Huntington Beach Desalination Plant
D2 and U2 – Alternative 1mm Screened Seawater Intake
Feasibility Analysis According to the OPA and CEQA

Prepared for:

Poseidon Water

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D2 AND U2 – ALTERNATIVE 1mm SCREENED SEAWATER INTAKE FEASIBILITY ANALYSIS ACCORDING TO THE OPA AND CEQA

1 INTRODUCTION

1.1 Background on Alternative 1mm Screened Seawater Intake Siting

The Santa Ana Regional Water Quality Control Board ("Regional Board") is preparing an amendment and renewal of the proposed Huntington Beach Desalination Project's ("HBDP") Order No. R8-2012-0007, NPDES No. CA8000403 and determination of compliance with California Water Code ("CWC") Section 13142.5(b) approved in February 2012.

In June 2015, Dudek prepared the first in a series of detailed alternative site analyses (Regional Board application Appendix E) evaluating the feasibility of siting the proposed HBDP and its seawater intake and discharge facilities at an alternative site along the coast of Orange County. The Regional Board has deemed the HBDP's application complete, and presumably has determined there are no other feasible sites along the coast of Orange County for the proposed HBDP that would minimize the intake and mortality of all forms of marine life compared to the proposed facility site. Therefore, the Regional Board is now conducting a detailed analysis of the optimal site offshore of the HBDP for the proposed 1-mm screened seawater intake.

The purpose of examining alternative sites offshore of Huntington Beach for a 1-mm screened seawater intake is to determine which intake site would best minimize the intake and mortality of all forms of marine life due to the construction, operation and maintenance of the HBDP 1-mm screened seawater intake. California Water Code Section 13142.5(b) and the California State Water Resources Control Board's Seawater Desalination Ocean Plan Amendment (OPA), set forth criteria for assessment of a reasonable range of alternative sites for screened intakes in OPA Section M.2.b., which states that "*Site is the general onshore and offshore location of a new or expanded facility. There may be multiple potential facility design configurations within any given site. The regional water board shall require that the owner or operator evaluate a reasonable range of nearby sites, including sites that would likely support subsurface intakes*." This analysis specifically addresses site location issues identified in subsections (3), (4), (5), (6), and (7):

(3) Analyze the feasibility of placing intake, discharge, and other facility infrastructure in a location that avoids impacts to sensitive habitats and sensitive species.

(4) Analyze the direct and indirect effects on all forms of marine life resulting from facility construction and operation, individually and in combination with potential anthropogenic effects on all forms of marine life resulting from other past, present, and reasonably foreseeable future activities within the area affected by the facility.

(5) Analyze oceanographic geologic, hydrogeologic, and seafloor topographic conditions at the site, so that the siting of a facility, including the intakes and discharges, minimizes the intake and mortality of all forms of marine life.

(6) Analyze the presence of existing discharge infrastructure, and the availability of wastewater to dilute the facility's brine discharge.

(7) Ensure that the intake and discharge structures are not located within a MPA or SWQPA with the exception of intake structures that do not have marine life mortality associated with the construction, operation, and maintenance of the intake structures (e.g., slant wells). Discharges shall be sited at a sufficient distance from a MPA or SWQPA so that the salinity within the boundaries of a MPA or SWQPA does not exceed natural background salinity. To the extent feasible, surface intakes shall be sited so as to maximize the distance from a MPA or SWQPA.

For purposes of Chapter III.M., feasible is defined in the OPA as "*capable of being accomplished in a successful manner within a reasonable period of time, taking into account economic, environmental, social, and technological factors*". Therefore, there are five (5) feasibility criteria: (1) timing (2) economic (3) environmental (4) social; and (5) technical.

Each of these feasibility criteria were evaluated for the proposed 1-mm screened seawater intake site (i.e., site E) and the two alternative seawater intake sites. The alternative seawater intake sites included in this study are:

1. Up-coast intake site (Alternative Site U2)
2. Down-coast intake site (Alternative Site D2)

Four other potential alternative intake sites farther up and down-coast and farther offshore were considered but were subsequently removed from further consideration after the Regional Water Board's Neutral Third-Party Review ("NTPR") process determined the other evaluated intake sites did not demonstrate reduced intake and mortality of all forms of marine life when compared to the proposed site (Site E).

