

San Francisco Estuary Partnership

**Eight Bay Area Water Districts Craft
Regional Contingency Plan for Drought**

**Juggling Jams and Floods
on the North Bay's Highway 37**

**Jewels in the Mountains
Bring Sparkle to the Bay**

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of Environmental Protection**

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ESTUARY



NEWS

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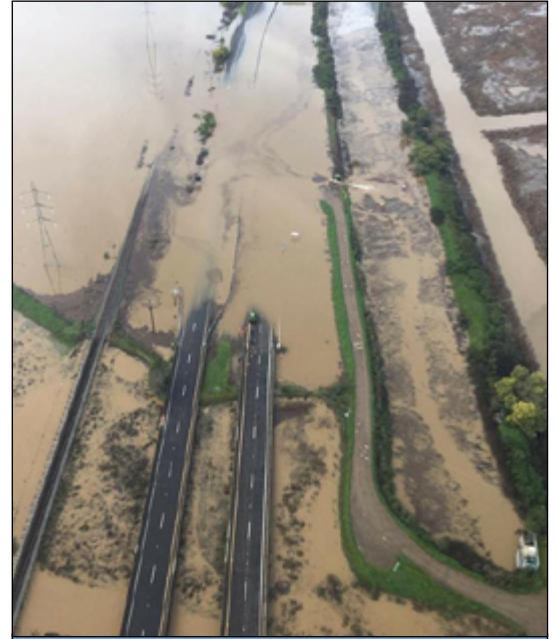
Prepping for SLR — Who's On First?

On an uncommonly sultry Thursday evening at the end of August several dozen people gathered in a grove at San Mateo's Coyote Point, sipping beer and listening to a presentation on sea level rise by staff from San Mateo County's Office of Sustainability. Then, accompanied by the sound of gunshots from a nearby firing range, everyone trooped down to the Bay's edge, where temporary markers indicated how high the water would rise under three different scenarios. In the most dire projection, water would cover the heads of the people standing on the beach.

The event, "Shrinking Shores," was presented by Sea Change San Mateo County, one a handful of county-level projects around the Bay that aim to assess local vulnerability to sea level rise and develop long-term adaptation strategies. Many of these projects are linked to the Bay

Conservation and Development Commission's Adapting to Rising Tides (ART) project, which used new FEMA coastal maps to develop detailed flooding projections for all nine Bay Area counties. "We've developed inundation maps that identify where the water is coming from, the type of shoreline, levees, berms, the height of tides and elevation of the shoreline in each location" says BCDC's Lindy Lowe. This article checks in with a variety of municipalities and planning efforts around the Bay to see how prepared they are for the rising seas, storm surges, and increased flooding promised by our climate changed future.

Go online to www.sfestuary.org/estuary-news to read this in-depth story in full, complete with details, photos, and comments from around the Bay.

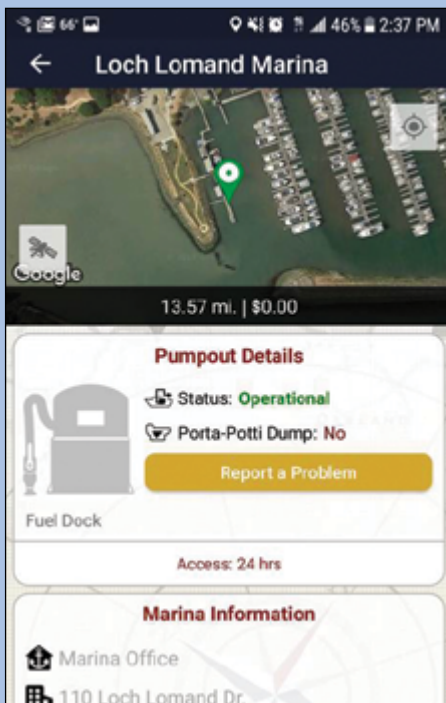


Closure of Highway 37 in the winter of 2017. Photo courtesy Sonoma Transportation Authority.

DOCKSIDE

Shorter Hunt for Working Pumpouts

Most Bay and Delta boaters know that discharging their waste overboard is a no-no, as dumping raw sewage is hazardous to human health and



local ecosystems. Yet some boaters still dump — even with maps showing the location of 90 pumpout stations around the Estuary that can send the waste to a treatment plant.

"One of the greatest frustrations we've heard is that pumpout stations sometimes don't work once boaters get there," says Adrien Baudrimont, San Francisco Estuary Partnership (SFEP) environmental planner.

Old-fashioned maps haven't solved the problem. And 74 percent of all boaters aren't aware that they could be fined \$2,000 for dumping raw sewage into California waters, according to a 2011 survey conducted by the state's Division of Boating and Waterways (DPW).

So the Partnership developed Pumpout Nav, an app that uses geolocation to show which stations nearby are in good working order — and which ones aren't. Funded by a Clean Vessel Act grant, the app helps advance the Partnership's goal of reducing the amount of sewage discharged into the Bay and Delta.

Pumpout Nav also enables the Partnership and marina managers to conduct regular monitoring of each station by entering testing data directly

into the app. Users can also report issues and upload photos, expediting the repair process.

"Boaters want convenient services and access to those services and education," says Vivian Matuk, DPW environmental boating program coordinator. "The app is both a more efficient way to maintain the pumpout stations and a more reliable way than using paper to collect data."

Pumpout Nav covers five counties in the Southern California region as well. Recently, several states and regions across the U.S. expressed interest in the app after Baudrimont and his team gave a demonstration at a conference. They'll be able get their pumpout stations into the app after SFEP finishes its second version. And since California will continue to host the app, other states will not have to pay to participate.

"The goal is to maximize the impact of California's Clean Vessel Act grant money," Matuk says. "The dollars we're investing in the app are being stretched as much as possible." **KrW**

Pumpout Nav, dbw.parks.ca.gov/?page_id=29601 (free download for iOS and Android)

High Road for the Wettest Highway?

As Bay Area cities and counties grapple with the formidable challenge of preparing for a higher San Francisco Bay, there is perhaps no better example of the obstacles and opportunities than the effort underway to adapt Highway 37.

The 21-mile North Bay corridor running from Vallejo to Novato has long been a source of tranquility and frustration. The highway offers sweeping views of tidal baylands dotted with roosting waterfowl and shorebirds plumbing mudflats for food, along with mile upon mile of open space — a bounty of natural land made possible by decades of careful planning and restoration work. And commuters often have ample time to enjoy the scenery: Highway 37 is one of the most congested in the region, with peak traffic producing delays as much as 40 to 80 minutes in each direction.

Congestion isn't the only problem facing Highway 37. This past winter a combination of storms and high tides caused Novato Creek to spill onto the low-lying highway, shutting it down for a total of 28 days.

"The only upside of the storm event is that it highlighted how vulnerable portions of this corridor are," notes Suzanne Smith, Executive Director of the Sonoma County Transportation Authority. "If a portion of the corridor goes down it has a significant impact on alternative routes which are limited in the North Bay."

While it wasn't the first time flooding impacted Highway 37, it's very clear that it won't be the last. A 2012 study by the Road Ecology Center at the University of California, Davis pointed out the highway's numerous vulnerabilities to flooding and sea level rise, and estimated that within 30-40 years various low spots in levees protecting the highway could fail to hold off rising bay waters.

"Obviously there was a growing sense of urgency due to the traffic, but the floods from last winter and road closure in Marin drove home the point that the sea level rise that seemed far off maybe isn't as far off as we think," says Daryl Halls, Executive Director of the Solano County Transportation Authority.

Both Smith and Halls staff the Highway 37 Policy Committee, a group composed of twelve elected officials from Solano, Napa, Sonoma and Marin Counties that has been meeting bi-monthly to wrestle with how to improve the beleaguered corridor before things get worse.

Like flooding, Highway 37's congestion is projected to significantly increase in the future. And the hotspot for both problems is the 9.3-mile stretch from Sears Point to the Napa River bridge. In this segment Highway 37 narrows to two lanes more suitable for a few tractors pulling hay than the estimated 45,000 daily trips it receives today. The road lies mere feet above the high tide line, often with only a narrow strip marsh between the highway and the Bay.

Intertwined with the discussion of Highway 37's future are its surroundings. Over the past few decades, the restoration community has made a significant investment in conserving and restoring thousands of acres of wetlands and open space in the North Bay.

"This project is the opportunity of a lifetime because it crosses four counties, connects two major highways, and is surrounded by tremendous ecological resources," says Jessica Davenport, a Project Manager with the California State Coastal Conservancy. "We don't want to miss this chance to come together and create a world class adaptation, restoration, and transportation project."

