5. HUMAN USE

Looking at the world around us, humans commonly think, "What's in it for me?" People have considered the Tijuana River Valley thus ever since they first arrived here. For Native Americans, the answer to the question, "What's in it for me?" was food. For early Californians the answer was fishing, farmland, and ranchland. After California became part of the United States, newcomers saw the estuary as real estate opportunity.

Unfortunately, the more people approach estuaries with a "what's in it for me" attitude, the more damage occurs. Globally, population growth, pollution and unchecked development destroy estuarine resources. Due to human use and human impacts, many of the world's estuaries have disappeared and others have suffered enormous degradation. In concert with the degradation, science teaches important lessons. The less healthy and less numerous the estuaries, the more polluted air, water, and food supplies become. People are finally realizing that unless we support thriving natural systems, we are seriouly impacting, not just other species, but humankind as well.

Therefore, responsibility has shifted. The question, "What's in the estuary for me?" has become, "What can I do for the estuary?" From previous sections, you already have an idea of how humans have misused the Tijuana Estuary in the past. Here, you will learn about specific impacts and how various groups are laboring to overcome them. People from every walk of life are working hard to answer the question, "What can I do for the estuary?"

The federal government's 1980 decision to preserve the Tijuana Estuary, for perpetuity, was the beginning of humankind's new assignment. Citizen volunteers, including teenagers, had already been working hard in the estuary, removing trash, construction material, and tires on a regular basis, before the 1980 decision.

To put an end to off-road and other vehicles destructive intrusions into the sensitive system, they also put up fencing and otherwise cordoned off the estuary. These undertakings, though considerable, only began to address the things humans could do for the estuary.

It was apparent that only enormous effort and millions of dollars could protect the existing resources, expand them where possible, and help the estuary do its greatest job - providing a health-giving, energy-producing margin between our continent and the Pacific Ocean.

Since the Coastal Zone Management Act of 1971, a National Estuarine Research Reserve System was created with twenty-seven sites around the country, including Tijuana Estuary, all under the National Oceanic and Atmospheric Administration (NOAA). NOAA regulations provide five specific goals for the NERR System:

1) Ensure a stable environment for research through long-term protection of NERR resources;

2) Address coastal management issues identified as significant through coordinated estuarine research within the NERR System;

3) Enhance public awareness and understanding of estuarine areas and provide suitable opportunities for public education and interpretation;

4) Promote federal, state, public, and private use of one or more Reserves within the NERR System when such entities conduct estuarine research; and

5) Conduct and coordinate estuarine research within the NERR System, gathering and making avail able information necessary for improved under standing and management of estuarine areas.

Estuary supporters realized that money and labor weren't going to materialize from thin air. Ambitious goals required big-time organization and funding. At the insistence of Mike and Patricia McCoy, they formed a non-profit corporation in 1979, the Southwest Wetlands Interpretive Association (SWIA), dedicated to "education in and preservation, restoration and acquisition of wetlands."

SWIA's Board of Directors was diverse and powerful, with scientists, political strategists and dedicated community activists. A team coalesced with SWIA to work toward the five important objectives. Money for acquisition, as well as programs, comes from state and federal agencies like the U.S. Department of Commerce (NOAA), California Coastal Conservancy, the U.S. Fish and Wildlife Service, the U.S. Environmental Protection Agency, the California State Parks, and the Southern California Wetlands Recovery Project. In the first twenty-five years since estuary preservation began, approximately $600,000,000 - over half a billion dollars from these various resources - contributed to making this natural resource an international treasure.

Growth throughout the watershed and particularly in Tijuana burgeoned during the twentieth century, as people from all over Latin America swarmed into the area in search of better lives. Tijuana became more metropolitan, industrial, and commercial. It was impossible to anticipate the problems that would befall the estuary as a result. Because there are so many challenges here at the Tijuana Estuary compared to other reserves in the NERR system, management practices became more rigorous here than elsewhere in the nation.

COMBATING SEWAGE AND POLLUTION

Conditions upstream in Mexico profoundly affect the estuary. Unfortunately, Tijuana has never had adequate sewer infrastructure to handle its population. Squatters have always occupied the *colonias* and canyons, in the flood plain that feeds the river. Without infrastructure, sewage washes right into the river, and intermittent flooding washes their shelters and belongings down to the estuary too.

