Feasibility Analysis for Project 2: Expand and Upgrade Tijuana River Diversion System in Mexico and Provide Treatment

Technical Memorandum

USMCA Mitigation of Contaminated Transboundary Flows Project

Prepared for:

United States Environmental Protection Agency
Office of Wastewater Management
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17 September 2021
Final Report

Work Performed Under EPA Contract No. 68HERH19D0033
Task Order No. 53

Version #	Stage	Description of changes	Changes made by	Date completed
1	Initial draft	Deliberative draft; copy editing and formatting	PG	1/14/21
2	Draft	EPA edits and comments on initial draft delivered 1/14/21	EPA	1/29/21
3	Draft	Address EPA comments; further copy editing and formatting	PG	2/23/21
4	Draft	Address EPA comments	PG	3/22/21
5	Final, revised	Address EPA comments; update with revised data; further copy editing and formatting	PG	9/17/21

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ABBREVIATIONS, ACRONYMS, AND SYMBOLS

APTP	Advanced Primary Treatment Plant
BOD_5	biological oxygen demand (five-day period)
CBP	United States Customs and Border Protection
CMDF	cloth media disk filter
EID	Environmental Information Document
EIS	Environmental Impact Statement
EPA	United States Environmental Protection Agency
ERG	Eastern Research Group, Inc.
$gal/ft^2/min$	gallons per square foot per minute
HDPE	High-density polyethylene
ITP	South Bay International Wastewater Treatment Plant
IBWC	International Boundary and Water Commission
$L/m^2/min$	liters per square meter per minute
MGD	million gallons per day
mg/L	milligrams per liter
O&M	operations and maintenance
PB-CILA	CILA Pump Station
PB1-A	Pump Station 1-A
PB1-B	Pump Station 1-B
RWQCB	Regional Water Quality Control Board
SAB	San Antonio de los Buenos
SABTP	San Antonio de los Buenos Wastewater Treatment Plant
SBOO	South Bay Ocean Outfall
TSS	total suspended solids
USACE	United States Army Corps of Engineers
USMCA	United States–Mexico–Canada Agreement
WWTP	wastewater treatment plant

EXECUTIVE SUMMARY

Project 2 involves upgrading the existing Mexico-side river diversion and CILA Pump Station (PB-CILA); constructing a new conveyance system to divert flows from PB-CILA to a new treatment plant on the U.S. side of the border; and constructing a new treatment plant to treat the river water. Project 2 is expected to eliminate the need for Pump Station 1-A (PB1-A), improve water quality in Tijuana River, reduce flows directed to the San Antonio de los Buenos Wastewater Treatment Plant (SABTP), and improve PB-CILA's reliability. PG evaluated both a 35 MGD and 60 MGD size and the feasibility and costs of each project are summarized below:

1. **A conveyance line that runs from PB-CILA across the border to the headworks of the newly constructed treatment plant (sub-project 1).** PG evaluated two conveyance options: 1) rehabilitating the existing 42-inch force main from PB-CILA to PB1-A, as recommended in the Arcadis report, and extending that force main to the new treatment plant, and 2) constructing a new force main from PB-CILA to the new treatment plant. Both alternatives were found to be technically feasible and are expected to effectively convey wastewater flows diverted from the upgraded PB-CILA to the new treatment plant on the U.S. side of the border, but the first alternative would cost less than the second. The estimated capital cost is $11.5 million, and the estimated 40-year life cycle cost is $12.3 million. Force main rehabilitation/extension would also be significantly less socially and environmentally disruptive to the project area than construction of an entirely new force main.

2. **Upgrading the Mexico-side diversion system to divert flows up to 60 MGD and upgrading the conveyance line to convey up to 60 MGD of flows to headworks of the newly constructed treatment plant proposed in sub-project 3 (sub-project 2).** PG evaluated upgrading the existing infrastructure in Mexico to divert up to 60 MGD of river water to the new treatment plant for treatment. These upgrades include expanding the river diversion, expanding the pretreatment system at PB-CILA, installing new pumps at PB-CILA, rehabilitating the existing force main from PB-CILA to PB1-A and extending it to the new treatment plant, and constructing a new 36-inch force main from PB-CILA to the new treatment plant. PG found this sub-project feasible to construct and operate; however, it requires upgrades to every component in the system and construction in dense urban areas. Therefore, a U.S.-side diversion (evaluated in Project 1) may be easier to construct at a 60 MGD size and may provide a larger improvement to water quality in Tijuana River transboundary flows due to more frequent operation. The estimated capital cost to upgrade the diversion and conveyance system to have a capacity of 60 MGD is $45.5 million, and the estimated 40-year life cycle cost is $49.9 million.

3. **A new treatment plant with a capacity of either 35 MGD or 60 MGD to continuously treat diverted river water from PB-CILA (sub-project 3).** PG evaluated constructing a new treatment plant that could treat diverted river water from PB-CILA to produce effluent that satisfies National Pollutant Discharge Elimination System effluent limits for advanced primary treatment during both dry and wet weather. PG evaluated constructing either a 35 MGD plant or a 60 MGD plant to match the proposed diversion sizes. PG determined that a plant at either size is feasible to construct and operate. The estimated capital cost to construct the new, 35 MGD treatment plant is $72.9 million, and the estimated 40-year life cycle cost is $373 million. The estimated capital cost to construct the new, 60 MGD treatment plant is $92.4 million, and the estimated 40-year life cycle cost is $440 million.

The 35 MGD diversion and treatment plant is expected to reduce the total volume of transboundary flows in the Tijuana River by 4–10% and reduce the BOD_5 load in transboundary flows by 27–45%. The reductions in flow and BOD_5 depend upon whether PB-CILA is shut off when the Tijuana River flow rates exceed 35 MGD, or kept operating at Tijuana River flow rates up to 60 MGD. The 60 MGD diversion and treatment plant is expected to reduce the total volume of transboundary flows in the Tijuana River by 14% and reduce the BOD_5 load in transboundary flows by 54%. Both diversion and advanced primary treatment plant sizes are expected to reduce sediment loads in the river by 1%. The 60 MGD diversion could achieve higher total volume and BOD_5 reductions in river flows if the diversion is operated at flow rates higher than 60 MGD. Both the 35 MGD and the 60 MGD diversion and treatment plant are also expected to reduce total volume of flow discharged to the Pacific Ocean via SAB Creek by 47%, which would result in a 27% reduction in the BOD_5 load discharged to the Pacific Ocean via SAB Creek.

Previously, PB-CILA was intentionally shut down during all wet-weather periods when Tijuana River flows exceed 29 MGD to protect the existing pumps from damage, which limited its operation to a 2016–2019 average of 212 days per year. However, the pumps at PB-CILA are currently being upgraded to units that are substantially more resistant to damage from sediment and trash. In addition, a new river water intake system is being implemented in Mexico that provides additional screening and sediment removal ahead of the new pumps. However, it is not known at this time how effective these improvements will be or how Mexico will modify its wet-weather operational strategy for PB-CILA. Finally, the estimated amount of TSS removed by Project 2 is based on limited river sampling data and is subject to change with the acquisition of additional sediment loading data.

Note that more information on background data analyzed and referenced in this document can be found in PG's *Baseline Conditions Summary: Technical Document*, available from EPA.

1. INTRODUCTION

Under EPA Contract No. 68HERH19D0033, Task Order No. 53, PG Environmental conducted a detailed feasibility analysis of 10 proposed projects to mitigate contaminated transboundary flows that cause impacts in the Tijuana River area and neighboring coastal areas in the U.S. Each feasibility analysis considered an estimate of capital costs; an estimate of design, project, and construction management costs; an estimate of operation and maintenance (O&M) costs; an estimate of total life cycle costs; regulatory, engineering, and any possible implementation issues; and social and environmental impacts.

This feasibility analysis specifically addresses Project 2: "Expand and Upgrade Tijuana River Diversion System in Mexico and Provide Treatment." During the analysis, PG consulted with stakeholders and reviewed previous work including the following:

- *Tijuana River Diversion Study: Flow Analysis, Infrastructure Diagnostic and Alternatives Development* (Arcadis 2019).
- *Modeling Impacts of Various Wastewater and Stormwater Flow Scenarios on San Diego South Bay and Tijuana Beaches* (Feddersen et al. 2020).

PG's *Baseline Conditions Summary: Technical Document,* prepared for EPA under the United States–Mexico–Canada Agreement Mitigation of Contaminated Transboundary Flows Project, contains more information on background data analyzed, U.S. and Mexico entities, infrastructure and its operating conditions, water bodies, affected areas, other studies, and reports, and dry- and wet-weather flow conditions referenced in this document.

This report has been revised and finalized from the draft version based on comments and discussions with EPA, on new information presented to PG, and has been updated to include information on upgrading the Mexico-side river diversion system to divert up 60 MGD from the river and convey it to a 60 MGD advanced primary treatment in the U.S. Consistent with the task order scope, PG is working with EPA to develop and analyze several infrastructure alternatives to mitigate the transboundary wastewater and stormwater flows. The alternatives include groupings of one or more projects evaluated in the feasibility analyses, scaled if necessary, and will be presented to EPA in the Water Infrastructure Alternatives Analysis report.

1.1 Project Purpose

The purpose of Project 2 is to eliminate the need for Pump Station 1-A (PB1-A), improve water quality in the Tijuana River, reduce flows directed to the San Antonio de los Buenos Wastewater Treatment Plant (SABTP) and improve CILA Pump Station (PB-CILA) reliability. The PB-CILA on the Mexico side of the border is currently being upgraded to transport up to 35 MGD of diverted river water contaminated with untreated wastewater to either the International Collector or to PB1-A. Project 2 would convey flows from PB-CILA to a new primary treatment plant in the United States and discharge through the South Bay Ocean Outfall (SBOO). PG evaluated the feasibility and cost of conveyance and treatment infrastructure at both a 35 MGD diversion size and a 60 MGD diversion size.

1.2 Current Conditions

This section summarizes the current conditions relevant to Project 2. Refer to the *Baseline Conditions Summary: Technical Document* for a more detailed discussion of the current conditions in the Tijuana River Watershed.

Diverted river water and untreated wastewater collected by the Tijuana wastewater collection system enters the network of pumps shown in Figure 1-1. The diverted river water includes treated effluent from the La Morita WWTP, treated effluent from the Herrera WWTP, untreated wastewater from developed but unsewered areas in the Tijuana metropolitan area, and (during wet weather) stormwater runoff from the Tijuana metropolitan area.

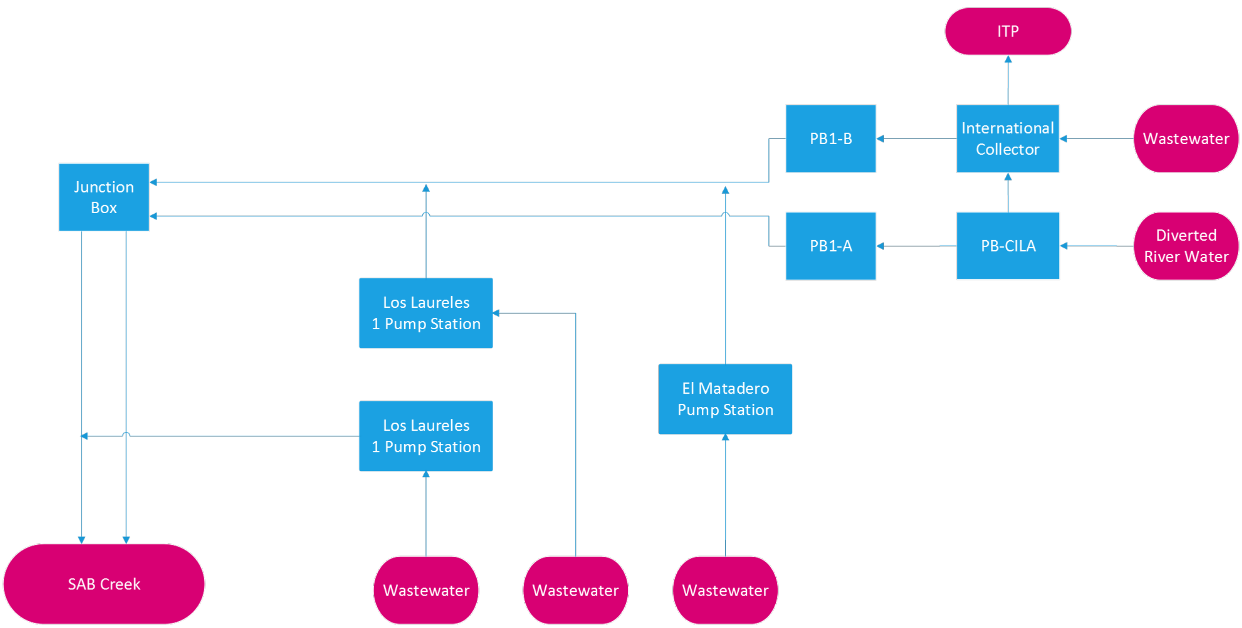


Figure 1-1. Flow Diagram of the Affected Tijuana Pump Station Network

The existing PB-CILA collects up to 23 MGD of diverted river water and discharges it to either PB1-A or the International Collector. PB-CILA currently consists of six pumps, each with a capacity of 11.5 MGD, with three pumps conveying flows to PB1-A and three pumps conveying flows to the International Collector. Under normal operational conditions, PB-CILA conveys all of the diverted river water to PB1-A. However, if the PB-CILA pumps designed to convey flow to PB1-A or the pumps at PB1-A break down, PB-CILA conveys some or all of the flows to the International Collector.

During wet-weather events, the flow rate of the river can greatly exceed 23 MGD, and that flow can contain large volumes of trash and sediment. PB-CILA is currently shut down during wet weather events where flows exceed 29 MGD to protect the pumps from that trash and sediment. According to its operating procedure, PB-CILA remains shut down after a wet weather event until the flow rate of the river falls below 29 MGD, when the trash and sediment levels no longer negatively affect the pumps. The high flows from wet-weather events cause transboundary flows that can reach the Tijuana River Estuary and ultimately reach the Pacific Ocean.

PB-CILA and its intake system are currently being upgraded to increase the pump station's capacity from 23 MGD to 35 MGD and to improve the reliability of the pump station. This ongoing upgrade involves installing four 11.5 MGD chopper pumps, expanding the river intake, installing pretreatment bar screens with a peak a capacity of 45 MGD, and installing vortex sediment removal having a capacity of 50 MGD. The upgraded PB-CILA is anticipated to collect dry-weather flows up to 35 MGD. The current Minute 320 treaty between the U.S. and Mexico (IBWC 2015) does not require Mexico to operate PB-CILA in wet weather.

As shown in Figure 1-1, the discharge from PB-CILA can be routed either to PB1-A or to the International Collector at the discretion of system operators. The diverted river water that is conveyed to the International Collector becomes blended with wastewater from the Tijuana wastewater collection system. An average of 20 MGD to 30 MGD of blended wastewater is conveyed from the International Collector to the South Bay International Wastewater Treatment Plant (ITP). Also as shown in Figure 1-1, wastewater from the International Collector that is not treated at the ITP is conveyed to Pump Station 1-B (PB1-B).