2 DESCRIPTION OF THE INTAKE SITES

2.1 Proposed Intake Site E Description

The existing seawater intake conduit extends approximately 1,500 feet offshore from the proposed HBDP. Intake site E is within the existing industrial footprint of the Huntington Beach Generating Station ("HBGS"), and was permitted for use by the HBDP in February 2012 by the Regional Board. The proposed HBDP seawater intake site is described in detail in the Final Subsequent Environmental Impact Report (FSEIR) certified by the State Lands Commission on October 19, 2017. Relative to sensitive habitats, intake site E is located 4.4 miles southeast of the Bolsa Chica Wetlands and 3.8 miles northwest of the Giant Sea Bass Nursery site (see Figure 1). Intake site E is located 30 feet below the ocean surface at mean sea level (MSL). The habitat at the proposed intake site E and the surrounding area is predominantly homogeneous sandy soft-bottom. Annual sediment characterization of the area stretching up and downcoast one mile from the HBGS intake structure consistently finds predominantly sand (>90% of all sediments), silt, and clay with little to no gravel (MBC 2016). Similar sampling near the San Gabriel River mouth and the Orange County Sanitation District outfall confirms the area encompassing the potential intake sites is relatively homogeneous soft-bottom (MBC 2012; OCSD 2016). Rocky reef habitat in the area is limited to anthropogenic structures including the Huntington Beach Generating Station intake and discharge structures and surrounding armor rock, the Huntington Beach Pier, and the Orange County Sanitation District outfalls. No kelp forests exist in the five miles surrounding the Huntington Beach area (Miller and Allen 2018).

2.2 Alternative Intake Site D2 Description

Alternative intake site D2 is located just offshore of the mouth of the restored Huntington Beach Wetland and is located 1.2 miles southeast of intake site E (see Figure 1). Relative to sensitive habitats, alternative intake site D2 is located 5 miles southeast of the Bolsa Chica Wetlands and 2.4 miles northwest of the Giant Sea Bass Nursery site. Therefore, this alternative intake site would be closer to the Huntington Beach Wetland, Giant Sea Bass Nursery site, and a Submarine Canyon when compared to the U2 and E intake sites.

This alternative intake site is located in the same depth of water as intake E (approximately 30 feet MSL). Offshore swell, locally driven waves, ocean circulation patterns, tidal patterns, and tidal elevations would reflect similar conditions to intake E. However, alternative intake D2 is located in an area where the seabed contours bend towards the shore, which may result in wave diffraction. Additionally, alternative intake D2 is sited closer to the entrance to the Santa Ana River when compared to the U2 and E intake sites. This is a more dynamic area than intake E. It is possible that the turbidity is higher at alternative intake site D2 when compared to the U2 and E intake sites due to sediments from the river, particularly during and after periodic storm events. There is a dynamic sand bar and regular maintenance sand removal and nourishment of the surrounding beaches (GHD 2018).

The habitat at alternative intake site D2 and the surrounding area is predominantly homogeneous sandy soft-bottom, similar to the proposed intake site E. There is no discernable difference in the habitat conditions throughout the offshore area that encompasses the three alternative intake sites being considered..

2.3 Alternative Intake Site U2 Description

Alternative intake site U2 is located 1.2 miles northwest of intake site E (see Figure 1). Relative to sensitive habitats, alternative intake site U2 is located 3.1 miles southeast of the Bolsa Chica Wetlands, 2.5 miles northwest of the Huntington Beach Wetlands, and 4.9 miles northwest of the Giant Sea Bass Nursery site. Therefore, this alternative intake site would be closer to the two Bolsa Chica Marine Protected Areas (Bolsa Bay State Marine Conservation Area and Bolsa Chica Basin State Marine Conservation Area) when compared to the D2 and E intake sites. Intake site U2 would be located 0.35 mile south of the Huntington Beach Pier.

This alternative intake site is located in the same depth of water as intake E (approximately 30 feet MSL). Documented oceanographic conditions support that offshore swell, locally driven waves, ocean circulation patterns, tidal patterns, and tidal elevations are similar to intake E. The habitat conditions at alternative intake site U2 are similar to those described for the alternative intake site D2.