In 2015, decades of work and planning culminated with the Sears Point and Cullinan Ranch restoration projects breaching levees to cheers, as bay waters returned to several thousands of acres that had been diked off for farming over a century ago.

"We've been working down in the baylands since the eighties," says Julian Meisler, Baylands Program Manager at the Sonoma Land Trust. His organization bought the Tolay Creek Ranch, the Sonoma Baylands and Sears Point — all of which surround Highway 37. According to Meisler, the Land Trust has protected about 6,500 acres just in the Sonoma County area around Highway 37. And in Solano County, Ducks Unlimited and the California Department of Fish and Wildlife have conserved and restored thousands more acres near the highway. "At least \$100 million, and maybe double that, has been spent," says Meisler.

For the restoration community, Highway 37 presents both a barrier and an opportunity. The highway disconnects the tidally-restored baylands from adjacent open spaces, preventing habitats and species from being able to migrate to higher ground as the bay advances.

"The highway interrupts the ecological processes," explains Meisler. "In some cases it's preventing the marsh from moving inland, in some cases it's preventing stormwater from flowing outward, in some cases it's preventing tidal water from moving upstream."



Photo courtesy Solano Transportation Authority & Caltrans

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other options such as a public-private partnership where risk, liability, management, and toll revenue are split between a private partner and government.

While no decision has been made yet, more and more committee members have acknowledged publicly that a toll seems to be the only way to raise the funds needed to fix the highway.

"The whole issue of whether to toll the corridor, that's a huge policy call. All we're saying is without funding you don't have improvements," says

Halls. "That's a question for the public — are they willing to consider what I call a 'user fee' to get this project going?"

Any tolling proposal for the highway raises serious questions regarding social equity. Highway 37 is the last major trans-bay route without a toll, and its commuters mostly live in the lower-income Solano County and work in wealthier Marin and Sonoma Counties.

Tolling, equity, and the ecological impacts of the proposed solutions are expected to be big topics of discussion in a series of public engagement workshops taking place in the four counties from September 20 to October 2, 2017.

As frustration with congestion increases, and water levels creep higher, there is a tension between moving full speed ahead on fixing the corridor's issues and proceeding in a deliberate, transparent process in order to ensure all stakeholder's concerns are met.

"We're trying to get all the right people to the table to not just talk, but to actually do something," says Halls. **IP**

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Don't miss the in-depth online story at www.sfestuary.org/estuary-news

If Highway 37 were elevated, rainfall and tidal waters could flow unimpeded to and from the bay as motorists pass by high above, yielding two-way passage for both people and wildlife. The benefits are many, according to Meisler: reconnecting natural processes rather than fortifying against them can help prevent flooding, saltwater intrusion, and habitat loss. "It becomes a much more functional system and one that would probably cost a lot less from a maintenance perspective for whomever ends up managing that road."

Davenport agrees. She has been coordinating a group of restoration organizations and land managers that have formed their own committee, called the State Route 37 Baylands Group. "There was a concern that with this accelerated schedule for redesign and construction of the highway there might not be enough attention paid to the ecological values of the area and how to protect and enhance them," she says. "We wanted to pull existing knowledge together in a way that could be communicated to both transportation planners and the public."

Looming over the hurdles facing Highway 37 is the price. The 2012 UC Davis study evaluated two basic options: expanding the levee that the road currently sits on or replacing it with an elevated causeway. Each potential solution brings with it complex engineering problems: widening and raising the existing levee to accommodate extra lanes and future water levels raises questions about how high is

high enough (a tricky issue as settlement of the soft bay mud under the levee already exacerbates the road's current vulnerability to flooding). The other option, building a four-lane causeway, would cost three or four times as much, but would minimize environmental impacts.

Smith emphasizes that these options are just sketch-level concepts. "[In the future] we'll be exploring more how you mix and match a levee and a causeway system in order to maximize benefits to the baylands and species out there," she says. "I can't imagine it will be just one big causeway or just one big berm, but it will be some combination."

Whatever solution is decided upon, it won't be cheap. The estimated price tag to fix just the most vulnerable 9.3-mile segment ranges from \$700 million to \$2.5 billion. And to fix the whole highway? Something like \$1.3-\$4.3 billion.

The daunting cost is why the Highway 37 Policy Committee has engaged in serious discussion over the possibility of tolling the highway — and they are not the only ones interested. In May of 2016, a private venture group submitted an unsolicited bid to the committee, in effect offering to fully fund the project in exchange for Caltrans relinquishing the highway segment to the company, along with its potential toll revenue.

But full privatization is just one way to bankroll the project. The Highway 37 Policy Committee has been exploring

Choice Mountain Parcels Help Preserve Bay

Follow San Leandro Creek upstream from its mouth at Arrowhead Marsh, across the flats of East Oakland and San Leandro, under two freeways, and finally into the hills where it flows through the Lake Chabot Dam, and you've traced only part of its remarkable journey. The creek's headwaters deep in the hills, miles upstream of Chabot, represent an even greater prize for the Martinez-based John Muir Land Trust, which seeks to permanently protect East Bay open spaces.

Similar conservation targets exist across the Bay Area, particularly on the outskirts: sprawling, undeveloped, privately owned parcels whose protection sends a variety of benefits cascading downhill toward cities and the bay. Headwater channels — the steep, confined, generally ephemeral channels at the top of watersheds — are primary sources of runoff, nutrients, sediments, and woody debris for downstream reaches, says Christina Toms of the San Francisco Regional Water Quality Control Board. "Without proper stewardship of these systems, it would be difficult if not impossible to protect water quality and habitats in downstream, more perennial reaches and the Bay."

In November 2016 the John Muir Land Trust announced one of its largest-ever purchases, the 604-acre Carr Ranch located southeast of Moraga within San Leandro Creek's upper watershed. Purchased in partnership with the East Bay Municipal Utility District (EBMUD), which now holds title, the property is bounded on three sides by other water-district lands and fills a significant gap in a patchwork of open-space protection that also includes Oakland's Redwood Regional Park.

"The watershed is relatively undeveloped, other than the city of Moraga," says Jose Setka, Manager of Fisheries and Wildlife for EBMUD. "I think it's less than 10 percent of the total watershed. So acquiring a piece of property like Carr Ranch is important for keeping the level of development low."

All creeks and streams in the vicinity flow first into the Upper San Leandro Creek Reservoir, a source of drinking water for tens of thousands of East Bay families, before draining to Lake Chabot four miles downstream. Limiting development here also preserves water for fish, Setka says — particularly the native rainbow trout in Upper San Leandro Reservoir and a

small yet viable run of steelhead below Chabot — and for countless other species along the creek's 22-mile run to the Bay, where it delivers fresh water to one of the East Bay's most important wetlands.

Sixty miles north on the slopes of Mount St. Helena, a similar story played out early this year. The protection of 7,300 acres adjacent to Robert Louis Stevenson State Park hinged not only on its dense forests, volcanic rocks, serpentine soils, and several dozen threatened or endangered species, but also on its rich water resources. Some 44,000 acre-feet of water fall on the property annually, of which more than half — enough for roughly 35,000 households — flows off in surface creeks and streams. The remainder seeps down into the water table to be slowly released over the years through some 60 to 70 springs, says Brendan Moriarty of the San Francisco-based Trust for Public Land, which worked with the Land Trust of Napa County to secure a conservation easement earlier this year.

The property also contains the headwaters of St. Helena Creek and drains primarily to Lake Berryessa, a critical source of water and hydroelectric power for the North Bay. Below the reservoir, the water continues through Putah Creek to the Yolo Bypass and finally the San Francisco Bay.

Representing more than 70 different parcels assembled over the course of 137 years, the property remains in pri-

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Carr Ranch. Photo by Adam Weidenbach.

WATERSHEDS, *cont'd from page 5*

vate hands and lacks public access, but is now prevented from being subdivided and developed into vineyards — not an otherwise unlikely fate given market pressures and the abundance of water, Moriarty says.

And since it's part of a broad swath of protected land totaling 34 square miles, its conservation also illuminates the key role that upper watersheds can play in habitat connectivity. This includes securing current wildlife corridors, and, years from now, providing refuge at various elevations for species impacted by climate change.

"Migration corridors follow streams," says Brian Mendenhall, a project manager with the Santa Clara Valley Water District. "And species are going to migrate with climate change, moving closer to or farther from the Bay."