In the normal mode of operation, the discharges from PB1-B and the canyon pump stations (Laureles 1, Laureles 2, and Matadero) are routed to the SABTP and thence via SAB Creek to the Pacific Ocean, described in the Scripps Report as the SAB outfall at Punta Bandera. The discharge from PB1-A is normally routed directly to the Pacific Ocean via SAB Creek without treatment. However, the split of flow routing from PB1-A, PB1-B, and canyon pump stations to SABTB and SAB Creek can be regulated at the junction box shown in Figure 1-1.

The 2020 Scripps report states that untreated and partially treated wastewater discharges emanating from SAB Creek are the dominant sources of Imperial Beach impacts predicted to result in beach closures (Feddersen et al. 2020). The Scripps model estimates that discharges from SAB Creek cause nearly all of the beach impacts predicted to result in beach closures during the dry season and about one-third of beach impacts predicted to result in beach closures during the wet season (Feddersen et al. 2020).

1.3 Major Project Elements Considered

For Project 2, PG evaluated the feasibility of diverting flows from the upgraded PB-CILA to a new treatment plant on the U.S. side of the border. This allows PB1-A to be decommissioned and removes diverted river water flows from the International Collector. The flow diagram of Project 2 is shown in Figure 1-2.

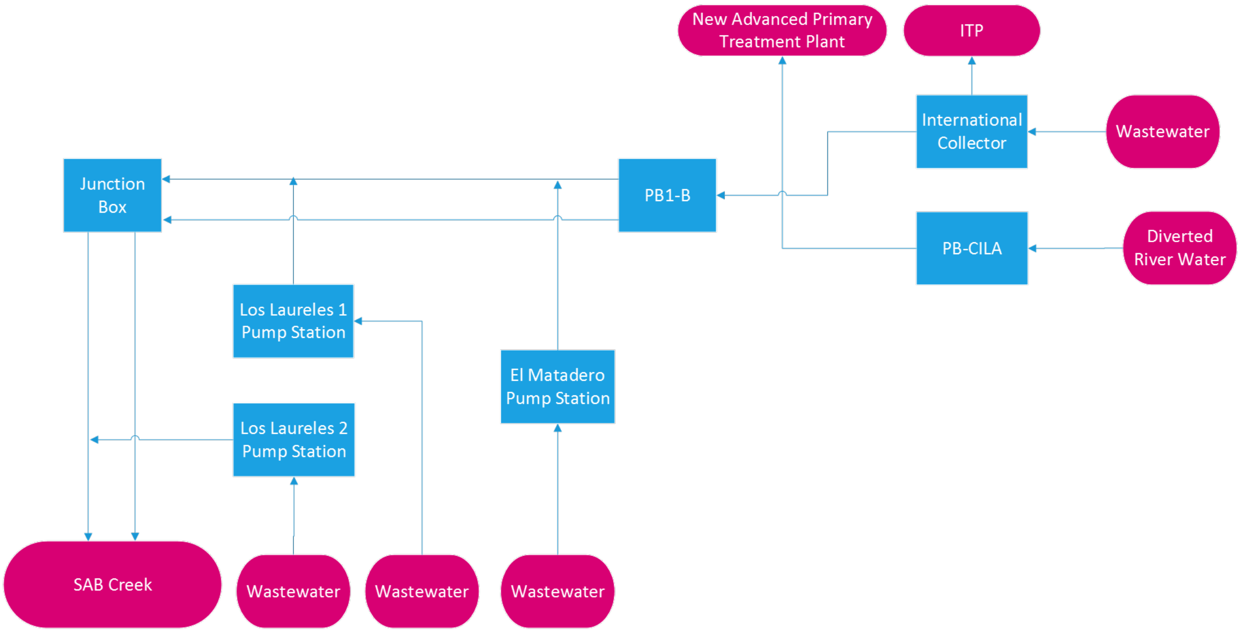


Figure 1-2. Flow Diagram of the Affected Tijuana Pump Station Network (With Project 2 Modifications)

PG evaluated the feasibility of the following three major sub-projects:

1. A conveyance line that runs from PB-CILA across the border to the headworks of the newly constructed treatment plant proposed in sub-project 3. PG evaluated two conveyance options based upon a design capacity of 35 MGD: 1) constructing a new force main from PB-CILA to the new treatment plant, and 2) rehabilitating the existing 42-inch force main from PB-CILA to PB1-A and extending that force main to the new treatment plant, which would direct flows away from PB1-A and allow it to be decommissioned.

2. Upgrading the Mexico-side river diversion and conveyance system to divert river flows up to 60 MGD to the new treatment plant proposed in sub-project 3. These upgrades include expanding the existing river diversion in the channel, installing additional pretreatment equipment, expanding PB-CILA, rehabilitating the existing 42-inch force main from PB-CILA to PB1-A and extending that force main to the new treatment plant, and constructing a new 36-inch force main from PB-CILA to the new treatment plant.

3. A new Advanced Primary Treatment Plant (APTP) to treat diverted river water from PB-CILA. The new plant would be constructed on the U.S. side of the border. PG evaluated two different treatment plant sizes for optimum pollutant removal performances to match the sizes of the conveyance lines, 35 MGD and 60 MGD. Effluent from the new APTP would be discharged through the SBOO. This proposed treatment system has the same treatment plant components as the 35 MGD APTP proposed in Project 1; however, the mode of operation is different. The 35 MGD treatment plant evaluated in Project 1 is intended to operate only when PB-CILA is shut down and river flows are 60 MGD or less; the plant evaluated in Project 2 is intended to operate only when PB-CILA is running. For the 60 MGD APTP, PG assumed that the plant would shutoff at flows greater than 60 MGD.

2. DESIGN INFORMATION

Sections 2.1 and 2.2 provide an overview of design features, engineering issues, and regulatory issues associated with the rehabilitated and extended conveyance line and treatment plant, respectively. Figure 2-1 provides an overview of the locations and known elevations of the proposed conveyance line and treatment plant, relative to the Federal Emergency Management Agency 500-year floodplain. PG designed the conveyance system and the APTP to allow PB-CILA to operate under the three following scenarios:

1. PB-CILA diverts all dry-weather flows up to 35 MGD. PB-CILA shuts off at flow rates greater than 35 MGD and captures no flow above that threshold.

2. PB-CILA diverts all dry-weather flows up to 35 MGD. PB-CILA continues to operate at flow rates up to 60 MGD and divert a 35 MGD portion of wet-weather flows. PB-CILA shuts off at flow rates above 60 MGD and diverts no flow above that threshold.

3. An upgraded diversion, PB-CILA and conveyance system to divert all dry weather flows up to 60 MGD. PB-CILA shuts off at flow rates greater than 60 MGD and captures no flow above that threshold.

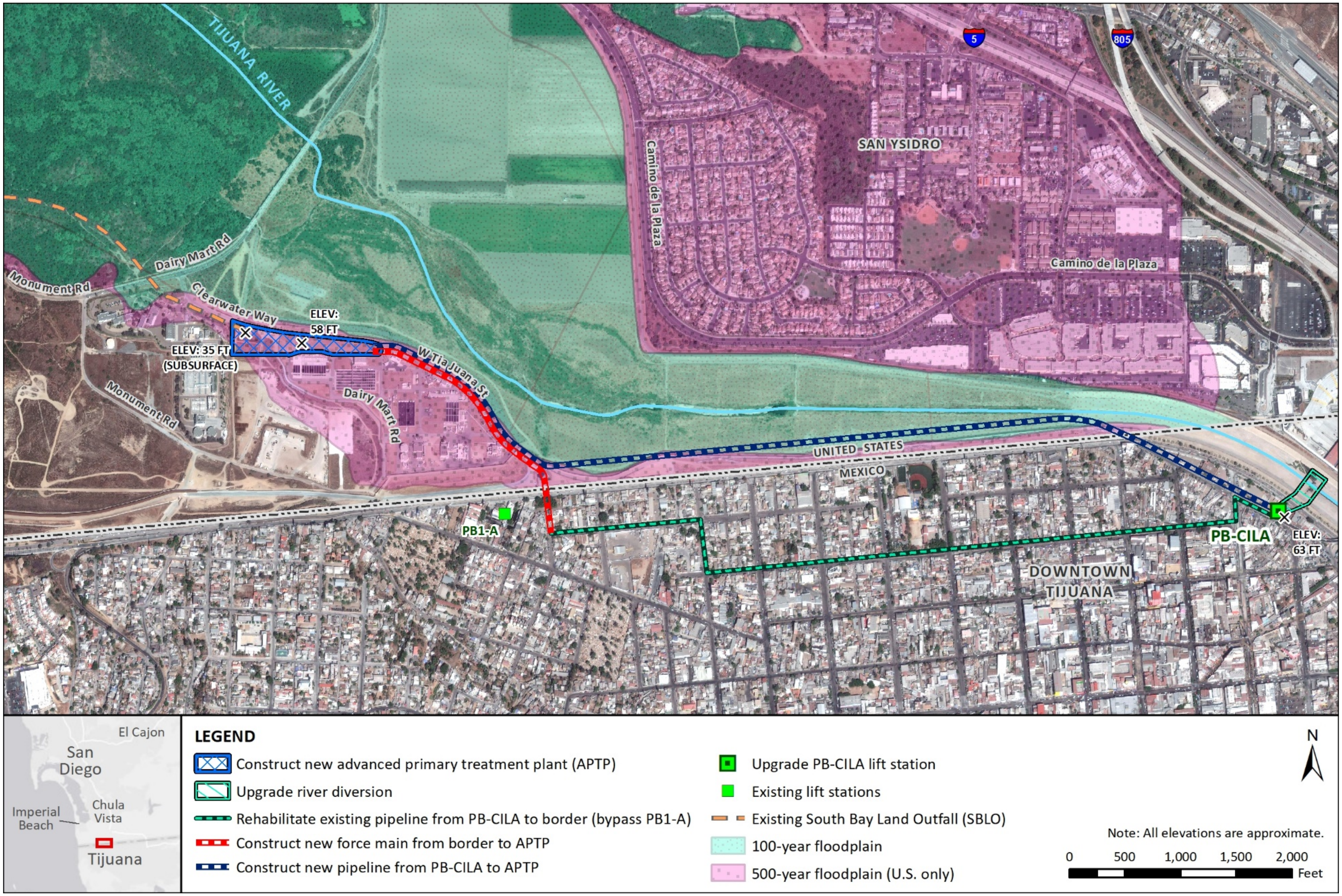


Figure 2-1. Locations and Known Elevations of the Proposed Conveyance Line and Treatment Plant

2.1 Conveyance System to the New Treatment Plant

2.1.1 Design Features: Conveyance Line from PB-CILA to the 35 MGD APTP (Sub-Project 1)

The intent of sub-project 1 is to convey diverted river water from the expanded PB-CILA to a new treatment plant in the northern area of the ITP shown in Figure 2-1. PG evaluated two conveyance designs: 1) rehabilitating the existing 42-inch force main from PB-CILA to PB1-A and extending that force main to the new treatment plant and 2) constructing a new force main from PB-CILA to the new treatment plant.

The rehabilitation and extension design is focused on the 42-inch force main that currently connects PB-CILA to PB1-A (Arcadis 2019). PG determined that the upgraded PB-CILA will likely generate sufficient hydraulic head to convey the 35 MGD design flow through the rehabilitated and extended 42-inch force main to the headworks of the treatment plant.

The section of the existing line that would be rehabilitated runs from PB-CILA to Avenue M in Tijuana and is about 7,300 feet long. Rehabilitation of this line includes installing mechanical joint restraints and applying corrosion protection, consistent with the recommendations presented in the Arcadis report (Arcadis 2019).

The extension part of the first option involves using micro-tunneling to install a new section of 42-inch force main from the PB1-A site and Avenue M in Tijuana to redirect flows north across the border and away from PB1-A. After crossing the border, the new section would turn to the north and follow the ITP property line for about 2,300 feet before reaching the headworks of the new treatment plant. The extended part would be about 3,200 feet in total length and would be constructed at a depth of 10 to 15 feet.

The route of the rehabilitated and extended force main is shown in Figure 2-1.

The new force main design involves constructing a new 42-inch force main from PB-CILA to the headworks of the new treatment plant. The new 42-inch force main would start at PB-CILA and run northwest along Avenue Alberto Aldrete for about 1,800 feet. After crossing under the U.S.-Mexico Border, it would then turn west and run beneath the concrete channel parallel to the border for about 5,000 feet. The line would then turn north and follow the ITP property line for about 2,300 feet before reaching the headworks of the new treatment plant.

After comparing these two conveyance options, PG determined that rehabilitating and extending the existing force main would have a lower capital cost, would be easier to maintain, and would likely be less disruptive to the community during construction than constructing a totally new conveyance force main. Therefore, the remainder of this report addresses only that option.

2.1.2 Design Features: Upgraded River Diversion, PB-CILA, and Conveyance System to Convey 60 MGD of Flows to the New 60 MGD Plant (Sub-Project 2)

Upgraded 60 MGD River Diversion Structure and Gravity Line to the Pretreatment Structure

The recently completed new river diversion in the Tijuana River channel is designed to divert up to 35 MGD of river flows toward the PB-CILA diversion system. The *2019 Arcadis River Diversion and Interceptor Study* (Arcadis 2019) evaluated upgrading the river diversion structure to divert up to 60 MGD. The new design would include a new weir in the river channel, approximately 2.5 feet tall, and new bar racks at the mouth of the gravity conveyance line to remove large pieces of trash from the diverted flows. The new screens would be coarse (0.5 inch to 0.75 inch in bar spacing) and would be mechanically cleaned.

According to information on the upgrades to PB-CILA provided to PG by the Comisión Estatal de Servicios Públicos de Tijuana, flows are currently conveyed to PB-CILA by a 48-inch ductile iron pipe. PG proposes replacing the 48-inch line with a new, 60-inch ductile iron pipe to convey up to 60 MGD of flow to PB-CILA. The new line would be installed in the path of the existing 48-inch diversion line using micro-tunneling (an underground tunnel construction technique) and would be approximately 100 feet in length.

The 35 MGD river diversion structure wouldn't be able to operate while it is being expanded to 60 MGD. PG proposes using the pre-2020 upgrade diversion structure to allow the river to continue to be diverted during construction. Discussions between PG and CILA indicated that the pre-2020 upgrade diversion is being kept operational.

<u>Upgraded Pretreatment System and Gravity Line to the Wet Well of PB-CILA</u>

Once the ongoing upgrades to PB-CILA are complete, the diverted river water will pass through fine trash screens and a 20-foot vortex desander. The fine trash screens have bars spaced such that they are capable of handling flows up to 45 MGD. The new vortex desander is designed to handle flows up to 50 MGD. Both the trash screens and the vortex desander would need to be upgraded to handle up to 60 MGD of flows.

PG proposes installing two new fine bar screens, consistent with the design proposed in the Arcadis report. The new bar screens would be mechanically cleaned, would be 7 feet wide by 5 feet tall, and would have bar spaces of 0.5 inches. PG also proposes installing an additional vortex desander with a capacity of 35 MGD. The trash screens and vortex desander would give the pretreatment system the capacity to handle up to 80 MGD of flows.

