The Business Case for Sustainable Infrastructure

CASE STUDIES SERIES

Gold Envision® Award

Clean Beaches Project
Santa Monica, Los Angeles

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Prof. S.N. Pollalis prepared this case study with researchers at The Zofnass Program as the basis for research and class discussion rather than to illustrate either effective or ineffective handling of the design, the construction, or an administrative situation.

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ABSTRACT

The City of Santa Monica faces tangible problems with water resources related to environmental degradation and extreme phenomena, such as beach pollution and drought periods. Both the City and the public are aware that these issues need to be properly managed to avoid consequences to the City's viability – unstable water sourcing, water scarcity, reliance on costly imported water, and health issues for beachgoers – which could lead to declines in tourism, jobs, and the overall economy.

The environmentally sensitive Clean Beaches project, recently completed, addresses water management considering climate change. Furthermore, it fulfills the regulation requirements driven by the Discharge Permit of the Municipal Separate Storm Sewer System (MS4), for fighting the pollution of Santa Monica. The Clean Beaches project includes the construction of a large water storage tank near the Santa Monica Pier and a corresponding stormwater diversion and harvesting system to collect urban runoff, stormwater runoff, and brackish water to be treated at the City's existing Santa Monica Urban Runoff Recycling Facility (SMURRF). The treated water is then available for non-potable use and groundwater injection.

The Clean Beaches project has the following sustainability objectives:

- Protection of fresh water,
- Water self-sufficiency,
- Preservation of the natural environment,
- Ensuring the people's health and safety,
- Safeguarding the economic prosperity of the City based on tourism,
- Minimizing the risks of climate change and providing extreme events management,
- Reducing carbon emissions.

This case focuses on the relationship between the sustainability features of the project and its long-term financial benefits. Initially, it touches upon the major environmental and water sourcing issues of the City, justifying the need for the Clean Beaches project. The project's performance in each Envision category is discussed, highlighting the Envision credits in which it achieved highest results. The financial analysis, apart from savings related to a reduction of water importing and of penalties for a polluted beach, focuses on the mitigation of negative externalities, such as health care costs, environmental damage, negative impacts on tourism and jobs, which also translate into economic benefits. The paper concludes that the sustainability features are central to the project's sound business decision. Furthermore, it highlights the unique public embrace of the project, reflected in the project's partial funding through Measure V, a parcel tax established with a public vote.

PROJECT BACKGROUND

1.1. Santa Monica's Water Supply

Santa Monica is a beachfront town west of Los Angeles with a nice Mediterranean climate (mild winters of 45–65°F and long, warm summers of 60–80°F). Annual rainfall is on average 15 inches, whereas the average rainfall in the continental USA is 32 inches. The low rainfall, combined with the absence of lakes and rivers in the area, does not meet the City's demand for drinking water.

The freshwater issue has been evident since the City was founded in 1875, and especially during the early 1900s when the population boomed as many moved to the west coast. Water from local wells partially addressed the problem but was not enough during drought. In 1913, the first aqueduct system (LA Aqueduct) was built to provide water to Southern California from Owens Valley at Central California. So in the mid 1910s, LA's water supply was delivered via the LA Aqueduct. It was a source of good drinking water for the City and other small cities around LA.[1]

Although the city of Santa Monica was facing major issues with its water supply, they decided to remain independent and purchased several existing small water purveyors such as the Arcadia Water Company and the Venice Water Company, to create its own water supply and administrative agency.

Fig. 1. *California Aqueducts (source: Zach Pollard lecture, Harvard Graduate School of Design, Cambridge, 2019)*

Due to continued development, the City Santa Monica along with 12 other governments formed the Metropolitan District (MWD) in 1928. MWD was originally created to build the Colorado River Aqueduct to supplement the water supplies of the original founding members. In 1972, MWD augmented its supply sources to include deliveries from the State Water Project via the California Aqueduct.[2]

The City of Santa Monica continues to purchase MWD water to supplement its water supply. In 2011, Santa Monica got 51% of its water supply from local wells and 48% bought from MWD. The remaining 1% came mostly from recycling[3].

[1] Zach Pollard " Santa Monica, Striving to reach water self-sufficiency" (lecture, Harvard Graduate School of Design, Cambridge, November 4, 2019)

[2] City of Santa Monica. "2015 Santa Monica Urban Water Management Plan". 2016. Accessed March 30, 2020. https://www.smgov.net/uploadedFiles/Departments/Public_Works/Water/2015_UWMP_Final_June_2016.pdf

[33] City of Santa Monica. "Sustainable Water Management Plan Update". 2018. Accessed March 30, 2020.https://www.smgov.net/uploadedFiles/Departments/Public_Works/Water/SWMP.pdf

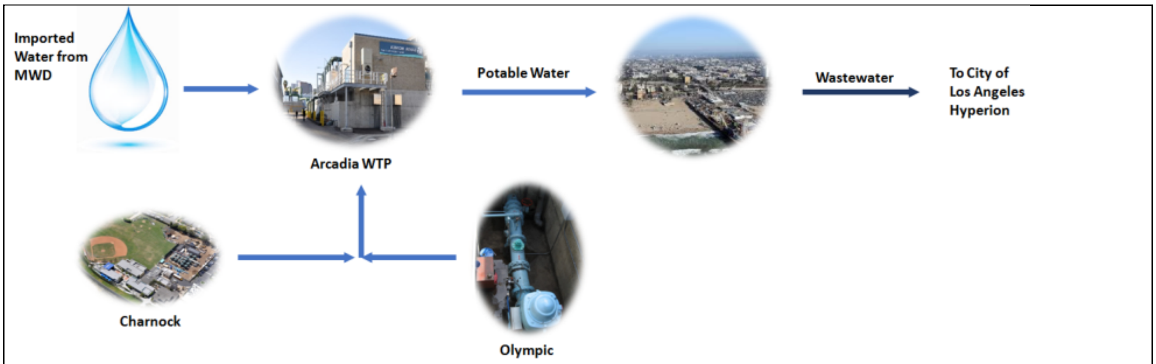

Fig. 1. *Santa Monica's initial Water management System (linear system)*

Santa Monica's water management followed a linear system (Fig. 2). The local groundwater, sourced from the Charnock, Olympic, and Arcadia wells, was treated together with the MWD water in the Arcadia Water Treatment Plant. The fresh (potable) water was directed to the City and the wastewater was transferred to the Waste Treatment Plant in the City of LA.

