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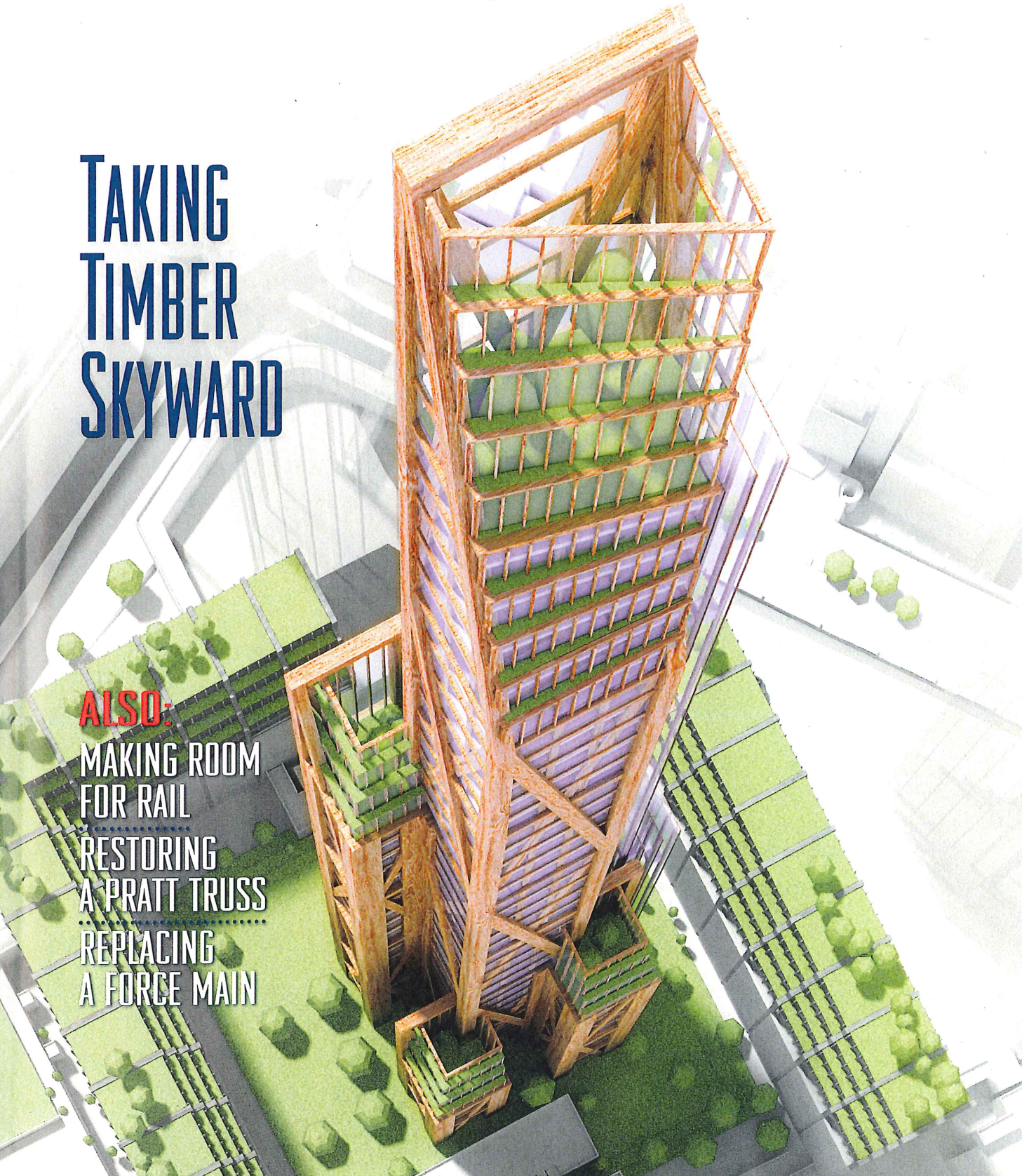

TAKING TIMBER SKYWARD

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Construction Begins On Lagoon Restoration Project near San Diego

CONSTRUCTION recently began on a long-planned effort to restore the San Elijo Lagoon, one of several such bodies of water along the coast of San Diego County, California, that has experienced deleterious effects because of past development. Intended to improve tidal flows, enhance water quality, and create new wetland habitat within the nearly 1,000-acre lagoon, the $120-million restoration project is one component of the larger effort known as the North Coast Corridor (NCC) program. To be conducted during the next three decades, the NCC program will include significant upgrades to Interstate 5, improvements to the regional rail system, enhancements to bike and pedestrian facilities, and protection and restoration of environmental resources.