<u>Upgrades to the Pumps, Wet Well, and Electrical System at PB-CILA</u>

The current wet well for PB-CILA would need to be expanded to handle up to 60 MGD of flow. PG proposes using the wet well expansion discussed in the Arcadis report to increase the capacity of the PB-CILA wet well (Arcadis 2019).

PB-CILA is expected to have a firm capacity[1] of 55 MGD once the ongoing upgrades are complete. The pumps are expected to have a pumping power of 495 hp when operating at the station's firm capacity. However, the upgraded firm capacity alone isn't sufficient to convey 60 MGD of flows to the new ITP. PG proposes installing two additional chopper-type pumps with capacity of 11.4 MGD and a pumping power of 125 hp. PG also proposes replacing the three 6.8 MGD pumps with new centrifugal pumps with a capacity of 4.6 MGD each and a pumping power of 50 hp. The replacement of the smaller pumps will improve the reliability of PB-CILA and allow the system to efficiently pump flow rates at river flow rates between the 11.4 MGD intervals of the larger pumps.

<u>Rehabilitated and Extended 42-inch Force Main and New 36-inch Force Main</u>

PG evaluated two potential conveyance designs for conveying up to 60 MGD from PB-CILA to the new APTP:

[1] The capacity of a pumping or treatment unit with the largest piece of equipment not operating.

1. Constructing a single new conveyance line from PB-CILA to the APTP.
2. Rehabilitating the existing 42-inch force main from PB-CILA to PB1-A and extending it to the new APTP, along with constructing a new supplemental force main from PB-CILA to the APTP.

PG determined that having two conveyance lines was necessary to maintain a linear velocity in the pipe between 2–8 feet per second across the range of flow rates that are expected to be diverted by the new 60 MGD diversion. Therefore, PG determined that the combination of rehabilitating the existing force main and extending it to the APTP, and constructing a new supplemental force main, is preferrable to constructing a new larger conveyance line from both operational and community impact perspectives.

The design of the rehabilitated and extended 42-inch force main is consistent with the rehabilitated and extended line outlined in Section 2.1.1 for the 35 MGD size. The rehabilitated and extended 42-inch force main would convey diverted river water flows up to 35 MGD. PG proposes constructing a new 36-inch HDPE force main to accommodate flow rates up to 25 MGD, yielding a total transport capacity from PB-CILA to the ITP of 60 MGD. As shown in Figure 2.1, the force main would flow northwest from PB-CILA underneath Avenue Alberto Aldrete and the U.S.-Mexico border, approximately 2,000 feet in length, before turning west. The new force main would continue west and run adjacent to the U.S.-Mexico border and the International Collector for approximately 5,300 feet before turning northwest underneath Stewart's Drain. The force main would run northwest along the perimeter of the ITP for approximately 2,000 feet until reaching the headworks of the new APTP located at the north side of the ITP. The maximum water surface elevation of the headworks of the proposed APTP is 58 feet.

The section of the 36-inch force main underneath Avenue Alberto Aldrete would be installed using micro-tunnelling to avoid open cut trenching under an urban area and to minimize disruptions to border patrol operations. All other sections of the new 36-inch force main would be constructed using conventional open-cut trenching.

The nine pumps at PB-CILA would be configured to allow PB-CILA to pump 60 MGD even if one of the large pumps—a chopper pump—is out of service. The proposed pump configuration allows linear fluid velocities between 2–8 feet per second to be maintained in either force main for the range of expected flow rates.

2.1.3 Engineering Issues

PG evaluated the available hydraulic data on the pumps at PB-CILA to determine whether they could generate sufficient hydraulic head to deliver up to 35 MGD through the existing 42-inch force main if it were rehabilitated and extended to the headworks of the new treatment plant. The current configuration of PB-CILA consists of two 12.5 MGD/125 horsepower pumps, one 9.1 MGD/75 horsepower pump, and three 6.8 MGD/50 horsepower pumps. (These are available capacity ratings and nameplate horsepower values: no field-measurement-based system head analyses are available to confirm the actual discharge capacities of these pumps when operated individually or in tandem. Actual pump outputs and horsepower capabilities may vary and should be verified as part of the ongoing design development process for Project 2.)

Currently, all the pumps at PB-CILA are centrifugal pumps. An upgrade to PB-CILA is underway that includes an additional 11.5 MGD/125 horsepower chopper-type pump and an improved river water intake system with trash screening and vortex sediment removal units. Upon completion, the total rated pumping capacity of the upgraded PB-CILA will be 66 MGD/600 horsepower with all pumps running at their rated capacities and nameplate horsepower. This capacity is substantially greater than the design flow rate of the proposed treatment plant at 35 MGD. However, the large number of pumps and their differences in capacities will allow great flexibility in matching PB-CILA discharge rates to river flow conditions and available capacity at the new APTP.

In its hydraulic and energy demand analyses, PG assumed that one of the 12.5 MGD pumps, the 11.5 MGD chopper pump, and two 6.8 MGD pumps would be used to convey the diverted river water through the rehabilitated and extended 42-inch force main. This combination of pumps would have a firm rated capacity of 37.6 MGD/350 horsepower. The second 12.5 MGD pump at PB-CILA—the highest-capacity pump—was assumed to be out of service due to functionality issues, and the 9.1 MGD pump and third 6.8 MGD pump were assumed to be intentionally offline. Ultimately, pump operational strategies would be determined as part of the ongoing design development process for Project 2. Based upon those final strategies, it may be possible to permanently decommission some of the existing pumps at PB-CILA.

PG evaluated the hydraulic head requirements of the rehabilitated and extended 42-inch force main based on a peak design flow rate of 35 MGD. PG assumed that PB-CILA pumps operate at 70% efficiency. Therefore, the combination of pumps PG has chosen for analysis would have an effective power of about 246 horsepower when operating at rated capacity. PG determined the required pumping power to deliver 35 MGD of river flow from PB-CILA to the new treatment plant is approximately 200 horsepower. Therefore, it is not anticipated that additional changes to the pumping equipment at PB-CILA would be needed, but it may be necessary to modify the existing pump discharge header piping based on the final operating strategy for PB-CILA.

The total energy required to convey flows from the Tijuana River to the new APTP was determined based on the difference between the minimum water surface elevation at the suction intakes of the pumps at PB-CILA and the maximum water surface elevation at the headworks at the new treatment plant at peak flow, plus the hydraulic head required to overcome friction losses and minor losses in the rehabilitated and extended force main. PG estimated that the water surface elevation difference between the PB-CILA pump suction intakes and the new headworks would likely be about 15 feet based on available data. PG estimated the hydraulic head loss in the force main by applying the Darcy-Weisbach equation to the ratio of the total pipe length to pipe diameter and the Moody friction factor. That head loss is expected to be about 8 feet at a flow rate of 35 MGD, which includes a 1.1 multiplier to account for minor losses at valves and fittings. PG determined that the Moody friction factor coefficient for the rehabilitated and extended 42-inch force main is 0.015 based on expected fluid flow properties, force main diameter, and pipe wall roughness.

2.1.4 Implementation and Regulatory Issues

PG assessed the likely implementation timeline for rehabilitating and extending the existing 42-inch force main, including design, regulatory approvals, contract bidding/awarding, and construction. This work is likely to take four to five years from initial authorization to proceed with preliminary design to completion of construction. However, this is likely less time than would be needed to build the new APTP. The new force main itself has minimal O&M funding requirements.

The 42-inch pipeline crossing north of Avenue N requires micro-tunneling for installation without disturbing border facilities. This micro-tunnel would cross under the border fence and then run parallel with it on the U.S. side of the border, as shown in Figure 2-1. The selection of micro-tunneling limits the amount of land that is disturbed by construction, but construction activities must be coordinated with U.S. Customs and Border Protection (CBP) operations to keep disturbance of those operations to a minimum. Micro-tunneling beneath the border would likely require a Presidential Permit.

On the U.S. side of the border, open-cut trenching to install the extended section of the 42-inch force main near the border will necessitate close coordination with CBP for the duration of construction.

2.2 New APTP (Sub-Project 3)

PG developed conceptual configurations of a new APTP that are designed to treat average daily flow rates of 35 MGD and 60 MGD from PB-CILA. This new plant would be located in the northern area of the ITP, shown in Figure 2-1. It would be equipped treat dry- and wet-weather flows, which could allow PB-CILA to operate in wet weather.

2.2.1 Design Features: Flow Characteristics

PG configured the proposed new APTP to process up to 35 MGD of either dry- or wet-weather flow. PG's analysis of transboundary flows between January 1, 2016, and December 31, 2019, as recorded at the International Boundary and Water Commission (IBWC) River Gauge, indicates that the proposed APTP would treat dry-weather flows under 23 MGD an average of 290 days per year. The new treatment facility will also treat wet-weather flows up to 35 MGD an average of 33 days annually if PB-CILA shuts off at flows above 35 MGD.[2] The new APTP could treat 35 MGD of wet-weather flows an additional 30 days per year if PB-CILA remained operating during wet-weather flow rates up to 60 MGD to capture a portion of wet-weather flows. The estimated influent concentrations for both dry and wet-weather flows are presented in Table 2-1. The new 60 MGD APTP would operate an average of approximately 320 days annually and would treat all dry- and wet-weather river flows up to 60 MGD that are diverted at PB-CILA.

PG estimated the annual BOD_5 reductions in the Tijuana River using flow sources data provided by CESPT and water quality monitoring data from IBWC (IBWC 2020). Sediment concentration estimates for wet-weather events are highly variable and not currently well understood. The influent TSS[3] concentration varies based on the flow rate in the river. PG estimated sediment concentrations in transboundary river flows using information on flow sources from CESPT, preliminary correlations derived from wet-weather monitoring data from San Diego State University and Southern California Coastal Water Research Project, and the U.S. Army Corps of Engineers (USACE) *Phase 2 Hydrology, Floodplain and Sediment Transport Study* (USACE 2020) (refer to the *Baseline Conditions Summary: Technical Document* for details).The methodology PG used to estimate sediment concentrations in the river is discussed in the *Baseline Conditions Summary: Technical Document*. More sediment loading data during wet-weather events will be necessary before the final design of the treatment process.

[2] Shutoff threshold flow rates are instantaneous flow rates rather than average daily flow rates. Therefore, implementing the shutoff thresholds will require real-time flow gauging.

[3] Throughout this report TSS refers to total suspended solids, and is used to represent the concentration of sediment suspended in water.

Table 2-1. Anticipated Influent Flow Characteristics for the Proposed Treatment Plant

Parameter	Diverted River Water at Average Daily Flow Rates Under 35 MGD	River Water at Average Daily Flow Rates from 35 MGD to 60 MGD
Average number of days annually	290	33*
Average flow rate during days of operation	23 MGD	35 MGD (35 MGD Plant, 60 MGD shutoff) 47 MGD (60 MGD Plant)
BOD_5 concentration	165 mg/L	67 mg/L to 165 mg/L
TSS concentration	200 mg/L	200 mg/L – 300 mg/L

* Depending on the operational protocol of PB-CILA.

In conjunction with EPA, PG held discussions with the Regional Water Quality Control Board (RWQCB) to determine the potential effluent limits that the new treatment plant might be required to meet. Although the RWQCB has not yet finalized new effluent guidelines, it is anticipated that the new treatment plant would have to provide advanced primary treatment. Table 2-2 shows the anticipated effluent limits for the proposed treatment plant.

Table 2-2. Anticipated Effluent Limits for the Proposed Treatment Plant

Parameter	Anticipated Effluent Guideline
Effluent TSS	60 mg/L for influent TSS < 240 mg/L
Effluent TSS % removal	75% (average) for influent TSS ≥ 240 mg/L
Effluent pH	6.0 to 9.0

To achieve the advanced primary standard, the process treatment train at the new plant is proposed to consist of the following major components: fine trash screens, aerated sediment removal, and ballasted flocculation treatment units. This process plant would be supported by independent screening facilities; sediment dewatering facilities; sediment storage/loading facilities; and sludge management facilities consisting of sludge storage, sludge thickening, sludge dewatering using belt filter presses, sludge conveyors, sludge truck loading, sludge pumping, and final effluent pumping (Figure 2-2). Captured trash, sediment (coarse sediment grains), and sludge would be isolated from one another to allow for selection of the most cost-effective disposal options. A block flow diagram of the proposed APTP process is shown in Figure 2-2.

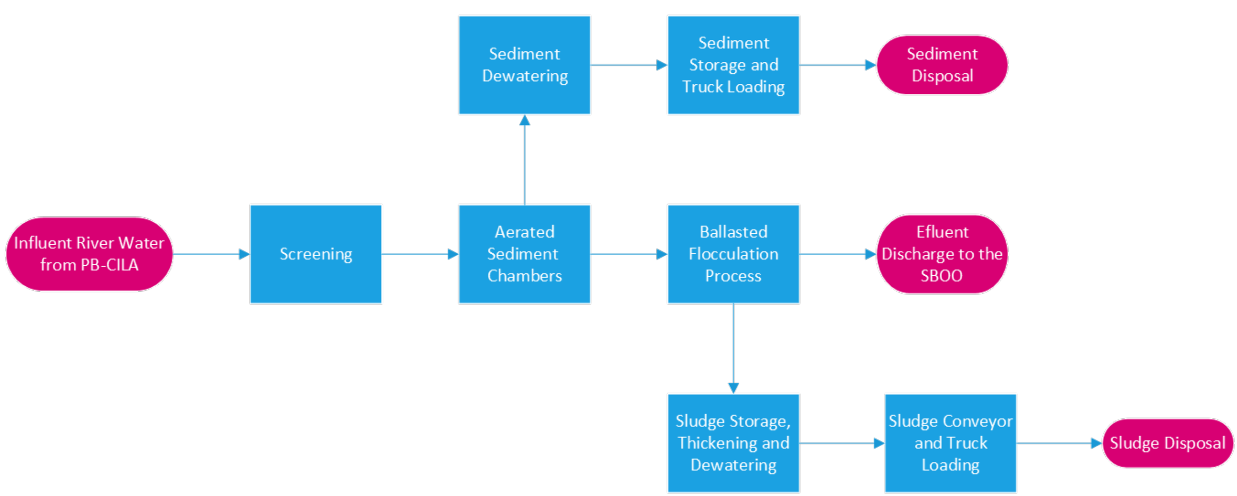


Figure 2-2. Proposed APTP Flow Diagram (Includes Sediment and Sludge Processing)

2.2.2 Design Features: Preliminary Treatment

The influent enters the headworks of the new treatment plant from the PB-CILA conveyance system. Part of the ongoing upgrade to PB-CILA includes the installation of pretreatment trash and sediment removal. However, the ballasted flocculation process is sensitive to trash and sediment. Therefore, additional trash screens and sediment chambers are incorporated into the treatment plant as a redundancy to protect the ballasted flocculation process. Automatically cleaned bar screens (with manually cleaned backup screens) will be used to remove large debris that enters the APTP. Screening removes gross pollutants from the waste stream to protect downstream operations and equipment from damage. The spacing between bars in the mechanically cleaned screens will likely need to be 0.25 to 0.5 inches. Below are the proposed configurations of bar screens for each plant size, developed to create adequate redundancy to maximize service lives and provide backup when individual units need maintenance.

