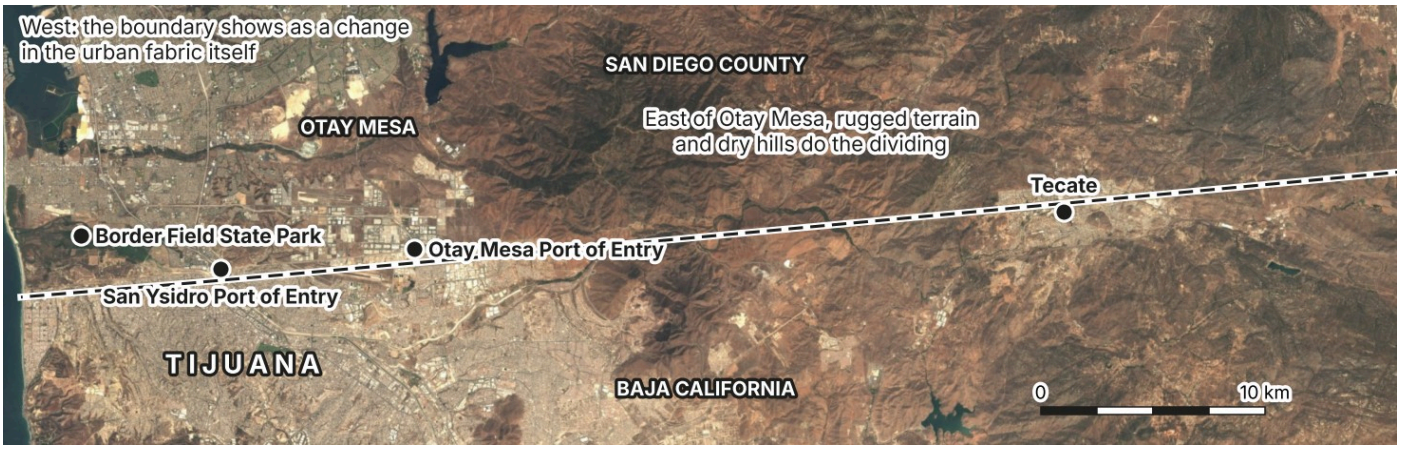
TEMPORAL DATA DYNAMICS · LOCATION DESK · AREA C

One Shoreline

The most celebrated beach in America sits a few miles from the border, beside the water where Navy SEALs train and across the bay from a waterfront rebuilt on industrial ground. The water connects them. A map can tell them apart.



The U.S.–Mexico boundary from the Pacific to Tecate (the strip map, inside the report). Sentinel-2 cloudless 2016, EOX IT Services GmbH, CC BY 4.0.

1,000
consecutive days the Imperial Beach shoreline had been closed, 3 Sept 2024 [23]

60,000×
TCE under Rohr's North Campus in 1993, against the drinking-water limit [34]

6.7 M
people in the six border jurisdictions, 2020 (Figure 3) [9][10]

1,168
acute GI illnesses among SEAL candidates, 2019–23 [31][32]

By PA-S1, location desk, Temporal Data Dynamics

Status v1.2, final and settled (adds the closing questions to Section 8)

Date 21 October 2026

Contents essay, 3 master maps, 1 strip map, 6 figures, methods, sources, QA log, open walls

In this report

> A sewage crisis at the U.S.–Mexico border is usually told as one story. On the map it is several. A river and a shoreline discharge foul an ocean beach and its air; a bay to the north carries its own industrial legacy, cleaned under state orders as a resort rose on it; and the city across the line, where the worst water lands, grew more than three times past the system built for it. This report sets the history, the measurements and the open questions side by side, with three master maps and six figures, and lists what is still unknown.

1 The postcard 3
2 Growth has a cost 3
3 The hidden side: water 4
4 The hidden side: air, and the people who train in it 6
5 The bay side: the waterfront that had to be cleaned first 8
6 Both sides of the line 11
7 Feared, then played down 12
8 One shoreline, two trajectories 14
Technical notes: methods, data and rights 15
Sources 17
Fact-check and QA log 19
Open walls and next steps 20

How to read the graphics

Each map opens with a short note on what it shows. Filled symbols are placed from an official record or an OpenStreetMap object; hollow symbols are approximate. Circles are places; red diamonds are sites under a Water Board cleanup order. Arrows that show water moving are schematic and are drawn above the pipes, because the water moves above them. Charts keep one measure per axis; when values span orders of magnitude the scale is logarithmic and says so. Bracketed numbers in the text point to the numbered sources at the back.

1 The postcard

In 1898 a camera crew from Thomas Edison's company came to Coronado. Among the short films they made was *Off for the Rabbit Chase*, shot at the Hotel del Coronado. The San Diego History Center's filmography of the region opens with that year's three Edison titles, which makes them among the first motion pictures made in San Diego [1][2].

Billy Wilder filmed *Some Like It Hot* at the Del in 1958, its turrets standing in for a Florida resort. Richard Rush shot *The Stunt Man* there in 1977 and 1978, with a scene at La Jolla's Children's Pool. The hotel was named a National Historic Landmark in 1977 [2][3]. In 2012 Stephen Leatherman, the coastal scientist known as Dr. Beach, ranked the beach in front of it the best in America [4].

The bay behind the hotel has its own record. Glenn Curtiss ran a flying school on North Island from 1911. The air station was commissioned in 1917. On 10 May 1927 Charles Lindbergh took off from North Island on the first leg of the journey that ended in Paris. By 1935 four aircraft carriers were based there, and during the Second World War dredging filled the Spanish Bight, the channel that had made Coronado two islands [5][6]. Across the water the *Star of India*, launched in 1863 and the oldest ship still sailing regularly, is moored at the Embarcadero [7]. In the 1940s an estimated 95 percent of the tuna canned in the United States was canned here [8].

That history is part of why people came, and kept coming. The climate, the harbour, the military and the border economy built a region that now holds more than six and a half million people on the two sides of the line (Figure 3) [9][10].