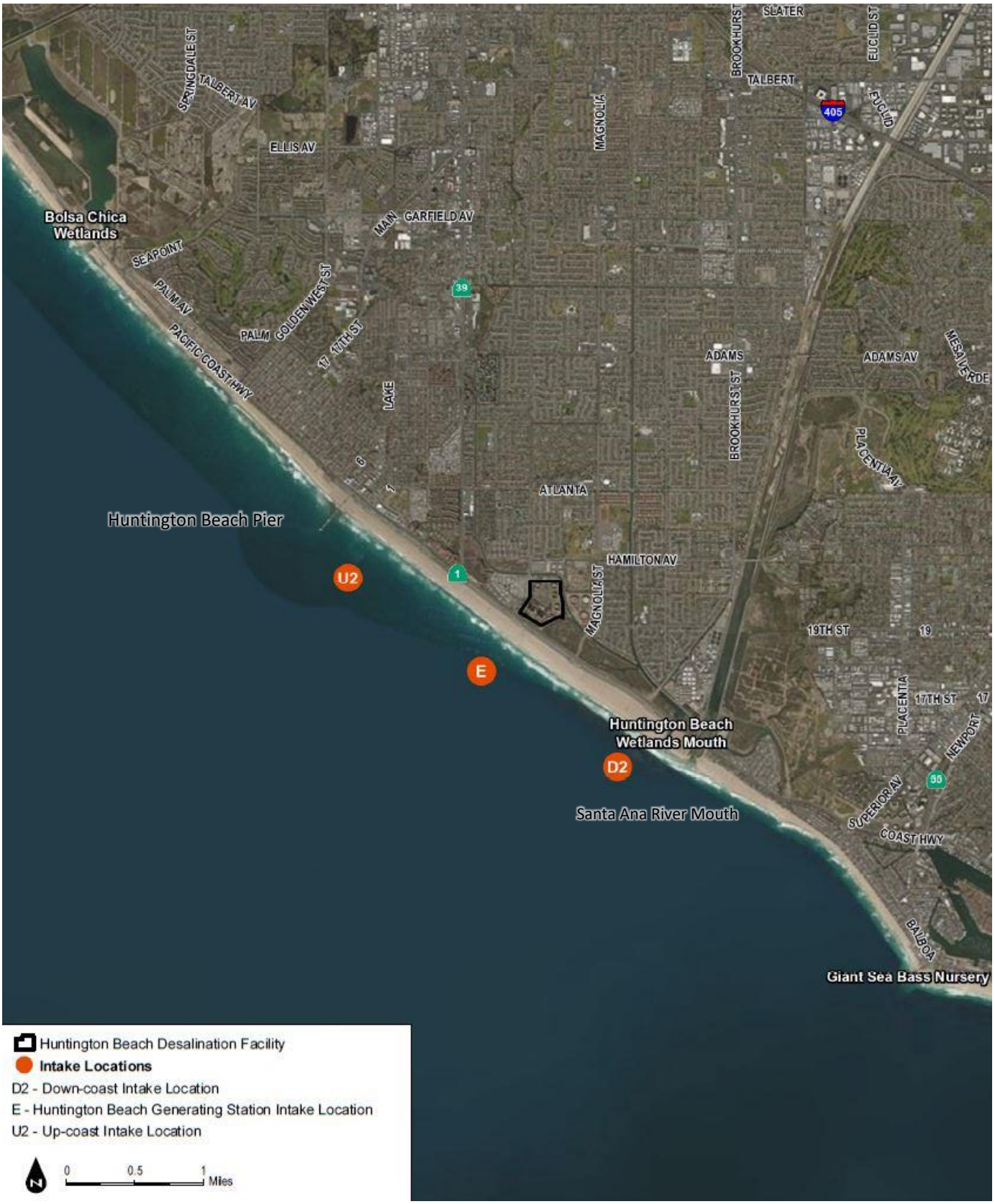

Figure 1. Alternative Intake Sites

3 DESCRIPTION OF THE SEAWATER INTAKE SYSTEMS

3.1 Alternative Intake Systems Considered

Due to the fact there is no available land to build the HBDP's onshore treatment facilities adjacent to the alternative seawater intake sites, this report assumes the HBDP onshore facilities would remain at the proposed HBGS site and the 1-mm screened seawater intake structures would be connected to the existing HBGS intake system to supply seawater.

Two general construction approaches were evaluated for connecting an intake at alternative sites D2 or U2 to the existing HBGS infrastructure:

1. an offshore alignment connecting the new piping to the existing HBGS offshore intake tower and then routing the new piping down or up coast either on the seabed or beneath the seabed;
2. an onshore alignment connecting the new piping to the existing HBGS 14-ft diameter pipeline at a location onshore and then routing the new piping down or up-coast beneath the State Beach.