35 MGD Three screens, each with a peak flow capacity of 20 MGD

60 MGD Four screens, each with a peak flow capacity of 25 MGD

Following initial screening of the influent river water, flow will move into the sediment removal stage of treatment. Below are the proposed configurations of aerated sediment removal chambers for each of the peak flow rate options, developed to create adequate redundancy to maximize service lives and provide backup when individual units require maintenance.

35 MGD Two aerated sediment removal chambers, each with a peak flow capacity of 35 MGD

60 MGD Three aerated sediment removal chambers, each with a peak flow capacity of 35 MGD

The high capacity of the sediment chambers allows for the treatment process to function during periods where one of the two chambers is not operating. The new aerated sediment chambers are expected to remove 25% of suspended sediment, even in the event of failure of the pretreatment infrastructure at PB-CILA. PG assumed that the wet sediment (50% dry sediment and 50% water) that is removed has a volume of 1.73 cubic yards per ton. PG estimated the volume of sediment that the grit chambers would produce for each APTP size, as shown in Table 2-3 below.

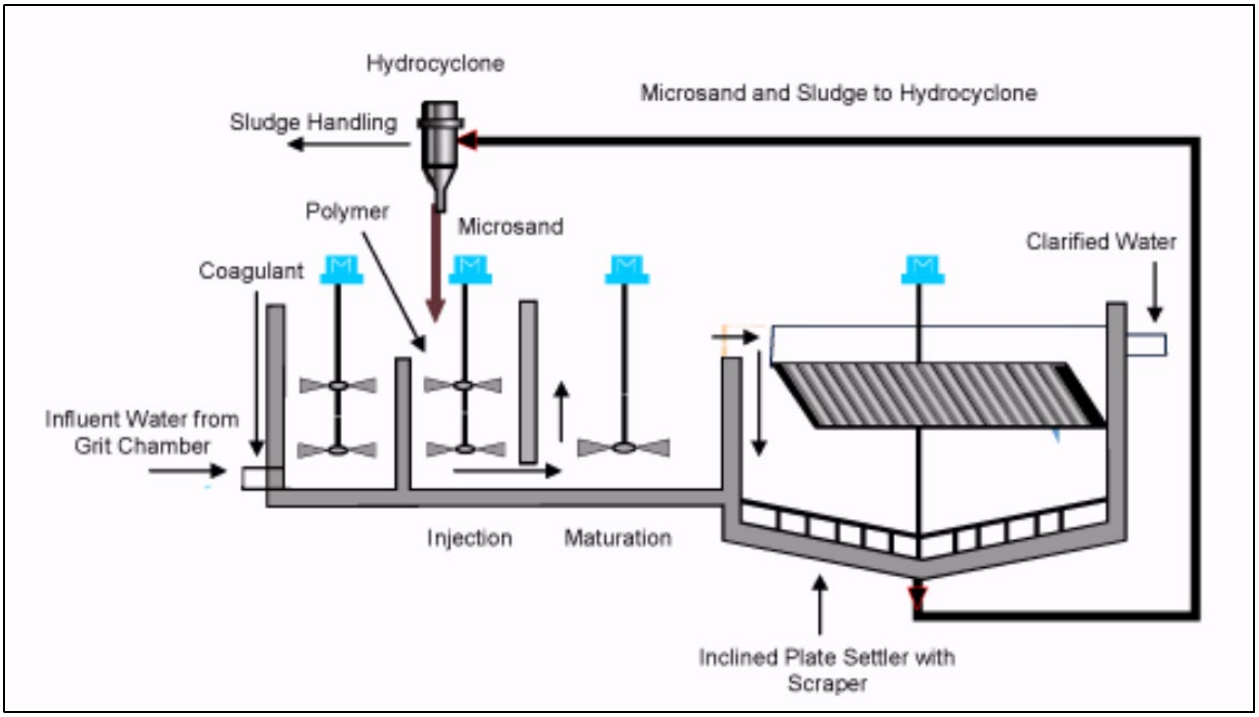
Table 2-3: APTP Sediment Production Rates for each APTP

Parameter	PB-CILA Collecting Flows Up to 35 MGD for Treatment on Dry-Weather Days Only	PB-CILA Collecting Flows Up to 35 MGD for Treatment on All Days When Tijuana River Flows Are 60 MGD or Less	PB-CILA Collecting Flows Up to 60 MGD for Treatment on All Days When Tijuana River Flows Are 60 MGD or Less
Annual number of days of operation	290	320	320
Average influent flow rate (MGD)	21	23	28
Annual influent sediment load (tons)	6,700	7,500	7,800
Annual sediment load removed by the grit chamber (tons)	1,630	1,880	1,950
Annual volume of sediment removed by the grit chamber (cubic yards)	2,820	3,250	3,370

2.2.3 Advanced Primary Treatment (Ballasted Flocculation)

After receiving preliminary treatment (screening and sediment removal), the river water will enter a ballasted flocculation process. Ballasted flocculation is a physical-chemical treatment process that uses continuously recycled media and a variety of additives to improve the settling properties of suspended solids via improved floc bridging. The ballasted flocculation process was chosen because it is less costly than conventional advanced primary sedimentation and has a smaller footprint. Moreover, the process is designed to go online and offline as necessary, which is ideal for the varying flow rates in this design application. Ballasted flocculation is a practicable treatment technology that is used in many wet-weather treatment systems in the U.S.

The three major stages of the ballasted flocculation process are chemical coagulation, flocculation in the presence of micro-sand, and clarification with inclined tube settlers (see Figure 2-7). This technology has been used both within traditional treatment processes and as overflow treatment for peak wet-weather flows. The ballasted flocculation system functions through the addition of a coagulant (usually ferric sulfate), an anionic polymer, and a ballast material (micro-sand or chemically enhanced sludge). When used with chemical addition, this ballast material is effective in reducing coagulation-sedimentation time. For example, ballasted flocculation units have operated with overflow rates of 815 to 3,260 L/m^2/min (20 to 80 gal/ft^2/min) while achieving TSS removal of 75% to 95%.



Source: EPA, "Wastewater Technology Fact Sheet: Ballasted Flocculation" (2003), modified from US Filter Kruger, 2002.

Figure 2-3. Ballasted Flocculation Process Flow Schematic

Surface overflow rates are very high for the ballasted flocculation inclined tube clarifiers, but the clarifiers function effectively because of enhanced floc formation. Thus, ballasted flocculation achieves much faster settling than use of traditional coagulants, yielding high TSS removal efficiencies. PG estimated TSS and BOD removal through the ballasted flocculation process to be

85% and 50%, respectively; BOD removal occurs via removal of colloidal and suspended degradable organic matter. Inclined tube settlers further enhance the settling process by providing a greater surface area over which settling can occur and by reducing settling depth. Ballast from the bottom of the chamber is separated from the sludge and re-introduced into the contact chamber. A hydro-cyclone uses centrifugal force to separate the sludge from the ballast and re-introduces it into the contact chamber. The sludge is processed through the sludge treatment system prior to final disposal.

To determine design parameters and the treatment efficiency of the APTP, PG used information from EPA about the ballasted flocculation process and interviewed a manufacturer's representative. Design parameters that PG considered for the proposed APTP were size (µm) of micro-sand, surface overflow rate (L/m^2/min), reactor detention time (minutes), total retention time (minutes), single-train capacity (MGD), and multiple-train capacity (MGD).

PG proposes using the following configurations of ballasted flocculation treatment trains for each of the peak flow rate options. Each treatment train can be turned down to about 10% of design capacity and has a peak hydraulic capacity of 140%.

35 MGD Two treatment trains, each sized for a design capacity of 25 MGD

60 MGD Three treatment trains, each sized for a design capacity of 25 MGD

2.2.4 Design Features: Sludge Treatment

Sludge will be removed from the ballasted flocculation process after a hydro-cyclone separates the liquid sludge from the micro-sand; the micro-sand is returned to the flocculation chamber for reuse in the liquid treatment process. Compared to sludge generated by a sewage treatment plant, the sludge generated by the APTP will have very low organic content, meaning that the sludge is not suitable for anaerobic digestion. For each flow rate option, sludge production rates are estimated in Table 2.5 below.

Table 2-4: Estimated Annual Sludge Production from the APTP

Parameter	PB-CILA Collecting Flows Up to 35 MGD for Treatment on Dry-Weather Days Only	PB-CILA Collecting Flows Up to 35 MGD for Treatment on All Days When Tijuana River Flows Are 60 MGD or Less	PB-CILA Collecting Flows Up to 60 MGD for Treatment on All Days When Tijuana River Flows Are 60 MGD or Less
Annual number of days of operation	290	320	320
Average influent flow rate (MGD)	21	23	28
Average sludge inflow rate (MGD)	0.17	0.17	0.18
Annual dewatered sludge produced (cubic yards)	19,200	21,500	22,400

Based on conversations with a ballasted flocculation treatment process manufacturer, and the expected influent TSS loadings, PG estimated that the sludge removed from the ballasted flocculation process is expected to be about 2% solids. PG has proposed onsite sludge storage to provide surge capacity prior to sludge processing. Sludge will then undergo gravity thickening to increase solids concentration to about 5%. After thickening, the sludge will be chemically treated to improve dewatering characteristics and will be dewatered with belt filter presses. Belt filter presses can be expected to produce sludge with about 25% solids. The dewatered sludge will discharge to a conveyor that will deposit it into trucks for offsite disposal. For each peak flow rate, PG has proposed the following belt press configurations:

35 MGD	Two 2-meter belt filter presses
60 MGD	Three 2-meter belt filter presses

2.2.5 Design Features: Effluent Discharge to SBOO

Effluent from the ballasted flocculation process will flow by gravity to the SBOO pipeline. To connect to the SBOO pipeline, a new pipeline must be constructed to convey effluent from the APTP to the SBWRP effluent structure (about 300 feet). The new pipeline will be installed via open trench cut and is expected to be confined to the boundaries of the ITP property. For the 35 MGD design option, the pipeline will be 60 inches in diameter. For the 60 MGD and 100 MGD designs, the pipeline will be 72 inches in diameter.

2.2.6 Engineering Issues

PG considered three alternative types of advanced primary treatment processes: chemically enhanced clarification, ballasted flocculation, and cloth media disk filters (CMDFs). Ballasted flocculation and CMDFs offer similar performance to chemically enhanced clarification, including efficient TSS removal, but have lower capital costs and significantly smaller footprints. PG ultimately chose ballasted flocculation because it is a more established technology. The diverted river water will likely contain high TSS loads during wet weather, which can damage cloth media disk filters. CMDFs would need further analysis, including bench testing and/or a pilot study, if chosen instead of ballasted flocculation for Project 2.

Proper operation of a ballasted flocculation process requires greater operator expertise than conventional primary treatment. Particularly with varying flow rates, the addition of ballast must be actively metered to ensure an efficient recycling process and to maintain effluent quality. Also, because of abrasion from the micro-sand, some ballasted flocculation equipment will need to be replaced relatively often, which increases O&M effort and has been accounted for in PG's life cycle cost estimate for Project 2.

For the 35 MGD design, PG has estimated that the APTP will require a staff of about 30 people, including one Grade V certified operator, two Grade IV certified operators, and six Grade III certified operators. For the 60 MGD design, PG has estimated that the APTP will require a staff of about 50 people, including two Grade V certified operators, three Grade IV certified operators, and ten Grade III certified operators. A significant portion of the operations staff will be needed to ensure effective solids handling and removal throughout the year.

During a site visit to the ITP, PG determined that the APTP could be constructed in the north area of the facility in a vacant space originally intended for chlorine contact chambers. As described above, the revised location for the APTP will significantly reduce that amount of piping necessary to construct either Project 2 size. The location in the north area of the ITP is expected to accommodate the APTP at either the 35 MGD or the 60 MGD size.

2.2.7 Implementation and Regulatory Issues

The final project needs to be consistent with current City of San Diego and/or San Diego County zoning and building requirements. All design parameters for the APTP must also satisfy State of California WWTP design criteria. Due to the immediate proximity to the border, all proposed intake and treatment infrastructure likely will also need review and approval from CBP. Border security concerns will also need to be accounted for during construction.

Since the new treatment facility will be subject to a National Pollutant Discharge Elimination System (NPDES) permit, anticipated effluent limitations, monitoring requirements, and other conditions set by the RWQCB must be achieved consistently once the treatment facility is operational. PG noted during the feasibility analysis that the most recent effluent dispersion model for the SBOO was conducted using data from 2002 to 2005 at a discharge rate of 40 MGD. Due to the additional flow rates that Project 2 proposes to discharge through the SBOO, PG conducted an updated flow dispersion model necessary to understand potential impacts to the coast. The results of the model suggest that 60 MGD of advanced primary effluent will not necessitate more stringent effluent limitations to protect the beneficial uses of the receiving water.

Based on information PG has reviewed, including information obtained during a site visit to the ITP, compatibility with existing facilities/operations at the ITP does not appear to pose significant barriers to implementation.

2.3 Sediment and Trash Management Plan

PG estimates that the sediment chambers and ballasted flocculation processes in the new treatment plant would remove 90% of suspended sediment in the diverted river water as either wet sediment or sludge. Both the wet sediment and dewatered sludge are waste products that would be loaded onto trucks and sent to a disposal site. PG used the estimated volume of wet sediment (shown in Table 2-3) and dewatered sludge (shown in Table 2-4) to estimate the annual volume of waste that would require disposal. PG assumed that the average truck used for sediment disposal has a capacity of 16 cubic yards. Table 2-5 shows the estimated volume of waste product that would require disposal and the estimated annual trucking requirements for each APTP size.

Table 2-5. Estimated Sediment Produced from the APTP

Parameter	PB-CILA Collecting Flows Up to 35 MGD for Treatment on Dry-Weather Days Only	PB-CILA Collecting Flows Up to 35 MGD for Treatment on All Days When Tijuana River Flows Are 60 MGD or Less	PB-CILA Collecting Flows Up to 60 MGD for Treatment on All Days When Tijuana River Flows Are 60 MGD or Less
Annual number of days of operation	290	320	320
Annual volume of wet sediment produced (cubic yards)	2,900	3,240	3,370
Annual volume of dewatered sludge produced (cubic yards)	19,200	21,500	22,400
Total volume waste product for disposal (cubic yards)	22,100	24,700	25,800

Parameter	PB-CILA Collecting Flows Up to 35 MGD for Treatment on Dry-Weather Days Only	PB-CILA Collecting Flows Up to 35 MGD for Treatment on All Days When Tijuana River Flows Are 60 MGD or Less	PB-CILA Collecting Flows Up to 60 MGD for Treatment on All Days When Tijuana River Flows Are 60 MGD or Less
Annual number of truck trips needed sediment disposal	1,380	1,540	1,610
Average daily number of truck trips needed for sediment disposal	4	4	4

The volume of sediment captured during the treatment process, particularly if operated during wet weather, it likely to likely necessitate onsite sediment storage and loading facilities. For the purposes of this feasibility analysis, PG assumed that the sediment (and dewatered sludge from the APTP) will be sent to the Miramar Landfill for disposal for a total cost of about $100 per ton. The 2020 *Feasibility Study for Sediment Basins Tijuana River International Border to Dairy Mart Road Final Feasibility Report* identified the Miramar Landfill or Nelson Sloan Quarry as the two most feasible alternative disposal options for sediment collected from the Tijuana River on the U.S. side of the border (Stantec 2020).