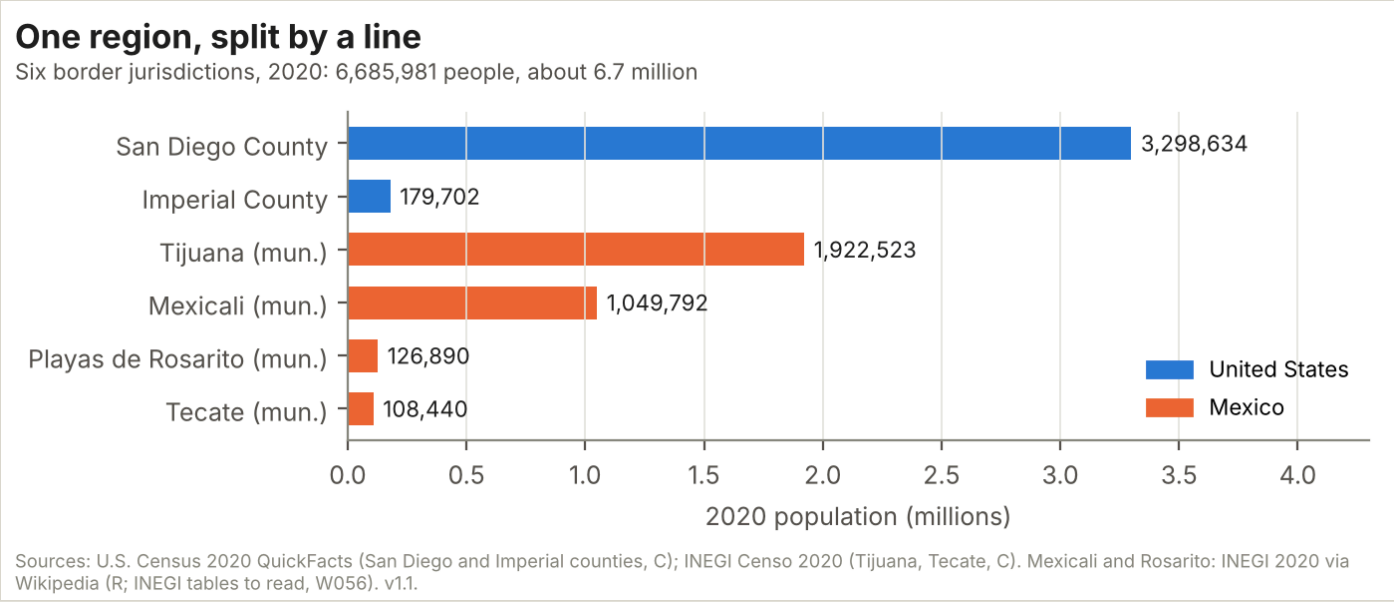


Figure 3. One region, split by a line. 2020 populations of the six border jurisdictions: 6,685,981 people.

2 Growth has a cost

Both sides grew for many of the same reasons. Mexico's border industrialization program began in the mid-1960s, and the assembly plants it brought, the maquiladoras, tied Tijuana's economy to California's [11].

On 30 November 1965 the two countries' boundary and water commission signed Minute 222, an emergency connection of Tijuana's sewage to San Diego's

metropolitan system [12]. The region shared a pipe a generation before it shared a trade agreement.

The pipes did not keep pace. Tijuana's collection system was designed for about 600,000 people [13]. The municipality counted 461,267 in 1980 and 1,922,523 in 2020, more than three times the design population (Figure 1) [9][14]. On the U.S. side, the South Bay International Wastewater Treatment Plant, built with $239.4 million from Congress, opened in 1997 at 25 million gallons a day, treating sewage only to an advanced-primary level. A federal court set 30 September 2008 as the deadline for it to meet the Clean Water Act; it missed it [15]. Secondary treatment came online in late 2010, and the plant met its permit consistently only from 2013 [16]. It reached 35 million gallons a day in August 2025, and a 50-million-gallon design is scheduled [17]. In December 2025 the two governments signed Minute 333, a new calendar of works on both sides [18].

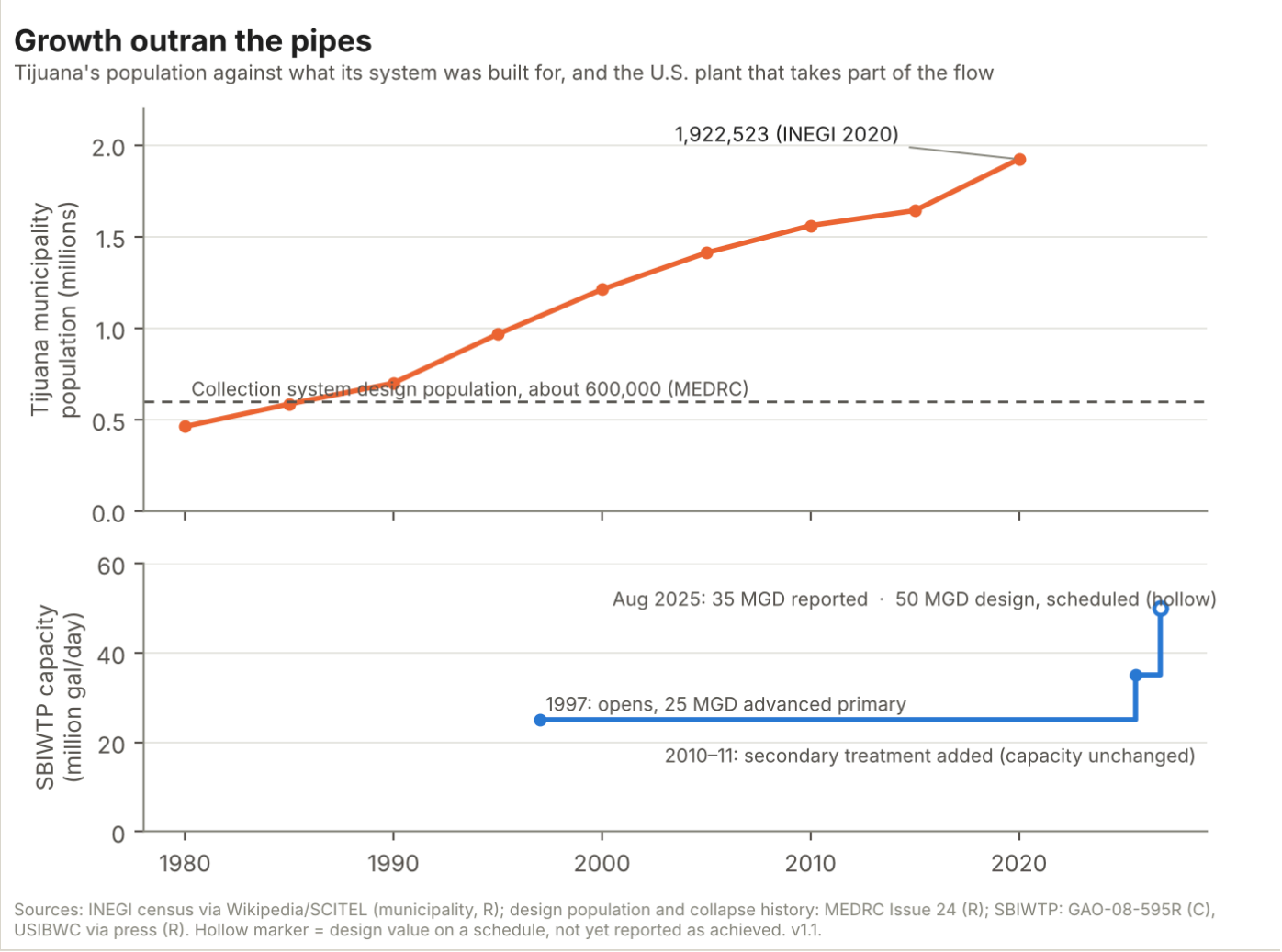


Figure 1. Growth outran the pipes. Tijuana grew past its system's design population by 1990; the U.S. plant's capacity held at 25 MGD for 28 years.

3 The hidden side: water

None of this is hidden. It is simply hard to see. On a satellite image the coast looks continuous, one long beach from Coronado past the border to Punta Bandera (Map 1). The water arriving on it comes from several places.

Where the water comes from

v1.1 · final · 21 Oct 2026

One shoreline, many inputs: a river, its canyons, two treatment plants and their outfalls, from Coronado to Punta Bandera

What you are looking at

A 2016 satellite image of the coast either side of the U.S.–Mexico boundary. Red arrows show untreated or partly treated water reaching the shore: the Tijuana River into its estuary, and the discharge at Punta Bandera, which waves carry north toward U.S. beaches. Grey lines are ocean outfalls on the seafloor that carry treated effluent offshore; the arrows are drawn over them because the water moves above the pipes. Numbers are keyed at right.



PLACES

- Place (position from OSM or official record)
- Place, position approximate

WATER

- River flow carrying sewage to the shore
- Shore discharge carried north by waves (schematic)
- Treated effluent released at the diffuser

INFRASTRUCTURE

- Ocean outfall pipe on the seafloor
- Outfall tunnel, underground (path schematic)
- Point Loma outfall break, Feb 1992 (approx.)