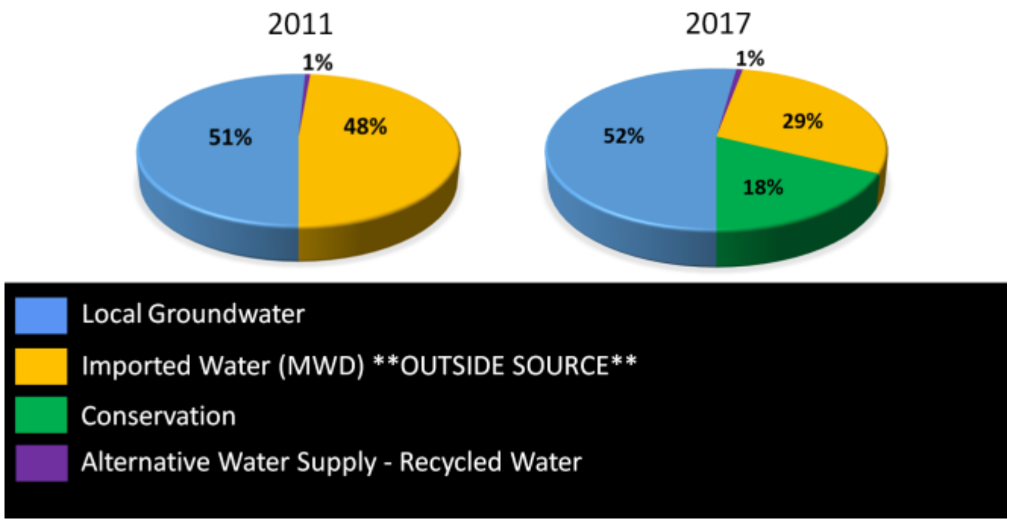

Fig. 2. *: Santa Monica Water Source (source: Zach Pollard lecture, Harvard Graduate School of Design, Cambridge, 2019)*

However, the City was not satisfied because of increasing rates for the wholesale water and the energy-inefficient means of transfer, with few gravity-fed systems. Furthermore, the Colorado River was not a dependable source, with droughts becoming more frequent due to climate change. In 2011–2014, California experienced the driest period in its history. So the City Council decided to achieve water self-sufficiency by:

- establishing a diverse, sustainable, and drought-resilient local water supply,
- reducing the energy footprint of the City's water supply,[4] and
- providing long-term cost benefits for residents.

[4] Santa Monica Public Works, Water Resources. «2019 Water/Wastewater Rate Study» Accessed February 25, 2020. https://www.smgov.net/departments/publicworks/water.aspx

1.2. Santa Monica's Approach to Sustainability

Santa Monica's sustainable attitude was evident in 1992 when the City's Task Force on the Environment proposed a sustainable plan for the City to meet its current needs – environmental, economic and social- without compromising the ability of future residents to meet their own.[5] In 1994, the City Council adopted the Sustainable City Program, which was updated in 2002 with the contribution of community stakeholders. It was also renamed to its current name: "Sustainable City Plan" (SCP). The program sets sustainability goals and strategies for the City government and the community, while progress on relevant targets is based on numeric indicators.

> *"(The SCP) is designed to help us as a community begin to think, plan and act more sustainably – to help us address the root causes of problems rather than the symptoms of those problems, and to provide criteria for evaluating the long-term rather than the short term impacts of our decisions – in short, to help us think about the future when we are making decisions about the present."*[6]

The City's efforts focus on renewable energy, sustainable procurement, green buildings, green public transit, and green businesses. They include retrofitting buildings to meet LEED certification, installing solar arrays, and taking steps to divert waste from landfills. According to the updated SCP of January 14, 2014, "many of the initial targets have been met or exceeded and Santa Monica is now recognized worldwide as a role model for sustainability."

1.3. Santa Monica's Sustainable Water Management Plan

In October 2014, the City adopted the Sustainable Water Management Plan (SWMP), a comprehensive plan toward water self-sufficiency by 2020, which, after further studies, was pushed out to 2023. SWMP combines water demand reduction strategies and the development of local water supplies in three steps:[7]

- **CONSERVATION:** Increasing water conservation efforts to permanently reduce water demand. Water conservation should increase from 18% in 2017 to 20% in 2023. It includes retrofits in both commercial and multifamily units for water conservation.
- **ALTERNATIVE WATER SUPPLY:** Developing sustainable and drought-resilient alternative water supplies. These supplies include captured rainwater and municipal wastewater for non-potable uses.

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5 Cool California. « Sustainable Santa Monica ». Accessed February 28, 2020. https://coolcalifornia.arb.ca.gov/story/sustainable-santa-monica

6 City of Santa Monica. « Sustainable City Plan » 2014. Accessed February 25, 2020. https://www.smgov.net/uploadedFiles/Departments/OSE/Categories/Sustainability/Sustainable-City-Plan.pdf

7 Ibid

- **NEW LOCAL GROUNDWATER:** Expanding local groundwater production within sustainable yield limits. For the locally controlled Charnock, Olympic, and Arcadia wells, additional pumping infrastructure will be introduced. Also, new wells will be drilled.

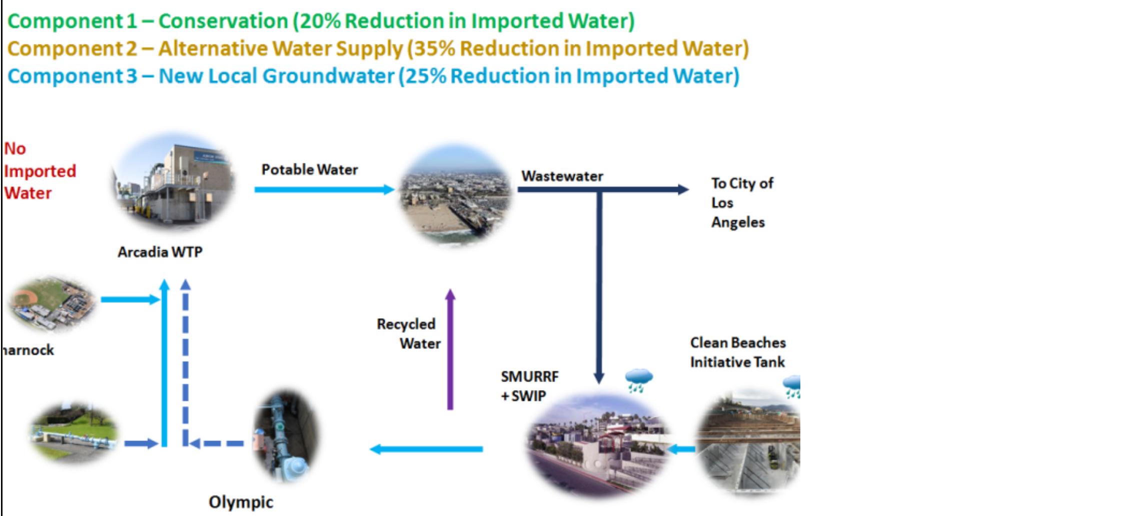

Fig. 3. Santa Monica's new Water System (According to SWMP)

As shown in Fig. 4, the drinking water will be coming from the City's resources and the wastewater will be going to LA. According to SWMP, up to 1.6 Mgal of wastewater per day can be captured and redirected to the Sustainable Water Infrastructure Project (SWIP) for advanced treatment. Stormwater runoff is used as an additional water supply source, diverted to the new underground tank of 1.5 Mgal, constructed at the Civic Center area. . The captured stormwater and wastewater are mixed and treated in the new Advanced Wastewater Treatment Facility (AWTF, part of the SWIP project). The existing Santa Monica Urban Runoff Recycling (SMURRF)h is upgraded with reverse osmosis to treat brackish water collected under the recently completed 1.6 Mgal capacity Clean Beaches stormwater harvesting tank.. All the treated recycled water is then directed to Santa Monica's purple pipe system for non-potable uses, such as irrigation, toilet flushing, etc. Additionally, new injection wells, a part of SWIP, have been constructed to inject the treated water back into the groundwater to replenish Santa Monica's aquifer for future use. It is expected that an extra 1.5 million gallons of treated water per day can be recycled back to the City to make up for the MWD water. Only 1% of water supply would still purposely sourced from MWD in order to keep the option to increase it in case of extreme events by 2023.

The aforementioned sustainable projects (SWIP, SMURFF, Clean Beaches, expansion of the Arcadia Water Treatment Plant) together with conservation measures will make Santa Monica water self-sufficient by 2023.