The 2016 *Nelson Sloan Management and Operations Plan and Cost Analysis* developed by AECOM evaluated the feasibility of using sediment from the Tijuana River or the canyons to fill and restore the Nelson Sloan Quarry (AECOM 2016). The report analyzed three total volumes of sediment disposal: 100,000 cubic yards, 1,000,000 cubic yards, and 2,000,000 cubic yards. Sediment processing would be required to separate trash from the sediment that is used to fill the quarry. Additionally, a grading permit would likely be required to use the sediment to fill the quarry. AECOM estimates that the total cost per cubic yard for transporting and disposing of the excavated sediment at the 100,000-cubic-yard, 1,000,000-cubic-yard, and 2,000,000-cubic-yard tiers is $40.23, $23.09, and $19.74, respectively (AECOM 2016). All three disposal costs represent significant savings compared to disposing of the sediment at the SABTP or Miramar Landfill. Therefore, disposing of sediment at the Nelson Sloan Quarry should be further evaluated before implementation of Project 2.

The mechanical bar screens at the river diversion and APTP would remove trash from the diverted river water, particularly during wet-weather operation. The collected trash is proposed to be hauled by truck to the Miramar Landfill for disposal. The disposal cost of the trash is estimated at $30 per ton (Stantec 2020).

3. PROJECT IMPACT

3.1 Water Quality Impacts

PG used transboundary flow data, monthly pump data, and flow/mass balances to estimate the effects of Project 2 on both transboundary flows and discharges at SAB Creek. As discussed in Section 1.2, both sources have water quality impacts to the Pacific Ocean. PG evaluated the water quality impacts of Project 2 under both PB-CILA operational scenarios presented in Section 2. PG used BOD_5 as the surrogate parameter to evaluate the presence of untreated wastewater in the primary areas of interest. PG used BOD_5 because it is readily measurable, BOD_5 data are already available for untreated wastewater in Tijuana, and the non-wastewater flows in the river generally have very low BOD_5 concentrations due to being primarily treated effluent from the Arturo Herrera and La Morita WWTPs, and flows from the tributary Alamar River.

For impacts on transboundary flows, PG estimated the reduction in the days of flow and total volume of flow based on IBWC Gauge data from January 1, 2016, through December 31, 2019—before PB-CILA was upgraded. PG estimated the reduction of BOD_5 and TSS using the influent water quality values discussed in Section 2.2.1. PG evaluated the impacts of both PB-CILA diverting all flows up to 35 MGD and shutting off at higher flow rates; and PB-CILA collecting all flows under 35 MGD and collecting 35 MGD of flows between 35 MGD and 60 MGD. All three scenarios are compared to the pre-upgrade conditions in Table 3-1.

Table 3-1. Project 2 Impacts on Transboundary Flows in the Tijuana River

Parameter of Transboundary Flows in the Tijuana River	Current Conditions[4]	35 MGD, shutoff at 35 MGD	35 MGD, shutoff at 60 MGD	60 MGD, shutoff at 60 MGD
Flow days (days/year)	153	73	73	46
Percent change	*N/A*	*-53%*	*-53%*	*-70%*
Flow volume (million gallons/year)	17,500	16,700	15,800	15,500
Percent change	*N/A*	*-4%*	*-10%*	*-12%*
BOD_5 load (tons/year)	1,670	1,210	871	762
Percent change	*N/A*	*-27%*	*-48%*	*-54%*
TSS (sediment) load (tons/year)	187,000	186,000	186,000	185,000
Percent change	*N/A*	*-<1%*	*-<1%*	*1%*

PG also evaluated the relationship between the effects of increasing the maximum flow rate PB-CILA operates at (shutoff flow rate) and the estimated percentage reduction in the annual BOD_5 load in transboundary flows. For the 35 MGD diversion and treatment plant, the effects of increasing the shutoff flow rate of PB-CILA on the percentage reduction in BOD_5 load in transboundary flows is shown in Figure 3-1.

[4] "Current conditions" are based on data from January 1, 2016, through December 31, 2019, and therefore do not reflect the upgrades to PB-CILA that commenced in 2020.

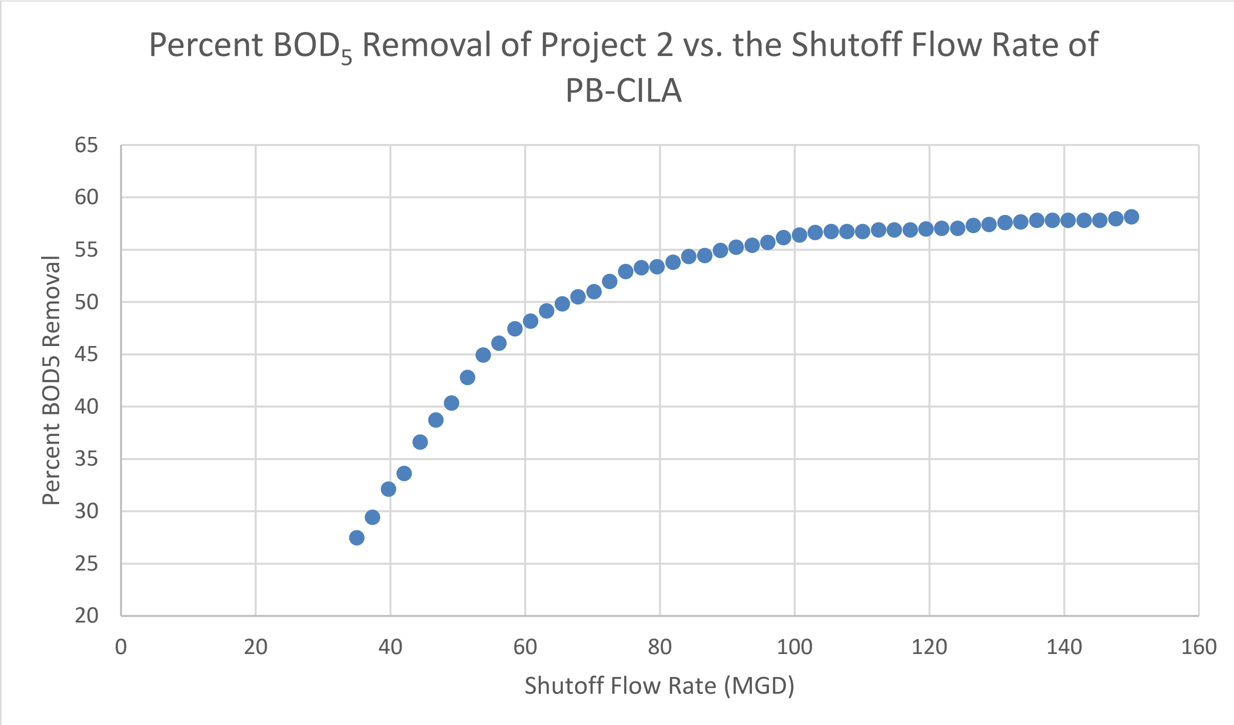


Figure 3-1. Plot Showing the Estimated Percent Reduction in Annual BOD_5 Load as the Shutoff Flow Rate of PB-CILA Increases (35 MGD Diversion)

Figure 3-1 shows that increasing the flow rate that PB-CILA can operate at significantly affects the percentage of BOD_5 that is removed from the river. Figure 3-1 indicates that the maximum percentage of annual BOD_5 load that PB-CILA would remove is about 58%, assuming year-round operation. As presented in Table 3-1, operating PB-CILA at flows up to 60 MGD is estimated to reduce BOD_5 loads in transboundary flows by 45%. This is significantly higher than the 27% reduction in BOD_5 flows that is provided by operating PB-CILA only at flows under 35 MGD. The 55% reduction in BOD_5 load provided by operating PB-CILA up to 60 MGD approaches the estimated maximum reduction in BOD_5 load of 58% reduction in the annual BOD_5 while avoiding the very high sediment disposal and pumping costs associated with treating river water at peak flow days.

For the 60 MGD diversion and treatment plant, the effects of increasing the shutoff flow rate of PB-CILA on the percentage reduction in BOD_5 load in transboundary flows is shown in Figure 3-2.

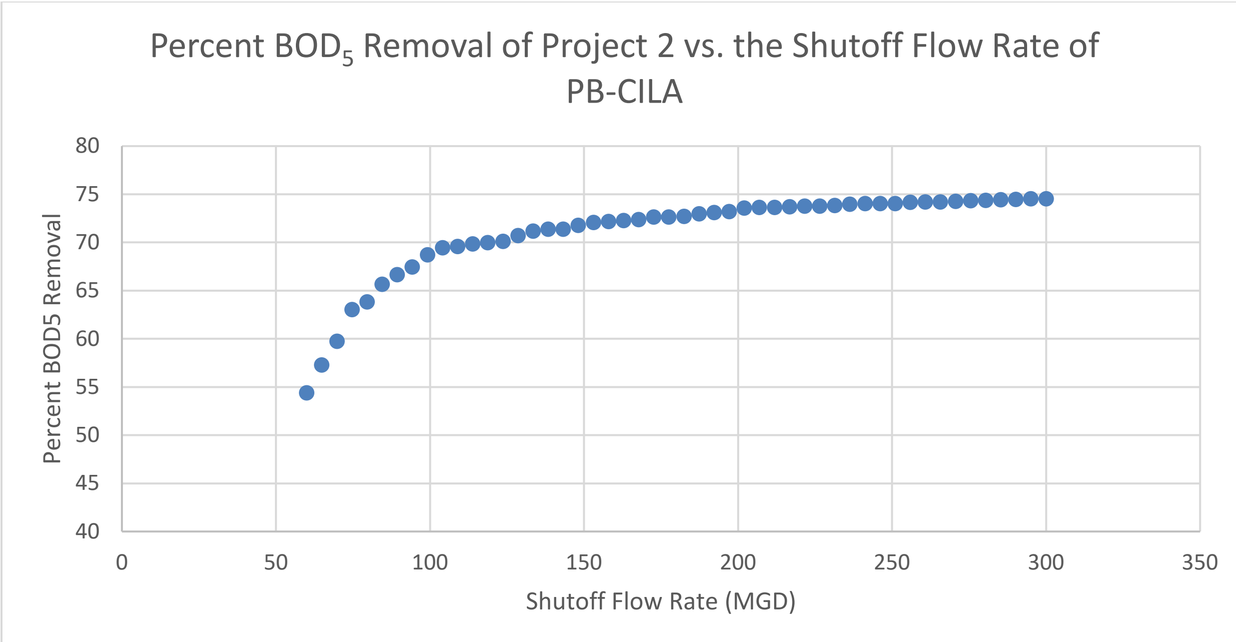


Figure 3-2. Plot Showing the Estimated Percent Reduction in Annual BOD_5 Load as the Shutoff Flow Rate of PB-CILA Increases (60 MGD Diversion)

Figure 3-2 shows that increasing the shutoff increases the percent reduction in BOD_5 load in transboundary flows for the 60 MGD plant, although not to the extent of the 35 MGD diversion. Figure 3-2 indicates that the maximum percentage of annual BOD_5 load that PB-CILA would remove is about 75%, assuming year-round operation. This is significantly higher than the 54% reduction in BOD_5 load that is provided by operating PB-CILA only at flows under 60 MGD.

Additionally, the redirection of the discharge from PB-CILA to the U.S. for treatment and decommissioning of PB1-A reduces the total volume of diverted river water conveyed to SAB Creek and ultimately discharged to the Pacific Ocean. PG estimated the reduction in flows sent to the Pacific Ocean via SAB Creek by comparing the estimated flow rates under current conditions to future flow rates following redirection of the PB-CILA discharge. PG estimated the discharges from the SAB Creek using flow data from PB-CILA, PB1-A, PB1-B, El Matadero Pump Station, and Playas Pump Station for January 1, 2016, through December 31, 2019, and flow balances. PG assumed that the Los Laureles pump stations contributed about 1.8 MGD of wastewater to the discharges to the Pacific Ocean via SAB Creek. The flow rate from the International Collector to ITP was assumed to remain constant at 23 MGD. Based on the Arcadis report, PG assumed that 2 MGD of flows came from sources other than the International Collector. The reduction in total flows from SAB Creek to the Pacific Ocean due to the redirection of PB-CILA discharges is shown in Table 3-2.

In addition to reducing total volume of flow to the Pacific Ocean via SAB Creek, redirecting the discharge from PB-CILA to new U.S.-side treatment facilities reduces the flow rate of untreated and partially treated wastewater that is discharged to the Pacific Ocean via SAB Creek. Both the 35 MGD diversion and the 60 MGD diversion allow PB1-A to be decommissioned and remove river water from the International Collector. PG compared the total BOD_5 and TSS loads discharged to SAB Creek under current conditions to the BOD_5 and TSS loads that would be discharged to SAB Creek after redirection of PB-CILA discharges to the new U.S.-side treatment plant. The discharges from SAB Creek for these before-and-after scenarios were estimated using mass balances and the flow rates that were calculated for the total discharge estimates. PG assumed that PB-CILA pumped only dry-weather flows during the timeframe when the flow data were collected; therefore, PG applied the dry-weather BOD_5 and TSS concentrations outlined in Section 2.2.1 to the diverted river water. PG assumed that the dry-weather flows from the Tijuana wastewater collection system and the canyon collectors were 100% untreated wastewater. The BOD_5 and TSS loads that are discharged to the Pacific Ocean via SAB Creek before and after redirection of PB-CILA discharges are presented in Table 3-2.

Table 3-2. Project 2 Impacts on Discharges to the Pacific Ocean via SAB Creek

Parameter of Discharges to the Pacific Ocean via SAB Creek	Current Conditions	Flows from PB-CILA are Redirected to a U.S.-Side Treatment Plant
Total annual flow (million gallons/year)	13,100	6,600
Percent change	N/A	-50%
BOD_5 load (tons/year)	17,200	11,000
Percent change	N/A	-36%
TSS (sediment) load (tons/year)	17,900	11,000
Percent change	N/A	-39%

As shown in Table 3-2, implementing Project 2 reduces the total annual flow discharges to the Pacific Ocean via SAB Creek by 50% and the total annual BOD_5 load by about 36%. PG estimates that the project would reduce the untreated wastewater discharges to SAB Creek from an average flow rate of 28 MGD to an average flow rate of 18 MGD. Scripps Institute of Oceanography estimated that reducing untreated wastewater discharges from SAB Creek to an average of 10 MGD and eliminating transboundary flows below 35 MGD would reduce the frequency of beach impacts predicted to result in beach closures at Imperial Beach from an average of 14% of the time to 7% time. The Scripps report also estimated that reducing the untreated wastewater discharges from SAB Creek to an average of 10 MGD would reduce regional impacts predicted to result in beach closures during the dry tourist season (May 22 through September 8) from an average of 24% of the time to an average of 9% of the time (Feddersen et al. 2020). Although Project 2 alone does not reduce untreated wastewater discharges at SAB Creek to less than 10 MGD, the results from the Scripps report indicate that the reduction in untreated wastewater discharges to SAB Creek caused by the implementation of Project 2 is likely to have a positive impact on the water quality at the beaches and Naval facilities in San Diego County, including the Navy SEALs training facility in Coronado, California. Additionally, Project 2 combined with other improvements could bring the average untreated wastewater discharges below 10 MGD.