BOUNDARY

- U.S.–Mexico boundary

NUMBERED PLACES

1. Hotel del Coronado
2. Naval Amphibious Base Coronado (SEAL training)
3. Silver Strand State Beach
4. Imperial Beach Pier
5. Tijuana River mouth [approx.]
6. Border Field State Park
7. Smuggler's Gulch (canyon flows)
8. South Bay International Wastewater Treatment Plant
9. South Bay Ocean Outfall diffuser (3.5 mi out)
10. Playas de Tijuana
11. Punta Bandera shore discharge (MX) [approx.]
12. Point Loma Wastewater Treatment Plant

NOTES

The Punta Bandera plume reaches U.S. beaches mostly under summer south swell; Scripps DNA work traced it to Silver Strand, ~20 km.

SBIWTP: 25 MGD (1997) → 35 MGD (Aug 2025); a 50 MGD design is scheduled.

Only 6 of Tijuana's 16 treatment plants were working as designed in Sept 2025 (CESPT to a state legislative committee).

Imagery: Sentinel-2 cloudless 2016 by EOX IT Services GmbH (contains modified Copernicus Sentinel data 2016), CC BY 4.0, lightened 12–16% so symbols read; it predates the Gaylord (2025). Boundary: Natural Earth 10m. Positions: OpenStreetMap contributors (ODbL) and City of San Diego outfall inspection reports; hollow symbols are approximate. UTM 11N (EPSG:32611). Temporal Data Dynamics / PA-S1, v1.1, 21 Oct 2026. Flow paths are schematic, not model output. Land more than about 3 km from water is faded so the eye stays on the shore; nothing there is hidden.

Map 1. Where the water comes from. Sources, flows and outfalls from Coronado to Punta Bandera, on a 2016 Sentinel-2 image. Flow paths are schematic.

The Tijuana River drains a watershed that lies mostly in Mexico and reaches the sea through an estuary just north of the border. About ten kilometres south of the border, sewage that the San Antonio de los Buenos plant cannot treat runs onto the beach at Punta Bandera [20]. Scripps researchers who modelled every transboundary flow in 2017 found that in wet weather the river caused about two-thirds of the closures; overall, the dominant source was the Punta Bandera discharge, and in the dry season it accounted for every closure at the Imperial Beach pier [19]. Under the south swells of summer, waves carry that water north through the surf zone, and DNA tracing has followed it as far as Silver Strand State Beach, about 20 kilometres away [20].

Mexico rebuilt the San Antonio de los Buenos plant in 2025 to treat 800 litres a second; Rosario Norzagaray of the group Costa Salvaje says its late-1980s design was 1,200, for a city of about 900,000 [21]. In September 2025 the head of Tijuana's water utility, CESPT, told a state legislative committee that only 6 of the city's 16 treatment plants were working as designed; the rest ran irregularly or not at all [22].

The result on the U.S. side is a beach that is often closed. On 3 September 2024 the Imperial Beach shoreline passed 1,000 consecutive days closed [23].

4 The hidden side: air, and the people who train in it

The water does not stay in the water. In 2023 Scripps researchers Matthew Pendergraft, Kimberly Prather and colleagues found that up to three-quarters of the bacteria in Imperial Beach's coastal air came from sewage-polluted water thrown up by the surf. The authors were careful: the study did not show that anyone was made ill [24].

The sewage also gives off hydrogen sulfide, the gas behind the smell of rotten eggs. On 19 March 2026 it reached about 500 parts per billion near Imperial Beach schools, more than 15 times California's one-hour standard of 30, according to CalMatters. The air district paid for 199 air purifiers for local schools [25]. In October 2024 county and CDC interviewers surveyed 189 households in Imperial Beach, Nestor and San Ysidro. Ninety-five percent said they had smelled sewage in the previous 30 days (Map 2) [26].

What the air and water carry

v1.1 · final · 21 Oct 2026

An exposure you cannot see but can smell: the closed shoreline, and the neighbourhoods and schools beside it

What you are looking at

The same coast at closer range. The red line marks the shore from the boundary to Coronado, the reach where county health officials post closures and advisories when bacteria levels exceed state limits; which stretches are closed changes day to day. Points mark public places named in health reporting. No illness is mapped: exposure is not the same as harm, and no study yet links the two here.



PLACES

- Place (position from OSM or official record)

WATER

- Closure and advisory shoreline (traced)

BOUNDARY

- U.S.–Mexico boundary

NUMBERED PLACES

1. Hotel del Coronado
2. NAB Coronado (SEAL training beaches)
3. Imperial Beach Pier
4. Imperial Beach Civic Center
5. Berry Elementary School, Nestor
6. Nestor
7. Tijuana River Valley Regional Park
8. Border Field State Park
9. San Ysidro Port of Entry

NOTES

The Imperial Beach shoreline passed 1,000 consecutive days closed on 3 Sept 2024.

19 Mar 2026: hydrogen sulfide about 500 ppb near Imperial Beach schools, over 15× the 30 ppb state standard; the air district funded 199 purifiers.

CDC CASPER, Oct 2024: 189 households interviewed; 95% had noticed a sewage smell in the past 30 days.

Off NAB Coronado about 3 in 4 water tests exceeded standards, Feb–Sep 2024; 1,168 acute GI illnesses among SEAL candidates, 2019–23 (DoD IG).

Air-monitor sites to be added from the air district (W063). Places, not persons: no residences are shown.

Imagery: Sentinel-2 cloudless 2016 by EOX IT Services GmbH (contains modified Copernicus Sentinel data 2016), CC BY 4.0, lightened 12–16% so symbols read; it predates the Gaylord (2025). Boundary: Natural Earth 10m. Positions: OpenStreetMap contributors (ODbL) and City of San Diego outfall inspection reports; hollow symbols are approximate. UTM 11N (EPSG:32611). Temporal Data Dynamics / PA-S1, v1.1, 21 Oct 2026. Land more than about 4.5 km from water is faded so the eye stays on the shore; nothing there is hidden.

Map 2. What the air and water carry. The closure and advisory shoreline, traced from the image, with the public places named in health reporting. No illness is mapped.

A South Bay pediatrician, Dr. Vi Nguyen of Kaiser Permanente in Otay Mesa, has described more asthma, pneumonia and headaches among the children she treats. She has spoken on the record but has not published figures [27][28]. One peer-reviewed study, in the *Western Journal of Emergency Medicine* in 2025, found that emergency visits for diarrhea at a nearby hospital tracked the river's flow in summer 2023, rising to more than three times the weekly average after Tropical Storm Hilary [29]. No published study yet measures children's health here. The county began an exposure study with UC San Diego in 2026 and plans a retrospective study of hospital, cancer and death records [30].

The same water runs past Naval Amphibious Base Coronado, where candidates for the SEAL teams train in the surf. The Pentagon's Inspector General reported in February 2025 that from February to September 2024 about three in four water tests off the base exceeded state standards, and that 12 of 265 water-training events, about 5 percent, were moved. From 2019 to 2023 the command diagnosed 1,168 cases of acute gastrointestinal illness among candidates (Figure 2) [31][32]. The Navy agreed to set rules for monitoring the water and moving training. Whether it tracks what repeated exposure does to candidates is a question for Naval Special Warfare.