3.1.1 Offshore Alignment

The offshore alignment option would involve placing 1.2 miles of large diameter piping on the seabed parallel to shore from the existing intake tower to alternative site D2 or U2. There are two approaches for constructing the offshore alignment: either placing the pipeline on the surface of the seabed or excavating the entire distance and burying the pipeline. Both of these approaches have constructability issues since the water depth is shallow enough to be a safety hazard to floating equipment, but too deep to be constructible from the intertidal zone. The approaching waves will be shoaling at the 30-ft contour causing an increase in wave height and then breaking. The long wave periods transfer significant force, and the wave heights can be sufficiently large to be dangerous to a non-draft restricted vessel.

If constructing the offshore alignment is done by placing the new shore-parallel pipe on the seabed, the new pipe would be perpendicular to the incoming wave direction and would expose the entire length of pipe to forces from the incoming waves. Wave induced forces are typically calculated per unit length as a component of horizontal, uplift and buoyancy force. These forces will be significantly larger applied over 1.2 miles of pipe, compared to just the intake tower. The potential impacts from sea bed movement and scour are greater for a pipe laid parallel to the shore compared to perpendicular. Tidal currents and potentially sediment movement this close to shore are on/off-shore. At 30-foot depth, the pipe could have an impact on the hydrodynamics. A rule of thumb used by the USACE in deep water, is that changes to the seabed bathymetry of less than 10% of the water depth are less likely to have an impact on the wave characteristics. For 30-feet depth this rule of thumb would limit the height of the pipe to 3 feet or less. For pipe diameters in the 10 to 14-foot diameter range particularly in shallow water (water depth / wave length < 0.04), this rule of thumb is exceeded. Therefore, it seems likely that the wave characteristics would be impacted by the shore parallel pipe. This could be unfavorably viewed by the permitting agencies and potentially by the local surf and recreational-sports community.

If constructing the offshore alignment is done by placing the new shore-parallel pipe beneath the seabed, many of the wave loading issues could be mitigated. However, there would be significant constructability

issues associated with trenching long sections up to 16 to 20-feet deep in the surf zone from floating equipment. Given the dynamic nature of the surf zone, excavating to place the pipe would likely involve removal of a far larger volume of material than the pipe diameter and associated scour protection, since excavated slopes will be unstable. Much of the excavated sediments may become suspended causing a temporary turbidity issue. Further analysis by marine construction expert (Highlands Construction Solutions, LLC [HCSLLC]) indicates that trenching from floating equipment to bury a new large-diameter pipe is not viable based on the quantity of material that would have to be excavated for proper pipe placement. For these reasons, HCSLLC recommended that the construction alternative of using floating equipment to conduct offshore trenching be eliminated for consideration.

The use of a trestle is another alternative construction approach for an offshore pipe alignment that would place the new shore-parallel pipe beneath the seabed. This construction approach is described in detail in the California Coastal Commission's Independent Scientific & Technical Advisory Panel ("ISTAP") Phase 2 report (HBDP application Appendix G). The trestle approach would allow for sheet piles to be placed along the alignment on both sides of the trestle which would significantly decrease the amount of material that would need to be excavated. The sheet pile walls would also prevent material from sluffing into the excavation and would eliminate the need to re-excavate to maintain the trench profile. In addition to the offshore shore-parallel trestle, three shore-perpendicular trestles would be required to provide access for personnel, equipment and materials for the pipeline installation. Each of the shore-parallel trestles would also require a construction haul road from the State Beach parking area across the beach. In addition to the significant social impacts associated with beach disturbance (which could last from 6 to 8 years), there still remains a significant safety concern associated with construction in the surf zone during severe wave loading events, especially during storms. For these reasons, HCSLLC recommended that the offshore trestle construction alternative be eliminated from consideration.

In evaluating which of the construction alternatives to utilize for connecting the existing pipeline to sites D2 or U2, the option of extending a pipeline from the existing concrete intake tower at site E to either site D2 or U2 by placing a new, large diameter pipeline on the seabed (offshore alignment) was first considered the most practical approach. However, as detailed above, this approach was later determined to be infeasible due to hydrodynamic forces on the large pipeline and the impact that pipeline would have on wave characteristics. The option of extending the pipeline from the existing concrete intake tower at site E to either site D2 or U2 below the seabed was also evaluated but this option was rejected due to constructability and schedule issues.

3.1.2 Onshore Alignment

The onshore alignment was determined to be the only viable constructible solution for connecting an intake at alternative sites D2 or U2 to the existing HBGS infrastructure. The onshore alignment is the basis of design used in this feasibility report; it is discussed below in Section 3.2.2.