3.2 Sediment Impacts

The implementation of Project 2 is not expected to significantly reduce the amount of sediment that is deposited in the estuary or transported to the ocean by transboundary flows. As presented in Table 3-1, PG estimates that all three of the Project 2 scenarios reduce the average annual sediment load in transboundary flows by less than 1%. These results are supported by the 2020 USACE *Phase 2 Hydrology, Floodplain and Sediment Transport Study* (USACE 2020), which suggests flows from extreme storm events greater than the average two-year storm have a more significant impact than less extreme events that occur more frequently.

3.3 Trash Impacts

The implementation of Project 2 is not expected to significantly reduce trash loads during wet-weather flow days that enter the estuary.

3.4 Non-Water-Quality Environmental Impacts

In conjunction with the feasibility assessments, ERG is currently preparing an Environmental Information Document (EID) that will describe the potential environmental impacts of the 10 proposed projects (including Project 2), focusing on impacts in the U.S. or caused by activities in the U.S. According to available information, Project 2 is not expected to trigger any non-water-quality environmental impacts of concern.[5] The EID, and subsequent Environmental Impact Statement (EIS), will include a more thorough evaluation of potential non-water-quality impacts in the U.S.

3.5 Social Impacts

Under Project 2, long-term positive socioeconomic impacts to affected populations (e.g., reduced public health risk and increased economic activity in coastal areas) are expected to outweigh the short-term, negative, localized impacts during construction (e.g., temporary increase in noise, equipment/dust emissions, and traffic) and long-term operation of the new APTP (e.g., increase in truck traffic and sludge disposal). The EID, and subsequent EIS, will include a more thorough evaluation of potential socioeconomic impacts in the U.S.

Project 2 would reduce contaminated transboundary flows near border infrastructure where the Tijuana River crosses into the U.S. However, it would not resolve existing impacts to CBP operations and workforce resulting from exposure to contaminated transboundary flows near border infrastructure in Goat Canyon or Smuggler's Gulch.

[5] ERG considered the following "impacts of concern" to be indicators of potentially significant environmental impacts that warrant detailed review during preparation of the EID, the subsequent National Environmental Policy Act process, and related consultations and resource-specific studies: disproportionate, adverse effects on minority and/or low-income communities; potential for adverse effects on federally listed threatened or endangered species or their critical habitat; adverse effects on tribal/cultural resources; adverse effects on important natural resource areas such as wetlands, floodplains, coastal zones, and significant fish or wildlife habitat; modification, diversion, and/or alteration of the main course of the Tijuana River; criteria pollutant emissions that exceed Clean Air Act General Conformity Rule *de minimis* thresholds; and significant public controversy about a potential environmental impact.

4. COST IMPACT ANALYSIS

PG developed comparative project construction cost estimates for Project 2 to a Class V level of accuracy in accordance with AACE International's recommended practice No. 17R-97 (AACE International 2020). According to this system, Class V estimate accuracy can range from +40%/ -20% to as high as +200%/-100%. Based on the information that was reviewed, the estimated accuracy goal for construction in the U.S. is +50%/-25%, meaning actual construction costs may range from 50% higher than the estimated cost to 25% lower. Because there are fewer sources of cost data for construction in Mexico, the estimated accuracy goal for construction in Mexico was +100%/-50%, meaning actual construction costs may range from 100% higher than the estimated cost to 50% lower. More details on this methodology can be found in the *Baseline Conditions Summary: Technical Document.*

The sum of project construction cost plus equipment/material cost was multiplied by 1.4 to account for project engineering and owner administration costs. That total was multiplied by a general contingency factor of 1.5 to account for unanticipated construction, unknown subsoils, and other factors. Therefore, project capital cost equals the sum of project construction cost and equipment/material cost × 1.4 × 1.5, which is equivalent to the sum of project construction cost and equipment/material cost × 2.1. For project construction cost data, PG used manufacturers' cost information, EPA Cost Curves and adjustments for a 2020 *Engineering News-Record* (ENR) construction cost index of 11,455.

PG's cost analysis of the proposed diversion systems conveyance systems, force mains and the APTP was prepared based on information from the following sources:

- The 2019 Tijuana River Diversion Study from Arcadis. (Arcadis 2019)
- R.S. Means Heavy Construction Cost Data 2020. (RS Means, 2020)
- Pumping cost curves (Turton, 2012)
- EPA cost curves (U.S. EPA, 2012)
- Previous contractor bids
- CAPDET software
- Manufacturers' cost information
- EPA cost curves

PG used previous feasibility studies by Stantec and HDR, manufacturers' information, and EPA cost curves to develop O&M costs. An interest rate of 3% and an inflation factor of 2% annually were applied to calculate the life cycle cost for each sub-project over a 40-year lifespan. PG estimated O&M cost and 40-year life cycle cost of operating PB-CILA at flows up 35 MGD. O&M costs would increase if PB-CILA were operated during higher flow events to capture a portion of wet-weather flows as discussed in Section 3-1. The cost estimates for both the 35 MGD 60 MGD diversion represent the net change in O&M costs for the conveyance system, and do not include current O&M costs for PB-CILA. Therefore, the current O&M expenses for PB-CILA are not included in the cost estimate.

Tables 4-1 through 4-4 summarize the capital, O&M and life cycle costs that were estimated for each sub-project. An itemized cost impact analysis for each project is provided in Appendix A.

Table 4-1. Cost of Rehabilitating and Extending the Existing Conveyance Force Main

Category	Item	Estimated Cost
Capital costs	Equipment/material costs	$1,360,000
	Construction costs	$4,090,000
	Indirect costs (engineering, project administration, general contingency)	$6,000,000
	Total capital cost	**$11,500,000**
O&M	Maintenance	$22,500
	Annual O&M costs	**$22,500**
Life cycle factors	Interest rate	3%
	Inflation rate	2%
	Total life cycle used	40 years
Total 40-year life cycle cost		**$12,300,000**

Table 4-2 Upgrading the Existing Mexico-Side River Diversion and Conveyance System to 60 MGD

Category	Item	Estimated Cost
Capital costs	Equipment/material costs	$10,200,000
	Construction costs	$11,400,000
	Indirect costs (engineering, project administration, general contingency)	$23,900,000
	Total capital cost	**$45,500,000**
O&M	Personnel	$75,100
	Energy	$26,400
	Maintenance	$15,000
	Annual O&M costs	**$117,000**
Life cycle factors	Interest rate	3%
	Inflation rate	2%
	Total life cycle used	40 years
	Major upgrade cost	$710,000
	Major upgrade year	20
Total 40-year life cycle cost		**$49,900,000**

Table 4-3. Cost of a New 35 MGD Ballasted Flocculation APTP

Category	Item	Estimated Cost
Capital costs	Equipment/material costs	$8,400,000
	Construction costs	$26,200,000
	Indirect costs (engineering, project administration, general contingency)	$38,200,000
	Total capital cost	**$72,900,000**
O&M	Personnel	$3,010,000
	Energy	$709,000
	Chemicals	$1,300,000
	Sludge/sediment disposal	$2,210,000
	Monitoring	$241,000
	Maintenance	$680,000
	Annual O&M costs	**$8,150,000**
Life cycle factors	Interest rate	3%
	Inflation rate	2%
	Total life cycle used	40 years
	Major upgrade cost	$40,000,000
	Major upgrade year	20 years
Total 40-year life cycle cost		**$373,000,000**

Table 4-4. Cost of a New 60 MGD Ballasted Flocculation APTP

Category	Item	Estimated Cost
Capital costs	Equipment/material costs	$9,300,000
	Construction costs	$34,700,000
	Indirect costs (engineering, project administration, general contingency)	$48,400,000
	Total capital cost	**$92,400,000**
O&M	Personnel	$3,000,000
	Energy	$838,000
	Chemicals	$1,460,000
	Sludge/sediment disposal	$277,000
	Monitoring	$782,000
	Maintenance	$2,580,000
	Annual O&M costs	**$8,940,000**
Life cycle factors	Interest rate	3%
	Inflation rate	2%
	Total life cycle used	40 years
	Major upgrade cost	$60,000,000
	Major upgrade year	20 years
Total 40-year life cycle cost		**$440,000,000**

5. DISCUSSION

5.1 Feasibility

PG determined that both the rehabilitation of the existing 42-inch pipeline and constructing an extended section of that pipeline to convey flows from PB-CILA to the new APTP is feasible and will effectively convey wastewater flows diverted from the upgraded PB-CILA to the new treatment plant on the U.S. side of the border. The new conveyance line and APTP would allow PB1-A to be decommissioned, which reduces PB-CILA downtime due to malfunctions of PB1-A that cause an operational bottleneck, forcing PB-CILA to be shut off. Rehabilitating the existing 42-inch pipeline and using micro-tunneling to install pipe to transport flows underneath the border eliminates the need to disturb the dense urban development in the Tijuana. This makes the construction of the conveyance system from PB-CILA to the new treatment plant significantly easier and reduces noise/traffic issues that would have negative social impacts on residents of Tijuana.

The proposed new 35 MGD APTP is feasible to construct and will be effective at treating the river water. The small footprint of the ballasted flocculation process is advantageous due to the limited amount of land available at the treatment plant and the other proposed projects that require land for treatment. The redundancy of the two separate treatment trains allows one treatment train to sufficiently treat flows if the other train experiences planned or unplanned downtime. It is important for the ballasted flocculation process to be afforded some planned downtime to allow the tanks to dry out, minimizing buildup of biological growth within the treatment units. The planned downtime periods can be scheduled during the dry season when peak flow rates are unlikely.

As discussed in Section 1.2, Mexico currently operates PB-CILA when flows in the Tijuana River are under 29 MGD and is anticipated to operate PB-CILA at flow rates up to 35 MGD after the upgrade that is currently underway is completed. Mexico would have to approve increasing the PB-CILA operational capacity to capture a portion of wet-weather river flows. Operating PB-CILA during wet weather will increase the energy costs due to the increased annual flow through PB-CILA. Additionally, the increased operation will increase maintenance requirements for the pumps and pretreatment infrastructure at PB-CILA due to the increased pump usage and additional diverted sediment and trash. The increased cost burden will require additional funding. However, decommissioning PB1-A and reducing the flow discharged at SAB Creek reduces pumping costs and pump maintenance requirements on the Mexico side of the border and may offset the increase in cost and maintenance efforts at PB-CILA.

The proposed upgrades to the diversion and conveyance system to divert flows up to 60 MGD from PB-CILA to the new 60 MGD APTP is feasible to construct and operate but requires upgrades to the entire conveyance system from Mexico-side diversion to the new APTP. Additionally, the 60 MGD upgrades would take place in dense urban areas. This increases the capital cost and would cause negative social impacts like traffic and noise during construction. Therefore, a U.S.-side diversion (evaluated in Project 1) may be easier and more economical to construct at the 60 MGD size. It is more likely that the U.S.-side diversion would be able to partially divert river flows above 60 MGD, which would increase the percentage reduction in BOD_5 load in transboundary flows, as shown in Figure 3-2. The proposed 60 MGD APTP has similar considerations to the 35 MGD design and would be able to accommodate the downtime requirements of the APTP.

Overall, Project 2 is feasible to construct and operate. The water quality impacts discussed in Section 3.1 show that Project 2 has a significant positive effect on both dry-weather and wet-weather water quality for the Tijuana River area and neighboring coastal areas in the U.S. The results of the modeling by Scripps suggests that the reduction in untreated wastewater discharges in both transboundary flows and discharges at SAB Creek is likely to have a positive impact on the beach communities and the Navy SEALs training facility.

5.2 Other Stakeholder Information

A major benefit of Project 2 on the Mexico side of the border is lower cost and maintenance requirements. Maintenance costs are reduced because Project 2 eliminates the need for PB1-A, so the pump station can be decommissioned.

6. CONCLUSION

The purpose of Project 2 is to eliminate the need for PB1-A, improve water quality in the Tijuana River, reduce flows directed to SAB Creek, and make PB-CILA more reliable. Project 2 proposes to convey all flows from PB-CILA, either with the currently underway upgrades to 35 MGD or to the proposed expansion to 60 MGD, to a new APTP on the U.S. side of the border. The proposed designs are technically feasible to construct and operate. The capital cost of the rehabilitated and extended force main and 35 MGD treatment plant is $11.5 million, and the 40-year life cycle cost is $12.2 million. The estimated capital cost to upgrade the diversion and conveyance system to a capacity of 60 MGD is $45.5 million, and the estimated 40-year life cycle cost is $49.9 million. The estimated capital cost to construct the new 60 MGD APTP is $92.4 million, and the estimated 40-year life cycle cost is $440 million.

The rehabilitated and extended conveyance system and treatment plant address the project's purpose as follows:

1. The proposed rehabilitated and extended force main from PB-CILA will convey flows from PB-CILA directly to the new treatment facility, eliminating the need for PB1-A.

2. PG estimates that Project 2 would reduce flows directed to SAB Creek by 6,500 million gallons annually, or 50% of the total flow at both the 35 MGD and 60 MGD size. Additionally, PG estimates that both Project 2 sizes would reduce the BOD_5 load conveyed to SAB Creek by 6,200 tons annually, or 36% of the total annual BOD_5 load. Modeling by Scripps indicates that the reduction in pollutant discharges to the Pacific Ocean via SAB Creek is likely to have a positive beach impact for coastal communities and the Navy SEALs training facility during the dry and wet season.

3. The exact reduction in BOD_5 in transboundary Tijuana River flows depends on both the size of PB-CILA diversion system and the extent that the upgraded PB-CILA can operate during wet-weather events. The reduction in the untreated wastewater loads in transboundary flows is likely to have social and environmental benefits to the estuary.

    a. PG estimates that the 35 MGD diversion and APTP, operating at flows up to 35 MGD would reduce the BOD_5 load that flows transboundary in the Tijuana River by 458 tons annually, or about 27% of the annual BOD_5 load. The 35 MGD size of Project 2, operating at flows up to 35 MGD is estimated to reduce the TSS load by 1,000 tons annually, which is less than 1% of the total annual TSS load.
    b. PG estimates that the 35 MGD diversion and APTP, operating at flows up to 60 MGD would reduce the BOD_5 load that flows transboundary in the Tijuana River by 799 tons annually, 48% of the total annual BOD_5 load. The 35 MGD size of Project 2, operating at flows up to 60 MGD is estimated to reduce the TSS load by 1,000 tons annually, which is less than 1% of the total annual TSS load.
    c. PG estimates that the 60 MGD diversion and APTP, operating at flows up to 60 MGD would reduce the BOD_5 load that flows transboundary in the Tijuana River by 909 tons annually, or about 54% of the total annual BOD_5 load. The BOD_5 load reduction could be increased if the diversion and PB-CILA are operated to partially divert flows above 60 MGD. The 60 MGD size of Project 2, operating at flows up to 60 MGD is estimated to reduce the TSS load by 2,000 tons annually, which is approximately 1% of the total annual TSS load.