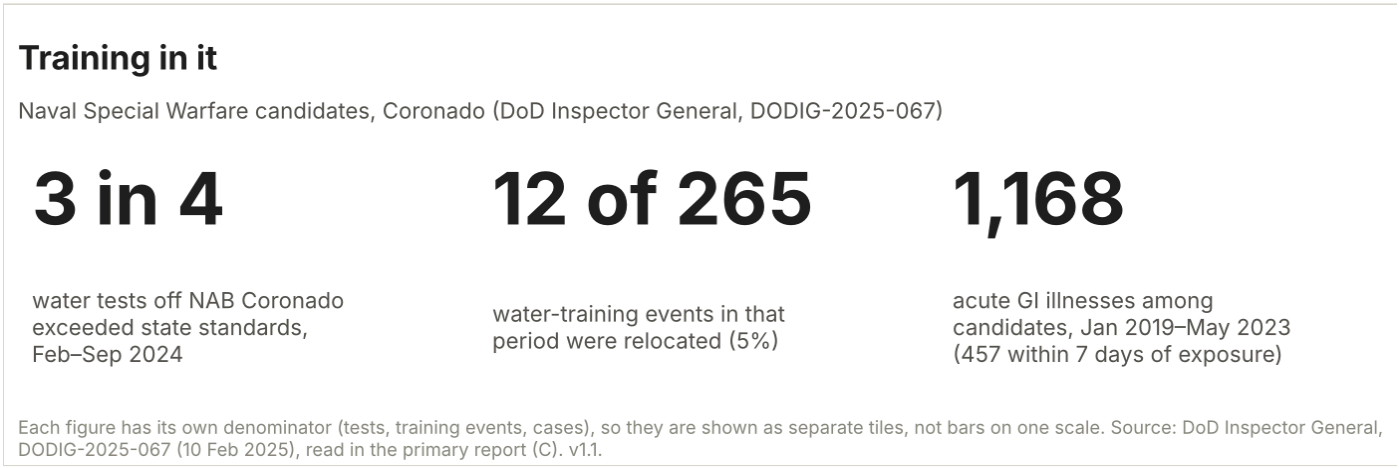


Figure 2. Training in it. Three figures from the Pentagon Inspector General, each on its own denominator.

5 The bay side: the waterfront that had to be cleaned first

Six miles north, across the Silver Strand, lies a different body of water with a different problem. San Diego Bay meets the Pacific only at its mouth, between Point Loma and North Island (Map 3). Its southern shore, Chula Vista's bayfront, spent most of the twentieth century as industrial ground.

The bay, from its mouth to the bayfront

v1.1 · final · 21 Oct 2026

A century of flight, defence, fish and industry around one bay, and a South Bay waterfront cleaned before it could be rebuilt

What you are looking at

San Diego Bay opens to the Pacific between Point Loma and North Island (left) and curves south and east to Chula Vista. Black circles mark the history that made the region; red diamonds mark industrial sites the regional Water Board has ordered cleaned up. This bay is separate water from the ocean plume on the other maps: it meets the Pacific only at its mouth.



PLACES

- ● Place (position from OSM or official record)
- ○ Place, position approximate
- ◆ Site under a Water Board cleanup order
- ◇ Cleanup-order site, position approximate

NUMBERED PLACES

1. Cabrillo National Monument, at the bay mouth
2. Site of the first military flight school, North Island (1911)
3. Spanish Bight, a channel filled in WWII [approx.]
4. Hotel del Coronado (1888; NHL 1977)
5. Liberty Station, former Naval Training Center
6. Marine Corps Recruit Depot
7. Star of India (1863), Maritime Museum
8. Tuna Harbor, the old tuna-fleet waterfront
9. San Diego Convention Center
10. Chicano Park, Barrio Logan
11. Naval Base San Diego
12. Gaylord Pacific Resort (opened May 2025)
13. Sweetwater Marsh (refuge; contaminated sediment)
14. Rohr North Campus, 850 Lagoon Dr (order R9-2021-0042)
15. Rohr South Campus, foot of H St (order R9-2014-0019) [approx.]
16. Former South Bay Power Plant (closed 2010)

NOTES

Rohr (aerospace, 1941–2002): TCE in North Campus groundwater up to 300,000 µg/L in 1993, against a 5 µg/L drinking-water limit.

Interim barriers of iron, vegetable oil and dechlorinating microbes on Parcel H-3 from 2020; order estimate $18.7–26.8 million.

The 2014 South Campus order lists future hotel guests among those to protect. Mapping the order boundaries is open (W060).

Tuna: about 95% of U.S. tuna was canned here in the 1940s; the last cannery left in 1984.

Imagery: Sentinel-2 cloudless 2016 by EOX IT Services GmbH (contains modified Copernicus Sentinel data 2016), CC BY 4.0, lightened 12–16% so symbols read; it predates the Gaylord (2025). Boundary: Natural Earth 10m. Positions: OpenStreetMap contributors (ODbL) and City of San Diego outfall inspection reports; hollow symbols are approximate. UTM 11N (EPSG:32611). Temporal Data Dynamics / PA-S1, v1.1, 21 Oct 2026. Former features (Spanish Bight) are placed approximately. Land more than about 1.6 km from water is faded so the eye stays on the shore; nothing there is hidden.

Map 3. The bay, from its mouth to the bayfront. Historic places (circles) and sites under Water Board cleanup orders (diamonds).

Rohr, the aerospace manufacturer, made aircraft components there from 1941 until it left in 2002. The regional Water Board's cleanup orders read like a solvent catalogue: trichloroethylene (TCE) and the compounds it breaks down into, 1,1,1-trichloroethane, hexavalent chromium, lead, cadmium and PCBs [33][34]. For TCE and PCBs alike, the federal health goal for drinking water is zero, and federal rules let ground where people will spend time keep no more than 1 part per million of PCBs without further controls [35][36]. In 1993 groundwater under Rohr's North Campus held TCE at 300,000 micrograms per litre, against a drinking-water limit of 5 (Figure 6) [34]. From 2020, on a parcel within the bayfront plan, contractors installed underground barriers of iron, vegetable oil and *Dehalococcoides*, bacteria that strip chlorine from the solvent one atom at a time until it becomes harmless ethene [34][37]. The board estimated the work its 2021 order requires at $18.7 million to $26.8 million [34]. Its 2014 order for the South Campus, at the foot of H Street, lists the people the cleanup must protect. Among them are future hotel guests [33].

> *Among them are future hotel guests.*
>
> The 2014 cleanup order for Rohr's South Campus, on the people the cleanup must protect [33]