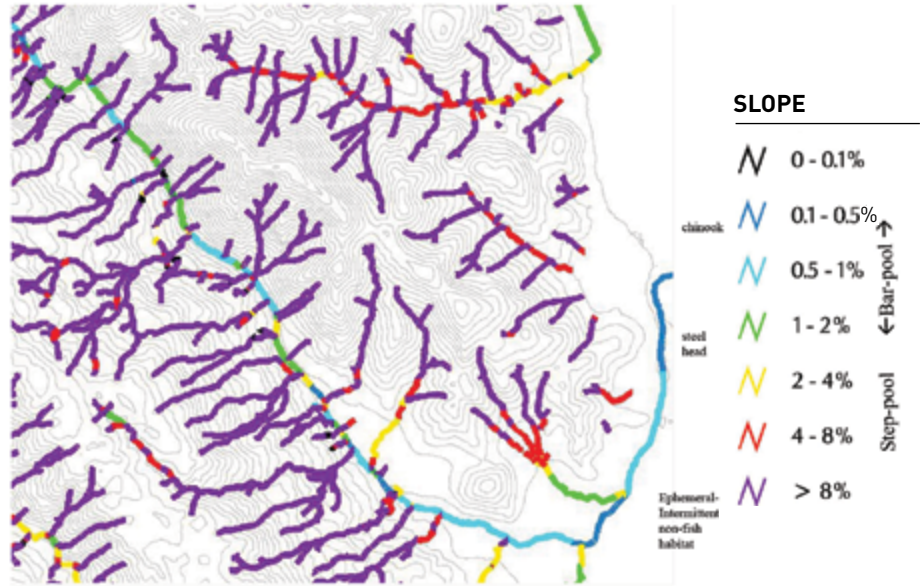
Granted, his agency is just as concerned with sediment flows and flood control, Mendenhall says, and properly managed upper-watershed lands have a role there, too. For example, by restoring and occasionally flooding former wet meadows in the southern portion of the massive Coyote Creek Watershed, which drains to the Bay through San Jose, the water district can

capture and sink additional rainwater before it reaches urban flood channels in the lower watershed, Mendenhall says: further proof that while upper watersheds may be remote, their benefits are anything but. **NS**

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HEADWATER CHANNELS DRY CREEK WATERSHED, NAPA COUNTY



Headwater channels (the steep, confined, generally ephemeral channels at the top of watersheds), shown in purple, are the primary sources of runoff, nutrients, fine sediment, and large woody debris to downstream reaches. Map courtesy Mike Napolitano, SFBRWQCB, (originally from Bill Dietrich, UC Berkeley).

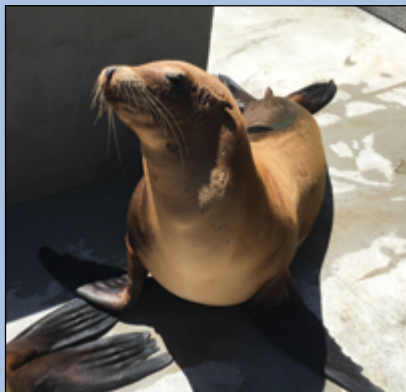
SPECIES SPOT

Toxic Summer for Sea Lions

The Marine Mammal Center in Sausalito is wrapping up a busy summer after receiving an influx of adult California sea lions diagnosed with domoic acid poisoning.

During algal blooms along the coast of Northern California, an algae species called *Pseudo-nitzschia australis* sometimes propagates the neurotoxin called domoic acid. As it accumulates up the food chain, it can reach concentrations dangerous for higher level predators.

"Amnesiac shellfish poisoning," as the effect is known in humans, was discovered in 1987 after a bout of food poisoning in Eastern Canada was linked to Prince Edward Island mussels with high concentrations of the toxin.



Some cases reported memory loss and even permanent neurological damage. Domoic acid targets the hippocampus, which is the brain region tied to memory and can have similarly devastating effects on sea lions.

Dr. Claire Simeone, a veterinarian with the Center, describes the condition as "either acute or chronic." "Acute" refers to a strong dose delivered quickly, causing disorientation and seizures. A more gradual build up of the toxin, or "chronic," results in unpredictable, sometimes aggressive behavior. "It feels like a really bad headache," she says. Affected sea lions can lose the ability to forage and mothers often unwittingly abandon still-nursing pups.

At the Sausalito hospital, teams of trained volunteers assist the veterinarians as they provide the sick animals anti-seizure medication, a domoic acid-free diet, and fluids to flush the toxin

from their system. "If we can respond quickly and flush quickly, their prognosis is quite good," says Simeone.

To facilitate a rapid response, the Center asks that members of the public call their rescue hotline if they believe they have spotted a sick sea lion. Giancarlo Rulli, a center spokesperson, says to "look for erratic behavior like head weaving" and to "maintain a 50-foot distance from the animal." During a busy month like July, rescue volunteers respond to as many as ten new reports a day.

Dr. Simeone referred to sea lions as a "sentinel species," meaning they act as an early warning system for localized ocean toxicity. They are the "canary in a coal mine," if you will, for the California coast. While their population is not currently at risk, the number of cases in sea lions could rise as warming oceans catalyze more frequent toxic blooms. For now, though, our canary is still singing. **MHA**

Rescue Hotline 415-289-SEAL (7325)

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P L A C E S

The Delta from Within

Highway 160 runs along a levee, hugging the Sacramento River as it curves through the Sacramento-San Joaquin River Delta. Heading north from Rio Vista, blue water sparkles on the left. On the right, vibrant green fields, orchards and vineyards go on forever. A few miles up the winding road, shaggy valley oaks meet overhead, a reminder of what was here before people tamed the water and turned the Delta — where California's two largest rivers meet on their way to the sea — into a patchwork of islands and meandering sloughs.

As an outsider, it's easy to see the Delta as a mess. News reports are alarming: once a paradise of wildlife, the Delta is now an ecological disaster of endangered fish and subsided land; the crumbling levees that protect the Delta islands are an accident waiting to happen; and, of course, the Delta is the nexus of the fierce water wars between the state's wet north and dry south.

But there's much more to the Delta, which was settled and reshaped beginning with the Gold Rush. The 33 miles between Rio Vista and Sacramento feel like another world. The levee road is far above the land: drivers look down to the river, directly at crowns of huge oak trees, and clear across the tops of fruit trees. The sky is big and the land stretches out in all directions, bounded only by a 360-degree horizon.

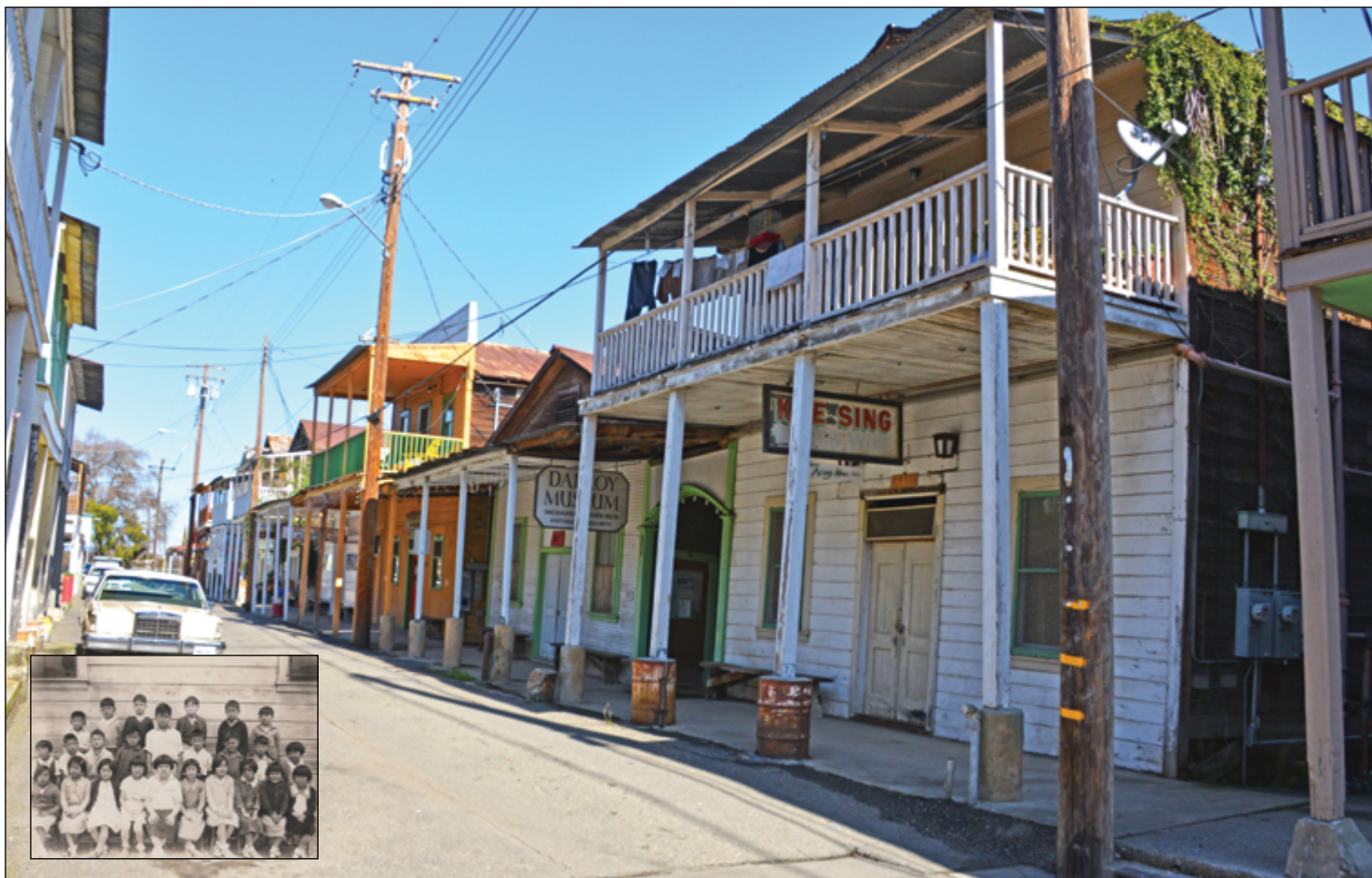
Isleton, the first town after Rio Vista, is three miles in. Population 804, elevation eight feet above sea level. Seven miles later comes the first of many drawbridges that link the islands. Yellow and scarcely wide enough for today's cars, this one leads to Ryde. Population 60, elevation one. Three more miles and a second bridge, gray green this time, leads to Walnut Grove. Population 725, elevation 23. And so on, all the way to the edge of Sacramento.