In the eighties, Tijuana channelized part of the river. On the one hand, this urban renewal "cleaned up" the watershed to the degree that it got rid of squatters in and along the river. But the concrete-lined river became a catch basin and superhighway for discharged industrial pollutants as manufacturing in Tijuana grew. With very loose regulations, pollution proliferated in the city and farther up the watershed too, including agricultural runoff containing heavy-duty chemicals, pesticides and herbicides that are no longer allowed in the United States. Polluted runoff from as far away as Tecate, with its own unregulated industries, found its way to the Tijuana Estuary.

Common Estuarine Pollutants

Lead
Mercury
Zinc
Organic solvents, including hydrocarbons
Helicopter fuel spills

Clearly, it was critical to think of the estuary not just as an isolated area, but in a broader "bio-regional context." Estuarine health critically depended on a bi-national effort. As a means of addressing sewage overflow and lessening pollution, the estuary team sought a way to treat Tijuana effluent - what they called "renegade sewage flows" - and return water to groundwater or use by businesses or golf courses. Methods had to be cheap, effective and decentralized.

SWIA contracted to build a pilot wastewater recycling plant on the U.S. side of the border in 1983. After refining this tech-

nology, SWIA oversaw the binational implementation of "Ecoparque," an innovative, low-tech wastewater recycling project in Mexico. This was funded through the California Coastal Conservancy. Since the mid-nineties, Ecoparque's treated wastewater has been used to irrigate a "greenscape" and is a landmark in the district just south of the Otay Mesa border crossing in Mexico. Ultimately, the International Border Sewage Treatment Facility (paid for by the Environmental Protection Agency) helped lessen the pollution that enters the estuary and ocean. Nonetheless, Tijuana doesn't yet have effective, comprehensive sewage treatment, and squatters still live on tributaries to the river. Sewage remains a problem, delivering pollution to the estuary during wet weather, due in part to inadequate infrastructure and also as a consequence of existing infrastructure, which has been developed to collect the polluted water from the riverbed, being overwhelmed. Tijuana has developed a sewage Master plan and a new controversial plant is in the works.

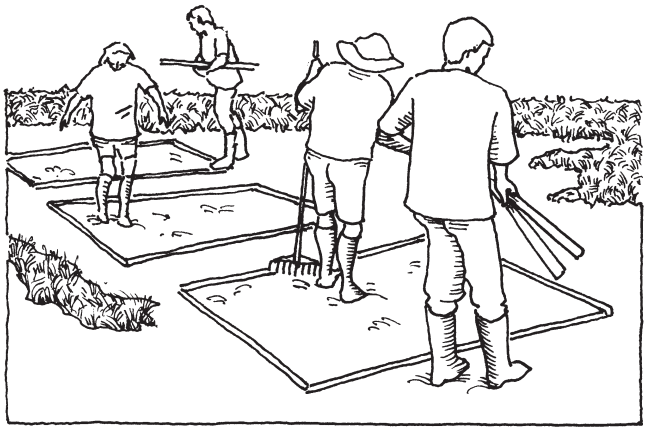
RESEARCH

Although innumerable researchers have contributed to the body of knowledge about the Tijuana Estuary, it was salt marsh ecologist Dr. Joy Zedler and her students at San Diego State University who laid the original foundation. In the early eighties, Zedler established the Pacific Estuarine Research Laboratories (PERL). PERL research would provide a basis for *restoration ecology*, in other words, the best methods for recreating and expanding the estuary's zones, as described in the curriculum's *Ecology* section.

Top Estuarine Study Topics

Salinity
Substrate
Accretion
Nitrogen
Vegetation

In addition to work within PERL's laboratory, researchers set up study areas in various parts of the estuary. Project "mesocosms" attempted to mimic nature on a measurable scale. Striving for biodiversity, they propagated and planted multiple salt marsh plants in what they called a "mosaic." As the experimental salt marsh grew,



they subjected it to different inundation schemes and gathered data. Researchers worked to understand and quantify estuarine processes such as salt marsh structure and function and the interactions between physical and biological processes.

One major objective was learning how to stabilize sand dunes. Another was watching competition between high and low salt marsh plants to see how best to recreate these habitats. Researchers measured the success of these habitats by watching how other species used them. Birds in particular are a good indicator species.