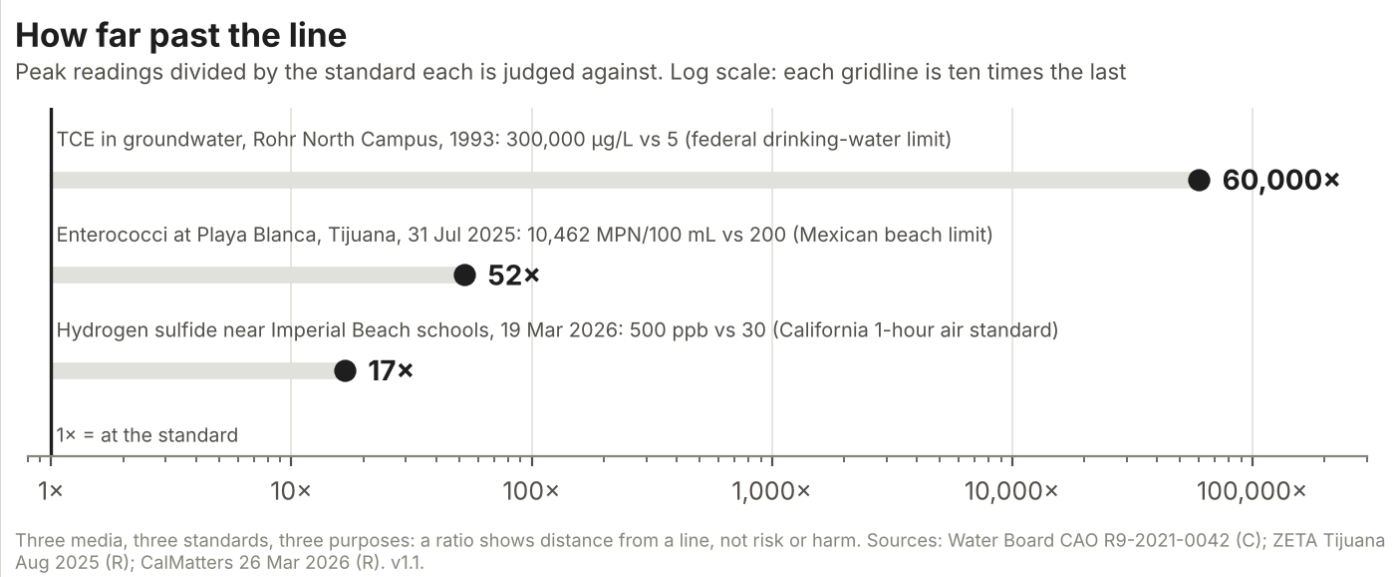


Figure 6. How far past the line. Peak readings as multiples of the standard each is judged against: a distance from a line, not a measure of harm.

Next door, the South Bay Power Plant ran for about five decades until the end of 2010 and was imploded in February 2013 [38]. The marshes at the bayfront's edge, now a national wildlife refuge, hold contaminated sediment from waste disposal and industry that began in the late 1800s [39].

By 2010 local press called the bayfront's redevelopment a "38-year effort" [40]. The California Coastal Commission approved the Chula Vista Bayfront Master Plan unanimously on 9 August 2012 [41]. On 15 May 2025 the Gaylord Pacific Resort and Convention Center opened there: about $1.35 billion by the Port's figure, 1,600 rooms and some 477,000 square feet of indoor and outdoor event space [42][43]. The San Diego Convention Center downtown has 615,701 square feet of total exhibit space; one hotel now sits in the same order of magnitude as the region's main convention venue (Figure 4) [44]. Chula Vista's mayor projects $475 million a year in economic activity [42].

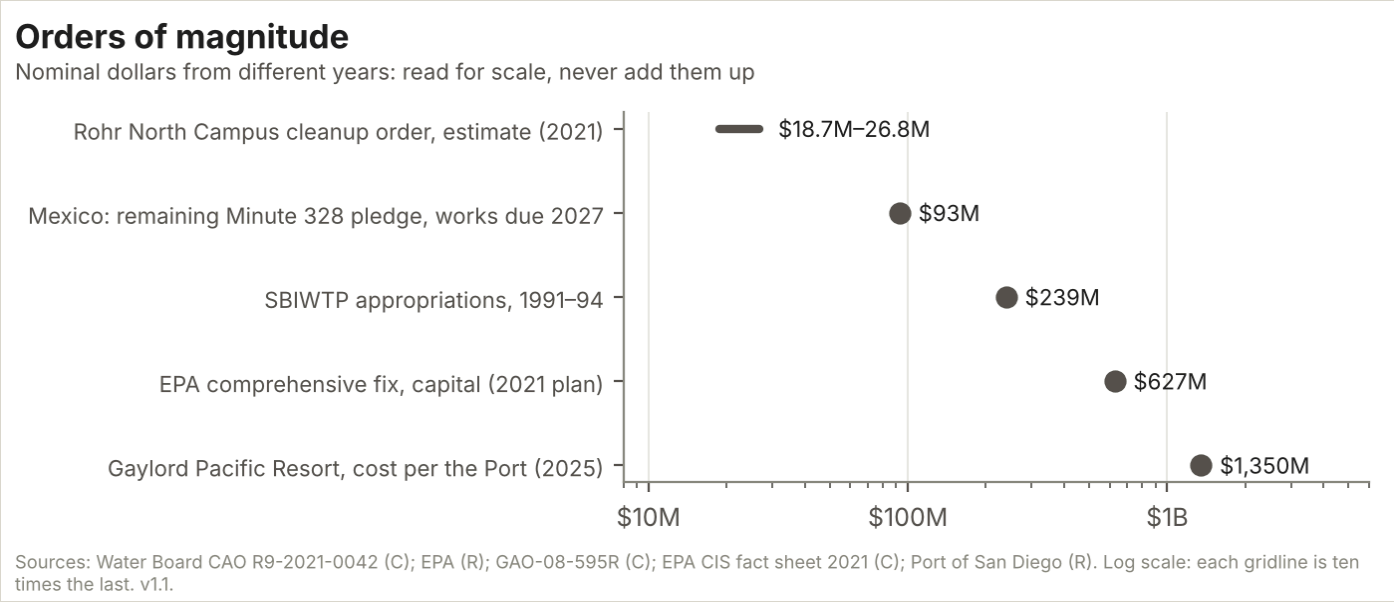


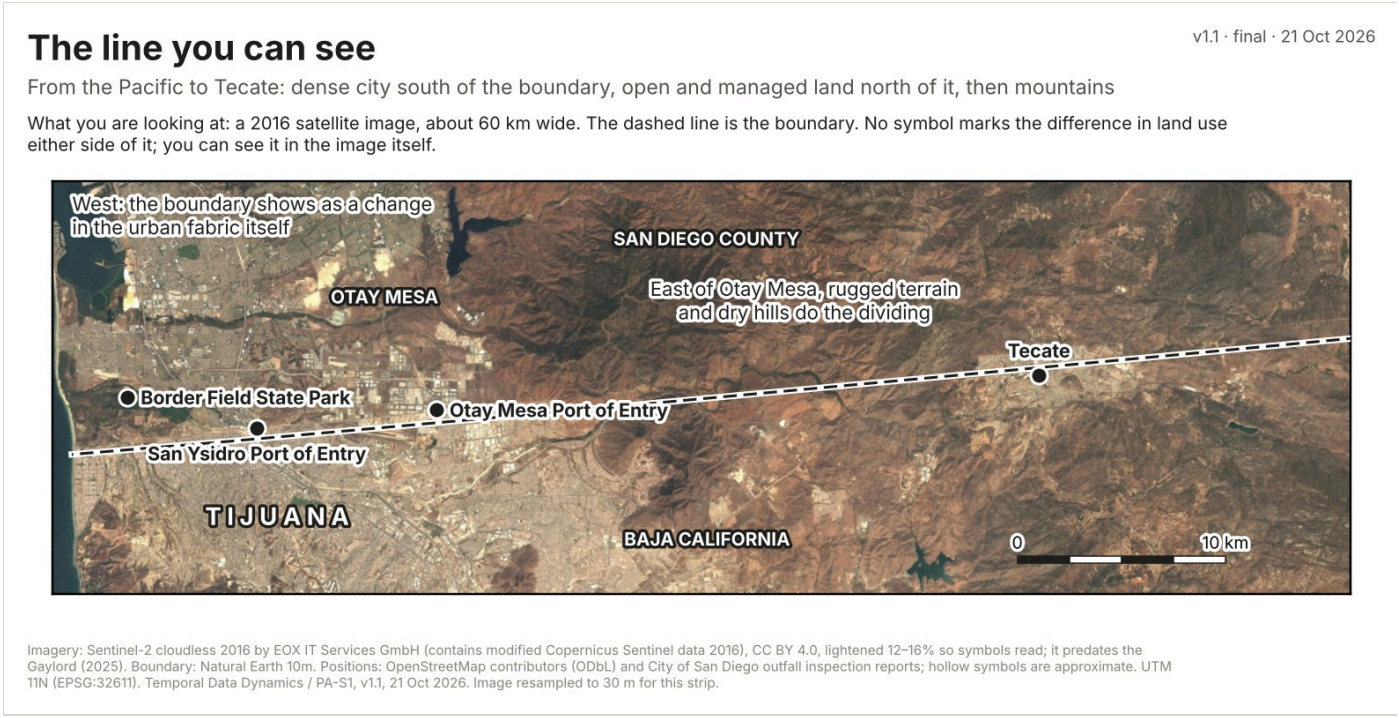
Figure 4. Orders of magnitude. Nominal dollars from different years, for scale only.