Located on the California coast between the cities of Encinitas and Solana Beach, the San Elijo Lagoon has undergone significant physical changes as a result of bridge construction and other human influences. Before the lagoon was subjected to human intervention, its inlet is thought to have remained open most of the time, facilitating tidal flows within the water body. However, the construction of a rail bridge and berm across the lagoon in 1881, followed by the construction of the Pacific Coast Highway a decade later, "locked" the inlet in its current location and helped lead to its closure, says Doug Gibson, the executive director and principal scientist for the San Elijo Lagoon Conservancy (SELC), of Encinitas.

Subsequent decades saw the development of two municipal wastewater treatment facilities on the shore of the lagoon, while a third was located upstream on a waterway that drains into the lagoon. With the inlet closed most of the time, the discharges from the treatment facilities led to the deposition of nutrient-laden sediment within the lagoon, as did increased runoff entering the lagoon from upstream development. Upon its completion in the mid-1960s, I-5 bisected the lagoon, amounting to the "nail in the coffin" in terms of its water circulation and creating a "cascade of other effects," Gibson says.

Most conspicuously, the earthen berm built for the highway constricted water flows to an approximately 120 ft wide channel. The narrow opening caused water from upstream to back up in the lagoon, exacerbating the problem of sediment deposition. In turn, high nutrient levels associated with the sediment frequently have led to eutrophic conditions within the lagoon, causing low levels of oxygen that have resulted in fish kills. California has designated the lagoon as impaired under Section 303(d) of the Clean Water Act for its high levels of sediment, nutrients, and bacteria.

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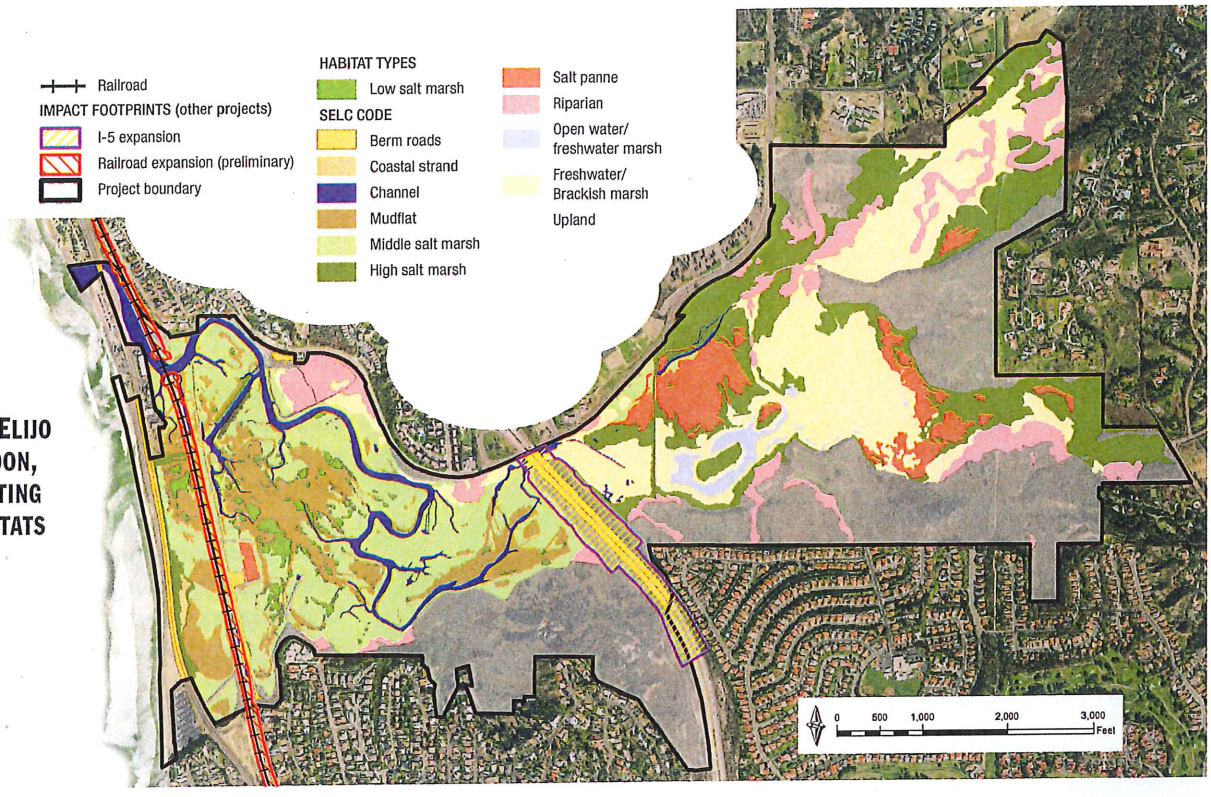
The closure of the inlet led to the impoundment of freshwater within San Elijo Lagoon for long periods of time, resulting in significant changes in habitat types. In general, the lagoon transformed from a "highly channelized and vegetated system" to one that, in places, largely lacked vegetation and "started to act like mudflats," Gibson says. In other locations, areas that had been populated by saltwater vegetation have been colonized by freshwater species. Despite these changes, the lagoon remains a critical habitat for a variety of plants and animals, including two endangered bird species—the Ridgway's Rail (*Rallus obsoletus levipes*) and the Belding's Savannah Sparrow (*Passerculus sandwichensis beldingi*). Both species inhabit coastal salt marsh, a type of habitat that has been greatly diminished by development.