Early research projects were fraught with various incursions. Illegal immigrants tromped through experiments, with border patrol staff chasing them. A model airplane club owned a piece of land right next to the research lab itself, north of Monument Road at the west end of the river valley. Model airplanes strayed off course, going

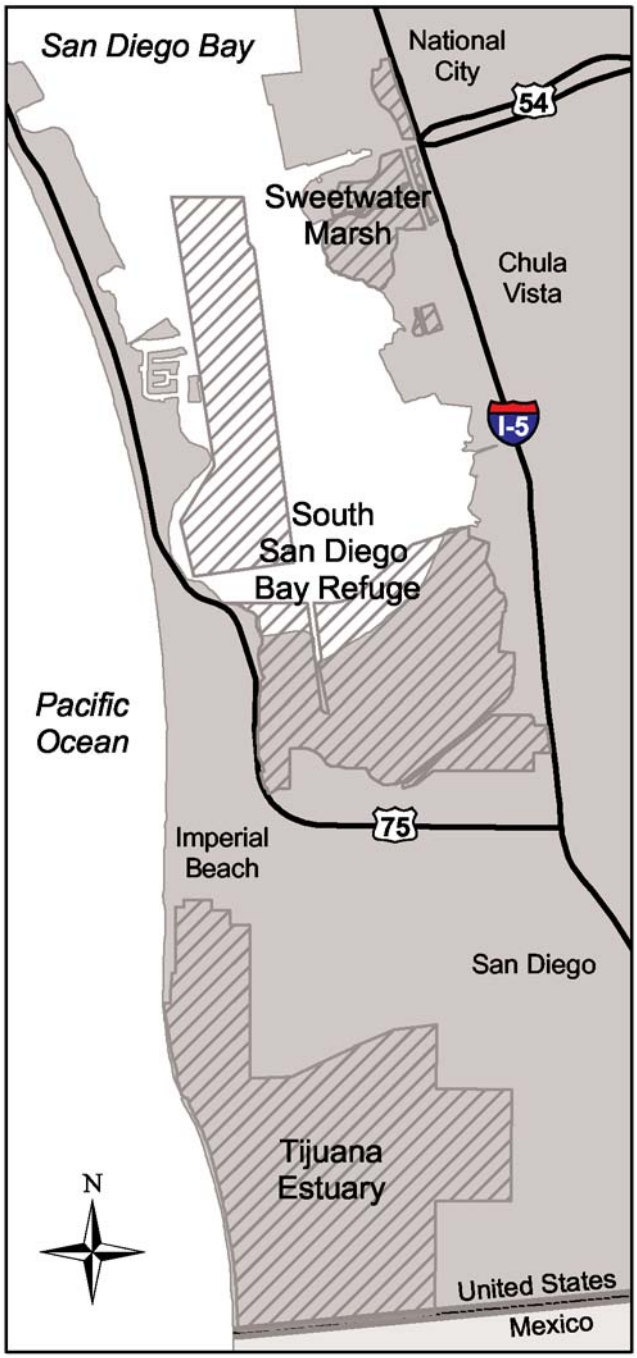
right through researchers' projects, many times missing an ear by just a few inches. It seemed inevitable that someone was going to get hurt. Finally, California Coastal Conservancy funds were used to purchase the land and the model airplane club was relocated. Nevertheless, scientists had to abandon the site because disturbance from illegal immigrants was unrelenting.

The U.S. federal government was so concerned about flooding impacts on human habitat and sensitive natural habitat in the Tijuana River Watershed that it designated this watershed as a National Community Demonstration Project in 1998. The Tijuana River Watershed (TRW) was one of six projects selected nationally to show how geographic information systems (GIS) and related geospatial technologies could be used to help solve local environmental problems. New aerial photography flown by NOAA, together with an existing GIS database previously prepared by San Diego State University (SDSU) and El Colegio de la Frontera Norte (COLEF), provided much of the data needed for the Tijuana National Community Demonstration Project.

The demonstration project assessed the vulnerability of human population to flooding in Goat Canyon/Cañon de los Laureles, a critically important side canyon in the lower watershed. Specific research questions were 1) What areas of Goat Canyon are likely to be inundated by 25-, 50-, 100-, and 500-year flood events? 2) What critical facilities, economic activities, and areas of population and housing are at risk given these different events? The principal partners for this project were the Federal Geographic Data Committee, NOAA, SDSU, and COLEF. Dr. Richard Wright (SDSU) and Nina Garfield (NOAA) were the local and federal leaders, respectively.