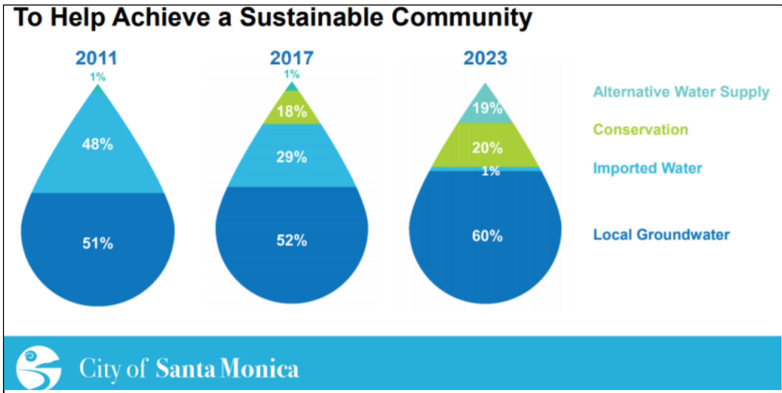

Fig. 4. *Water Supply plan evolution*

1.4. Santa Monica's Policies on Pollution

The City of Santa Monica is a densely populated small beach town along one of the most popular beaches of Santa Monica Bay. The beach is widely accessible from the entire LA County and is considered a main recreational and tourist destination. Responding to this demand, the natural habitat and landscape of Santa Monica have been totally urbanized. Among other consequences,[8] the urbanization has affected the water quality of the beach since stormwater runoff is disposed of in the ocean.[9] According to Curbed LA, "in 2018, for the fifth year in a row, Santa Monica Pier was one of the most contaminated stretches of shoreline in California, in spite of significant efforts by local officials to clean up the water."[10].

Santa Monica's 106-acre downtown watershed, with five major storm water outfalls (Fig. 7), is one of the significant sources of pollutants in LA County. **Pollutants are a problem in both wet weather (rain events) and periods of dry weather (runoff from overirrigation, washing**

[8] "Despite past successes in improving beach water quality, the Santa Monica Pier unfortunately continues to stay on the Beach Bummer list, ranking it No. 5 this year. From 2011 to 2012, Heal the Bay partnered with the City of Santa Monica and the University of California at Los Angeles to conduct a Bacterial Source study. The study results indicated that (1) conditions under the pier (moisture and lack of sunlight) promote bacterial persistence, (2) bird specific bacteria were detected, and (3) human specific bacteria were undetected. The City continues to implement best management practices to improve beach water quality." (Heal the Bay. "Beach Report Card 2015 - 16". 2016. Accessed February 25, 2020. https://www.healthebay.org/sites/default/files/BRC_2016_final.pdf)

[9] "Discharges of polluted urban runoff result in elevated bacteria levels and increased illness rates among swimmers, and the association between heavy precipitation (leading to increased runoff) and waterborne disease outbreaks is well documented. For instance, a 2012 California study investigated surfers' risk of contracting gastrointestinal illness during dry weather and in post-storm conditions in the coastal waters of Southern California based on enterococcus and fecal coliform concentrations in the water. The researchers found that "at most beaches, there are higher GI risks after rainfall than during dry condition[s]" and that "some beaches have significantly elevated health risks for surfers after a storm event…A large-scale 1995 epidemiological study, also in California, investigated possible adverse health effects of swimming in ocean waters contaminated by urban runoff. The study found an increased risk of illness associated with swimming near flowing storm drain outlets in Santa Monica Bay, compared with swimming more than 400 yards away. Swimmers near storm drains were found to have a 57 percent greater incidence of fever, for instance, than those swimming farther away". (Natural Resources Defense Council. "The Impacts of beach pollution". 2014. Accessed February 25, 2020. https://www.nrdc.org/sites/default/files/ttw2014_Impacts_of_Beach_Pollution.pdf

[10] Elijah Chiland "Santa Monica is still the filthiest beach in L.A." Los Angeles Curbed. June 2018. https://la.curbed.com/2018/6/8/17440210/santa-monica-pier-beach-safe-to-swim

of sidewalks, vehicles, business equipment, and draining of pools).[11] These pollutants impact the recreational use of the beach.[12]

Selim Eren, the supervisor of the Clean Beaches project describes the drainage system at the pier watershed: "The prior storm drain system was fairly simple. Few pipes collected the stormwater runoff and sent it to the outfall at the pier, under which there is a 60'' stormwater pipe where everything is discharged into the ocean, at the most visited location by tourists."

Faced with this problem, strict pollution reduction regulations for storm drains were enacted by the Los Angeles Regional Water Quality Control Board, the state agency responsible for protecting the beaches and the Santa Monica Bay from stormwater pollution. To preserve and restore the water quality in the Bay, the City developed an enhanced watershed management plan (EWMP) per the requirements driven by the Municipal Separate Storm Sewer System (MS4)[13] Discharge Permit.[14] The City also developed and implemented regional best management practices (BMPs)[15] for addressing the water quality goals and for reducing the pollutants and the runoff from the built-out urban environment at Santa Monica Bay.

11 Santa Monica Public Works, Civil Engineering. "Why is Measure V needed". Accessed February 25, 2020. "**https://www.smgov.net/Departments/PublicWorks/ContentCivEng.aspx?id=9573**

12 Recreational use of the beach includes swimming, fishing, drinking water, navigability, and wildlife habitats and reproduction (Santa Monica Public Works (2017) City Council Report :Award Construction Contract for Clean Beaches Project (Agenda Item:3H)

13 The Federal Clean Water Act (CWA section 402) requires the issuance of a permit to regulate municipal stormwater discharges, known as the MS4 permit. EPA defines an MS4 as a conveyance or system of conveyances (including roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, man-made channels, or storm drains) owned or operated by a State (40 CFR 122.26(b)(8)). The MS4 permit defines a Total Maximum Daily Load (TMDL) as the maximum amount of a pollutant that a body of water can receive. Established TMDLs for Santa Monica Bay include coliform bacteria, DDT (pesticide), 9 of 18 PCBs (manufactured organic chemicals), and debris. The SWRCB monitors and enforces the MS4 permit compliance.

14 Selim Eren "Protecting the Santa Monica Bay & Beneficial Use of Stormwater: Santa Monica Clean Beaches Project." (Selim Eren lecture, Harvard Graduate School of Design, Cambridge, November 4, 2019)

15 I Best Management Practices (BMPs) are structural water pollution controls installed on individual parcels or in the public right-of-way in order capture, treat, and infiltrate or use rainwater/stormwater for beneficial use. (City of Santa Monica, Office of Sustainability and the Environment. "Urban Runoff, BMP Reporting". Accessed February 26, 2020) https://www.smgov.net/Departments/OSE/Categories/Urban_Runoff/BMP_Reporting.aspx

Fig. 5. Pier watershed within the City of Santa Monica (source: Santa Monica Public Works documents)

To keep the beach water of Santa Monica Pier safe for swimming, the City awarded a Clean Beaches Initiative (CBI) grant to build a regional, multi-benefit project to capture the wet-weather runoff from the sub-watershed of downtown. **In addition, for the purpose of implementing quality improvements in urban runoff water according to the City's Watershed Management Plan of 2006, a property tax raise** was approved by the citizens. The new tax, known as the Clean Beaches and Ocean Parcel Tax or "Measure V," was passed by over two-thirds of voters in the City of Santa Monica.[16]

The Clean Beaches Project will improve the water quality by harvesting and treating stormwater, which was being discharged untreated into Santa Monica Bay. The project will assist the City in its efforts at compliance with the stormwater non-point source discharge requirements set forth in the final amended Municipal Separate Storm Sewer System (MS4) permit. It will also provide a new water source by recycling brackish water and urban runoff after treatment at the SMURFF.

