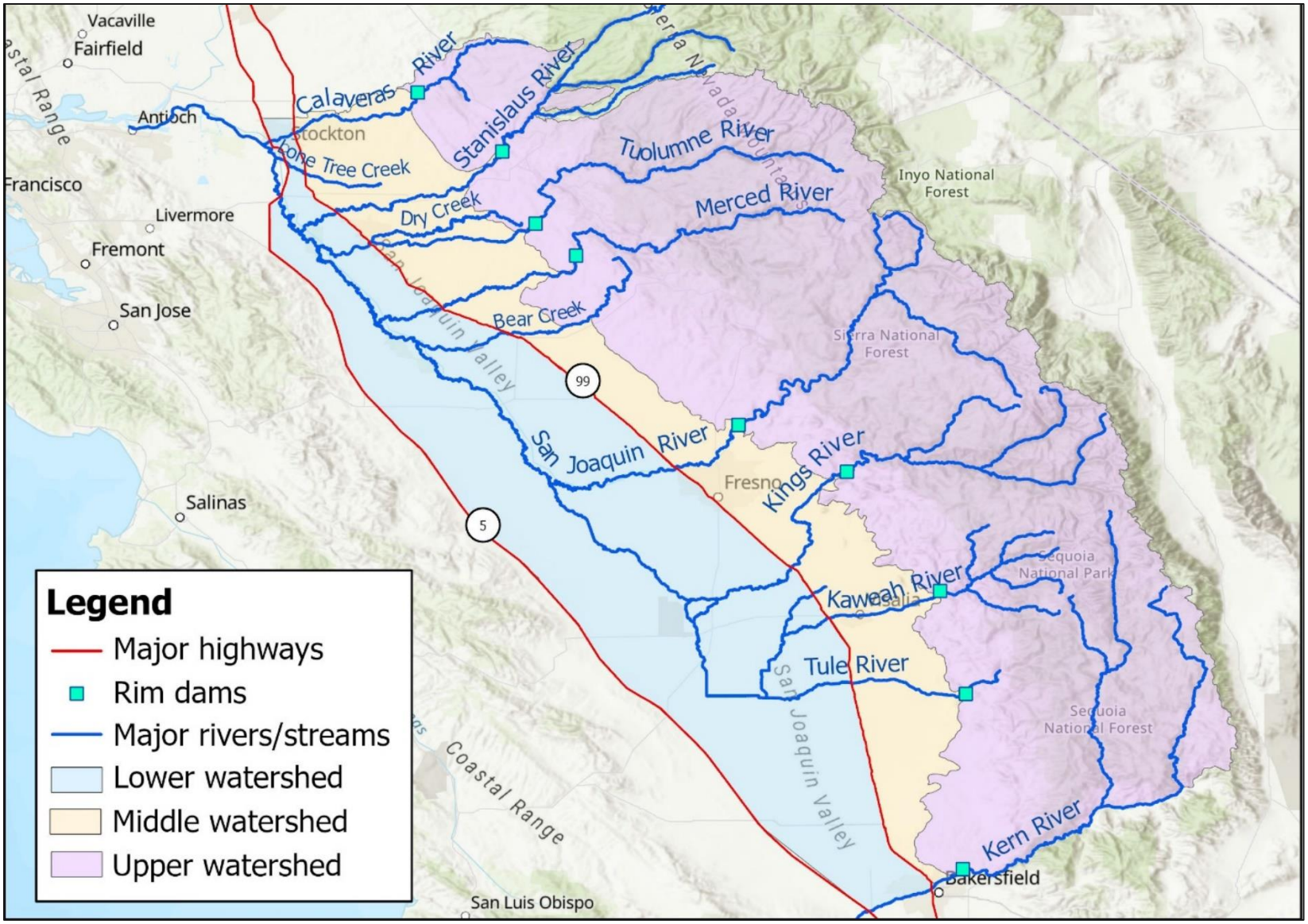

Figure 8. Map of the study area and watershed segments.