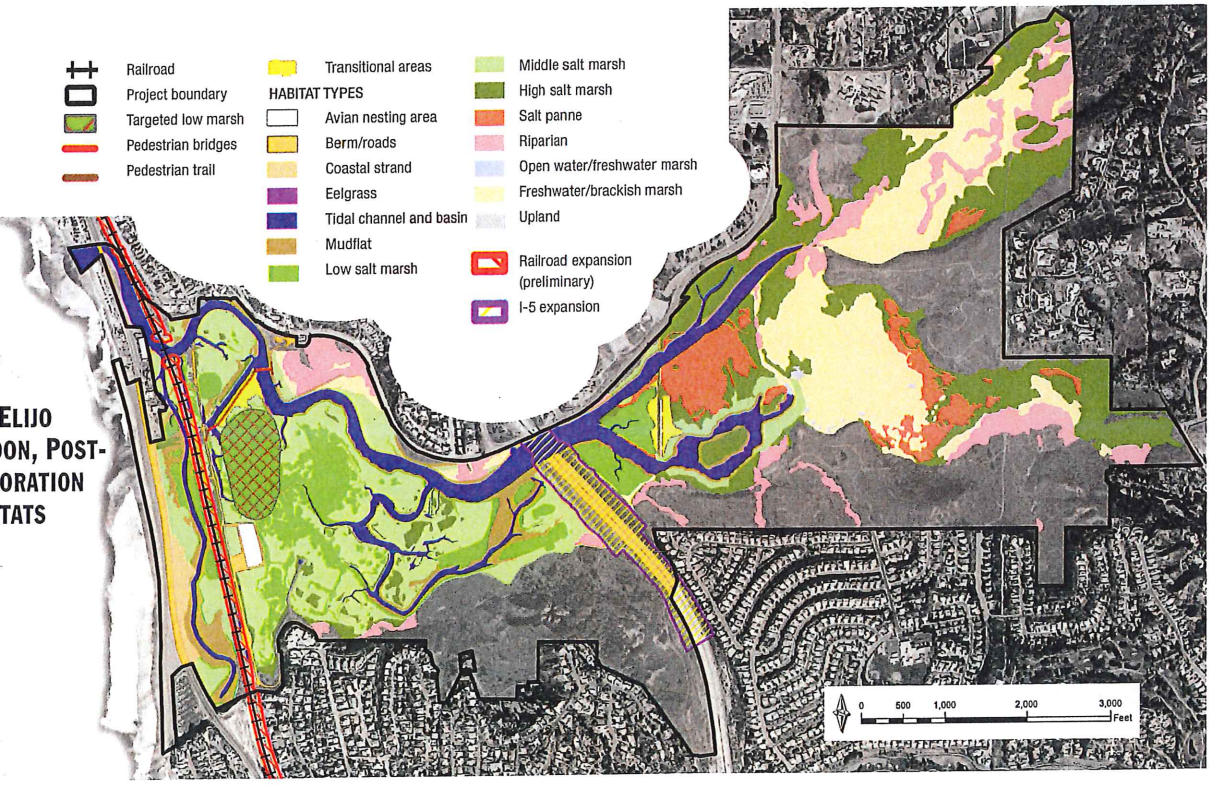
In 2001, the SELC began excavating the inlet annually to return tidal flushing to the lagoon system. However, the existing sediments that contain high levels of nutrients continue to impair the health of the lagoon, as does the constriction of water flows caused by the I-5 bridge. For its part, the NCC program aims to address both issues by means of improvements to I-5 and by a separate effort to remove the sediment and reconfigure much of the lagoon to create the conditions necessary to promote certain habitats.