[16] Santa Monica Public Works, Civil Engineering. "Background". 2020. Accessed February 25, 2020. "**https://www.smgov.net/Departments/PublicWorks/ContentCivEng.aspx?id=9573**

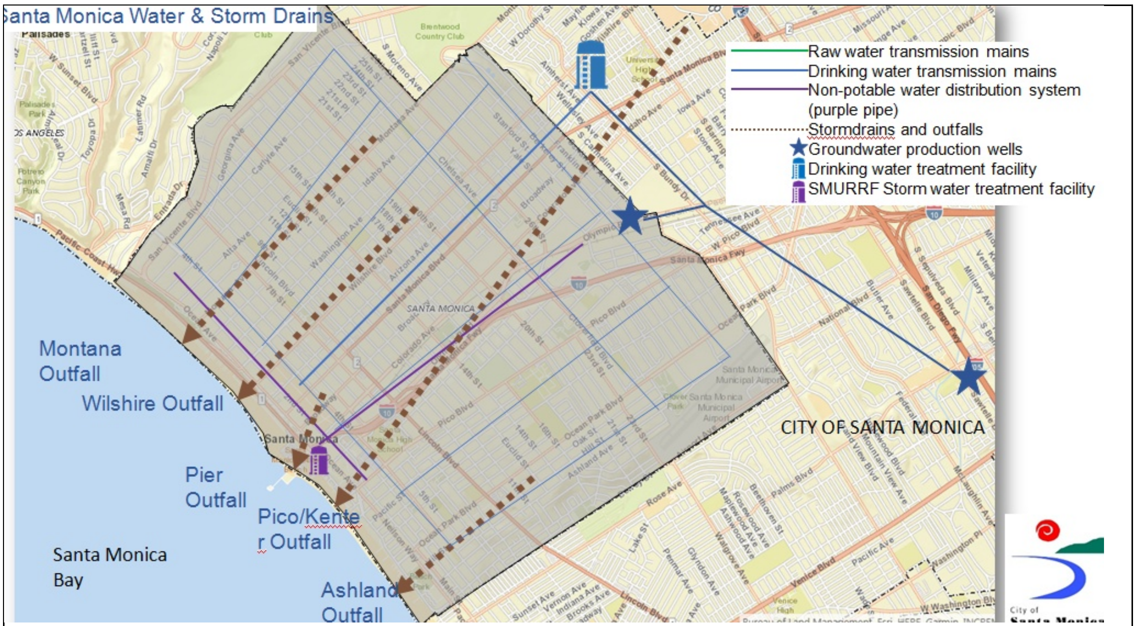

Fig. 6. Santa Monica's water and storm drains (source: Santa Monica Public Works documents)

1.5. Project Scope

The City of Santa Monica made significant efforts in recent decades to eliminate water pollution at its beach by implementing various mitigating measures, such as using netting to limit access under the pier to wild birds, whose droppings combined with the absence of sunlight contribute to bacterial pollution under the pier. But most importantly it has implemented dry-weather diversions to either the sewers or to the existing SMURFF to collect urban runoff for recycling.

The Clean Beaches project is the City's new strategy to complement prior efforts with a harvesting tank that supports SMURFF.[17] Eren describes: "We want to completely eliminate this [wet-weather] charge, which is found to be the most contributing to the bacterial pollution. With the Clean Beaches project this is what we are focusing on: wet-weather flows." The storage facility also aims for drought resiliency by collecting brackish groundwater when stormwater is scarce.[18] According to Eren, "the Clean Beaches project is all about protecting the beaches, preserving the environment, and helping the City use the resources efficiently and thoughtfully."

1.6. Project Location

The diversion structure and pipeline are constructed under Santa Monica Pier, where stormwater from this part of the City is discharged to Santa Monica Bay.

[17] Due to its limited diversion capacity, SMURRF currently captures and treats dry weather runoff, and only a small amount of wet weather runoff. This has resulted in wet-weather bacterial TMDL exceedances near the Santa Monica Pier Outfall. This Project was modeled in and is consistent with, the EWMP for the Pier drainage basin.

[18] Selim Eren "Protecting the Santa Monica Bay & Beneficial Use of Stormwater: Santa Monica Clean Beaches Project." (Selim Eren lecture, Harvard Graduate School of Design, Cambridge, November 4, 2019)

Fig. 1. Project Location

The location of the project's tank is directly related to the area's natural topography. Eren explains that "the lowest point of the watershed is the best place that ensures that the runoff from the entire watershed is captured," and therefore the Clean Beaches harvesting tank is located right by Santa Monica Pier, which is the lowest point of the watershed. The underground cistern was constructed in the undeveloped vacant lot north of the existing Beach Maintenance Yard, known as the "Deauville Site," which is developed into a paved public parking lot as an expansion of the existing Lot 1 North.

1.7. The Components of the Project

Triggered by regulation, a primary objective of the Clean Beaches project is to improve the quality of the beach water. The project also provides a new source of non-potable water as it also harvests brackish groundwater. A set of perforated underground pipes have been installed under the underground tank to capture brackish ground water from the relatively elevated water table during dry weather.

To comply with the MS4 permit's requirements set by Los Angeles Regional Water Quality Control Board (LARWQCB) , the project targets capturing the 85th percentile runoff of a 24-hour storm event on the specific site. The size of the tank was determined using this criterion, which is equivalent to a 1-inch, 24-hour rainfall. A new stormwater drain system is designed to retrofit the existing infrastructure to divert flows to the new tank. A hydrodynamic separator is used for pretreatment.

The stored urban and stormwater runoff with the brackish water is pumped to SMURRF by a new pressurized main line that was built beneath the Appian Way as part of the project.[19] The treated water will be used for non-potable uses and for groundwater injection. Overflows from the tank would be discharged into the sanitary sewer system. According to the website of the City of Santa Monica, the use of this treated water offsets up to 182.5 Mgal of drinking water per year, enough to fill 276 Olympic-size pools.[20]

19 Santa Monica Public Works (2017) City Council Report :Award Construction Contract for Clean Beaches Project (Agenda Item:3H)

20 City of Santa Monica. "Santa Monica Draws Line in the Sand on Water Infrastructure Innovation". 2018. Accessed February 26, 2020. https://www.santamonica.gov/blog/santa-monica-draws-line-in-the-sand-on-water-infrastructure-innovation

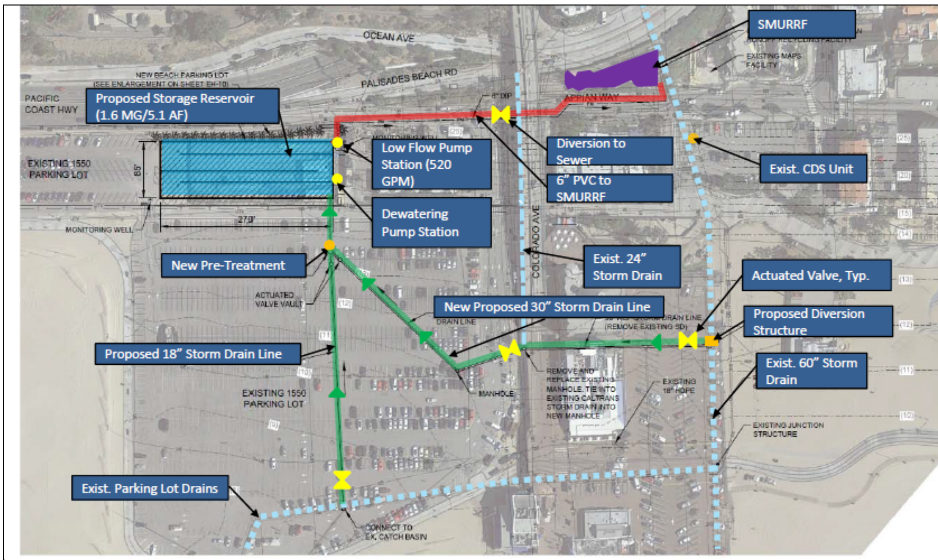

Fig. 2. *Pier strom drain diversion system*

This project incorporates a real-time supervisory control and data acquisition (SCADA) system to further increase performance.[21] Eren adds it is "a system that looks at real-time predictions and weather forecast and switches back and forth between using brackish groundwater versus preparing for the upcoming storm. The primary objective is to capture the stormwater."