4.4.3 Bringing Back the Beaver

Beavers as an ecosystem technique

Many people think utilizing beavers to restore ecosystems is a good idea, citing groundwater recharge, drought resilience and the creation of fish habitat as some of the main benefits. A tribal member talked about how beavers are part of Traditional Ecological Knowledge (TEK) and how TEK should be embedded in science and policies. Another person noted that if we embrace beavers as a restoration technique, we need to think in terms of a decades-long timeline. He stated that this type of approach is not about beavers - it is really about floodplain restoration. Beavers are one of the tools we center on because they are lovable. In other words, beavers are not the end goal - rather they are a means to the end goal of floodplain restoration. He mentioned Michael Pollock's view[6] that beavers are true ecosystem engineers and ecosystem farmers – and that they do it better than us and they do it cheaper.

Some people highlighted the potential for beavers to populate side channels of larger rivers and tributaries, particularly the low-lying floodplains adjacent to the main rivers. One individual mentioned that there is a push by federal and state agencies, along with private landowners and their consultants, to create more side channels and floodplains on the Tuolumne River. He thinks side channels can be good for rearing juvenile fish and some spawning (steelhead) because the main channel of the Tuolumne is so degraded and entrenched by road building and levees. In contrast, it would take so much gravel and money to restore the main stem of the Tuolumne River that it would be a better result for the dollar spent to work on the side channels.

Another person noted it would be interesting to try beaver reintroduction on a pilot basis, maybe on a smaller stream that flows into the Tuolumne or one of the small streams in Merced. He mentioned that Stanislaus County conducted a feasibility study of building small dams on Dry Creek to reduce flooding that impacts Modesto. He wonders if beaver dams instead could mitigate flooding and be less impactful than a series of concrete dams.

Only one person stated that beavers are not a good tool for either ecosystem restoration or groundwater recharge, and that the beavers in his area (Tulare basin lower watershed) are "mud" beavers – they like water but don't need water flow. He thinks they are not necessarily the same kind of beaver as you would find on the Kern River and up in the Sierra Nevada mountains.[7] He talked about how his grandfather went into the back country in the early 20th century and used to tell stories of U.S. Forest Service paying packers in the 30's and 40's to move beavers so they

[6] Research Fish Biologist at NOAA Fisheries https://www.fisheries.noaa.gov/contact/michael-m-pollock-phd and one of the authors of The Beaver Restoration Guidebook (Pollock, Lewallen, Woodruff, Jordan, & Castro, 2023). https://www.researchgate.net/profile/Michael-Pollock-6

[7] All beavers in California are from the same species (*Castor canadensis*). Beavers may or may not build dams and/or bank burrows depending on the site conditions (water level, stream gradient, etc.) (Pollock, Lewallen, Woodruff, Jordan, & Castro, 2023).

could repopulate the area with the intention of slowing down water to reduce flood flows and damage on the valley floor. According to him, it did not work.

Main impediments and solutions to bringing back the beaver

Survival and habitat conditions

In order to ensure the success of beaver populations, one academic noted that habitat connectivity is a major consideration, and that less grazing pressure on riparian areas is needed. Some others described conditions in the forest where there has been intensive cattle grazing, and that there may not be enough resources to support beavers because cattle eat beaver food sources such as willows and alders. It would take some long-range planning to fence out cattle from riparian areas.

Multiple people noted that it is difficult to find new locations to reintroduce beavers where there is a good chance of survival. Topography is an important consideration – according to one interviewee, Michael Pollock states that beavers like a 1% gradient, so this limits their ability to inhabit many areas in steeper terrain[8]. Also, throughout the watershed, floodplains are often elevated too high outside of incised rivers to receive flows. Attempts to change flows to inundate historical floodplains all seem to end up in lawsuits, according to one interviewee. Reducing the elevation of the floodplains and simultaneously bringing gravel into the main channel to bring the bed up might help. One person noted that alders are at their endgame, and they need a good flood so their seeds can come down and regrow. The introduction of fine sediments pushed up onto the floodplain would allow alders and willows to reforest.

Highly engineered and regulated water systems

Multiple people felt that beavers are not suitable in areas where water infrastructure is highly developed. Levees were brought up as one area where beavers should definitely not be established, since levee managers don't want any vegetation or burrowing in the levees. Another person stated that the San Joaquin Valley has a highly engineered water system so it is rarely okay to let beavers do their business – and that the water delivery system cannot be clogged up in any way. She mentioned that during the reclamation period when they were developing the swampy areas of the valley, covenants were developed on properties that required them to take drainage from upland areas. If beavers blocked outflow to drainage, these properties would be violating their covenants. She stated that habitat managers have actually cleared out beaver dams because they are on properties with those covenants because otherwise, water would back up into the neighbors' properties. Another interviewee recommended that the state do a property records study to identify locations across the San Joaquin Valley that hold such drainage covenants.