Thanks to Dr. Zedler, research at the Tijuana Estuary had a head-start on other reserves. Research provided the basis for estuary maintenance and restoration, in a

dynamic process known as *adaptive management*. This means that the results of experiments, as they were accumulated, could be applied to improving the ecology. On-going monitoring, initiated by Dr. Zedler and continued today with support from NOAA informs the scientific database. Over the years, scientists from across the country have become vitally interested in the Tijuana Estuary. This intensely impacted wetland, in an urban setting on an international border, is our region's highly valued addition to the National Estuarine Research Reserve System.



RESTORATION

To increase viable wildlife habitat and enhance the tidal flushing (circulation) that keeps the estuary vital, much preserved land as well as newly purchased land was badly in need of restorative care. SWIA worked with other agencies on the Tijuana River National Estuarine Research Reserve Management Authority to improve these lands, thus facilitating the recovery of the Reserve's natural setting. One of the first things accomplished, for instance, was at the site of the model airplane club, where workers tore out the pavement and removed the toxicity left by the asphalt. A freshwater seasonal marsh was allowed to develop.

In the mid-1980's, the California Coastal Conservancy organized a planning effort to restore the estuary and surrounding salt marsh. A team - including SWIA, Dr. Zedler and other PERL scientists, and the reknowned hydrologist Phil Williams - took on this very difficult task.

Vegetated barrier dunes are critical to the life of the estuary. Tijuana Estuary's barrier beach dunes were once 40 feet high, but were degraded by recreation vehicles and other human impacts. They became susceptible to being overtopped during winter storms, filling tidal creeks and salt marsh with sand. In 1983, a huge storm severely choked off the estuary. Sand from devegetated dunes moved into the major tidal creek that maintained the north arm of the estuary. With the river mouth closed off and the tidal exchange curtailed, the whole system was destablized. As the water evaporated, the remaining water became "hypersaline." Increasing salinity killed many plants and animals. Dependent species departed. The endangered clapper rails disappeared.

In order to restore the tidal function, the U.S. Fish and Wildlife Service came in with a dragline and a lowboy. Bulldozers

worked around the river mouth to pile the sand up, reforming the dune system. They spent $100,000 in 1984 to clean out the accumulated sand and restore the tidal flushing. Within two years, the clapper rail population returned and expanded, and the area began to regenerate. In 2004, twenty years later, plant diversity is almost what it was in 1984.

As you know from reading the *History* section, the Tipai planted melons and other crops in the flooded river valley and subsequent settlers also attempted longer-term farming in the saline flood plain. As a result of cycles of rainfall, drought and pumping, groundwater levels fluctuate throughout the Tijuana River Valley. Irrigating from the many wells that exist in the valley, both in the United States and Mexico, created a problem, however. When freshwater is pumped out of an aquifer for irrigation, it depletes the groundwater table of fresh water. In the void salt water intrudes, replacing the fresh water. This *saltwater intrusion* destroyed crops. As a result, in the upper regions of the reserve, abandoned and non-viable agriculture fields interfaced with the estuary. Public agencies purchased several hundred acres of these former farmlands on the margins of the historic salt marsh. These areas are suitable for salt marsh restoration today.

In the past, sewage impacts to the estuary hadn't only been from Mexico. In the north arm of the estuary, in an area called the Oneonta Slough, were two abandoned sewage settling ponds that had been used as an old sewage treatment system for the City of Imperial Beach. Over time this area had turned into mudflats, frequented by shorebirds and wading birds. In 1984, managers cut the dikes on these ponds in order to increase tidal circulation in the estuary. Over the next twenty years, with the increased circulation, tidal creeks started to develop and the former mudflats were gradually infiltrated by cordgrass, with clapper rails, bitterns, and herons replacing the shore and wading bird populations. The disappearance of these mudflats alerted the restoration team to a disturbing phenomenon at the estuary and elsewhere in the region. Mudflats are in decline. Biologists are concerned about the fate of these shorebird and wading bird species, as well as other species that make their home in mudflats. Restoration or creation of mudflats is now a top priority.