Fig. 3. *Project Diagram*
(City of Santa Monica, https://socalwater.org/files/9-sm-castle--sw-management-program_00126.pdf

2. PROJECT DEVELOPMENT

2.1. Project Team and Selection Process

The Clean Beaches project design and construction were undertaken by the Civil Engineering Division of Santa Monica's Public Works (SMCE). It started with a feasibility study by SMCE presenting

21 Selim Eren "Protecting the Santa Monica Bay & Beneficial Use of Stormwater: Santa Monica Clean Beaches Project." (Selim Eren lecture, Harvard Graduate School of Design, Cambridge, November 4, 2019)

alternatives for dry-weather runoff and runoff generated by the 85th percentile, 24-hour storm event within the Pier Watershed. The study was completed in 2014 and presented 5 alternatives. Among the alternatives, the City decided to proceed with the Clean Beaches holding tank and the supporting utilities for the runoff diversion. Selim Eren, the design manager of the project, says the decision was not determined by economic parameters: "It was by far the best alternative considering the lifecycle cost, lifecycle energy, and lifecycle carbon reduction."

On January 14, 2016, SMCE issued an RFP and four engineering consulting firms responded. Following a selection process that included portfolios and interviews, the City awarded the project to Tetra Tech. The use of Envision® from the early stages of the design was a contractual requirement to ensure the sustainability of the project.

Tetra Tech prepared four interim reports for internal peer reviews at the stages of 10%, 30%, 60%, and 100% of the final design. Coordination between the design manager and the project operators was also scheduled to ensure that the design addressed the operational specifications. To reduce the construction costs, value engineering was performed at 30% of the final design. The main decisions were:

- The decision on a gravity-fed system through the underground tank solution versus using pumps for diverting the water into the tank. The value engineering considered long-term benefits, including O&M and energy savings.
- The decision to use precast modular construction that could be produced off-site to reduce construction time and environmental impacts.
- The decision to filter and reuse excavated materials for beach nourishment. Local reuse of the excavated sand would reduce transportation and environmental impacts.[22]

The project delivery method was design-bid-build, so right after the design completion, the required permits, and the availability of the funds, the City selected Reyes Construction, Inc. among five bidders. The selection was based on lowest price, quality of services, and experience with similar projects (Santa Monica Public Works, 2017). The contract for the construction was signed as a lump sum.

The City managed a large part of the project internally. In addition to Selim Eren, the design manager, there was a SMCE employee onsite as construction manager, Zach Pollard. The Water Resources Department is responsible for the operations and maintenance (O&M) of the project.

2.2. Project Schedule

The project was initiated with the feasibility study in 2014, and its construction was completed in August 2018. Construction lasted one year, as planned, from September 2017 to August 2018. According to Eren, "the project does function as conceived and designed, it is really successful."

The project's schedule was largely followed. Nevertheless, there were change orders related to unforeseen site conditions. During excavations, foundations of older structures were discovered on the site but did not cause significant delays. The main project milestones are shown below:

MILESTONES	DATES
Feasibility start	June 16, 2014
Feasibility completed	October 30, 2014
Application for state grant	January 27, 2015
Grant execution	December 28, 2015

[22] "Transporting soils is economically expensive and environmentally damaging. Trucks transporting soils emit greenhouse gases and changing site topography can alter runoff patterns, increasing erosion and damaging down-stream aquatic environments. Depending on the distance of transportation, moving soils may also result in the introduction of alien species to a region." (Source: Institute for Sustainable Infrastructure, "Envision® Sustainable Infrastructure Rating System," accessed April 29, 2013, http://www.sustainableinfrastructure.org/rating/index.cfm.)

Advertise to procure design consultant	January 14, 2016
City Council approval of design consultant contract	April 12, 2016
Design start	May 24, 2016
Bid advertise date	January 24, 2017
City Council approval of construction bid	June 27, 2017
Construction start	September 11, 2017
Construction completion	August 28, 2018
Project closeout	December 31, 2018

There were also financial challenges related to fluctuations of the construction costs, especially when regional prices rose sharply. The project's initial cost estimates were lower than the actual construction bid, so additional funds had to be allocated. Value engineering justified the difference in cost between the initial bid and the final cost estimate prepared by the construction contractor, considering the following parameters:

- The construction duration being limited to approximately 12 months (365 working days), which obligated the contractor to assume additional cost risks,
- The cost associated with construction phasing requirements to reduce construction impact to adjacent businesses,
- Unforeseen significantly high costs specific to the dewatering, shoring, and precast materials,
- Unique conditions of the project site being adjacent to the pier and on the beach, visited by many pedestrians,
- A hot construction market in Los Angeles County.

3. SUSTAINABLE FEATURES OF THE PROJECT

3.1. Leadership's Commitment to Sustainability

One of the most important features of this project is the City's approach to sustainability. The leadership's commitment to sustainability is essential for construction projects not only because it sets clear goals, restrictions, and related funding opportunities, but also because it encourages the engagement of the community. The water system that the City designed and operates as part of the water self-sufficiency target of 2023 is comprised of groundwater basins, treatment facilities, and imported water connections (Santa Monica, 2018). Its forward thinking and interest in local water production have been evident since 2001 when the City built the first urban runoff recycling facility in LA County (SMURFF). The sustainable water system today includes dual plumbing, which is a requirement for new nonresidential developments to comply with the new Zero Net Energy (ZNE) ordinance[23] voted in 2016. The City is the first in California to adopt a ZNE ordinance aiming at energy-efficient, cost-effective developments. According the State Assembly member Richard Bloom, "this ordinance reflects the City's leadership on local policymaking as well as its commitment to doing its part to reduce greenhouse gas emissions and energy consumption."

[23] According to the California Green Building Standards Code (2016), a ZNE building is one where the value of energy produced on-site by renewable energy resources is equal to the value of the energy consumed annually by the building. (City of Santa Monica. "Santa Monica City Council Votes in the World's First Zero Net Energy Building Requirement; Implementation Begins in 2017". 2016. Last accessed February 26, 2020. "https://www.santamonica.gov/press/2016/10/27/santa-monica-city-council-votes-in-the-world-s-first-zero-net-energy-building-requirement-implementation-begins-in-2017)

The City's commitment to sustainability is demonstrated with the Santa Monica Sustainable City Plan, which, according to the Clean Beaches design team,[24] is an example of a sustainability report. It is also evident with the passing of Measure V (Clean Beaches& Ocean Parcel Tax) ordinance to improve water quality. The latter is the result of a systematic and conscious strategy of the City to engage the entire community in sustainability values. The Sustainable City Plan states: "In order to reach our goals, community members must be informed, empowered and motivated. Informing the public is our primary job."