[8] Beavers prefer to build dams on small- to-medium-sized, low-gradient streams, with less than 6% slope. They will generally populate the lowest gradient (slope <1-2%) sites first. (Pollock, Lewallen, Woodruff, Jordan, & Castro, 2023).

Perceptions of beaver dams as a fish passage barrier

Some interviewees talked about the issue of whether beaver dams are a barrier to fish passage. One person described "a whole industry around fish barriers" and what constitutes a barrier and what does not. She said that the Department of Water Resources' fish barrier program in the early 2010s that was working to support the San Joaquin River Restoration Program identified fish barriers, and every one of the barriers was a beaver dam[9]. Other interviewees note that beaver dams have been proven not to be fish barriers[10] and most people agree beavers are good creators of fish habitat.

People and beavers

Multiple people thought that landowners - and farmers in particular - may be a main impediment to beaver restoration. Years ago, one person talked to a landowner near Great Valley Grasslands State Park who was struggling with beavers, and they had very little interest in what not controlling beavers would look like. One tribal member noted that beavers don't have protection from depredation in mountain meadows. Even for those willing to live with beavers on their property, their migration might become an issue as beavers move onto neighboring properties. However, some property owners are less risk averse than others and are willing to host beaver populations.

Building support for beavers

Public outreach

Many interviewees felt that educating people about the benefits of beavers is a fundamental step in building support for them. For the general public, this can take the form of interaction with beavers at preserves, an outreach campaign that talks about all the good things that beavers do such as building ecosystems on rivers, and having the beaver serve as a sort of mascot for rewilding the valley.

Agricultural outreach

Multiple people talked about the importance of working with the agricultural community in particular. One interviewee said that the farming community in his area wants to see the river do

[9] The San Joaquin River Restoration Program published a Fish Passage Evaluation (California Department of Water Resources, 2012) in 2012 describing that the majority of beaver dams on the San Joaquin River have been located within the San Luis Wildlife Refuge and that when backwatering is present in the Refuge, the beaver dams are not really a problem for fish passage because they are submerged by several feet of water. Depending on the height of the dam and presence of a staging pool (an area where fish wait before moving to the next area) or not, there are some locations where construction of a staging pool, dam removal, or dam modification may be needed to facilitate fish passage. The report recommends an annual survey of beaver dam locations, heights, and the presence of a staging pool (depth and distance).

[10] This view is supported by a recent experiment to assess fish passage across BDAs on Sugar Creek, a tributary to the Scott River in Siskiyou County, California (Pollock, Witmore, & Yokel, 2022)

well, and that beavers could be framed as a way to achieve river health. Another person talked about developing resources and information targeted to the agricultural community, so that fear of beavers can be eliminated or at least reduced. People noted that it is important to show positive examples of how agriculture can deal with beavers.

Trusted messengers

Some interviewees discussed how it is important to work with key influencers and trusted messengers first, before conducting a general campaign in the agricultural community. For instance, a local irrigation district was cited as having a high level of trust with local farmers, so if the district could be convinced about the benefits of beavers, then the farmers might follow. Other key influencers mentioned were local farm bureaus, water agencies, industry groups, SGMA (Sustainable Groundwater Management Act) working groups and leaders of organizations that already exist. One person stated it was essential to get CDFW buy-in before any outreach to locals, otherwise entities like the California Farm Bureau won't even entertain the idea.

Limit locations

One interviewee mentioned that water in the valley is very scarce, highly engineered and intensively managed, so he doesn't know if there is a lot of political appetite for beavers. In particular, flood agencies don't want anything planted on levees because levee failure or blocked conveyance could cause catastrophic damage in flood years, which are predicted to be more severe with climate change.

Another person stated that beavers are important, but there is no space for them in the valley due to how we have altered the rivers. He thinks that beavers should be in the Sierra Nevada upper watershed, storing water where they can be far away from people.

4.4.5 Mapped Beaver Locations and Activities

The following figures show where evidence of beaver is found in the San Joaquin Valley, according to first-hand accounts of the people interviewed. **Figure 9** gives a bird's eye view of locations of beaver activity. **Figure 10** and **Figure 11** show the types of evidence of beaver activity, such as beaver ponds and vegetation damage.