So the bayfront arrived just as the sewage headlines peaked. The two are separate problems. One is legacy pollution, cleaned under orders; the other is a chronic discharge that is still arriving. From a distance they blur into one picture of the South Bay. On the map they are miles and a peninsula apart.

6 Both sides of the line

It would be easy to tell this as Mexico's sewage on America's beaches. The record does not support that. Mexico's acting foreign minister has said the heaviest concentration of pollution is on Tijuana's own beaches [45]. At Playa Blanca, beside the Punta Bandera discharge, enterococcus bacteria measured 10,462 per 100 millilitres on 31 July 2025, against a Mexican limit of 200 [21]. People born in the United States are the largest group among Mexico's foreign-born residents [46]. Margarita Díaz of Proyecto Fronterizo de Educación Ambiental put the gap plainly to the Tijuana weekly *Zeta*: the United States is meeting its dates, and Mexico is behind [21]. Mexico's commitments under the 2025 agreement, backed by $93 million left over from a 2022 pledge, are due by the end of 2027 [47].

Inside one country, a dispute like this goes to court, and on the U.S. side it did. In 2018 Imperial Beach, Chula Vista and the Port of San Diego sued the U.S. section of the boundary commission; San Diego, the Water Board, the State Lands Commission and the Surfrider Foundation followed. The suits settled in April 2022 [48]. Across the line no court has authority over both sides. There is a treaty minute and a calendar (Strip map).



Strip map. The line you can see. From the Pacific to Tecate, the boundary shows in the land itself: dense city to the south, open land to the north, then mountains.

7 Feared, then played down

This coast has had a sewage emergency before. On 2 February 1992, at the northern end of the same shoreline, the Point Loma outfall, the pipe that carries San Diego's treated sewage offshore, broke about 3,000 feet from shore in roughly 35 feet of water [49][50]. For about two months nearly 190 million gallons a day poured into the kelp forest instead of deep water [51]. Scientists feared for the forest. When Mia Tegner, Paul Dayton and colleagues studied it, they made the question their title: catastrophe or disturbance? Near the break the kelp suffered. Beyond a kilometre, the extra nitrogen fed a canopy starved of nutrients, and after the repair the hardest-hit zone grew back as dense forest. They called it "a modest disturbance" [51].

That spill was sudden and short, and was treated as an emergency. The flow at the border has run for decades and been treated as a chronic condition (Figure 5). The fixes now under way, from the expanded plant to the river diversion, are real and scheduled. Whether the response matches the scale is for readers to weigh against the figures. Several questions remain open: what the county's health studies find, what the Navy measures, and when Imperial Beach's closures stop being counted in years.

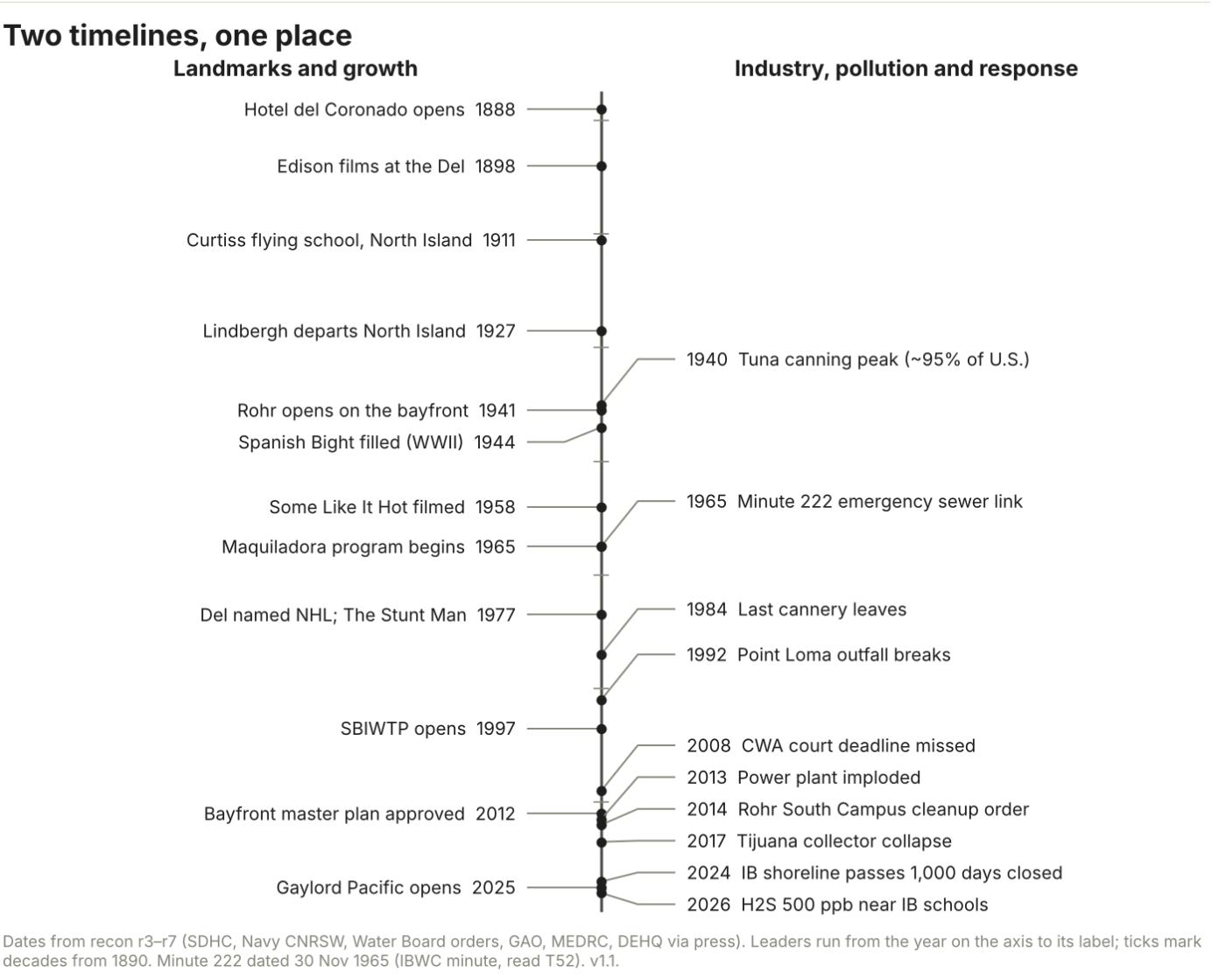


Figure 5. Two timelines, one place. Landmarks and growth on the left; industry, pollution and response on the right.

How the map separates what perception merges

The location desk built this piece the way it builds a map: data first, then judgement.