This is the heart of the Delta, says Erik Vink, director of the Delta Protection Commission. He wants to raise awareness of the Delta as a place rich in California's cultural history. A proposal before Congress could help: it would designate the Delta as a National Heritage Area — lived-in landscapes that tell stories celebrating our country's diverse cultures. "The focus is not on the land but on humans' role in shaping the natural environment," Vink says.

Chinese laborers built the Delta's first levees in the late 1800s. Many came from China's Pearl River Delta, where they had learned to turn wetlands into farmland. After building levees in the Sacramento-San Joaquin River Delta, some stayed to work the fertile soil, settling near Walnut Grove in the town of Locke. "The Delta reminded them of home," says Clarence Chu, a founding member of the Locke Foundation, which is dedicated to conserving the town's heritage. "That is why they were so in love with this area."

The historic Chinese section of Locke is compact — 23 wooden build-

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The Delta town of Locke. Photo: Amber Manfree. Inset: Schoolchildren from early Locke. Photo courtesy Locke Foundation.

ings on one block — but it was everything to the people who once lived here. Chu tells their story on a tour of key buildings that have been restored as museums. Newcomers joined the Chinese Association, now a museum, where they received mail, read Chinese newspapers, and socialized. “It was like a big brother association,” he says. “It helped them start a new life.”

Small as it is, Locke had three gambling houses because this was a popular way to relax after a hard day’s work in the fields. But gambling was not yet legal in California. One of the establishments is now the Dai Loy Museum, and the windows were boarded for concealment, the main door was reinforced against unexpected entry, and extra doors were built for escape. “A hidden lookout pressed a secret button to alert that the sheriff was near,” Chu says.

Children learned Cantonese at the Chinese School in the afternoon, after their regular public school got out. Neat rows of dark wooden desks line the one-room museum, and

neat rows of children lined up for the black-and-white photographs on the wall. The school closed decades ago because Locke no longer had enough Chinese youth.

When Chu came to California in the 1970s, he befriended the elderly Chinese people who still lived in Locke. “There were 60 or 70 then and hardly any are left now,” he says. “Locke is a living community and most of the people are non-Chinese — it’s important to preserve its history.”

Six miles up Hwy. 160 from Locke, a yellow drawbridge crosses Steamboat Slough. Designed by Joseph Strauss, chief engineer of the Golden Gate Bridge, it leads to land Tim Neuharth’s family on his mother’s side has farmed since 1848. “They came out from Tennessee for the Gold Rush, saw all the water and the rich soil, and decided it was a good place to stay,” he says.

Neuharth sits at a picnic table under the shade of a spreading oak tree, looking towards the

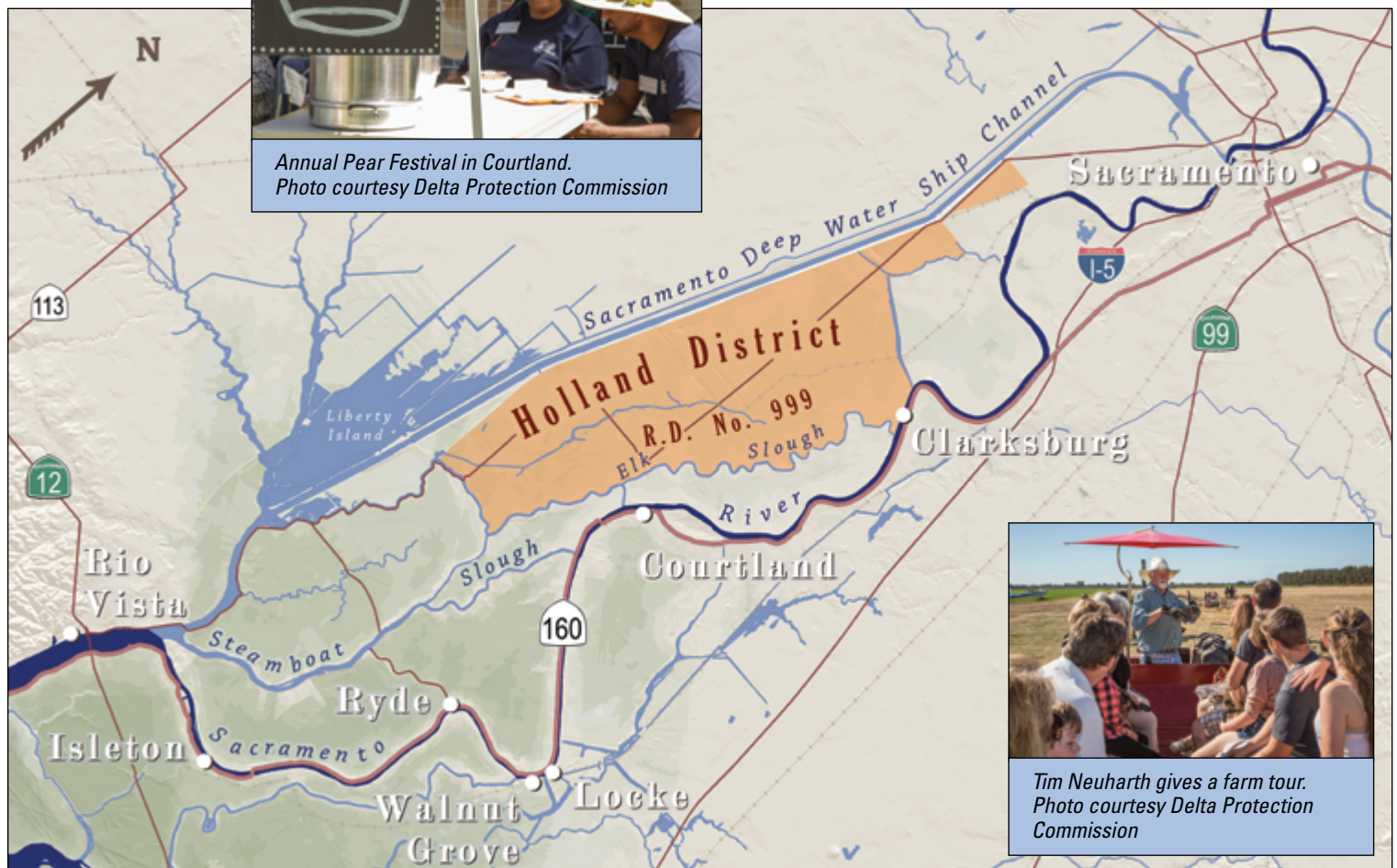
bridge and a sandy beach along the slough. Birdsong is all around and a breeze eases the heat of the summer day. Neuharth is the fifth generation to work the farm, called Steamboat Acres, and his son is the sixth. He hopes his recently-born grandson will be the seventh. “We are very blessed to be here,” he says.