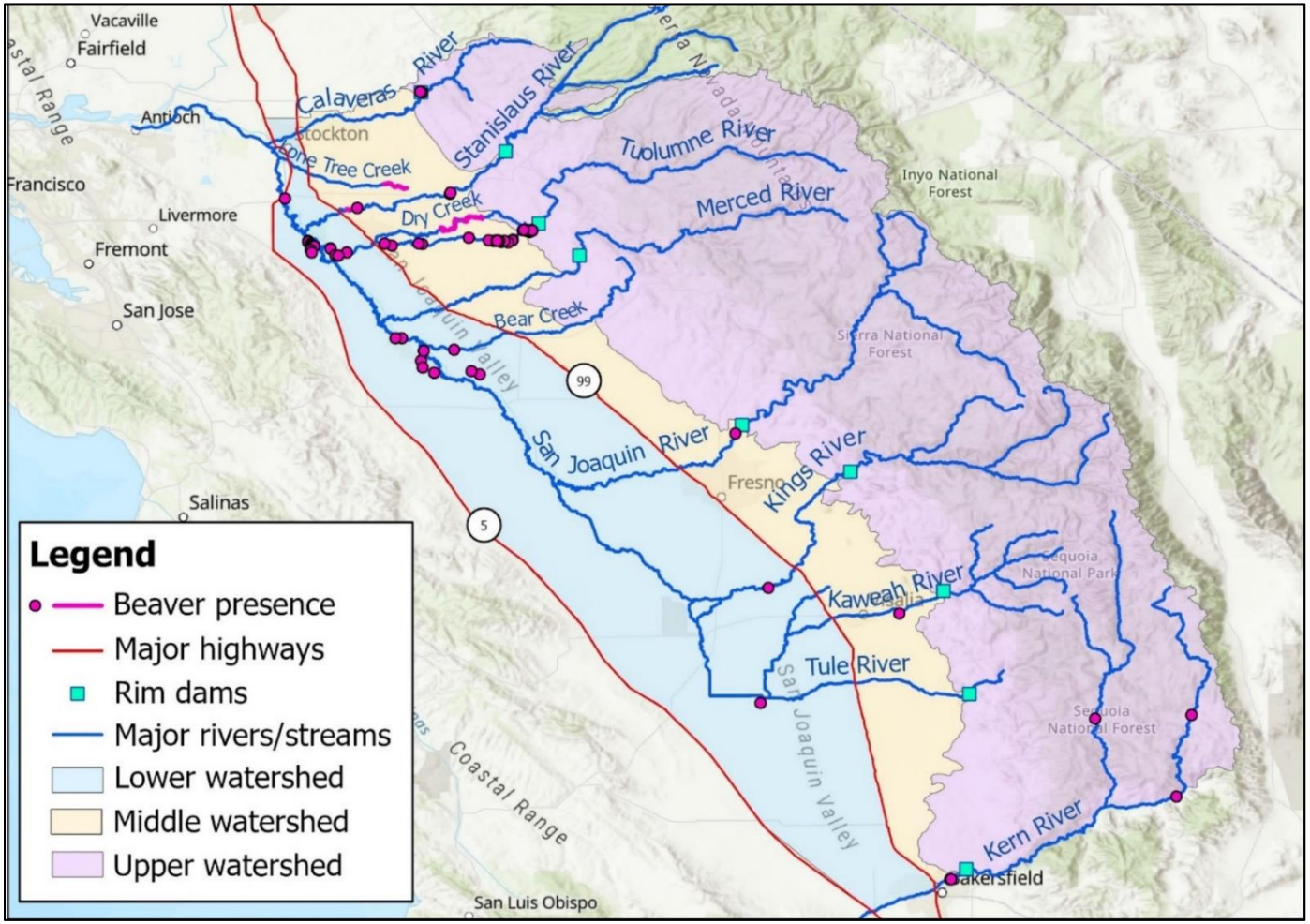

Figure 9. Locations of beavers or evidence of beavers, as provided by interviewees.