You already know that sediment and siltation are huge problems at our reserve. Researchers have found sediment accreting (accumulating) at many times the normal frequency due to erosion and flooding. Single events can deposit as much as two to three feet of sediment. Over all, this accretion process will effectively "kill" the estuary, depriving estuarine plant and animal species of the conditions they require in order to survive. To reverse this trend, the *Tijuana Estuary Tidal Restoration Program* (TETRP) started in 1985. *TETRP* emerged from several years of documentation and review under state and federal environmental laws and included the preparation of engineering designs and detailed construction plans. One of Dr. Zedler's former students, Chris Nordby and his company, Tierra Environmental Services, led the planning and execution of the restoration projects. Mr. Nordby and his company could manage the estuarine restorations very effectively because, having worked at the estuary since 1978, Nordby knew the habitats very well -- everything from the oceanic to the salt marsh and the ecology to the uplands.

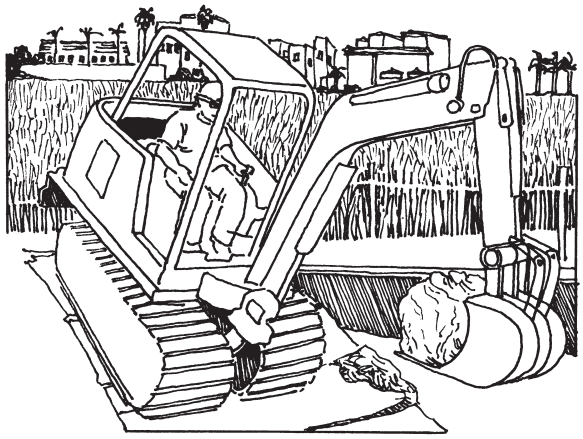
TETRP enables research, management, and government permitting staff to come together to restore and protect these complex systems. Its multi-phased program, in the southernmost portion of the reserve, just north of the U.S. Mexico border, is gradually restoring tidal exchange and wetland habitats to as much as 500 acres over the next fifty years. As regulatory demands intensify over time, the team revisits its

restoration projects in more detail. Each phase includes an extensive research component, coordinated by the Reserve and conducted by PERL, San Diego State University and the Scripps Institution of Oceanography, University of California, San Diego, etc., including a graduate research fellowship program through NOAA.

Tidal Prism

The estuary is a semi-contained basin, which changing tides fill and partially empty. When tides go out, the estuary empties; the flushing activity keeps the mouth open. The "tidal prism" is the amount of water that an estuary can hold. As it fills, it reaches what is called its maximum tidal prism. Accretion decreases the Tidal Prism by limiting the flushing activity as well as the available submersible areas.

Sediment accretion had raised the elevation so high in the northern end of the estuary that it was effectively "dead." The team recognized that a connector channel between the old settling ponds and the north arm of the estuary, near the Visitors' Center, would increase the tidal prism there. Largely thanks to Jim King from the California Coastal Conservancy, they moved to excavate the Oneonta Tidal Linkage, also called "Jim's Ditch" in 1996.



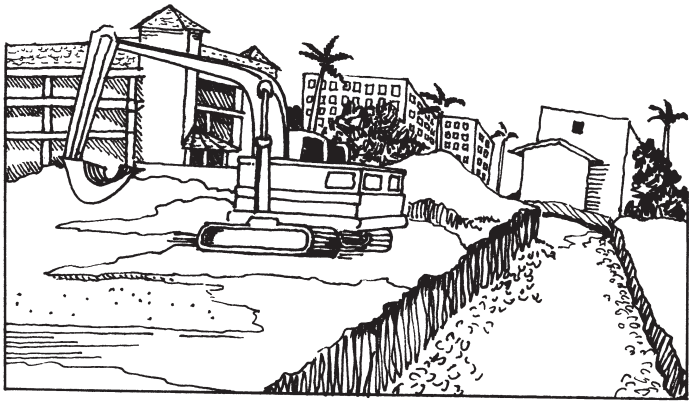
Many truckloads of dirt left the uplands. Figuring out where to put the dirt was a huge problem. Ultimately, contractors moved the dirt into the ocean using a dredge. A temporary pipeline pumped 17,000 cubic yards of dirt into a slurry and transported it to the ocean. In addition to creating a wetland and enhancing the tidal prism, the action also rebuilt the depleted barrier beach, protecting the estuary from dune over-wash. The resulting linkage immediately increased tidal flushing (circulation) and helped develop tidal creeks. This enhanced tidal prism refreshed and scoured the estuary.