But Neuharth also says it’s getting hard for small family farmers to survive. Fifty-two of his 280 acres are pears, one of the earliest crops in the Delta, and some of the trees are nearly 125 years old with gnarled black trunks and branches. Neuharth envisions doing for pears what Placerville’s Apple Hill does for apples. His eatery, Steamboat Landing, has views of a historic pear orchard and the menu includes pear tarts. He shares samples of his pears — Bartlett, Stark Crimson, Golden Bosc, and all certified organic — at regional markets. And his brochures proclaim, “Start a movement...EAT a PEAR!” Pears are rich in fiber, Neuharth winks, adding that this motto is not universally appreciated by the rest of his family.

He also gives farm tours in a tractor-drawn wagon, rents out his beach and barn for events, and co-



Annual Pear Festival in Courtland.
Photo courtesy Delta Protection Commission



Tim Neuharth gives a farm tour.
Photo courtesy Delta Protection Commission



Isleton Bridge. Photo courtesy Jenny Oh Hatfield, Plattyjo Blog

founded the Delta Farm & Winery Trail to get the word out about what he and other farmers here offer. “Hopefully it all adds up to the sustainability of us staying here,” Neuharth says.

Ten miles upriver from Steamboat Acres is Steve Heringer’s land, in the northern tip of the Delta near Clarksburg. “My great-great-grandfather emigrated from the Netherlands with his wife and four kids in 1868, and we’ve been farming here ever since,” he says. Like Neuharth, Heringer’s sons and daughter work with him, and grandsons give hope that the farm will stay in the family.

Also like Neuharth, Heringer loves the land. “So much is unchanged here,” he says. “Visitors say it’s like dropping back 100 years.” He credits the many multigenerational families as well as state policies that have protected the heart of the Delta from development. There’s no hint that Sacramento, where half a million people sprawl over 100 square miles, is just five miles up the highway from where he lives and works.

Heringer’s office is the converted garage of the house where he grew up and where his 96-year-old mother still lives. Minutes away is a spot that has been a favorite since he was a child: a levee road lined on both sides by oak trees, which touch each others’ branches overhead. Elk Slough is on the left and, as he drives, Heringer delights in the turtles that slide from logs into the peaceful water. Egrets and herons fish and fly by. “It’s a Garden of Eden here,” he says.

On the right, vineyards flourish. Like many farmers near Clarksburg, Heringer’s family has taken out sugar beets and other old-fashioned crops and put in wine grapes, which thrive in

the hot summer days and cool nights. The water table is so high that some vines don’t even need irrigation. “If you dug hole, at seven or eight feet you’d be digging in water,” Heringer says. His family grows two dozen wine grape varieties on 185 acres, and his son Mike began making their own wine after studying viticulture at California State University, Fresno.

Their winery, Heringer Estates, operates one of the 13 tasting rooms at the Old Sugar Mill in Clarksburg, which originally processed the family’s sugar beet crop. Photos on the tasting room walls tell the family story. In one, Heringer’s parents stand by a crawler tractor, which has tracks instead of wheels and was invented for working the Delta’s soft soil. In another, five hands clasp each other. “That’s my dad, me, my son and two grandsons,” Heringer says.

Protecting communities is a major goal of National Heritage Areas (NHAs) and if the bid to establish one in the Delta is successful, it could help future generations of Heringers add their hands to the photos in the tasting room. Administered by the National Park Service, NHAs get park service signage, with its instantly recognizable arrowhead logo, and up to \$10 million in federal funds for development and promotion — without federal ownership of the land or dictates on its use.

While the Park Service says the Delta meets the criteria for becoming an NHA, the path to designation is slow: the Delta’s bid has stalled four times since first being introduced to Congress in 2009. But the Delta Protection Commission’s Erik Vink is confident that it will get there. “These bills tend to be below the radar so they don’t move on their own,” he says. “But it’s

WATERWORKS

Reclamation District No. 999

The pump house is the first stop on Steve Heringer’s tour of Holland District, the Delta island his family has farmed for a century and a half. “In the 1850s, this was swamp with tules,” Heringer says. Drying out this 25,000-acre tract took a team of water system engineers — including Guy Fraser, who had previously worked on the Panama Canal — as well as \$2.9 million, 33 miles of levees, 260 miles of ditches, and a pair of water pumps that stand as tall as a person.

Cast in 1915 in a San Francisco foundry, the pumps were initially intended for the Dutch. But World War I brought fears that the ship carrying them would be sunk en route, so Heringer’s island bought the pumps instead. The pump house can drain 280,000 gallons per minute, with the original pumps providing three-fifths of the capacity; the rest is from four smaller pumps that were installed later.

“We’re completely surrounded by levees so when it rains, we have to pump out the ditches so they don’t flood fields and destroy crops,” says Heringer, who sits on the board of Reclamation District No. 999, which manages the island’s water. “Last winter was so wet that the pumps ran more on than off for four months.”

In the summer, the District siphons water the other way, from sloughs into the ditches that run through the fields. The Delta has so much water that farmers there have plenty even when the rest of the state is parched, although Heringer says salt can be a “huge concern” during droughts.

The last stop on Heringer’s tour is a luxuriant vineyard his son put in. The district has not flooded since the early 1900s. **RM**

just a matter of time.” The Delta would be the nation’s fiftieth NHA and California’s first. **RM**

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S U P P L Y

Drought Contingency

Motivated by the recent drought, local water agencies have formed an unprecedented partnership aimed at reducing the impact of future dry spells.

“This is exciting because we have all the agencies working together and this type of project is not something we’ve done before in the Bay Area,” says Alice Towey, an engineer with East Bay Municipal Utility District (EBMUD).

The Bay Area Regional Reliability (BARR) partnership, formed in 2013, consists of eight of the region’s largest water districts. Together, they serve over six million people in six counties ranging from Marin east to Contra Costa, and south to the peninsula and Santa Clara valley. This summer, the partnership finalized a draft Drought Contingency Plan funded by a \$200,000 grant from the US Bureau of Reclamation, which examines both supply and demand and provides a vulnerability assessment.

“For the first time in the history of water delivery in the Bay Area, the water utilities are talking about how to assist each other when there is a shortage,” says Bob Whitley, an engineer specializing in water infrastructure and co-chair of the East Bay Leadership Council’s water resources standing committee.

Bay Area water comes from a wide array of sources and geographic regions, including groundwater, local watersheds and reservoirs, the Sacramento-San Joaquin Delta, the Russian River, Lake Berryessa, and the Mokelumne River and Hetch Hetchy reservoir in the Sierra. This means that not only does each agency respond to a situation such as a drought differently, but they also might experience very different effects from other agencies in the region.

“That can be confusing for customers—they wonder, ‘Oh gee, why do I only have a 10% restriction on my water while the guy across the street has a 30% restriction,’” says Towey, who is also a project manager for the Drought Contingency Plan.

“That drought knocked our socks off; it set a new dynamic in play,” says Grant Davis, recently appointed director of the California Department of Water Resources—who, until July, was participating in the BARR meetings in his role as the General Manager of the Sonoma County Water Agency. “We need to be looking at resiliency in the future.”

Collectively, while the BARR agencies expect they will be able to meet water demands in normal years, they predict an increasing shortfall in multi-year droughts. The Contingency Plan identi-



Los Vaqueros reservoir, a target for expanded capacity for contingencies. Photo courtesy CCWD.

fies a suite of measures to increase reliability and resilience including developing mobile water treatment facilities, diversifying and expanding current water sources (such as desalinization, and potable and non-potable re-use); increasing storage capacity; building interties that would connect and enable agencies to more easily transport water from one to another; and creating a regional water market program.

“Each project has its own utility individually but when you start to look at them all together, you start to see some really interesting ways that we will be better positioned in terms of future droughts as a region,” Towey says.

Potential projects that were identified in the report include expansion of the Los Vaqueros reservoir by the Contra Costa Water District, the Silicon Valley Advanced Water Purification Center, and the Del Valle reservoir storage system; as well as construction of a regional desalinization plant, a Walnut Creek water pretreatment plant,

and multiple interties throughout the region, including one between the Marin Municipal Water District and EBMUD.

Other sustainable local sources of supply that BARR agencies are considering expanding include rainwater, stormwater, graywater (such as from sinks, washers, and showers), blackwater (which includes the same elements as graywater, with the addition of toilets), and foundation drainage.

Many of the plan’s measures call for new facilities—which typically take a while to get up and running. “There are many steps—and it’s a change from what we’ve done traditionally,” Whitley says. “But the fact that the report was put together and all eight agencies signed off on it is an excellent sign.”

Development of the plan also included input from 25 stakeholder groups on a drought task force coordinated by Brown and Caldwell’s Cindy Paulson.