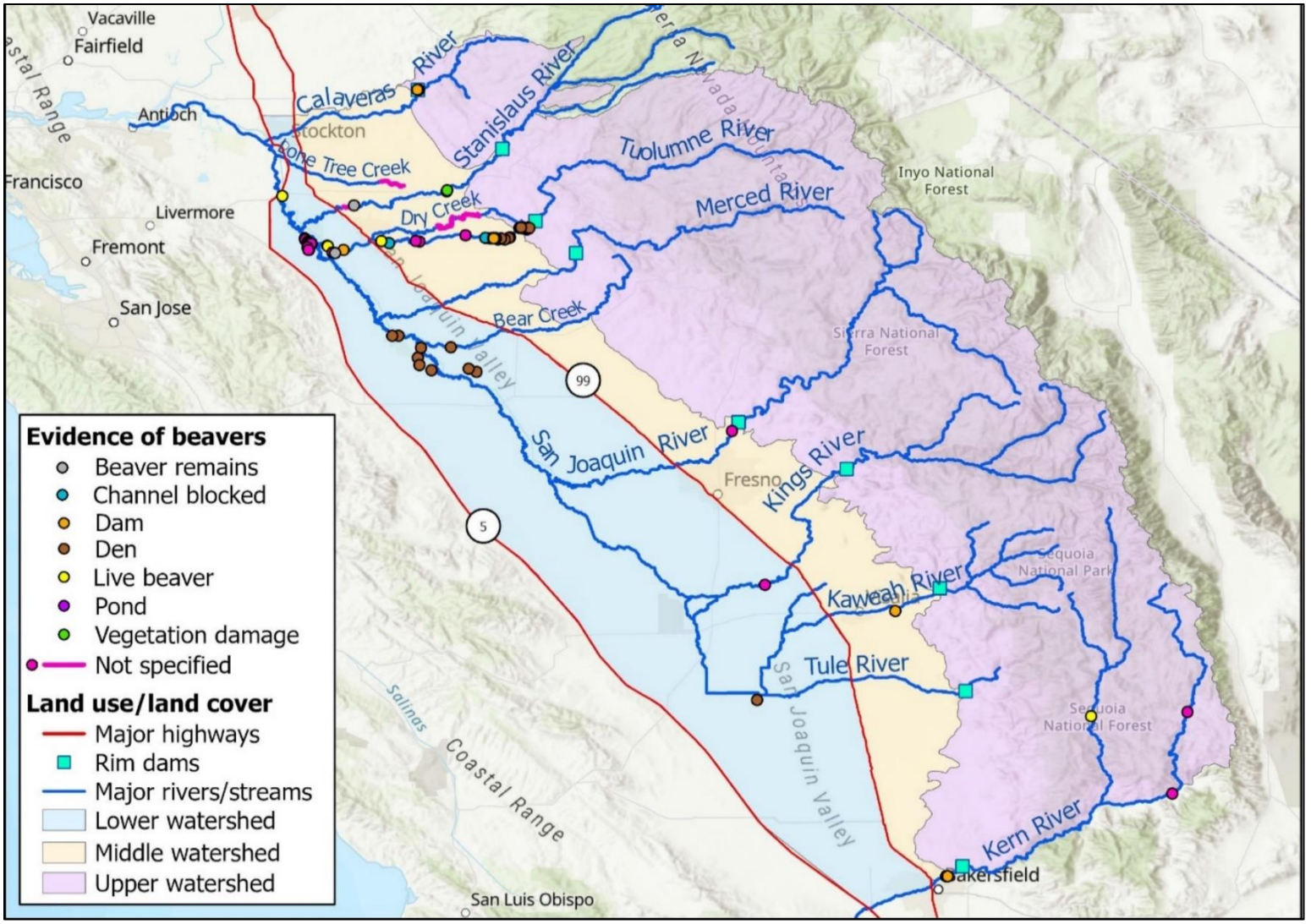

Figure 10. Evidence of beavers as described by interviewees.