After the heavy machinery departed, it was time for revegetation. Two strategies were implemented. One was straight restoration in an attempt to re-create a typical salt marsh, based on what was known at the time, and return it to wildlife use. The other was research to test different hypotheses about a number of species that occur in association with one another in a natural marsh. The experiment strove to discover methods for maximizing biodiversity and increasing estuary productivity with more biomass, as a means of informing future restoration efforts.

Even though much of the estuary was untouched by construction, development nevertheless took an enormous toll. Our forebears determined that they wanted to replace nature with businesses and housing, and they got cracking, particularly after World War II. They made plans and floated bonds to raise money. In came the dredges -- floating cranes with scoops - to dig out nearby salt marshes. In came the bulldozers to destroy the dunes and the bulldozers to distribute fill. This happened all along the Pacific coast, including the northern portions of the Tijuana Estuary that were filled to create parts of Imperial Beach.

Before the estuary's preservation, developers had put unauthorized fill on Seacoast Drive. It was almost 200 yards long and extended out thirty feet, into the northern end of the Oneonta Lagoon. (see map.) The City of Imperial Beach put in an assessment district and began charging property owners on Seacoast Drive extra taxes, to raise revenues for undergrounding power lines and improving the streets. The property owner became concerned

because he was being taxed on lands he couldn't develop because of environmental legislation. He became a willing seller. Many people and agencies worked to find the money to buy the property and remove 18,000 cubic yards of fill. Truckload after truckload of dirt departed. This prepared 1.25 acres for salt marsh and intertidal



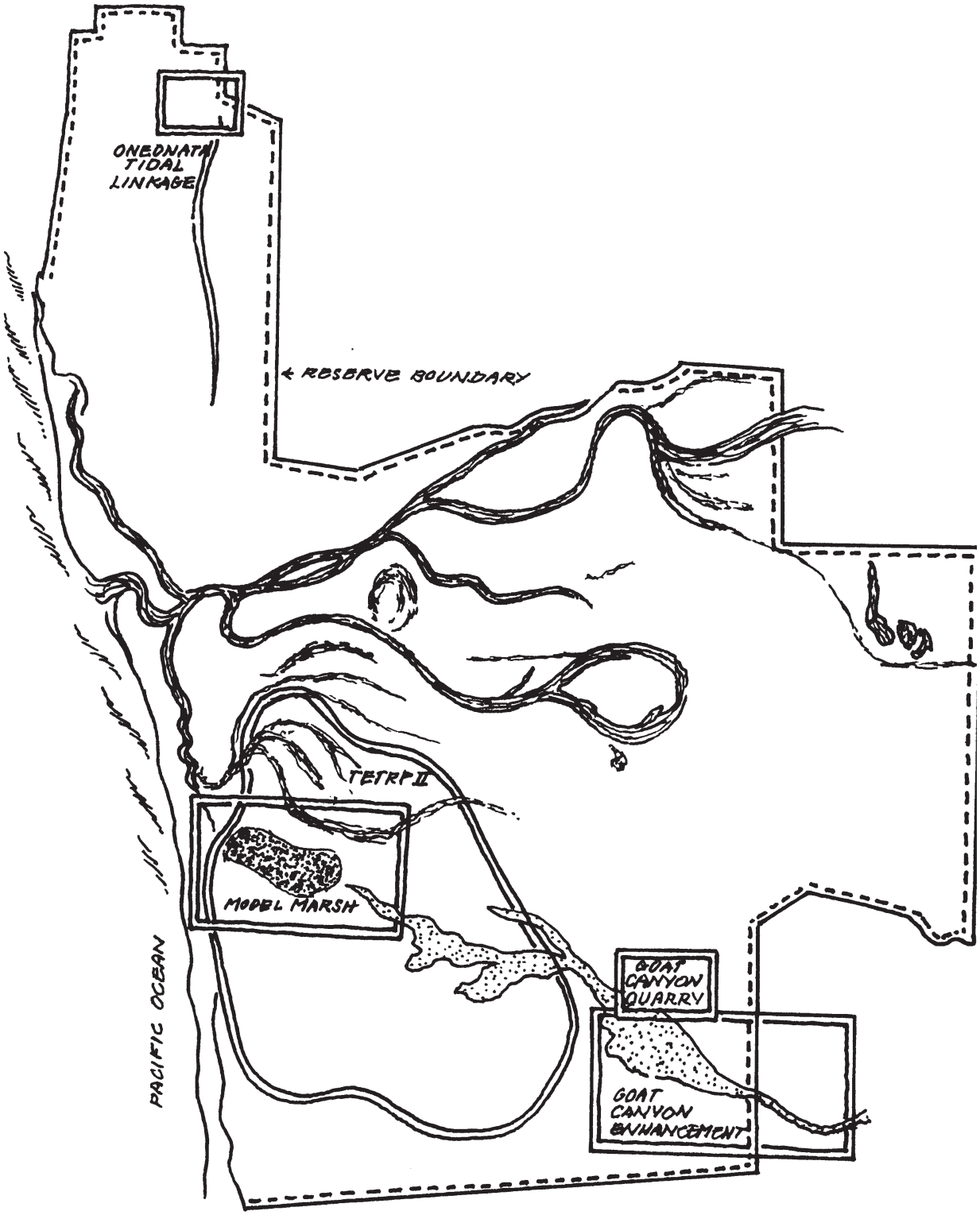
habitat restoration was completed in 2000. Afterward, the restoration team, again led by Chris Nordby, put together a habitat that is identical to surrounding habitat. You can't tell where it begins and ends. But you can see the names of contributors on a dedication plaque at a promontory right where it occurred.