“A very good aspect of this plan is that they are trying to optimize the infrastructure they have and make better use of the [region’s existing] resources,” says Sonia Diermayer, of the SF Bay chapter of the Sierra Club’s water committee,

one of the stakeholders participating in the process.

Diermayer added that the Sierra Club is not in favor of the regional desalinization plant, which is one of the drought mitigation measures included in the BARR plan. However, “We would like to see water conserved and used more efficiently by humans so we can leave as much as possible in the rivers, the Bay and the delta to serve that very important ecosystem.”

The new plan represents a milestone in the Bay Area’s ever-evolving conservation efforts, and also a model of the kind of regional watershed management Davis says his department will continue to support.

“Coordinated efforts are going to provide a more durable water supply and a far more resilient Bay Area community—as well as multiple benefits like habitat restoration, floodplain management, recharge, and recycled water,” says Davis. **JC**





Bay Area Regional Water Infrastructure

Brown AND Caldwell

Untreated Water Conveyance








Treated Water Conveyance

Facilities

-  Intake
-  Existing Intertie
-  Water Treatment Plant
-  Wastewater Treatment Plant

BARR Drought Mitigation Measures Legend

Interties

-  1 Transfer-Bethany Pipeline
-  2 Zone 7-EBMUD Intertie
-  3a ACWD-SFPUC Intertie and Local Supply
-  3b ACWD-SFPUC Intertie and IPR
-  4 West Side SFPUC-SCVWD Intertie
-  5 SFPUC-Zone 7 Intertie
-  6 MMWD-EBMUD Intertie

Storage

-  7 Los Vaqueros Expansion

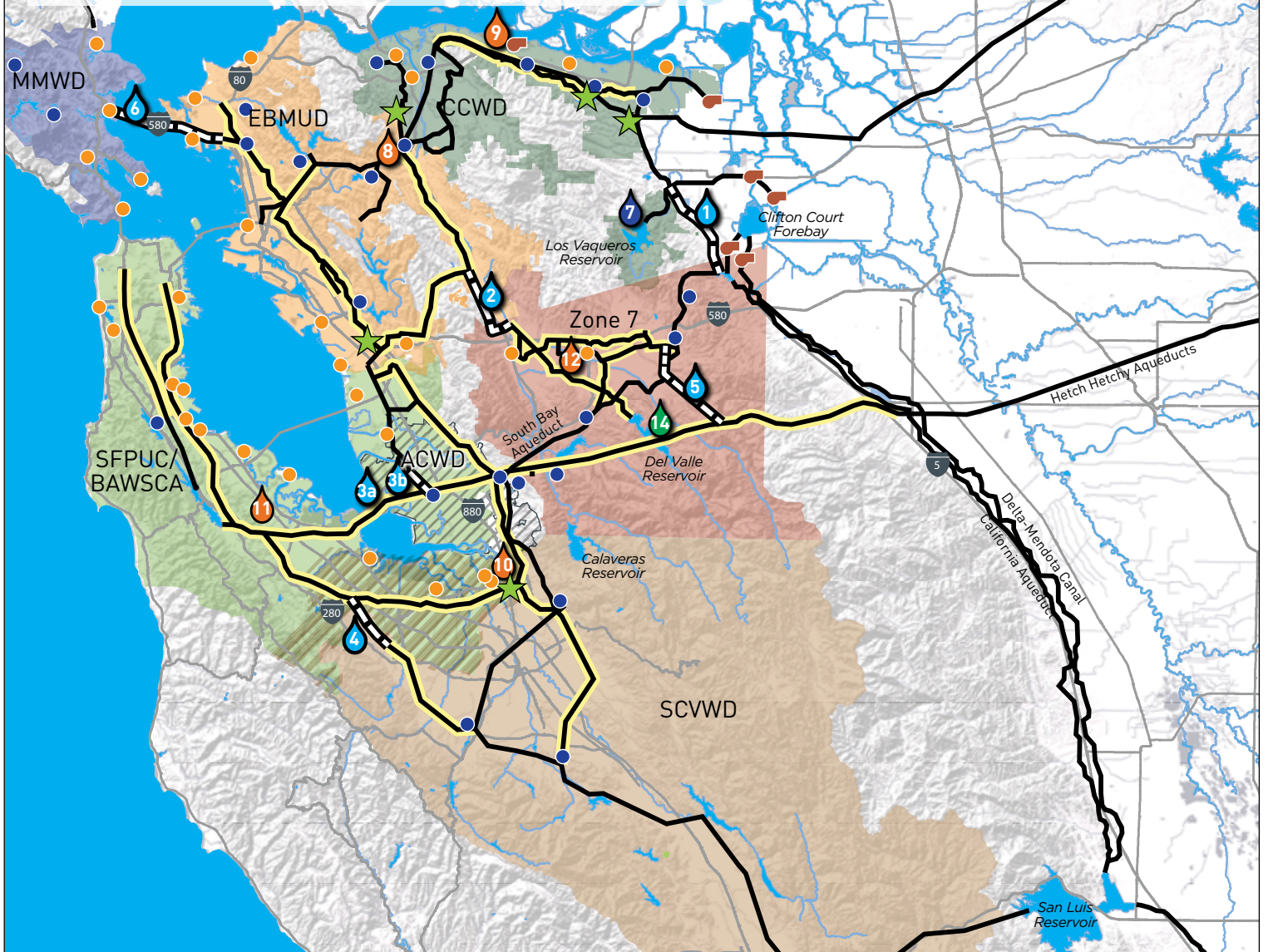
Treatment/Supply

-  8 Walnut Creek Water Treatment Pretreatment Facility
-  9 Regional Desalination Plant
-  10 Silicon Valley Advanced Water Purification Center Expansion
-  11 Mid-Peninsula Potable Reuse Exploratory Plan
-  12 Joint Tri-Valley Potable Reuse Feasibility Study

Operations

-  13 Regional Advanced Metering Infrastructure Feasibility Assessment*
-  14 Del Valle Reservoir Water Supply Storage Expansion Project
-  15 Bay Area Regional Water Market (Exchanges/Transfers) Program*

*Project location is to be determined at a later time



A N A L Y S I S

Indecision Point

Writer John Hart Reviews the Twists and Turns of Delta Plumbing Plans

On June 22, the Delta Stewardship Council “endorsed” a draft document titled “Delta Plan Amendments for Conveyance, Storage Systems, and the Operation of Both.” “We applaud the Council for addressing this difficult, important and controversial question,” wrote Gerald Meral for the Natural Heritage Institute. “Delta urban and farming communities, and California’s endangered fisheries, are being set up to be the losers,” countered Barbara Barrigan-Parrilla of Restore the Delta. What’s the fuss about? Is this a significant moment in the lengthy debate about replumbing the Delta to smooth the shipment (read “conveyance”) of water southward? Is it something more than that? Is it something less?

Fasten your seat belts, this is a technical ride to an unclear destination.

When the Delta Stewardship Council was created in 2009 legislation, it was given no say over a pending plan to create two new water tunnels. In those days the state was pushing a grand program combining the tunnels with major marsh restorations and other habitat improvements. The package, designed to settle the Delta problem for half a century, was called the Bay-Delta Conservation Plan. As long as BDCP went forward, the Legislature specified, it would automatically become a feature of the Council’s Delta Plan.

When the Delta Plan appeared in 2013, accordingly, it merely urged the state to get on with it — but added some “just in case” language in Appendix A: “If events in subsequent years reveal that the BDCP will not be successful in a timely fashion, the Council will consider then whether to amend the Delta Plan to prescribe conveyance.” It added: “The Council has the authority to dictate . . . the conveyance improvements it views as meeting the coequal goals.”

At this point let’s remember that the Plan contains provisions of two sorts. The numerous, well thought-out “Recommendations” are merely that; the 14

“Policies” bring authority with them. An action that seems to violate a Policy can be brought to the Council on appeal, and may be overturned. In 2013, the Council suggested that it might indeed, if BDCP collapsed, write a Policy about conveyance. Strong words.

In April, 2015, BDCP was in fact abandoned in favor of two new, independent programs: DeltaRestore, a reduced slate of habitat improvements; and California WaterFix, the tunnels. The situation for which Appendix A was written had come to pass. Wheels began to turn.



Tunnel skeptics and opponents pressed the Council to make a fresh start and adopt a new Policy concerning conveyance. But on June 22, the Council confirmed what had been evident for quite some time: that it would not take up this challenge. It framed its discussion of the tunnels (never mentioned by name) and related water supply matters as a package purely of Recommendations, with no Policy piece at all.