4. PG estimates that the 60 MGD diversion and APTP would reduce the BOD_5 load that flows transboundary in the Tijuana River by 909 tons annually, or about 54% of the total annual BOD_5 load. The BOD_5 load reduction could be increased if the diversion and PB-CILA are operated to partially divert flows above 60 MGD. Additionally, Project 2 is estimated to reduce the TSS load by 2,000 tons annually, which is approximately 1% of the total annual TSS load. The reduction in the untreated wastewater loads in transboundary flows is likely to have social and environmental benefits to the estuary.

5. Project 2 allows PB-CILA to operate independently of PB1-A at both 35 MGD and 60 MGD. This will increase the effectiveness of capture of Tijuana River transboundary flows, since PB-CILA would no longer need to be shut down because of an operational failure at PB1-A.

7. SUGGESTED NEXT STEPS

Several activities would improve the feasibility analysis and reduce any uncertainty and assumptions described above, facilitating implementation of Project 2:

- Obtain finalized effluent limits from the RWQCB for discharges of treated river water through the SBOO.
- Collect data on the performance of the upgraded PB-CILA and Mexico's operational strategy changes.
- Evaluate the effectiveness of the new trash and sediment pretreatment installations and determine if they remove enough sediment and trash to allow PB-CILA to operate during wet weather.
- Monitor the river during wet-weather flows to develop more accurate pollutant loading data. The sediment concentrations present in the river at higher wet-weather flow rates are not well understood, and better data are needed to finalize the design of the treatment process.
- Identify a source of funding to allow operation of PB-CILA during wet weather.
- Although ballasted flocculation was chosen as the proposed treatment technology, PG also evaluated the potential of using CMDFs in its place. CMDFs offer many of the same benefits as ballasted flocculation, including high average TSS removal rates, a small footprint, and rapid startup. In addition, CMDFs may be more tolerant of flow rate variations, particularly at startup. However, CMDFs are a less established technology than ballasted flocculation, and are mainly used in tertiary treatment applications. Additionally, excess sediment can damage CMDFs, making them possibly unsuitable for treating river water with high TSS concentrations. If CMDFs are to be further considered for Project 2, more analysis, including bench testing and/or a pilot study, will be needed.
- Further evaluate using the Nelson Sloan Quarry for sediment disposal.

8. REFERENCES

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APPENDIX A: Itemized Cost Impact Analysis

Project 2, Sub-Project 1: Rehabilitating and Extending the Conveyance Line to Divert 35 MGD of River Water to the New APTP - Opinion of Probable Costs

Category	Item	Quantity	Unit	Unit Price	Cost ($)	Source/Description
Equipment/Material Cost	Rehabilitate the existing 42 inch Force Main from PB-CILA to PB1-A.	7500	ft	$87.50	$ 657,000	PG Unit Price Index - ENR Adjusted, Adjusted to remove General Contractor and administrative Contingency for spreadsheet purposes
	48 Inch Tunnel Install Microtunnelled Section of Pipe Underneath Border	600	Ft	$381	$ 229,000	PG Unit Price Index - ENR Adjusted, Adjusted to remove General Contractor and administrative Contingency for spreadsheet purposes
	42 inch HDPE Force Main - Cost per foot from Database	2000	Ft	$206	$ 413,000	PG Unit Price Index - ENR Adjusted, Adjusted to remove General Contractor and administrative Contingency for spreadsheet purposes
	Allowance For Unquantified Line Items	5	%		$ 65,000	
	Total Equipment/Material Costs				**$ 1,360,000**	
Construction Costs	Rehabilitate the existing 42 inch Force Main from PB-CILA to PB1-A.	7500	Ft	202	$ 1,515,000	PG Unit Price Index - ENR Adjusted, Adjusted to remove General Contractor and administrative Contingency for spreadsheet purposes
	48 Inch Tunnel Install Microtunnelled Section of Pipe Underneath Border	600	Ft	880	$ 528,000	PG Unit Price Index - ENR Adjusted, Adjusted to remove General Contractor and administrative Contingency for spreadsheet purposes
	42 inch HDPE Force Main - Cost per foot from Database	2000	Ft	476	$ 952,000	PG Unit Price Index - ENR Adjusted, Adjusted to remove General Contractor and administrative Contingency for spreadsheet purposes
	Allowance For Unquantified Line Items	5	%		$ 150,000	PG Unit Price Index - ENR Adjusted, Adjusted to remove General Contractor and administrative Contingency for spreadsheet purposes
	General Contractor, Mob/Demob, Ins, Bonds, Gen Admin, Profit	30	%		$ 944,000	
	Total Construction Costs				**$ 4,090,000**	
Indirect Costs	Subtotal (Equipment/Materials + Construction)				$ 5,450,000	
	Administrative Costs (40% of Subtotal)				$ 2,180,000	
	Subtotal (With Engineering)				$ 7,630,000	
	Contingency (50% of the Total)				$ 3,815,000	
	Total Indiret Costs				**$ 6,000,000**	
	Total Capital Costs				**$ 11,500,000**	
O&M	Maintainence Labor - Force Main	300	hour	25	7,500	300 Labor hours at 25 $/hr to inspect force mains
	General Force Main Maintainence	1	Each	15000	15,000	$10,000 in vehicle expenses + $5,000 allowance for unquanitified maintainence
	Total O&M Costs				22,500	
Life Cycle Cost	Total Capital Cost				$ 11,500,000	
	Annual O&M Costs				22,500	
	Service Life				40	
	Interest Rate				3%	
	Inflation Rate				2%	
	Location Adjustment Factor				1	United States
	Total 40-Year Life Cycle Cost (35 MGD)				**$ 12,300,000**	

Project 2, Sub-Project 2: Upgrading the River Diversion, PB-CILA and the Conveyance Line to Divert 60 MGD of River Water to the New APTP - Opinion of Probable Costs Summarized

Cost Category	Sub Category	Cost
Capital Cost	Equipment/Material Cost	10,200,000
	Construction Cost	11,400,000
	Indirect costs	23,900,000
	Total Capital Costs	**45,500,000**
O&M Costs	Personnel	75,100
	Energy	26,400
	Materials (Chemicals)	0
	Monitoring	0
	Maintenance	15,000
	Sludge/Grit Disposal	0
	Total O&M Costs	**117,000**
Life Cycle Costs	Interest Rate	3%
	Inflation Rate	2%
	Service Life	40 years
	Mid Cycle Upgrades	710,000
	Upgrade Year	20
	Present Value of Mid-Cycle Upgrades	581,877
	Total Life Cycle Costs	**49,900,000**

Project 2, Sub-Project 2: Upgrading the River Diversion, PB-CILA and the Conveyance Line to Divert 60 MGD of River Water to the New APTP - Opinion of Probable Costs

Category	Item	Quantity	Unit	Unit Price	Cost ($)	Source
					New Diversion Structure	
Equipment/Material Cost	River Intake Box Expansion					
	Concrete Cast in Place 8'x8'. 6' Deep	4	EA	$20,000	$ 80,000	RSM Concrete UP per structure: (63 x 8 / 27 x $750) + (10 x 10 x 1.5 / 27 x 3 x $400) + (10 x 10 x 1 /27 x $1200) = $20,666 per structure
	Frames and covers, 30" to 36" frame	4	EA	$870	$ 4,000	Arcadis (Report Includes a 10% Markup for Installation and Labor, Reflected in Cost)
	Cast Iron Storm Sewer Grate 24"x48"	4	EA	$1,500	$ 6,000	Arcadis (Report Includes a 10% Markup for Installation and Labor, Reflected in Cost)
	Concrete , ready mix delivered 4,500 psi to 6,000 psi	700	CY	$600	$ 420,000	Arcadis (Report Includes a 10% Markup for Installation and Labor, Reflected in Cost)
	Concrete, ready mix delivered, 4,500 psi to 6,000 psi	150	CY	$600	$ 90,000	Arcadis (Report Includes a 10% Markup for Installation and Labor, Reflected in Cost)
	Sliding Metal gate for V-notch Canal	2	EA	$25,000	$ 50,000	Arcadis (Report Includes a 10% Markup for Installation and Labor, Reflected in Cost)
	Allowance for Unquantified Line Items	5	%			Arcadis (Report Includes a 10% Markup for Installation and Labor, Reflected in Cost)
	FRPMP pipe, 54 inch, gravity	264	Ft	$125	$ 33,000	PG Unit Price Index - ENR Adjusted, Adjusted to remove General Contractor and administrative Contingency for spreadsheet purposes
	Allowance for Unquantified Line Items	5	%		$ 34,000	
	Total Equipment/Material Cost				**$ 717,000**	
Construction Cost	Microtunnel for Gravity Line to PB-CILA, 6 ft in diameter	264	Ft	$2,150	$ 568,000	Bid estimates from Previous Projects - ENR Adjusted, Adjusted to remove General Contractor and administrative Contingency for spreadsheet purposes.
	Trench cut, fill, compaction and haul away excess for diversion	3000	CY	$13	$ 38,000	Arcadis (Report Includes a 10% Markup for Installation and Labor, Reflected in Cost)
	Allowance for Unquantified Line Items	5	%		$ 31,000	
	General Contractor, Mob/Demob, Ins, Bonds, Gen Admin, Profit	30	%		$ 192,000	
	Total Construction Costs				**$ 829,000**	
Indirect Costs	Subtotal (Equipment/Materials + Construction)				$ 1,546,000	
	Administrative Costs (40% of Subtotal)				$ 619,000	
	Subtotal (With Engineering)				$ 2,165,000	
	Contingency,50%				$ 1,083,000	
	Total Indiret Costs				**$ 1,702,000**	
	Total Capital Costs				**$ 3,248,000**	
O&M	Additional Cleaning Labor	320	hour	25	8,000	20 4hr-long cleaning visits per year, four people per crew. 25 $/hour
	Total O&M Costs				**8,000**	
					Upgrade of the Pretreatment System and PB-CILA for 60 MGD of River Water	
Equipment/Material Cost	New Vortex Desander Sized for 35 MGD.	1	Each	$2,100,000	$ 2,100,000	Manufacturer Information
	Mechanical Bar Screens, Fine	2	Each	$250,000	$ 500,000	Arcadis (Report Includes a 10% Markup for Installation and Labor, Reflected in Cost)
	Lift Station Control pannel and instrumentation	4	Each	$200,000	$ 800,000	Arcadis (Report Includes a 10% Markup for Installation and Labor, Reflected in Cost)
	Magnetic Flow Meter, Complete in Place	2	Each	$35,000	$ 70,000	Arcadis (Report Includes a 10% Markup for Installation and Labor, Reflected in Cost)
	New Wet Well, cast in place, complete in place	1	Each	$250,000	$ 250,000	Arcadis (Report Includes a 10% Markup for Installation and Labor, Reflected in Cost)
	1" Combination Air/Vacuum Valve, complete in place	6	Each	$3,000	$ 18,000	Arcadis (Report Includes a 10% Markup for Installation and Labor, Reflected in Cost)
	24" Check Valve: Includes stern, accessories, complete in place	4	Each	$57,000	$ 228,000	Arcadis (Report Includes a 10% Markup for Installation and Labor, Reflected in Cost)
	24" Globe Valve	4	Each	$45,000	$ 180,000	Arcadis (Report Includes a 10% Markup for Installation and Labor, Reflected in Cost)
	Concrete, ready mix delivered, 4,500 psi to 6,000 psi	350	cy	$600	$ 210,000	Arcadis (Report Includes a 10% Markup for Installation and Labor, Reflected in Cost)
	24" Ductile Iron Piping: lining for Wastewater (Includes Installation	640	ft	$300	$ 192,000	Arcadis (Report Includes a 10% Markup for Installation and Labor, Reflected in Cost)
	New 500 L/s 125 Chopper Pumps	2	Each	$100,000	$ 200,000	Cost from 2020 PB-CILA Upgrade
	New 200 L/s 50 hp Centrifugal Pumps	3	Each	$70,000	$ 210,000	Turton Cost Curve, ENR and Location Adjusted, Assumed Stainless Steel MOC.
	Hoist System 12X72 Steel Beam	180	ft	$50	$ 9,000	Arcadis (Report Includes a 10% Markup for Installation and Labor, Reflected in Cost)
	Hoist System 10X49 Steel Beam	600	ft	$30	$ 18,000	Arcadis (Report Includes a 10% Markup for Installation and Labor, Reflected in Cost)
	Electrical Controls and Instrumentation	1	LS	$50,000	$ 50,000	Arcadis (Report Includes a 10% Markup for Installation and Labor, Reflected in Cost)
	Isolating Transformer, 300 KVA	1	Each	$20,000	$ 20,000	Arcadis (Report Includes a 10% Markup for Installation and Labor, Reflected in Cost)
	Loop-Feed Switch	1	Each	$7,000	$ 7,000	Arcadis (Report Includes a 10% Markup for Installation and Labor, Reflected in Cost)
	Electrical Conduit replacement	2	Each	$20,000	$ 40,000	Arcadis (Report Includes a 10% Markup for Installation and Labor, Reflected in Cost)
	Incoming Switchboards, 600 amp	1	LS	$20,000	$ 20,000	Arcadis (Report Includes a 10% Markup for Installation and Labor, Reflected in Cost)
	Diesel Power Generator Set: 60 Hz-350 kVA, complete in place	2	Each	$100,000	$ 200,000	Arcadis (Report Includes a 10% Markup for Installation and Labor, Reflected in Cost)
	SCADA and Telemetry System	1	LS	$400,000	$ 400,000	Arcadis (Report Includes a 10% Markup for Installation and Labor, Reflected in Cost)
	Allowance For Unquantified Line Items	5	%		$ 287,000	Arcadis (Report Includes a 10% Markup for Installation and Labor, Reflected in Cost)
	Total Equipment/Material Costs				**$ 6,009,000**	
Construction Costs	Hoist System Welding Steel Structure to Extend hoist.	240	LH	$350	$ 84,000	Arcadis (Report Includes a 10% Markup for Installation and Labor, Reflected in Cost)
	350 kVA demolition	1	Each	$2,000	$ 2,000	Arcadis (Report Includes a 10% Markup for Installation and Labor, Reflected in Cost)
	Electrical Improvements	1	Each	$100,000	$ 100,000	Arcadis (Report Includes a 10% Markup for Installation and Labor, Reflected in Cost)
	Trench cut, fill, compaction and haul away excess	3000	Cu Yd	$16	$ 47,000	Arcadis (Report Includes a 10% Markup for Installation and Labor, Reflected in Cost)
	Allowance for Unquantified Line Items	5	%		$ 12,000	
	Total Construction Costs				**$ 245,000**	
Indirect Costs	Subtotal Subtotal (Equipment/Materials + Construction)				$ 6,254,000	
	Engineering Costs	40	%		$ 2,502,000	
	Subtotal With Engineering				$ 8,756,000	
	Contingency	50	%		$ 4,378,000	
	Total Indirect Costs				**$ 6,900,000**	
	Total Capital Costs				**$ 13,200,000**	
O&M Costs	Additional Energy Costs for pumping	264000	kWh	0.1	26400	Energy Costs Data from PB-CILA and PB1 provided by CESPT
	Additional Operating Labor	2000	hr	25	50000	2000 Labor hours, 25 $/hour
	Additional Maintainence Labor Labor	384	hr	25	9600	20 4hr-long cleaning visits per year, four people per crew. 25 $/hour
	Total O&M Costs				76400	
Mid Cycle Upgrade	Chopper Pumps	5	Each	100000	500000	Cost from 2020 PB-CILA Upgrade, Year 20 pump replacement
	Centrifugal Pumps	3	Each	69960	209900	Turton Cost Curve, ENR and Location Adjusted, Assumed Stainless Steel MOC, Year 20 pump replacement
	Total Mid-Cycle Replacement Costs				**709900**	
					Rehabilitation and Extention of the Conveyance Line From PB-CILA to the New APTP	
Equipment/ Material Costs	Rehabilitate the existing 42 inch Force Main from PB-CILA to PB1-A.	7500	ft	$87.50	$ 657,000	PG Unit Price Index - ENR Adjusted, Adjusted to remove General Contractor and administrative Contingency for spreadsheet purposes
	48 Inch Tunnel					
	Install Microtunnelled Section of Pipe Underneath Border	600	Ft	$381	$ 229,000	PG Unit Price Index - ENR Adjusted, Adjusted to remove General Contractor and administrative Contingency for spreadsheet purposes
	42 inch HDPE Force Main - Cost per foot from Database	2000	Ft	$206	$ 413,000	PG Unit Price Index - ENR Adjusted, Adjusted to remove General Contractor and administrative Contingency for spreadsheet purposes
	Allowance For Unquantified Line Items	5	%		$ 65,000	
	Total Equipment/Material Costs				**$ 1,364,000**	