- **Positions are tiered.** Each of the 41 plotted places carries its source: official coordinates (the City of San Diego's outfall inspection reports), an OpenStreetMap object, or a hand placement drawn as a hollow symbol and logged as approximate [52].
- **The shore is measured.** The closure shoreline on Map 2 was traced from the satellite image, scanning each row from the open sea to the first land, rather than taken from a generalized coastline.
- **Water is drawn over pipes.** Flows sit above the outfalls because the water moves above them, and every flow path is labelled schematic, not model output.
- **Co-location is not cause.** The bayfront's legacy and the ocean's plume lie near each other; nothing here claims one causes the other, and no illness is mapped.
- **Every gap is written down.** Positions still to verify, cleanup boundaries still to overlay and air-monitor sites still to add are listed as open walls at the back, so the next draft can close them.

8 One shoreline, two trajectories

From a distance, all of it is one stain: a closed ocean beach, a century of industry on the bay, a city across the line. The word that carries it is pollution. It is accurate, and it is too large to act on.

On the map it comes apart. The bay's problem is old and fixed in place. Its solvents and metals were left by industries that have gone, and they are being cleaned under state orders, parcel by parcel [33][34]. Beside those parcels a 1,600-room resort opened in May 2025 [42][43]. That trajectory is legible: a legacy, a cleanup, a reuse.

The ocean's problem arrives new each day, with the river's flow and the discharge at Punta Bandera, and it ignores the boundary that every fix must respect. Its trajectory is a schedule: 35 million gallons a day reached in 2025, a larger plant designed, a treaty minute signed [17][18]. Even a schedule kept is not the end. Studies of beaches elsewhere find that fecal bacteria persist longer in sand than in water [54]. No one has published what the sand at Imperial Beach holds, or how long it would take to clear once the flow stops.

Seen from farther away, the separation disappears altogether. In December 2025 the county kept an advisory on the Children's Pool in La Jolla, a harbor-seal rookery [55]. In May 2026 it closed the Campland shore of Mission Bay after its tests flagged contamination, naming no source [56]. The same December week, the shoreline from the border to the end of Imperial Beach's Seacoast Drive was under a sewage advisory [55]. Three places, three causes, many miles apart. And after every heavy rain the county advises people to stay out of the whole coast, from San Onofre to Border Field and both bays, for 72 hours, because of urban runoff [57]. A reader in another state sees one headline: San Diego's beaches are closed again.

What rides on that headline is large. The coast is the region's postcard, the one this essay began with, and visitors spent $14.4 billion in San Diego County in 2025, by the tourism authority's count [53]. The region on both sides of the line holds more than six and a half million people (Figure 3). It financed a $1.35 billion resort on its bay; EPA's 2021 capital estimate for the comprehensive fix was $627 million (Figure 4). Both are nominal and given for scale only. What the closures have cost, in visits, property, health or training, has not been counted, and this report does not guess.

The Hotel del Coronado stands at the northern end of the same closure shoreline (Map 2), and the bayfront that spent decades getting clean sits a peninsula away. Whether repeated headlines change how people see them, and how long a reputation takes to recover once the water does, is not measured either. The people who live along this shore have answered a simpler question. In the county and CDC survey, 95 percent of households said they had smelled sewage in the past month [26].

A closure notice is local; the headline is not. Where do these stories travel, and do they reach the places the region invites people from: the visitors, the students, the young workers recruited on the promise of the coast? Those questions are for a follow-up.

Technical notes

Base imagery and projection

Sentinel-2 cloudless 2016 (EOX IT Services GmbH; contains modified Copernicus Sentinel data 2016; CC BY 4.0) was fetched as zoom-13 Web Mercator tiles through a browser, mosaicked, JPEG-encoded and moved in base64 chunks; each mosaic was reassembled and checked against its SHA-256 hash (T1 44c2befc…, T2 fb871760…). The 2016 layer was chosen for its open licence; it predates the Gaylord Pacific.

Each map frame is resampled from the mosaic to UTM zone 11N (EPSG:32611) by inverse mapping with bilinear interpolation at 10–15 m (30 m for the strip). Graticule ticks sit on the neatline; the grid-north note gives the convergence at the frame centre (+0.06° to +0.09°). Scale error in the frame is below 0.05%.

Opacity: the image is lifted 12–16% toward white and desaturated 15–20%, chosen from a side-by-side trial at the river mouth (lift 0, 0.12, 0.22, 0.35). That is enough for black and red symbols to read without hiding the ground the text refers to.

Focus: in version 1.0, land farther than a set distance from water (about 3 km on Map 1, 4.5 km on Map 2, 1.6 km on Map 3) is faded further, on a 1.2–2 km ramp, so the shore the story is about carries the eye. Water is found from the image itself (blue exceeds red, dark pixels), cleaned of small specks; nothing in the faded land is removed.

Positions and symbols

Each of the 41 plotted places carries a position tier. C: official coordinates (South Bay Ocean Outfall manholes from the City of San Diego's 2022 inspection report). R: an OpenStreetMap object found through Nominatim or Overpass (SBIWTP relation 13577729; Point Loma plant way 558337895; the first-flight-school memorial node 814679473; the Point Loma outfall way 877911189). S: hand-placed from text and drawn hollow. All placements are logged in POSITIONS_v1_1.csv.

Symbols are kept small (4.2–4.6 pt with a thin white ring) so they mark a place without covering it. Shape carries meaning: circles are places; diamonds are sites under a Water Board cleanup order.

Stacking order follows the physical world: image, graticule, underground tunnel, seafloor pipes, boundary, water movement, then symbols and labels. Water is drawn over the outfall pipes because it moves above them.

Labels are numbers placed by a rule-based placer (ranked positions above, below and right of the point; Maplex-style weights; a leader only if no clean fit; a label must sit nearer its own point than any other). Every placement is logged in LABEL_LOG_v1_1.csv; version 1.1 has no label conflicts.

Shoreline tracing

The closure shoreline on Map 2 and the surf-zone path on Map 1 come from the image itself: each image row is scanned from the open sea eastward to the first run of four land pixels. Scanning from the sea side avoids the headland error found in earlier work (K077). The trace is a 10–15 m approximation of the waterline on the image date, not a legal shoreline.

Flows and what they are not

Flow arrows are schematic. The river path follows the valley on the image. The surf-zone path from Punta Bandera follows the traced shore about 450 m offshore and stops at Silver Strand, the farthest point to which Scripps DNA tracing has followed the discharge. None of the arrows is model output.

Charts

One measure per axis; no dual axes. When figures have different denominators (Figure 2) they are shown as separate tiles, not as bars on one scale. Log scales are used where values span orders of magnitude (Figures 4 and 6) and are labelled as such. Colour follows identity: blue for the United States and orange for Mexico, both validated for colour-vision deficiency (protan ΔE 24.7). Text is never coloured by series. Dollar figures are nominal and never summed.

Editorial rules applied

Places, not persons: no residences are mapped; health appears only as published survey results and on-record statements. Exposure is not risk: no illness is mapped and no cause is drawn from co-location. Schedules are reported as schedules, not forecasts. The editor's working hypotheses are kept out of the copy.

Data rights

Layer or data	Source	Licence / terms
Satellite imagery	Sentinel-2 cloudless 2016, EOX IT Services GmbH	CC BY 4.0, attribution on every map
International boundary, coastline (locator)	Natural Earth 10m	Public domain
Place positions	OpenStreetMap contributors via Nominatim and Overpass	ODbL 1.0, attribution on every map
Outfall coordinates	City of San Diego, SBOO and PLOO inspection reports	Public record
Census figures	U.S. Census Bureau; INEGI	Public data
Gallery works consulted	Esri Map Gallery entries (study only)	Not reproduced; concepts adapted and credited in the PA-S1 gallery log

Changes in v1.2

- Section 8 closes with two sentences of open questions on where the headlines travel and whom they reach, introducing the planned follow-up. No new numbers or sources. Maps and figures are unchanged from v1.1 and keep their v1.1 tags.