Zack Pollard, Santa Monica's Principal Civil Engineer, says that the City organizes public outreach events during design and construction for all construction projects. He adds that "we have multiple outlets for the public to be engaged along the way," because it is essential for people to be informed, to participate, and eventually to support sustainability decisions. To engage the public, Selim Eren underlines the importance of partnering with NGOs: "we are heavily engaged with the local NGOs. What we say is not as acceptable as when it comes from outside the City staff. So, we partnered with the local businesses; we introduce them and let them be the advocates. This is nothing new. This is part of Envision®."

3.2. The Project's Sustainable Strategies

Consistent with the City's guidelines, the legislative framework and requirements, as well as Envision, the project team's efforts toward sustainability are reflected in the following strategies:[25]

Underground Tank

The decision to place the tank underground, right near the Pier, was an unconventional solution with construction challenges, considering that the tank was similar in size to a football field. The project team was motivated by Envision and placed the tank about 15 feet below the initial ground surface, to use gravity for the runoff directed to the tank. The selection of a gravity system instead of a pumped system reduces energy consumption and lowers greenhouse gas emissions. Additionally, the O&M costs of the underground tank are lower. However, there were risks involved regarding the stability of the tank and buoyancy from the elevated water table, sea level rise, or flooding. Eren describes: "we designed the tank to be completely submerged … and we assumed that it was empty. We considered that when it is empty, it needs to stay in place." The tank was designed to avoid traps and vulnerabilities, according to Envision.

Enhanced Public Space

Apart from the underground harvesting tank and the diversion system, the Clean Beaches project also proposed a public parking lot with 110 additional spaces to reduce congestion at the Pier and provide residents and visitors with improved access to the beach. The new Clean Beaches parking facility is adjacent to Santa Monica Pier. The project site used to be a storage yard, with a negative visual impact. Its conversion to this public parking facility in accordance with the City's Zoning and Municipal Code, which requires the use of efficient lighting, stormwater management techniques, and landscaping, will upgrade the public space and improve the ocean views.

Use of Brackish Water

[24] As stated in Santa Monica Clean Beaches Project Documentation for Envision Assessment

[25] The strategies described have been selected among many sustainable strategies of the Clean Beaches project's design and engineering teams, as the most important to mention for the scope of this case study.

The use of brackish water as a new water source to offset imported water not only contributes to the City's target of minimizing imported water, but also reduces energy use and emissions associated with importing water and therefore contributes in reducing the City's carbon footprint.

Resilience to Extreme Events

Southern California is anticipated to experience longer periods of dry weather, followed by intense winter storms. Both the Sustainable City Plan and the Climate Action Plan address and manage extreme environmental changes. Some of these strategies are proposed for this project, i.e., storage of water, reuse of recycled water, reducing the heat island effect. Use of brackish water is also a sustainable strategy for resiliency to drought. During long dry-weather conditions, it will be the main water source to be treated in SMURFF. Bypasses have also been incorporated to prevent overflooding of the tank during larger storm events. According to Eren, "We put a diversion pump station to be able to switch from pumping into the recycling facility versus sewer. So, when we need to empty the tank, then we basically use our sewer system and put the storm water into the sewers."[26]

Long-Term Monitoring

A long-term monitoring system has been introduced in the Clean Beaches project. It is part of the Coordinated Integrated Monitoring Program (CIMP) of a regional collaboration among the City of LA, the County Flood Control, the City of Santa Monica, and the City of El Segundo. It monitors the water quality throughout Santa Monica Bay and the related watershed. In addition, the real time control systems record and report the amount of water that the infrastructure harvests on a monthly and annual basis. This information is suitable for public engagement to inform people on the amount of water used and treated.

4. ECONOMIC PERFORMANCE

4.1. Project Funding Sources

The project's total cost was $15 million, funded from three sources.

FUNDING SOURCES	
Santa Monica City Clean Beaches and Ocean Parcel Tax Fund (Measure V)	$6.0M
State Water Board, Clean Beaches Initiative Program grant/Prop 40	$3.7M
City water funds	$5.3M

The largest amount ($6 million) was funded by Measure V, which passed in 2006. In the City's website, Measure V is described as "raising property tax revenue to be used solely for the purpose of implementing urban runoff water quality improvements in the City in accordance with the City's Watershed Management Plan adopted in 2006. It is the most equitable source of funding to pay for new urban runoff treatment projects that will prevent

26 Selim Eren "Protecting the Santa Monica Bay & Beneficial Use of Stormwater: Santa Monica Clean Beaches Project." (Selim Eren lecture, Harvard Graduate School of Design, Cambridge, November 4, 2019)

our unhealthful water pollution from reaching Santa Monica beaches and the Santa Monica Bay."[27]

Approximately $3.7 million was funded by the **SWRCB's Clean Beaches Initiative Grant Program.** Following past efforts to keep the water around Santa Monica Pier safe for swimming, the City successfully won a Clean Beaches Initiative (CBI) grant to build a regional, multi-benefit project to capture the wet-weather runoff from the sub-watershed. The remainder of the project is funded by the City Water Funds.[28]

Construction cost	13,953,800
Construction inspection	333,200
Design	755,500
Feasibility	29,900
Administration	106,000
Public outreach	42,000
Total Project Cost	**15,220,400**

4.2. Long-Term Benefits

Return on Investment[29]

The return on investment (ROI) analysis is based on a 30-year lifecycle, taking into consideration:

- the savings from avoided imported water costs when operating SMURRF at full capacity,
- the maintenance and operation costs of the project,
- the sewer fees associated with use of sewer discharges

SUMMARY OF YEAR ONE COSTS and SAVINGS[30]	
Construction cost	($14,856,970)
Annual O&M cost	($100,000)
Annual sewer fee	($56,000)
Savings	$568,108

SUMMARY OF 30 YEARS COSTS and SAVINGS [31]	
Construction cost	($14,856,970)
Present value of cumulative annual O&M cost, escalated at 2% for 30 years*	($2,613,553)

27 Santa Monica Public Works, Civil Engineering. "Background". 2020. Accessed February 25, 2020. "**https://www.smgov.net/Departments/PublicWorks/ContentCivEng.aspx?id=9573**

28 Santa Monica Public Works, Civil Engineering. "Clean Beaches Project for Pier Drainage Basin", 2020. Accessed February 25, 2020. https://www.smgov.net/Departments/PublicWorks/ContentCivEng.aspx?id=54194

29 Santa Monica Public Works (2017) City Council Report :Award Construction Contract for Clean Beaches Project (Agenda Item:3H)

30 Santa Monica Public Works documents provided by Selim Eren

31 Ibid

Present value of annual sewer fee, escalated at 2% for 30 years*	($1,463,590)
Present value of savings from avoided imported water cost, escalated at 7% for 30 years*	$31,249,245
NET PRESENT VALUE for 30 YEARS*	**$12,315,132**

* discount rate 3% annually

Santa Monica's Investment in Water Self-Sufficiency

In a broader perspective, the proposed SWMP represents a considerable investment towards the City's future resiliency and water self-sufficiency by 2023. Santa Monica's development of cost-effective local, sustainable, and drought-resilient water supplies will provide the City's taxpayers with long-term cost benefits and will give the City greater cost certainty on water rates compared to the continued purchase of imported water. SWMP (update 2018) compares the annual average water production cost once water self-sufficiency is achieved versus imported water costs, and points out that "the City and its taxpayers will begin to see a return on its investment to achieve water self-sufficiency in just three years after 2023 when the average local water production cost is estimated to be lower than the imported water cost. This analysis assumes the imported water cost from MWD will increase at an annual rate of 5 percent."[32]