3.2 Intake System Overview

3.2.1 Existing Intake E Site System

The existing HBGS seawater intake withdraws cooling water from the ocean through a concrete conduit with an internal dimension of 14 feet (inside diameter). At the intake end a vertical riser with internal

dimensions of 21 feet by 16 feet elevates the inlet 11.7 feet above the sea floor to minimize direct disturbance to the sea floor that may result from currents created by the intake flow. The riser is fitted with a velocity cap that reduces entrapment of motile fishes in the intake conduit by creating a horizontal flow vector in the inflow current, thereby triggering a flight response in many fish. Maximum mean water velocity at the velocity cap inlet is 2.0 feet per second under HBGS operating conditions (CSLC 2017).

3.2.2 Alternative Intake U2 and D2 Site Systems

The construction of proposed intake site D2 or U2 would require substantial site modifications outside of the existing industrial footprint of the HBGS. The site can generally be parsed into two parts: 1) the onshore components – the pipelines and vaults and 2) the offshore components – pipeline and wedgewire screen (WWS) array.

The onshore components of alternative intake sites D2 and U2 would be the same. A connection vault would be constructed on the beach adjacent to the existing HBGS pipeline to provide access for connecting the new pipeline to the existing pipeline. The new pipeline would be 14 feet in diameter (same as the existing HBGS pipe diameter) to ensure adequate suction pressure at the intake pump station and to account for occlusion of the internal surface by biofouling. A 1.2-mile long intake pipeline (with multiple manhole access points) would be installed under the State Beach, and for portions of the U2 pipeline, also under the Huntington Beach City Beach, to connect the existing HBGS intake pipe to the junction vault where the new intake pipeline would turn 90 degrees and head offshore towards the WWS array. This junction vault would also include an aboveground building to house the air compressors and receivers for an airburst system (if technologically feasible).

As above, regardless of the alternative intake site being evaluated, the offshore components of the proposed screened ocean intake would be the same. Cylindrical WWS with 1-mm slot widths would be installed approximately 1,840 feet offshore. An array of four copper nickel alloy, passive WWS would be mounted on a common header, which would be tied into a transition structure connecting the WWS manifold to the new intake pipeline to convey the feedwater flow to shore (Figure 2). The header and intake pipeline would be installed below the sea floor and would be covered by rip rap armoring.

Utilization of either alternative intake site (D2 or U2) would require heavy onshore and offshore construction to install conveyance pipelines as well as new lease agreements for the permanent structures (vaults and manholes) on the beach and permits (e.g., CA State Lands Commission, CSLC).

3.3 Design of Intake Systems

3.3.1 Intake System at Proposed Site E

The existing HBGS intake tower would undergo technological enhancements and be modified to add a manifold with four, 91-inch-diameter, 1-millimeter slot cylindrical WWSs (three main operating screens and an additional one for redundancy). Each screen would rise approximately 13.5 feet above the sea floor and be oriented perpendicular to the shoreline. Screen lengths would be about 26 feet, each with an effective screening area of approximately 105 inches. This would increase the size and shape of the intake facilities on the ocean floor and increase the footprint, including protective riprap, by 608 square feet, to include approximately 1,319 square feet not within the existing intake facility footprint. Screens would be spaced

approximately 3.8 feet from each other to maximize the sweeping velocities between screens to sweep debris and organisms away from the intake area (CSLC 2017).

The WWS will be constructed of stainless steel per the 2017 SEIR from the CSLCSLC. However, per applicant-proposed measure 8 (APM 8), if Poseidon "*demonstrates to the satisfaction of California State Lands Commission staff that the use of copper nickel alloy screens would not result in chemical leaching in excess of Ocean Plan Water Quality Objectives for Protection of Marine Life standards*", a copper nickel alloy (e.g., Z Alloy or a similar material) may be used to minimize biofouling. To minimize screen occlusion by free-floating debris, an airburst system will be included in the design (if technologically feasible).

Construction and installation of the WWS manifold and associated infrastructure would take approximately 3 months. Work would be conducted from a derrick barge moored above the existing HBGS intake tower and would be confined to the area directly surrounding the tower. The wedgewire screens would be fabricated at an off-site location, transported to the Port of Long Beach, loaded onto a support barge, and taken to the installation site. Onshore support vehicles at the Port of Long Beach may include pick-up trucks, forklift, crane, and wheel loader. Construction crews and vessels would vary depending on the scope of work occurring each day. In addition, two gravity anchor blocks would be installed, to be used if Poseidon implements a boat-based air burst screen cleaning system for screen maintenance. The gravity anchors would be installed during construction of the WWS intake system using the same vessels and crew as has been proposed for the WWS installation.