Council staffer Keith Coolidge points out that the existing plan contains Policies that apply to the WaterFix decision. Among these are Water Resources Policy 1, calling for reduced reliance on Delta water; Ecosystem Restoration Policy 1, concern-

ing flow requirements for the Delta and its tributary rivers; and Delta-as-Place Policy 2, about respecting local land-use in siting water (and other) facilities. Any of these might provide (rather tangential) grounds for a tunnel appeal.

If not an enforcement stick, what do the Amendments add?

They tell a good story, revisiting familiar problems in the light of a likely “new normal” of drought and flood, and thumbing through a well-worn portfolio of solutions. They carefully and properly place Delta conveyance in the larger context of state water plumbing and policy. Unlike the original Delta Plan, the Amendments explicitly endorse “dual conveyance” in the Delta, without mentioning WaterFix by name. They also underline the need for new facilities outside the Delta to ease water transfers; and

they support the current push for added storage for wet-year flows, both in the form of surface reservoirs and better-managed groundwater basins. These recommendations are hedged about with cautionary language — boiling down, in the end, to “Be sure you do your homework, think about the whole system, and don’t make things worse.” They seem thorough, respectable, and guaranteed not to rock anyone’s boat.

One somewhat mixed review comes from the Delta Independent Science Board, another of the useful creations of the Delta Reform Act. While striking a generally positive tone, board members cautioned

against overly strong claims of scientific grounding. Their conversations this summer circled around uncertainties. We cannot really know the effect of some of our bright ideas.

The amendment process is not over. The package is now entering environmental review; a comment period comes next, followed by adoption, it is hoped, next spring. When this occurs, neither the fears or the hopes about this document seem likely to be borne out.

The Amendments for Conveyance, Storage Systems, and the Operation of Both are the latest stage in a long, long conversation.

They will not change the world. **JH**

P R O F I L E

Teacher Nurtures Young Scientists

Emily Koller's fifth grade students have collected water quality data along the Richardson Bay shoreline, built their own underwater explorer submarines, and participated in Ocean Beach cleanups.

Yet to Koller—who has been teaching conservation, citizen science, and environmental science at Bahia Vista School in San Rafael for nine years—one of the most impactful lessons in science and watershed education takes place in the students' own backyard, where they have helped to restore a section of wetlands in Pickleweed Park on San Rafael Bay.

"The best place for our students to learn about the environment is in their own community," Koller says. One good example, she says, is learning how their own playground is part of the Bay's watershed, and that pollution or any piece of litter can make it down to the Bay.

The park, which is located just around the corner from Bahia Vista, was filled with invasive plant species before Point Blue Conservation Science's STRAW (Students and Teachers Restoring A Watershed) program started working with the school five years ago.

With help from Point Blue staff — who receive guidance from Marin Audubon on the native bushes that best support local birds — Koller's students and their parents pull out the plants and replace them with native versions that act as shoreline buffers to sea level rise. The plants also provide food, protection and habitat for birds such as the San Pablo song sparrow and common yellowthroat. Ridgway's rail (formerly known as the clapper rail) and the salt marsh harvest mouse, both endangered species, have been given a lift as well from the restoration.

"Even though some of the parents have more than one job, they make the time to come and help," Koller says of the students' families, many of whom are low income and originally from Guatemala and El Salvador. "Students who have gone on to middle school have come back to visit Pickleweed Park and been thrilled when they saw a bird hiding in the shrub that they planted."

Bahia Vista students and STRAW have been restoring the park for five years. In total, 633 students and 56 parents and volunteers have contributed to planting close to 700 native plants in an area of 8,554 square feet. Approximately 150 cubic yards of invasive plants have been removed.



Photo: Kristine Wong

"Emily cares so deeply about each of her students," says Gina Graziano, STRAW education coordinator. "She honors their ideas, and values them as young scientists and contributing members of their community. Students are prepared and eager to make a difference restoring their local wetland, because they've learned about its importance through Emily's class."

Student pride in Pickleweed Park goes beyond just the flora and fauna. Koller recalls a time when her students noticed that an education board highlighting local species at the park had been damaged. They contacted local officials and advocated that it be fixed — and were successful.

A Northern California native who grew up enthralled with everything from the insects in her Vallejo backyard all the way up to the panoramic vistas at Santa Cruz's Natural Bridges State Park, Koller understands the important role that early exposure plays in instilling a passion for caring for the natural world.

"I'd help my dad plant trees, and my parents took me on hiking trips," she says. "We'd be driving on the freeway and my dad would pull over so we could take a walk up the hill."

Koller's students are immersing themselves further in environmental

stewardship as well. A few have signed up for WildCare's Junior Conservation Camp. Her curriculum involves students in making scientific observations in Pickleweed Park, doing active role playing to demonstrate how a piece of trash moves down from Mt. Tam to the Bay, and conducting citizen science by counting birds each winter for the Audubon Society. The Greater Farallones National Marine Sanctuary gives a series of in-classroom lessons throughout the year. Each year, she also creates a different theme inspired by Watershed Week, Point Blue's annual teacher training.

While themes from past years focused on developing curriculum around scientific topics such as carbon sequestration and climate-smart plants, this year's "Sense of Place" theme is a perfect platform for Koller to draw her students in to a new dimension of local watershed education.

"They will be mapping the park and the surrounding community," she says. "I'm excited to start a new school year with a set of tools that foster a sense of guardianship of their land." **KrW**

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Students at Bahia Vista School planting native species. Photo: Emily Koller

F I S H

Sturgeon Surgeons

Studies of contaminants in sport fish have unearthed some interesting things about white sturgeon: First that selenium keeps turning up in specimens from the North Bay, and second that testing for the element may not have to be a necessarily fatal process.

Sturgeon first appeared on Earth over 175 million years ago and their prehistoric appearance is a testament to their resiliency. Growing up to 20 feet long and living up to 100 years, these venerable giants have quietly patrolled the depths as the world around them has reshaped itself time and time again.

Imagine the white sturgeon as a living museum. A single sturgeon may very well have lived through the industrialization of Central Valley agriculture and the ensuing runoff that flowed down the Sacramento River into the Bay. It may have even seen the rise of oil refineries along the shorelines.

In the mid 1980s this aging sturgeon might also have witnessed the arrival of the overbite clam, which soon displaced native species and drastically changed the estuary ecosystem. White sturgeon, far from picky eaters, simply made the newcomer a dietary mainstay.



Green sturgeon left; white sturgeon right. Both occur in San Francisco Bay. Photo courtesy RMP

These seemingly disparate changes combined to introduce harmful elements, like selenium, into the food web. By the time the Regional Monitoring Program began monitoring contaminants in sport fish, our hypothetical sturgeon could have been exposed for decades. As such, today's living fish have become valuable not just for sport, but for the stories they tell.

"White sturgeon are a popular species people like to eat, so we want to keep a close eye on contaminants in their tissues," says Jay Davis of the San Francisco Estuary Institute. While current levels seen in fish pose low risk for human consumption, they may be high enough threaten to the reproductive success of the sturgeon themselves.

Concentrations of selenium, which occurs naturally in soil, occasionally exceed the regional regulatory target (as described in the North Bay TMDL) established to protect the health of sturgeon. Suisun Bay, located at the confluence of the Sacramento and San Joaquin Rivers, is a particular hot-spot. The San Joaquin is a prime channel for selenium-rich runoff from Central Valley agriculture. The proliferation of the overbite clam compounds the problem. Not only does the clam accumulate selenium at a much higher rate than native competitors, but it has also become a primary food source for sturgeon.

While the plight of white sturgeon in the North Bay isn't a new discovery, a new RMP sampling protocol comes with the hope of less invasive methods of data collection. Rather than testing fish fillets from dead sturgeon, researchers can pull small plugs of tissue from living fish and get equally reliable results. New selenium analysis methods developed by Robin Stewart of the US Geological Survey have helped make this non-lethal sampling approach viable for white sturgeon.

Adopting this new method is not without challenges for the collectors on sampling vessels. According to Jennifer Sun, an environmental analyst with the San Francisco Estuary Institute: "These are powerful fish which aren't so pleased to be caught."



Removing a muscle plug. Photo courtesy RMP

The crew has to measure, tag, and extract both a muscle plug and a blood sample so that the fish can be returned to the water in an expedient fashion. "It's a priority for us to minimize the stress," she says. She adds that while it can be an analytical challenge dealing with the new small tissue samples, she is hopeful muscle plug sampling is here to stay.

Although the widespread impact of selenium on the sturgeon's viability remains to be seen, it's a good sign that individuals no longer need to be removed from the ecosystem to be monitored. "Because these fish can have long life spans and take many years to mature, they aren't as replaceable as other species," says Sun. "You can get people sampling these fish that are in the same age range as the fish they are collecting."