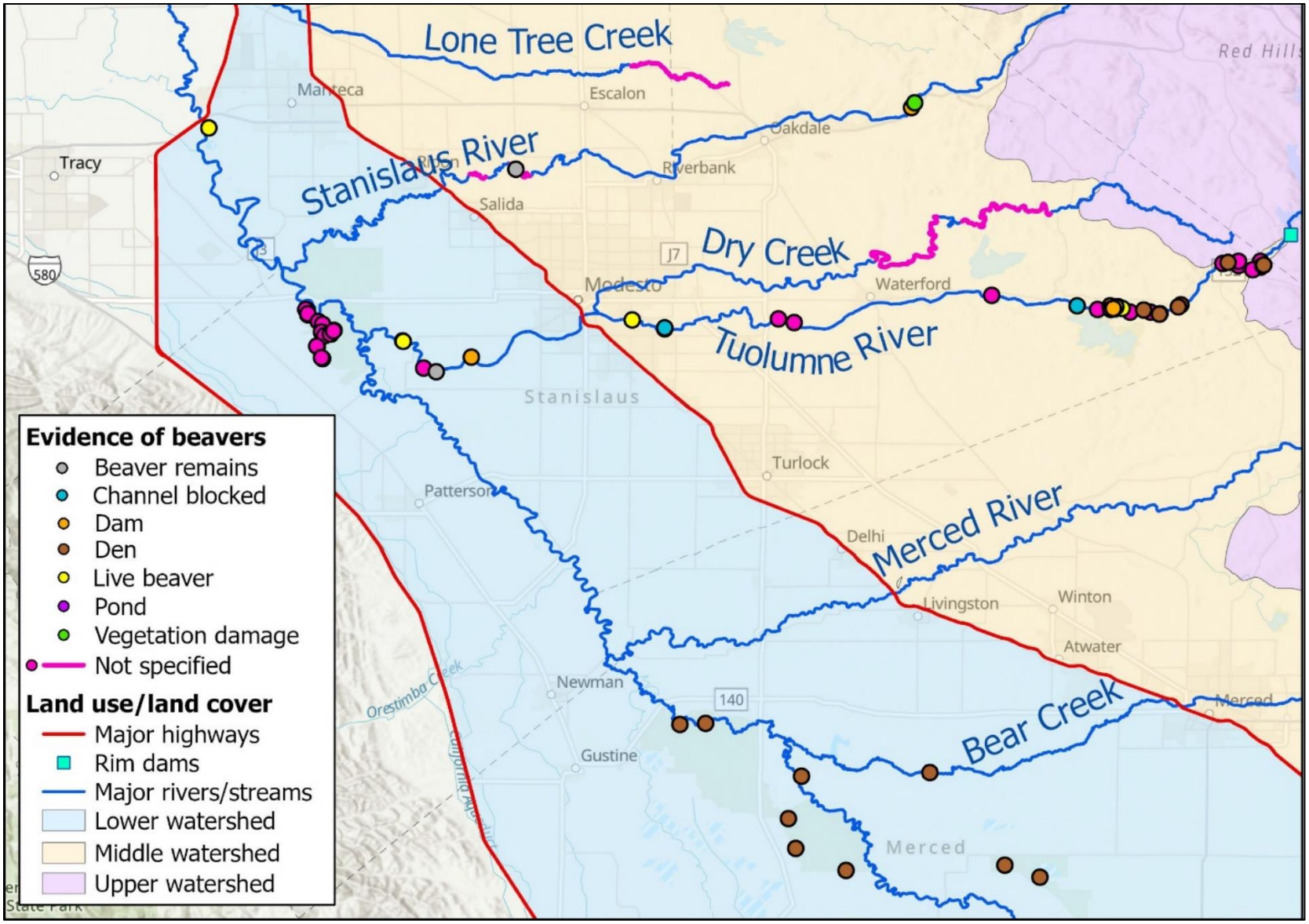

Figure 11. Close-up of beaver evidence types on the San Joaquin River and Tuolumne River.

5.0 Summary of Findings

In summary, beavers are increasingly being recognized in California as a promising approach towards low-tech, process-based restoration that help to build climate resilience by improving habitat, reducing fire risk, and keeping water on the landscape longer. CDFW has made recent strides in how they manage beavers in California, including hiring more staff to address beaver-wildlife conflicts and developing a Beaver Restoration Program, and many organizations and individuals are now working towards "bringing back the beavers" in California.

Interviewees report that beavers are present throughout the waterways in the San Joaquin valley. The interviews revealed a particular concentration of beavers in the Tuolumne River region and in close proximity to the wildlife refuges. However, due to the limited number of people we talked to, there may be beavers in other locations. As one interviewee stated, beavers are likely to be present anywhere that there is water and trees – and the limiting factor is that there are not many places where there are both flowing water and trees. Meadows in the upper watershed may be the most appropriate for beaver restoration because there is a lot of public land with trees. Another area of promise to explore may be the middle watershed, between the rim dams and Highway 99, since there is less irrigated agriculture in that area, there are more trees, and the benefits of slowing down water there could benefit that region and the lower watershed.