The ongoing $480-million NCC project to improve I-5 from Solana Beach to Carlsbad includes the addition of a new high-occupancy vehicle (HOV) lane in each direction as well as the construction of new sound walls. The addition of the HOV lanes requires the replacement of the existing bridge that spans the San Elijo Lagoon. Besides being wider to accommodate the HOV lanes, the new bridge will be longer to improve lagoon health, says Arturo Jacobo, P.E., the project manager for the California Department of Transportation, which is overseeing the project. Modeling of the lagoon's hydrology indicated that doubling the existing channel width at the location of the I-5 bridge would restore tidal flushing to the large section of the lagoon east of the interstate, Jacobo says. Whereas the existing four-span bridge has a length of approximately 341 ft, the new three-span structure will be approximately 559 ft long. "That is sufficient to restore the tidal flushing to the east side of the lagoon," he says.

Designed by T.Y. Lin International Group, the new bridge is being constructed by a joint venture comprising the Flatiron Construction Corp., of Broomfield, Colorado; the international construction company Skanska; and Stacy and Witbeck, of Alameda, California. Known as FSSW, the joint venture was hired to deliver the first phase of the NCC program, including



SAN ELIJO LAGOON, EXISTING HABITATS



SAN ELIJO LAGOON, POST-RESTORATION HABITATS

SAN ELIJO LAGOON CONSERVANCY, *BOTH*

the improvements to I-5, as well as the restoration of the San Elijo Lagoon, by means of the construction manager/general contractor method. In this way, FSSW was able to join the effort during the design phase and offer input on how best to conduct the project, Jacobo says. Construction began on the new I-5 bridge in late 2016 and is expected to conclude in early 2021.

Also as part of the NCC program, FSSW is replacing an existing single-track timber rail bridge located in the San Elijo Lagoon with a new double-track concrete bridge. Conducted as part of efforts to add a second mainline rail track on the coastal rail corridor in San Diego County, the new rail bridge will have fewer support columns than the existing structure, further helping to increase tidal flows within the lagoon.

As for the restoration of the lagoon itself, the notice to proceed was issued to FSSW in November 2017, Gibson

says. To be completed by early 2021, the restoration will take a two-pronged approach that entails deepening and widening channels to improve water circulation in addition to contouring various areas to increase certain habitat types. To improve water quality, the nutrient-laden sediment will be excavated and placed in a 40 ft deep pit, which will be created by the removal of about 580,000 cu yd of sand to sequester the fill material. The filled pit then will be capped with sand and topped with crushed shell to facilitate its use as an avian nesting area.

Accurately determining the anticipated consolidation rate of the dredged materials to be placed in the pit proved to be a "very challenging design issue," says Chris Webb, a supervisory coastal scientist for the global infrastructure advisory firm Moffatt & Nichol, which has served as the design engineer and prime consultant on the project for the SELC. "We're trying to achieve a very specific final elevation," Webb says. If the materials consolidate too much, the area occupied by the pit will become mudflat or subtidal habitat, rather than the low salt marsh that is expected to result over time. Because low salt marsh is the habitat of the Ridgway's Rail, "we want to have as much out there as possible," Webb says.

If the materials in the pit were to consolidate too much, the extremely fragile nature of much of the lagoon would greatly complicate any efforts to return to the site in the future to attempt to rectify the problem. "It would be challenging to fix," Webb notes, particularly because of the presence of sensitive habitats and endangered species. In fact, these constraints represent one of the other main design challenges that had to be overcome on the current project. Restoring degraded natural areas while in close proximity to fragile ecosystems and rare species requires "very clear demarcation" of which areas are protected and which can be disturbed during construction, Webb says. —JAY LANDERS