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Table 5. Comparison of Average City Water Production Cost Versus Imported Water Cost Once Water Self-Sufficiency is achieved in 2023

YEAR	AVERAGE CITY WATER PRODUCTION COST (($/AF)	IMPORTED WATER COST ($/AF)	DIFFERENCE
2023	$1,336	$1,248	$88
2024	$1,357	$1,310	$47
2025	$1,378	$1,376	$2
2026	$1,400	$1,445	($45)

4.3. Indirect Avoided Costs

In addition to the savings from the avoided imported water, other economic benefits could be taken into account, such as indirect costs related to tourism and health impacts caused by the beach's pollution. Coastal tourism generates substantial revenues for state and local governments as well as for businesses. According to Santa Monica's Travel and Tourism,[33] the local tourism industry supports about 13,000 jobs.[34],[35] Economists estimate that a typical

32 https://www.smgov.net/uploadedFiles/Departments/Public_Works/Water/SWMP.pdf
33 SMTT is a nonprofit organization that promotes Santa Monica as a travel destination.
34 "Santa Monica 2017 Summary Tourism Economic & Fiscal Impacts, Visitor Profile," https://www.santamonica.com/wp-content/uploads/2018/05/2-Page-Econ-Imp-Summary-2017.pdf).
35 To receive the same level of city services Santa Monica residents currently experience, it is estimated that each Santa Monica household would have to pay an additional $1,379 in property taxes to maintain city services if tourism revenues and the TOT (Tax Our Tourists) did not exist. In 2017, visitors spent a record-breaking $1.96 billion in the city of Santa Monica (source: https://www.santamonica.gov/blog/by-the-numbers-tourism-s-economic-impact-in-santa-monica).

swimming person-day is worth approximately $35 to the City. Depending on the number of potential visitors to a beach, the loss of beach days due to health warnings or closures can be quite significant.[36] Even for areas that choose not to monitor the quality of their beaches or not to close them when water quality drops below standards, there are costs related to medical treatments and lost workdays. According to a Southern California study, every year fecal contamination at Los Angeles and Orange County beaches caused between 627,800 and 1,479,200 excess gastrointestinal illnesses, with a public health cost of $21 to $51 million.[37]

Additionally, avoided costs relate to penalties when facilities do not meet regulations for water quality standards. Santa Monica City's website officially states: ***"Santa Monica may be in violation of the new regulations and subject to $10,000 per day fines without construction of new projects that will be funded by Measure V to reduce storm drain pollution."*** (Santa Monica Public Works, Civil engineering, 2020)[38]

1. OVERALL SANTA MONICA VISITOR ACTIVITY INDICATORS (2017 VS. 2016)

Indicator	2017 Number	2017 % Change	2016
Total Number of Visitors[1]	8,710,468	3.6%	8,408,350
Average Length of Stay (days, all visitors)	1.36	-.7%	1.37
Total Visitor Days	11,852,965	3.2%	11,484,900
Total Annual Visitor Spending	$1.96 billion	5.1%	$1.87 billion
Per-capita Daily Visitor Spending	$166	1.8%	$163
Hotel Tax Revenue to City (from non-local visitors)[2]	$54,353,740	6.7%	$50,938,600
Visitor Retail Sales Tax Revenue to City[2]	$12,176,830	2.5%	$11,883,450
Santa Monica Jobs Supported by Tourism	13,345	.7%	13,256

Source: Lauren Schlau Consulting and CIC Research, Inc. for Santa Monica Travel & Tourism

source: https://www.santamonica.com/wp-content/uploads/2019/05/2-Page-Econ-Imp-Summary-2018.pdf

5. ENVISION RATING

The project used Envision® from the early design stages. It achieved the Envision® Gold award, although, according to Santa Monica's City's expectations, it initially aimed for Platinum. Nevertheless, the Gold award is a high score, obtained for the first time by an infrastructure project in Santa Monica. The project's specific scores in each Envision category are shown in the following table:

Envision Sustainability Rating | Achieving the GOLD Standard	
CREDIT CATEGORY	**VALUE**
Quality of Life	**34%**
Leadership	**47%**

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36 One study estimated economic losses as a result of closing a Lake Michigan beach due to pollution could be as high as $37,030 per day: https://www.nrdc.org/sites/default/files/ttw2014_Impacts_of_Beach_Pollution.pdf)

37 S. Given et al., "Regional Public Health Cost Estimates of Contaminated Coastal Waters: A Case Study of Gastroenteritis at Southern California Beaches," *Environmental Science and Technology* 40, no. 16 (2006): 4851. (Source: https://www.santamonica.com/wp-content/uploads/2019/05/2-Page-Econ-Imp-Summary-2018.pdf.)

38 https://www.smgov.net/Departments/PublicWorks/ContentCivEng.aspx?id=9573

Resource Allocation	**51%**
Natural World	**55%**
Climate and Risk	**43%**

Based on the material submitted to ISI, a brief description of the project's performance for each Envision category is provided in the following paragraphs.

Quality of Life

This is where the project performed lowest (34%), although it achieved the maximum points in QL1.1 *Improve Quality of Life* by explaining how its scope is about improving the quality of life. For QL3.3 *Enhance Public Space*, it also scored the maximum points through the conversion of the existing private storage yard to a public parking lot over the tank with public access. Other than that, the project did not score in QL 3.1 *Preserve Historic and Cultural Resources*, QL2.4 *Improve Community Mobility and Access*, or QL2.1 *Enhance Public Health and Safety.*

Leadership

In this category the project scored 47%, achieving the maximum points in LD1.4 Provide for stakeholder involvement, LD2.2 Improve infrastructure integration, and LD3.1 Plan for long-term monitoring and maintenance. LD2.1 Pursue byproduct synergy opportunities did not score well.

Resource Allocation

In this category the project achieved its second highest score (51%), just below its score in the Natural World category. The credits in which it reached the highest possible scores are: RA1.4 *Use of regional materials*, RA2.1 *Reduce energy consumption*, RA2.3 *Commission and monitor energy systems*, and RA3.1 *Protect freshwater availability*. Regarding the latter, it is quoted in the Envision Score Summary: "In order to minimize the long-term negative net impact on water sources, the project is implementing the use of hydrodynamic separators, underground storage galleries and urban water recycling facilities in order to increase local freshwater resources. This is done by offsetting offsite potable water demand through recycled water uses, this will exceed the potable water demand created on site due to irrigation, providing a net benefit." Also, in this category it is interesting that the project team, through Envision®, addressed the excavated material in a nonconventional manner, responding to RA 1.3 *Use recycled materials* and RA1.6 *Reduce excavated materials taken off site*. Eren states that "*typically you excavate and export the material and that's where Envision® came in; it forced us to look at this material. Can we use it in some beneficial way? We said, we are in the beach, this is all beach sand, so we ended up not trucking, so all the trucking was eliminated and any emissions that came with it. So, we basically filtered and cleaned all the sand and spread it on the beach, we used it as beach nourishment*."

Natural World

This is the category where the project obtained its highest score (55%). However, several credits were not applicable. The high score in NW2.1 *Manage stormwater*, which is the facility's principal objective, contributed to the final high result.