6.0 Opportunities

This section examines possible avenues for the reader and for Sustainable Conservation to be involved in beaver restoration in California.

6.1 Opportunities for Further Research and Involvement in Beaver Restoration

Opportunities to stay apprised and advance further thinking regarding beaver restoration are listed below.

- CDFW is currently working to improve its understanding of the current range of beavers in California and is requesting submissions of additional beaver observation data. To submit a beaver observation (including their dams and lodges) and contribute to this mapping effort, report an observation through CDFW's California Beaver Observation Survey.
- Observations can be added to iNaturalist to help map current beaver sightings. iNaturalist is used by people worldwide to document nature sightings and identify the plants and animals around them. Anyone can sign up for an account on iNaturalist and add observations of beavers, including signs of beaver like chewed trees, dams, or dens, or photos of beavers, living or dead. See existing sightings of beaver in California on iNaturalist here. There is a Getting Started page with instructions for the beginning user.
- There are opportunities to explore and exemplify coexistence strategies that work in a range of contexts. The CDFW Beaver Restoration Program and the California Beaver Coexistence

Training and Support Program being developed by the Occidental Arts and Ecology Center (OAEC) are two programs to track. People with beaver conflicts who are looking for coexistence solutions can contact the OAEC or the CDFW Human-Wildlife Conflicts Program for technical assistance.

- If someone is interested in having beavers on their land, they can find more information and links to the Beaver Restoration Project Proposal form under the Beaver Translocation Projects section of CDFW's Beaver web page.
- Connections between nutria and beavers are a potential avenue to explore. If the presence of beavers reduces the numbers of nutria, this might be an incentive to introduce or expand beaver populations (CDFW, n.d.).

6.2 Existing Intersections with Sustainable Conservation's Accelerating Restoration (AR) Program

Sustainable Conservation examined how our existing AR work is already related to Process Based Restoration (PBR) and beaver restoration.

Programmatic Permits Have Been Used for BDA and PBR Projects

The Habitat Restoration and Enhancement Act, which was created through legislation that Sustainable Conservation sponsored in 2015, and which we helped renew through legislation in 2021, has been used for several beaver dam analog projects and process-based restoration projects including Scott River Watershed Council's French Creek BDAs (Scott River Watershed Council, n.d.) and Sugar Creek BDAs (Scott River Watershed Council, n.d.) in Siskiyou County, California.

Our partners at the NOAA Restoration Center in the North Coast and Central Coast have used programmatic authorizations for multiple process-based restoration projects. Bob Pagliuco, Marine Science Specialist at the NOAA Restoration Center on the North Coast and close partner to the AR program, was on a BDA tech team with other federal and state agencies and helped get the first BDAs in California permitted on French Creek. Bob Pagliuco and NOAA have also been involved in research on fish passage and BDAs (Pollock, Witmore, & Yokel, 2022).

Beaver dam analog projects, including at Tásmam Koyóm with the Maidu Summit Consortium, used the Small Habitat Restoration Permit with the State Water Resources Control Board/Regional Water Quality Control Boards. Projects covered under that authorization are limited by size, so restoration proponents must make careful calculations of how many BDAs they can implement to stay within the size limit.

Statewide Restoration Authorizations Completed in 2022

Process-based restoration project types, including BDAs and floodplain restoration, are included in both the federal and state authorizations completed as part of Sustainable Conservation's Statewide Restoration Permitting Initiative. Both authorizations do not include specific size limits for projects, enabling PBR projects to be as large as they need to be to achieve their goals instead of being size limited in order to utilize an accelerated permitting process (Sustainable

Conservation, 2023). Because of the statewide scope of these authorizations and the lack of a specific size limit, these newer permitting pathways can be used for larger projects in more parts of California than ever before, including the restoration of 13 meadows using PBR for the Kern Plateau Meadow Restoration Project (Sustainable Conservation, 2023).

Attending Relevant Meetings

Sustainable Conservation has been attending the monthly meetings of the **California Beaver Policy Working Group** since December 2022 to stay up to date on the Beaver Restoration Program, beaver related news and events, legislation, and to continue learning about beavers from presentations given during these meetings.