	Rehabilitate the existing 42 inch Force Main from PB-CILA to PB1-A.	7500 Ft	202	$	1,515,000	PG Unit Price Index - ENR Adjusted, Adjusted to remove General Contractor and administrative Contingency for spreadsheet purposes
	48 Inch Tunnel					
	Install Microtunnelled Section of Pipe Underneath Border	600 Ft	880	$	528,000	PG Unit Price Index - ENR Adjusted, Adjusted to remove General Contractor and administrative Contingency for spreadsheet purposes
Construction Costs	42 inch HDPE Force Main - Cost per foot from Database	2000 Ft	476	$	952,000	PG Unit Price Index - ENR Adjusted, Adjusted to remove General Contractor and administrative Contingency for spreadsheet purposes
	Allowance For Unquantified Line Items	5 %		$	150,000	
	General Contractor, Mob/Demob, Ins, Bonds, Gen Admin, Profit	30 %		$	899,000	PG Unit Price Index - ENR Adjusted, Adjusted to remove General Contractor and administrative Contingency for spreadsheet purposes
	Total Construction Costs			**$**	**4,044,000**	
	Subtotal (Equipment/Materials + Construction)			$	5,408,000	
	Administrative Costs (40% of Subtotal)			$	2,164,000	
Indirect Costs	Subtotal (With Engineering)			$	7,572,000	
	Contingency (50% of the Total)			$	3,786,000	
	Total Indiret Costs			**$**	**5,950,000**	
	Total Capital Costs			**$**	**11,358,000**	
	Maintainence Labor - Force Main	300 hour	25		7500	300 Labor hours at 25 $/hr to inspect force mains
O&M Costs	General Force Main Maintainence	1 Each	15000		15000	$10,000 in vehicle expenses + $5,000 allowance for unquanitified maintainence
	Total O&M Costs			**$**	**22,500**	O&M for both force mains is included in these costs

	New Conveyance Line From PB-CILA to the APTP					
Equipment/Material Costs	Install Microtunnelled Section of Pipe Underneath Border - 48 inch tunnel	2000 Ft	$381	$	762,000	Bid estimates from Previous Projects - ENR Adjusted, Adjusted to remove the engineering administrative contingency for spreadsheet purposes.
	36 inch HDPE Force Main - Cost per foot from Database	7000 Ft	$181	$	1,267,000	Bid estimates from Previous Projects - ENR Adjusted, Adjusted to remove General Contractor and administrative Contingency for spreadsheet purposes.
	Allowance For Unquantified Line Items	**5 %**		$	102,000	
	Total Equipment/Material Costs			**$**	**2,131,000**	
Contstruction Costs	Install Microtunnelled Section of Pipe Underneath Border - 48 inch tunnel	2000 Ft	$880	$	1,760,000	
	36 inch HDPE Force Main - Cost per foot from Database	7000 Ft	$418	$	2,926,000	
	Allowance For Unquantified Line Items	5 %		$	235,000	
	General Contractor, Mob/Demob, Ins, Bonds, Gen Admin, Profit	30 %		$	1,406,000	
	Total Construction Costs			**$**	**6,327,000**	
Indirect Costs	Subtotal Subtotal (Equipment/Materials + Construction)			$	8,458,000	
	Administrative Costs (40% of Subtotal)			$	3,384,000	
	Subtotal (With Engineering)			$	11,842,000	
	Contingency (50% of the Total)			$	5,921,000	
	Total Indiret Costs			**$**	**9,305,000**	
	Total Capital Costs			**$**	**17,763,000**	

Project 2, Sub-Project 3: New 35 MGD Advanced Primary Treatment Plant - Opinion of Probable Cost

Category	Item	Quantity	Unit	Unit Price	Cost ($)	Source/Description
Equipment/Materials Costs	Headworks - Screens				$560,000	EPA Cost Curves; ENR adjusted; Capdet verified
	Headworks - Sediment Chambers				$830,000	EPA Cost Curves; ENR adjusted; Capdet verified
	Ballasted Flocculation				$1,000,000	Manufacturer Information
	Sludge Storage				$530,000	EPA Cost Curves; ENR adjusted; Capdet verified
	Sludge Thickening				$290,000	EPA Cost Curves; ENR adjusted; Capdet verified
	Sludge Dewatering				$2,100,000	EPA Cost Curves; ENR adjusted; Capdet verified
	Sludge Conveyor				$1,320,000	EPA Cost Curves; ENR adjusted; Capdet verified
	Sludge Pumping				$250,000	EPA Cost Curves; ENR adjusted; Capdet verified
	Effluent Discharge Piping - 60 in	300	ft	400	$120,000	EPA Cost Curves; ENR adjusted
	Allowance for Unquantified Line Items	5%			$1,360,000	5% of equipment/materials and construction line items
	Total Equipment/Materials Costs				**$8,400,000**	
Construction Costs	Headworks - Screens				$640,000	EPA Cost Curves; ENR adjusted; Capdet verified
	Headworks - Sediment Chambers				$970,000	EPA Cost Curves; ENR adjusted; Capdet verified
	Ballasted Flocculation				$1,500,000	Manufacturer Information
	Sludge Storage				$1,220,000	EPA Cost Curves; ENR adjusted; Capdet verified
	Sludge Thickening				$960,000	EPA Cost Curves; ENR adjusted; Capdet verified
	Sludge Dewatering				$1,400,000	EPA Cost Curves; ENR adjusted; Capdet verified
	Sludge Conveyor				$560,000	EPA Cost Curves; ENR adjusted; Capdet verified
	Sludge Processing				$2,620,000	EPA Cost Curves; ENR adjusted; Capdet verified
	Sludge Pumping				$250,000	EPA Cost Curves; ENR adjusted; Capdet verified
	Effluent Discharge Piping - 60 in	300	ft	600	$180,000	EPA Cost Curves; ENR adjusted
	Site Improvements				$1,000,000	EPA Manual CD-53, 1980, ENR adjusted
	Misc. Metals				$550,000	EPA Manual CD-53, 1980, ENR adjusted
	Piping				$2,000,000	EPA Manual CD-53, 1980, ENR adjusted
	Electrical				$2,200,000	EPA Manual CD-53, 1980, ENR adjusted
	Controls				$1,000,000	EPA Manual CD-53, 1980, ENR adjusted
	Shop & Garage Facilities				$750,000	Allowance to expand existing ITP facilities
	Laboratories				$500,000	Allowance to expand existing ITP facilities
	Controls & SCADA Building				$1,950,000	Allowance to expand existing ITP facilities
	General Contractor, Mob/Demob, Ins, Bonds, Gen Admin, Profit	30%			$6,080,000	
	Total Construction Costs				**$26,300,000**	
Indirect Costs	Subtotal (Equipment/Materials + Construction)				$34,700,000	
	Engineer and Administrative Contingency, 40% of subtotal	40%			$13,900,000	
	Subtotal (With Engineering)				$48,600,000	
	Contingency 50%	50%			$24,300,000	
	Total Indirect Costs				**$38,200,000**	
	Total Capital Costs				**$72,900,000**	
Operations and Maintenance Cost	Labor				$3,010,000	EPA cost curves, BF manufacturer information, adjusted for estimated sediment loads
	Energy				$709,000	EPA cost curves, BF manufacturer information, adjusted for estimated sediment loads
	Chemicals				$1,300,000	EPA cost curves, BF manufacturer information, adjusted for estimated sediment loads
	Monitoring				$241,000	EPA cost curves, BF manufacturer information, adjusted for estimated sediment loads
	Maintenance				$680,000	EPA cost curves, BF manufacturer information, adjusted for estimated sediment loads
	Sludge/Sediment Disposal	22,100	CY	100	$2,210,000	Based on SBWRP grit disposal cost
	Total Annual O&M Costs (35 MGD)				**$8,150,000**	
Life Cycle Cost	Life Cycle				40	
	Interest Rate				3%	
	Inflation Rate				2%	
	Major Upgrade(s) Cost				$40,000,000	Estimated value
	Major Upgrade Year				20	
	Present Value of Major Upgrade(s)				$32,700,000	
	Location Adjustment Factor				1.0	United States
	Total Life Cycle Cost				**$373,000,000**	

Project 2, Sub-Project 3: New 60 MGD Advanced Primary Treatment Plant (60 MGD) - Opinion of Probable Cost

Category	Item	Quantity	Unit	Unit Price	Cost ($)	Source/Description
Equipment/Materials Costs	Headworks - Screens				$700,000	EPA Cost Curves; ENR adjusted, Capdet verified
	Headworks - Grit Chambers				$750,000	EPA Cost Curves; ENR adjusted, Capdet verified
	Grit dewatering and loading facility				$650,000	BPJ
	Ballasted Flocculation				$1,250,000	Manufacturer Information, Capdet verified
	Sludge Storage				$530,000	EPA Cost Curves; ENR adjusted, Capdet verified
	Sludge Thickening				$290,000	EPA Cost Curves; ENR adjusted, Capdet verified
	Sludge Dewatering				$1,600,000	EPA Cost Curves; ENR adjusted, Capdet verified
	Sludge Conveyor				$1,300,000	EPA Cost Curves; ENR adjusted, Capdet verified
	Sludge Pumping				$350,000	EPA Cost Curves; ENR adjusted, Capdet verified
	Effluent Discharge Piping - 72 in	300		500	$150,000	EPA Cost Curves; ENR adjusted, Capdet verified
	Allowance for Unquantified Line Items	5%			$1,713,250	5% of equipment/materials and construction line items
	Total Equipment/Materials Costs				**$9,300,000**	
Construction Costs	Headworks - Screens				$800,000	EPA Cost Curves; ENR adjusted, Capdet verified
	Headworks - Grit Chambers				$1,400,000	EPA Cost Curves; ENR adjusted, Capdet verified
	Grit dewatering and loading facility				$1,800,000	BPJ
	Ballasted Flocculation				$2,100,000	Manufacturer Information, Capdet verified
	Sludge Storage				$1,400,000	EPA Cost Curves; ENR adjusted, Capdet verified
	Sludge Thickening				$1,000,000	EPA Cost Curves; ENR adjusted, Capdet verified
	Sludge Dewatering				$1,100,000	EPA Cost Curves; ENR adjusted, Capdet verified
	Sludge Conveyor				$600,000	EPA Cost Curves; ENR adjusted, Capdet verified
	Sludge Processing Building				$2,800,000	EPA Cost Curves; ENR adjusted, Capdet verified
	Sludge Pumping				$300,000	EPA Cost Curves; ENR adjusted, Capdet verified
	Effluent Discharge Piping	300		750	$225,000	EPA Cost Curves; ENR adjusted, Capdet verified
	Site Improvements				$1,200,000	EPA Manual CD-53, 1980, ENR adjusted
	Misc. Metals				$720,000	EPA Manual CD-53, 1980, ENR adjusted
	Piping				$2,700,000	EPA Manual CD-53, 1980, ENR adjusted
	Electrical				$2,800,000	EPA Manual CD-53, 1980, ENR adjusted
	Controls				$1,550,000	EPA Manual CD-53, 1980, ENR adjusted
	Shop & Garage Facilities				$900,000	allowance to expand existing ITP facilities
	Laboratories				$800,000	allowance to expand existing ITP facilities
	Controls & SCADA Building				$2,500,000	allowance to expand existing ITP facilities
	General Contractor, Mob/Demob, Ins, Bonds, Gen Admin, Profit	30%			$8,008,500	
	Total Construction Costs				**$34,700,000**	
Indirect Costs	Subtotal (Equipment/Materials + Construction)				$44,000,000	
	Engineer and Administration, 40% of subtotal	40%			$17,600,000	
	Contingency, 50%	50%			$30,800,000	
	Total Indirect Costs				**$48,400,000**	
	Total Capital Costs				**$92,400,000**	
O&M Costs	Personnel				$3,000,000	EPA cost curves, manufacturer information, adjusted for estimated sediment loads
	Energy				$838,000	EPA cost curves, manufacturer information, adjusted for estimated sediment loads
	Materials (Chemicals)				$1,460,000	EPA cost curves, manufacturer information, adjusted for estimated sediment loads
	Monitoring				$277,000	EPA cost curves, manufacturer information, adjusted for estimated sediment loads
	Maintenance				$782,000	EPA cost curves, manufacturer information, adjusted for estimated sediment loads
	Sludge/Grit Disposal	25,800	CY	100	$2,580,000	SBWRP grit disposal cost
	Total Annual O&M Costs				**$8,937,000**	
Life Cycle Cost	Total Capital Cost				$92,400,000	
	Annual O&M Costs				$8,937,000	
	Service Life				40	
	Present Value of Service Life O&M				$293,443,590	
	Major Upgrade(s) Cost at 20 years				$60,000,000	
	Present Value of Major Upgrade(s)				$49,172,668	
	Interest Rate				3%	
	Inflation Rate				2%	
	Location Adjustment Factor				1.0	United States
	Total Life Cycle Cost				**$440,000,000**	