Changes in v1.1

- New Section 8, 'One shoreline, two trajectories': a closing summary drawn from the essay's own record, with five new sources [53]_[57] and two new open walls (W071, W072).
- Section 7: the 1992 Point Loma break is now placed 'at the northern end of the same shoreline'. It had read as though the break were in the South Bay; the outfall is off Point Loma, on the ocean side (editor's correction).
- Maps 1–3: the locator's red 'C' now sits above its box, beside the A and B labels (editor's suggestion).

Changes from draft 2 to final (v1.0)

- Maps: land away from the water the story is about is faded further (a focus fade), so the subject stands in full colour and the context recedes. Borrowed as a concept from an award-winning gallery map (G34); nothing reproduced.
- Maps: the side legend is grouped under headers (Places, Water, Infrastructure, Boundary), then the numbered places, then the notes; spacing is computed from type size so no block can overlap another.
- Maps: page furniture rebuilt: the title, subtitle and intro sit clear of the map frame; the scale-bar note stays inside the frame; the 'Pacific Ocean' labels sit inside the neatline; the source line sits under the map; empty space below Maps 2 and 3 is trimmed.
- Maps: the map-specific fade distance is stated in each source line; the SBIWTP and Rohr notes are shortened and split so each note carries one fact.
- Figure 5: decade labels that hid event dots (1888, 1992, 2008) are replaced by ticks; every event already carries its year. The figure is shorter so it sits on a page with the sidebar. A stale note saying the Minute 222 date was pending was corrected: the date (30 Nov 1965) was confirmed from the IBWC minute at T52 (W059 closed).
- Report: a by-the-numbers band on the cover; a contents page with page numbers and numbered sections; one pull quote, taken verbatim from the essay; the status, footer and figure notes changed from draft to v1.0.
- No facts changed. The essay text is the draft 2 text Red and Blue reviewed; only the front matter (date, status) differs.

The draft 1 → draft 2 change log is kept in the v1.0 and draft 2 reports.

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Fact-check and QA log

Every load-bearing figure in the essay was re-checked for draft 2 by an independent check that had not seen the text, then reconciled here.

Claim	Verdict	As used in the essay	Source
Visitor spending $14.4B, 2025 (Section 8)	Confirmed	As stated, attributed to the tourism authority	[53]
Fecal bacteria persist longer in sand than water (Section 8)	Confirmed	General finding, stated as studies elsewhere; not measured at IB (W072)	[54]
Children's Pool advisory, Dec 2025; seal rookery	Confirmed	As stated; no sewage cause claimed	[55]
Campland closure, May 2026; no source named	Partly	As stated; secondary relay of county dashboard	[56]
General rain advisory: San Onofre to Border Field, both bays, 72 h, urban runoff	Confirmed	As stated	[57]
Edison films at the Del, 1898	Partly	"Among the first motion pictures made in San Diego"; the filmography opens with them	[1]
Some Like It Hot 1958; *The Stunt Man* 1977–78; NHL 1977	Confirmed	As stated	[2][3]
Dr. Beach No. 1, 2012	Confirmed	As stated	[4]
Lindbergh departure	Corrected	10 May 1927, not 9 May	[6]
Spanish Bight fill	Confirmed	During WWII (finished 1945)	[5]
Tuna 95%; 12,000 jobs	Partly	"An estimated 95 percent"; jobs figure not used	[8]
Minute 222 date	Corrected	30 Nov 1965	[12]
Minute 333 wording	Partly	Quoted phrase removed; date only	[18]
SBIWTP secondary treatment	Partly	Late 2010; consistent compliance from 2013	[16]
SAB/Punta Bandera dominance	Partly	Dominant overall and in the dry season, not "year-round"	[19]
San Antonio de los Buenos design 1,200 L/s	Partly	Attributed to Costa Salvaje via *Zeta*	[21]
CESPT 10 of 16 failing	Partly	"Only 6 of 16 working as designed"	[22]
1,002 consecutive closure days	Partly	"Passed 1,000 days on 3 Sep 2024"	[23]
H2S 500 ppb; 199 purifiers	Confirmed	As stated	[25]
CASPER 189 households; 95% smelled sewage	Confirmed	As stated	[26]
Air bacteria up to 3/4 from sewage	Confirmed	As stated, with the authors' caveat	[24]
SEAL water and illness figures	Confirmed (refined)	"About three in four tests exceeded"; "12 of 265 events moved"; 1,168 cases	[31]
SEAL exposure or antibody study	Not found	Posed as a question for the record	[31]
Rohr TCE, barriers, cost	Partly	All credited to the 2021 North Campus order; barriers on Parcel H-3 (interim)	[34]
MCLs and PCB cleanup level	Confirmed	As stated	[35][36]
South Bay Power Plant 1960–2010	Partly	"About five decades until 2010"; imploded Feb 2013	[38]
Gaylord cost and impact	Partly	$1.35B per the Port; $475M is the mayor's projection	[42][43]
SDCC exhibit space	Partly	"Total exhibit space" 615,701 sq ft	[44]
Mexico $93M	Partly	Remaining Minute 328 pledge, not the total cost	[47]
Lawsuits 2018–2022	Confirmed	Plaintiffs and April 2022 settlement as listed	[48]

Claim	Verdict	As used in the essay	Source
1992 outfall break	Partly	2 Feb 1992; ~188 MGD; no official cause found	[49][50] [51]
Populations 2020	Confirmed	Six jurisdictions, 6,685,981; Mexicali and Rosarito via INEGI as cited	[9][10]
Maquiladora start	Partly	"Mid-1960s"	[11]

Open walls and next steps

What is not yet known or not yet verified, stated so a later edition can close it.

Wall	What is missing	Route
W060	Cleanup-order boundaries overlaid on the Gaylord and bayfront parcels	Water Board GeoTracker case files; Port parcel data
W063	Air-district hydrogen sulfide monitor sites and odour-complaint data	San Diego APCD
W064	Excavated volumes, disposal routes and total remediation spend, Rohr and power plant	GeoTracker; Port records
W065	Whether the Navy monitors exposure or immune response in candidates	Naval Special Warfare public affairs; NHRC
W066	U.S. residents on the Tijuana and Rosarito coast	INEGI microdata; U.S. consulate
W067	Remaining hand-placed positions (river mouth, Punta Bandera, Spanish Bight, Rohr South Campus)	IBWC, CESPT, Navy history, GeoTracker
W068	Newer imagery under an open licence	Landsat/Sentinel-2 scenes; NAIP for the U.S. side
W054	Cause of the 1992 Point Loma outfall failure	City of San Diego engineering archive; 1992 press
W071	What the closures have cost (visits, property, health, training), and whether repeated headlines change how Coronado and the bayfront are seen	Tourism-authority visitor research; county economic studies; media-reach study (planned)
W072	What the sand at Imperial Beach holds, and how long it would take to clear once the flow stops	Sand sampling studies (SCCWRP, Scripps, county)
W056	Mexicali and Rosarito 2020 populations from INEGI's own tables	INEGI Censo 2020

A note from the location desk

When I first walked the Esri gallery I saw finished maps. Going back to the basics for this piece, I saw decisions instead: why a number sits above a point rather than beside it, why a legend counts its cells, why water should sit above a pipe. The first base map taught me that resolution decides what can be seen and that a coastline needs a side to scan from. This one added three lessons. A symbol on imagery should mark a place without hiding it. A ratio to a standard (Figure 6) carries proportion better than a raw number. And an independent fact-check, by an agent that had not seen the draft, corrected nineteen of thirty-three claims, most of them by degrees rather than in substance. That last one is the habit to keep.