The California Process-Based Restoration Network was formed in 2022 and has two-hour meetings, approximately bimonthly, as well as a quarterly newsletter and occasional training workshops. At least one AR team member has been attending these meetings and attended the virtual portion of a workshop that was held in 2022.

The Sierra Meadows Partnership is a group dedicated to Sierra meadow restoration, protection, and conservation. They hold 1-hour, bimonthly meetings online. Like the California Process-Based Restoration Network meetings, these meetings are important for someone from the AR team to attend to share Sustainable Conservation permitting resources with restoration implementers and stay informed about permitting challenges. The Partnership has a permitting subcommittee that gives a report out at each meeting. Sustainable Conservation is often called upon and gives regular updates.

Permitting Technical Assistance

The AR team has been providing free permitting technical assistance since 2015 to project implementers, funders and agencies statewide. The team provides information to help utilize and effectively navigate permitting for restoration projects depending upon the project types and size, including for process-based restoration and beaver dam analogs.

6.3 Areas for Potential Continued and/or Further Action by Sustainable Conservation

Sustainable Conservation recognizes that there are many experts and organizations working to support beaver restoration in California, and that the role we play should support the work of others and not duplicate effort. Below is how Sustainable Conservation sees itself supporting beaver restoration and process-based restoration (PBR) in California through our Accelerating Restoration and Water for the Future programs going forward:

Accelerating Restoration Program Activities

- Continue to stay apprised of beaver-related news and developments so we can provide well informed policy and permitting input.
- Continue to include PBR and beaver restoration guidance documents on the Accelerating Restoration website.

- Continue to track how efficient permitting pathways are used for PBR projects and where improvements/refinements could be made.
- Continue to attend California beaver Policy Working Group meetings to stay up to date on CDFW's Beaver Restoration Program, and beaver-related legislation and news.
- Continue to attend meetings of the California Process-Based Restoration Network and Sierra Meadows Partnership, to connect and share our resources with restoration implementers, and hear about restoration implementation challenges.
- Continue providing permitting technical assistance for PBR and other projects.
- Continue to track beaver related legislation and CDFW funding in the state budget. Support state legislation or budget actions on a case-by-case basis.
- When appropriate, connect people who have beaver coexistence problems to resources like the Beaver Restoration Program and OAEC.

Water for the Future Program Activities

- Continue to track San Joaquin Valley beaver projects and news.
- As appropriate, support and help facilitate pilot projects that build knowledge (i.e. gather data) of how beavers can coexist with humans, help with recharge, retain water on the landscape, and build overall climate change resiliency.
- If Sustainable Conservation is to engage in beaver-specific promotional outreach in the San Joaquin Valley, it should be preceded by local, on-the-ground pilot projects to show local examples of positive coexistence between beavers and humans.
- Explore if and how Sustainable Conservation could support Tribes with beaver restoration and build relationships with Tribal members.

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Appendix. Interview Questions

Beaver Interview Questions

PICK the ones you think are most important

- Geographic Extent
    - Do you know of any beavers in your area? Where? (get specific geolocations on a map if possible)
    - Do you know of any beavers in other areas? Where? (get specific geolocations on a map if possible)
    - Do you know people who have beaver on their land? (get contact info)
    - Do you know people who are likely to know where beavers are in the area? (get contact info)
- Impacts
    - What are some of the negative impacts of beavers that you have noticed?
    - What are some of the positive impacts of beavers that you have noticed?
- How to Live with Beavers
    - What are some strategies you have seen or heard about that help to resolve conflicts between beavers and humans?
- Beavers as a restoration technique
    - What do you think of efforts to utilize beavers as an ecosystem restoration technique?
    - What do you think are main impediments to bringing beavers back into the ecosystem?
    - What have you heard, if anything, of beaver dam analogs?
    - Have you heard of process-based restoration?
- Perceptions
    - How do you view beavers, both positive and negative?
    - How do you think others view beavers, both positive and negative?
    - Do you think beavers have a place in the San Joaquin Valley? What role do you think they play?
- Building support
    - How do you think we could build public support for bringing back the beaver in the San Joaquin Valley?
- Sustainable Conservation role in beaver restoration
    - What role do you think Sustainable Conservation should play in beaver restoration efforts?