A series of human-induced and natural events had filled hundreds of acres with fill and sediment, in the southern arm of the estuary in Border Field State Park near the ocean. Some of this site was farmed previously. The Model Marsh Project restored twenty acres in the late nineties, ten times the size of the Oneonta Tidal Linkage. Here, restoration specialists successfully applied PERL's data to an actual setting. Even though the Model Marsh Project has only a one-percent slope, excavating 100,000 cubic yards of soil led to the creation of three different habitat types - mud flat, salt marsh and high salt marsh.

Development demands construction materials - rock, sand and gravel. It is not surprising that some impacts to the estuary are the direct result of eroded soil from a nearby quarry. H. G. Fenton (who had worked as a farmer for E. S. Babcock, the builder of the Hotel Del Coronado) operated a gravel quarry in Goat Canyon on the west slope of Spooner's Mesa, which was later abandoned. Public agencies acquired this land, as part of the Tijuana River National Estuarine Research Reserve. (See map.)

In 2000, the quarry slopes were reconstructed using fill from the Model Marsh Project. To provide soil for growing upland plants which don't like salt, crews "capped" (topped) the fill with non-saline soil from the quarry itself. To stabilize the slopes, they then planted and irrigated maritime succulent scrub seed, gathered from plant species in the immediate vicinity. The rooted plants hold down the soil and create another rare habitat type, maritime succulent scrub, which is only found on hillsides very close to the ocean.

The westernmost tributary to the estuary is a 4.6 square mile watershed that begins in Mexico, extends through Cañon de los Laureles and ends at Goat Canyon (Cañon de los Laureles's name in the U.S.) near Monument Road. There, squatters build impromptu houses on tires, wedged into steep slopes. The encampments pose a major threat to the Goat Canyon's restoration. These houses have no infrastructure, no sewers, and no water supply, which is bad enough even in good weather. During bad weather, flooding washes houses, trash and even people right through the canyon and out toward the estuary. More than thirty acres of salt marsh have been buried by sediment conveyed by winter floods. To stop sediment and trash from moving into the United States, crews began to construct two sediment basins in Goat Canyon in 2003 and 2004. The plan included important Mexican erosion control and safety measures, but implementation has been slow south of the border. Again, bi-national effort is necessary to guarantee preservation of rare coastal salt marsh and



Map of Restoration Sites within the Estuary

secure opportunities for more restoration.

HUMANITARIANISM AND IMMIGRATION

The team - larger now and including organizations and cities on both sides of the border -- is looking for a way to extend restoration and humanitarian efforts into Cañon de los Laureles, the extension of Goat Canyon in Mexico. Not only will such efforts minimize the devastating effect of pollution and sedimentation on the estuary, it will also build more amicable relations between people living on both sides of the border.