The white sturgeon, like most species on Earth, faces an uncertain future in a rapidly changing ecological landscape. But Dr. Davis doesn't try to hide his enthusiasm for protecting these fish: "It's just a cool species that we want to protect for its natural value."

It's an easy sentiment to agree with. After all, on a planetary scale this is a species that has survived a devastating meteor impact and warming/cooling cycles that dwarf the current one. Perhaps there's much more these aquatic giants can teach us. **MHA**

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M O N I T O R I N G

Beacon Not Burden

What some might call a regulatory burden on industry, commerce, and American greatness, others might call the road to success.

Jay Davis, a serious guy, doesn't crack a smile when he describes the Bay Area's Regional Monitoring Program as "a beacon of environmental protection." It may sound a little over the top, for a PhD who ran the program for more than a decade, but all you have to do is fact check. Ask some of the oil refineries, power plants, cities, engineers, ports, scientists, and regulators who've participated in this 25-year old collaborative monitoring program to confirm this result and they all say the same thing. It takes time but saves money. It helps those being regulated deal with water quality challenges — whether it's a spill, toxic algae blooms, or a new perfume or pesticide — and helps regulators drive water quality improvements.

"Whatever the pollutant de jour, the RMP helps us adapt," says Karin North of the City of Palo Alto, Vice Chair of RMP Steering Committee. "We're not missing a thing working together; instead we're getting a lot of our management questions answered."

"The data from the RMP are available to everyone and are developed by a very good scientific staff with no agenda," says Peter Carroll of the Tesoro-Martinez oil refinery, who sits on the RMP Steering Committee. "Since the RMP has been in existence, we've had great dialogue and reached a sound consensus on most decisions. It's a good constructive group to work with."

When the RMP started up 25 years ago, it focused on monitoring contaminants in water, sediment, clams, and fish in the open Bay. These measurements helped regulators make important water quality decisions, with selenium along with PCBs, DDT, and heavy metals on their front burner early on. Selenium sources included upstream inputs from the Delta farm fields and North Bay inputs from oil refinery discharges then cycled through the food web by hyper-active invasive clams.

In the 1990s, the regional regulatory boards asked the farmers and the refineries to reduce their selenium inputs. "With added treatment, the load from refineries dropped over 70% in just a few years, it's a good story," says Peter Carroll. As the oil refinery's technical lead on selenium for eight years, Carroll recalls working with various entities to do and redo technical studies that are now more easily handled through the RMP. "We recently developed a way to integrate and synthesize existing RMP data and North Bay selenium studies that's going to be very helpful in the long term," he says.



State vessel used in sturgeon sampling.
Photo courtesy CDFW

In the 2000s, the RMP branched out from traditional contaminants, moving up into watersheds to look for sources, and tackling emerging problems like pesticides in urban runoff. In the last five years, the RMP has moved into the margins of the Bay, expanded its work on emerging contaminants beyond single compounds to whole classes of chemicals, and installed an array of moored sensors that allow it to monitor nutrients every 15 minutes, rather than every 30 days as it had before.

"We all pay into the program, and we want the program to be addressing the most relevant issues. If those aren't our individual issues we're okay with that," says Bridgette DeShields of Integral Consulting Inc., Chair of the RMP Technical Review Committee. "We want science to be informing priorities."

In the last five years, one priority has been getting a better handle on growing inputs of nutrients, which

affect oxygen and algae levels in the Bay and local reservoirs. Levels of nutrients in our water — which come from fertilizers, sewage, and runoff — can change on an hourly basis due to tides, turbidity, and photosynthesis. "There's no way to understand something like this unless you're monitoring at a frequency that is higher than changes are happening," says the RMP's manager Phil Trowbridge.

To address this need, the RMP deployed eight new sensors around the South Bay. They're generating gigabytes of data in need of storage, analysis, and quality assurance, but the RMP is stepping up to the task. The Program recently created some powerful new computer models of how nutrients behave in the Estuary, models it can now also use to make predictions about the mass balance of other kinds of contaminants.

Another priority has been monitoring what's coming out of the mouths of small tributaries, and here timing is important as well. When it began pouring rain last January, marking the end of California's extended drought, scientists rushed to the RMP begging for a chance to get out in the storm and sample the effects. More water, sediment, and buried contaminants were pouring off the hillsides, into the Bay, and out the Golden Gate in a few weeks than had in the last five years.

"When we had that high flow event, we were able to approve funding for teams to go out and get measurements in the field by email," says Karin North. "Municipal agencies can't be that nimble. But because we pool our resources, put proposals through the RMP review committees, and have a cohesive governing board, we can be quick to respond. It's a great system."

A third priority has been to keep up with the hundreds of new chemicals and products, with their potentially harmful ingredients, introduced on the market every year. To stay current, and prevent replacement products that can be even more harmful than those banned, the RMP's Contaminants of Emerging Concern (CECs) program now looks at classes of chemicals rather than one at a time.

Which brings us to another good story from the RMP archives. Within a few years of receiving the scientific evidence that flame retardants were turning up in both harbor seals and Bay Area wom-

continued to back page



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San Francisco Bay and the Sacramento-San Joaquin River Delta comprise one of 28 "estuaries of national significance" recognized in the federal Clean Water Act. The San Francisco Estuary Partnership, a National Estuary Program, is partially funded by annual appropriations from Congress. The Partnership's mandate is to protect, restore, and enhance water quality and habitat in the Estuary. To accomplish this, the Partnership brings together resource agencies, non-profits, citizens, and scientists committed to the long-term health and preservation of this invaluable public resource. Our staff manages or oversees more than 50 projects ranging from supporting research into key water quality concerns to managing initiatives that prevent pollution, restore wetlands, or protect against the changes anticipated from climate change in our region. We have published *Estuary News* since 1993.

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BEACON, *cont'd from page 15*

en, the state had banned PBDEs, and reduced the flammability standard from open flame to smoldering cigarette. "It makes a big difference to our wastewater quality if a product is 30% active ingredient or much less," says North. The CEC program is now tracking spot-on flea controls, microplastic, pharmaceuticals, and personal care products passing right through treatment plants into the Bay. "We rely on the RMP scientists to give us the data we need to do public education about pollution prevention, rather than having to get the data ourselves."

In the last five years, the RMP has also greatly expanded its monitoring of what's happening in the Bay margins. Here contaminants coming downstream attached to eroded sediment particles end up in mudflats and creek mouths where small fish hang out. "What's happening in the margins is very different from our old bathtub model of the Bay where all fish are exposed to all contaminants in the same way," says Trowbridge. "Our new understanding is that certain fish get a lot of their exposure to contaminants in the margins." In 2015, eager to tease out these differences, the RMP developed a study to measure the baseline contamination in the margins to define "how clean is clean." Past monitoring in the

margins was more focused on hot spots near pollution sources.

"These last years we've had big goals for big programs so we needed bigger money," says Bridgette DeShields. "It's expensive to monitor chemicals from so many potential sources, to cover so many tributaries and watersheds around the Bay, to work in the margins with small boats at high tide, while also maintaining important smaller programs around micro-plastics and selenium."

To cover some of these kinds of expansions, the Steering Committee reallocated some money from old priorities to new ones. "We asked the Regional Board if we could drop a bunch programs yielding 'non-detects' and redirect funding to CECs and they agreed," says Karin North.

Another windfall also helped make up the difference. In 2016, the RMP became an approved program for use of penalty fees from discharge violations. "We thought we'd get \$50K but we got \$400K in 2016," says Trowbridge. "It's helping us to make progress on multiple fronts, and to accelerate the pace of monitoring and research."

Twenty-five years in, industries and dischargers who might once have quibbled over where to spend research dollars, or resisted regulatory oversight

concerning what kind of data are necessary to collect, are quite content with decision-making through the RMP. "There are not many places in the world with a culture of collaboration that equals San Francisco Bay," says Phil Trowbridge.

Collaborative programs in all kinds of public environmental sectors were earmarked by the Trump administration early on as good candidates for budget cuts. This short-sightedness, along with equally short-sighted cuts to long-term EPA and USGS monitoring programs, promise to challenge the RMP, which hitchhikes on lots of federal vessels and equipment.

This year the RMP also recently lost one of its earliest investors: power plants. Protections for fish from the hot water they discharge caused the phase out of once-through-cooling of all the power plants in the state. The last one in the Estuary, Pittsburg Power Plant, shut down in 2017.

"For the first time in 25 years, we had to adjust RMP distributions in all sectors because one sector left the program," says Trowbridge. "That we survived shows the stability of the partnership." **ARO**