Climate and Risk

Although in this category the project obtained a relatively lower score (43%), it is the category in which according to Eren the Envision methodology reinforced further studies and higher performance than expected. For example, regarding CR2.4 *Prepare for short-term hazards* he mentioned: "*We asked ourselves: What if we cannot recycle the water? We still have to capture all that wet flow storm events, prevent all the pollution. What do we do? So, we put a diversion pump station to be able to switch from pumping into the recycling facility versus sewer. So, when we need to empty the tank, we use our sewer system and put our dirty water into the sewers.*"[39]

The project achieved maximum score in CR 2.1 *Assess climate threat*. The climate threat is for longer periods of dry weather followed by intense winter storms. During these long periods of dry weather, pollutant material will accumulate, causing higher concentrations in dry flows or first flush scenarios. The credit's justification states: "The project's diversion structure and storage galleries will be able to contain and settle those higher pollutant loads in order to protect the City's coastal waters. The galleries will also provide additional sources of irrigation water by recycling water which will save additional drinking water sources for periods of drought. Bypass is built into the system to prevent over flooding of the system during larger storm events."

6. CONCLUDING

The Clean Beaches project was conceived to address two challenges at the City of Santa Monica. To improve the beach water quality, meeting the relevant regulations, and to generate non-potable freshwater from brackish and stormwater. In addition, it enhances resiliency to drought and upgrades the quality of the public space. The project was developed without significant complications and was embraced and supported by the local community. Besides meeting the regulations, the project has had direct impact on people's health and sustaining tourism.

The sustainability-oriented leadership of Santa Monica, the availability of funding and the community support provided the context for the project to thrive.

The success of the project is reflected in environmental, social and economic benefits related to beach water quality upgrades, health risks minimization and tourism promotion.

This infrastructure project, with its sustainability objectively quantified with Envision® and the resulting Envision Gold award, is a sound business decision for the City of Santa Monica. It has long term economic benefits: it avoids penalties, it requires less imported costly, and the beach water quality has an impact on medical costs and the level of tourism.

Design decisions were not solely driven by economics, However, Selim Eren, the project's supervisor, underlines that Envision® contributed in the project's economic performance: "*…and I specifically want to emphasize that when we did the Envision analysis, it (Envision) really gave us the tools to justify costs; a lot more data to prove that this project pays clearly, pays itself*"[40]

The project has been in operation since it was completed in August 2018. Real-time controls embedded in the project provide data for pollutants. Furthermore, apart from its sustainable design and construction, the way it is operated is crucial, both for the environment and the

[39] Selim Eren "Protecting the Santa Monica & Beneficial Use of Stormwater: Santa Monica Clean Beaches Project." (Selim Eren lecture, Harvard Graduate School of Design, Cambridge, November 4, 2019)

[40] Ibid

associated costs. Since the benefits of the Clean Beaches project will solidify in the long-term, audits and optimizations are scheduled to take place regularly.

ABBREVIATIONS

BMPs	Best management practices
EWMP	Enhanced watershed management plan
NGO	Non-governmental organization
MWD	Metropolitan Water District
O&M	Operation and maintenance
SCP	Sustainable City Plan
SMCE	Santa Monica's Public Works
SMURRF	Santa Monica Urban Runoff Recycling Facility
SWIP	Sustainable Water Infrastructure Projects
SWMP	Sustainable Water Management Plan
SWP	State Water Project
SWRCB	State Water Resources Control Board

EXHIBIT 1: PROJECT OVERVIEW

Project Name:	Clean Beaches Project
Project Type:	Storm water and brackish water management, water harvesting and treatment
Location:	Santa Monica, LA
Area / Length:	Downtown – Pier Watershed 106 Acres Drainage area
Capacity:	1.6 Million Gallon (Underground)
Owner / Client :	The City of Santa Monica
Project Team:	Project Management: Santa Monica Public Works (Civil Engineering Division) Supervising Civil Engineer (Santa Monica) : Selim Eren Construction Management: Zach Pollard (Santa Monica) Feasibility: CWE Design and Engineering: Tetra Tech Construction Contractor: Reyes Construction, Inc Project Operator: Santa Monica Public Works (Water Resources Department)
Project Lifespan:	30 years
Current Status:	Operating
Funding model:	- State Water Resources Control Board Clean Beaches Initiative Grant Program - Santa Monica Clean Beaches and Ocean Parcel Tax and - City Water Funds
Delivery Method:	Lump Sum construction contract
Overall investment cost:	$ 15M
Design & Construction cost:	Total construction cost: $14 M Planning-Design and other costs: $1M Total cost: $15M
Year One- Savings	$568,108
Net Present Value of savings for the first 30 years. Discount rate 3%	$12,315,132

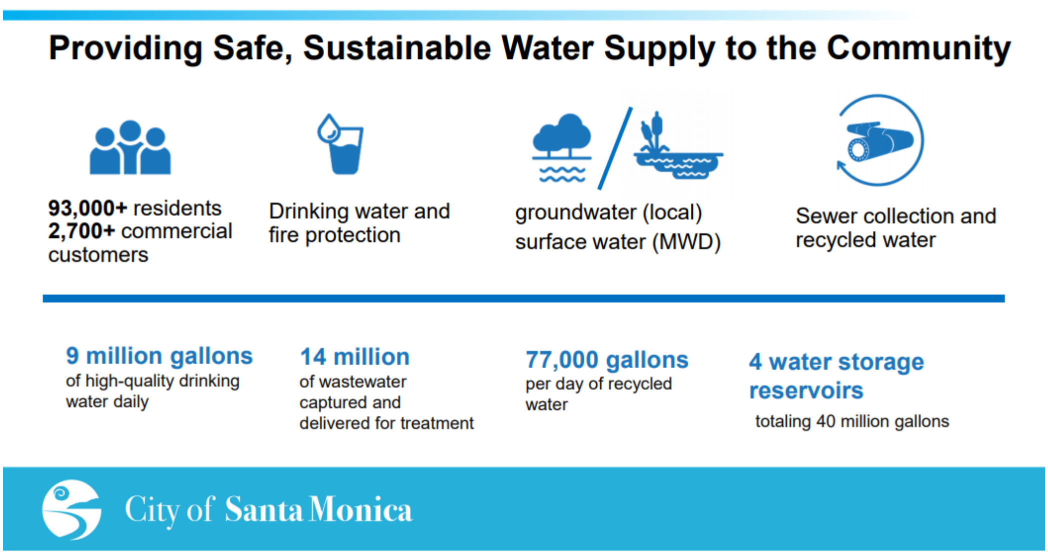
EXHIBIT 2: PROJECTED INVESTMENT COSTS TO ACHIEVE WATER SELF-SUFFICIENCY

PROJECTS	ESTIMATED CAPITAL COST
Arcadia WTP: Expand Capacity and Production Efficiency	$30 Million
Additional Well and Improvements: Increase Resiliency and Groundwater Production	$8 Million
Olympic Wellfield Restoration: New Advanced Water Treatment Facility and Pipeline[1]	$20.5 Million

[1]Funding for the Olympic Wellfield Restoration is from settlement funds received from the responsible party for the contamination. The settlement funds will also be used for annual operation/treatment costs, but is not included in this table.

(City of Santa Monica, "Sustainable Water Master Plan Update", 2018)

EXHIBIT 3: SANTA MONICA'S SUSTAINABLE WATER SUPPLY TO THE COMMUNITY



https://www.smgov.net/uploadedFiles/Departments/Public_Works/Water/2019_Water_Wastewater_Rate_Study_Presentation.pdf,