The Tijuana - San Diego border crossing is the busiest international border in the world. A relatively poor country is pressed right against the wealthiest country in the world, and the estuary is between them, directly north of the border. It has long been a byway for illegal immigrants crossing into the United States. At its peak, hundreds of people a day trudged through the salt marshes, flattening delicate plant species and even eating bird eggs. Reserve personnel tell stories of finding people that were dead or dying too. Immigrant numbers fell due to the construction of a border fence during the late eighties. In the nineties, a federal program called Operation Gatekeeper intensified border protection. Since 9-11-2001, border security is an even greater concern. The extension and improvements to fencing through and above the estuary to Border Field out into the Pacific Ocean needs to be very carefully considered, so as to avoid damaging the fragile soils and habitats. Grading, road-building, filling canyons and disrupting habitat create devastating environmental problems, with ramifications that extend far beyond the estuary.

EDUCATION

In 1990, the Tijuana Estuary Visitor Center, designed by architect Rob Quigley, was completed at the northern end of the Research Reserve. It cost $1.2 million, raised through coordinated fundraising,

involving the California Coastal Conservancy, California State Parks (CSP), USFWS, and NOAA. Both the building and the garden won local design awards. Exhibits and interactive activities explain about estuaries and watersheds, as do a collection of videos (including videos in Spanish) that are shown upon request. To promote estuarine appreciation, the bookstore sells field guides and videos.

Outside the Visitor Center, restored coastal sage scrub has matured. North and South McCoy Trails take visitors into prime birdwatching areas and to the mouth of the Tijuana River. Students and youth groups visit the estuary frequently, which underscores estuarine ties to classroom education, including art, language and social studies as well as science. This curriculum is part of that education engagement.

In 2002, the Reserve's Coastal Training Program went into effect, extending education opportunities to a broader base. Mexican officials finally participate on the Reserve's Management Authority. Now policy makers and the public on both sides of the border can learn the enormous merit of watershed management and act on that knowledge. The Coastal Training Program

makes sure important data reaches decision-makers, broadcasting estuarine conservation as an international priority.

COMPATIBLE USE

As a highly productive natural system, the estuary continues to work for us - cleaning water and air, nurturing the basis of the energy cycle (the food chain). Core areas are designated for total protection, but some unpreserved portions can still accommodate human use in the Tijuana River Valley. Nearby farmers are encouraged to employ integrated-pest management rather than pesticides, herbicide, and other non-sustainable resources within the watershed. The County of San Diego operates a bird and butterfly garden, as well as a community garden. A regional trail system will provide trails for horseback, hiking, and bikes to escort humans through many areas of the valley, from both Imperial Beach and San Ysidro to Border Field State Park.

POSITION IN THE BIG PICTURE

The Border Highlands, Border Field State Park, Tijuana River Valley County Park, Tijuana Slough National Wildlife Refuge and the Tijuana River National Estuarine Research Reserve constitute approximately 5,000 acres, a big interconnecting complex. Just to the north, South San Diego Bay, Sweetwater Marsh, and Paradise Marsh have always had an integral connection with the Tijuana River holdings, harboring shore and wading birds. In the ocean, nutrients connect the river mouth and the bay, all part of the same system. Therefore, the preservation of these other marshes is vital to the health of the estuary.

Environmental groups, elected officials, and federal and state agencies needed to cultivate agreement between numerous stakeholders, many of whom were wealthy, influential people and entities - like the Port of San Diego, Western Salt, and other commercial property owners and leaseholders. Therefore, the South San Diego Bay National Wildlife Refuge took 28 years to come to fruition. The establishment of this refuge in June of 1999, together with Sweetwater Marsh and Paradise Marsh, helped protect the ecological integrity of the natural areas that are left in San Diego Bay. It was an important step and yet another way dedicated people expressed what they could do for the Tijuana Estuary.

International awareness of the Tijuana Estuary extends beyond Mexico. In 2005, Tijuana Estuary become part of the Ramsar Designation of Wetlands of International Importance. This intergovernmental treaty, signed in Ramsar, Iran, in 1971, provides the framework for national action and international recognition and cooperation for the conservation and wise use of wetlands and their resources. One hundred thirty-eight countries, with 1369 wetland sites, totaling 119.6 million hectares, participate. From 1985 until

2004, environmentalists worked toward this designation, overcoming the federal government's resistance to ecological encumbrances.

As you can see, the estuary's success is on-going and interactive - humans helping the estuary, the estuary helping humans. What makes it work is the people-- the players who ask what they can do and then do it. What a pleasure to count you among them!