3.3.2 Intake Systems at Alternative Sites U2 and D2

The WWS would be mounted, with risers, to a new common header that would connect to a transition structure placed at the end of the new intake pipeline. The header would be oriented parallel to the shoreline and perpendicular to the intake pipeline. The WWS would be oriented perpendicular to the header and shoreline to maximize the wave-generated sweeping flows needed to keep the WWS free of debris. The intake pipeline would convey water from the ocean, through the onshore junction vault, to the connection with the existing HBGS intake pipeline.

The WWS array would be comprised of four 91-inch diameter WWS (3 plus one redundant) from Aqseptence (formerly Bilfinger Water Technologies) (or equal) with 1.0-mm slot widths (Figure 3). The overall screen lengths would be approximately 26 feet with an effective screening area of approximately 105 inches each. Individual WWS would be spaced one half of a screen diameter from each other to maximize the sweeping velocities between screens to sweep debris and organisms away. The WWS would stand at least one screen diameter above the seafloor.

The WWS will be constructed of stainless steel per the 2017 SEIR from the CSLC. However, per applicant-proposed measure 8 (APM 8), if Poseidon "*demonstrates to the satisfaction of California State Lands Commission staff that the use of copper nickel alloy screens would not result in chemical leaching in excess of Ocean Plan Water Quality Objectives for Protection of Marine Life standards",* a copper nickel alloy (e.g., Z Alloy or a similar material) may be used to minimize biofouling. To minimize screen occlusion by free-floating debris, an airburst system will be included in the design (if technologically feasible). As described above, the air compressors and receivers would be housed in a new aboveground building above the junction vault. In addition, the screens could be manually cleaned periodically by divers.

The WWS are designed to maintain a through-slot velocity of less than 0.5 feet/sec under all expected operating conditions. The design includes a fouling factor of 15%, meaning that under clean conditions, the design through-slot velocity is 0.43 feet/sec. All screens will be operable under typical conditions, meaning the through-slot velocity will be well below 0.5 feet/sec. In the event one screen is taken out of service, the intake system is designed to maintain a through-slot velocity below 0.5 feet/sec.

At the beginning of the onshore pipe segment, a vault would be constructed to provide a connection to the existing 14-ft diameter HBGS intake pipe. The onshore intake pipe segment would be installed via trench and fill, though since the excavation would be below the water table, much of the work would be completed in the wet. At the end of the onshore pipe segment, a vault would be constructed to turn the pipeline 90 degrees to head offshore. This vault would also include an aboveground building to house the airburst system. A trestle would be constructed from the shoreline to the offshore terminus to allow construction of the offshore intake pipe segment through the surf zone. The intake pipe would be installed in an excavated trench under the trestle, backfilled, and covered with rip rap armoring.

3.4 Intake Systems Technology and Equipment

3.4.1 Intake Systems E, U2, and D2

Narrow-slot cylindrical WWS have been proven for reducing impacts to marine organisms at water intakes. WWS are also designed to reduce impingement of organisms by providing a low through-slot velocity (0.5 feet/sec or less). At this low velocity, impingement is widely considered to be a non-issue (Gulvas and Zeitoun 1979; Zeitoun et al. 1981; Tenera 2010; SLC 2017 FSEIR) and meets the requirements of the OPA for minimizing impingement. Entrainment may be reduced with the presence of ambient currents (e.g., ocean, tidal) which can transport debris and non-motile early life stages with weak swimming abilities past or away from the intake.

Cylindrical WWS utilize wire that is V- or wedge-shaped in cross-section. The wedge-shaped wire eliminates the potential for debris to get lodged in the openings since the upstream side of the wire is narrower than the downstream side. The wire is welded to an internal framing system to form a slotted screening element (Figure 4). These screens have been biologically effective in preventing entrainment and impingement of fish and have not caused unusual maintenance problems in freshwater applications. However, the potential for clogging and biofouling remains a major concern in a marine environment where narrow-slot openings are required because marine larvae are typically smaller than freshwater larvae and few data are available on the performance in marine waters. For this reason, the use of copper nickel screening material is recommended due to its superior biofouling control performance.

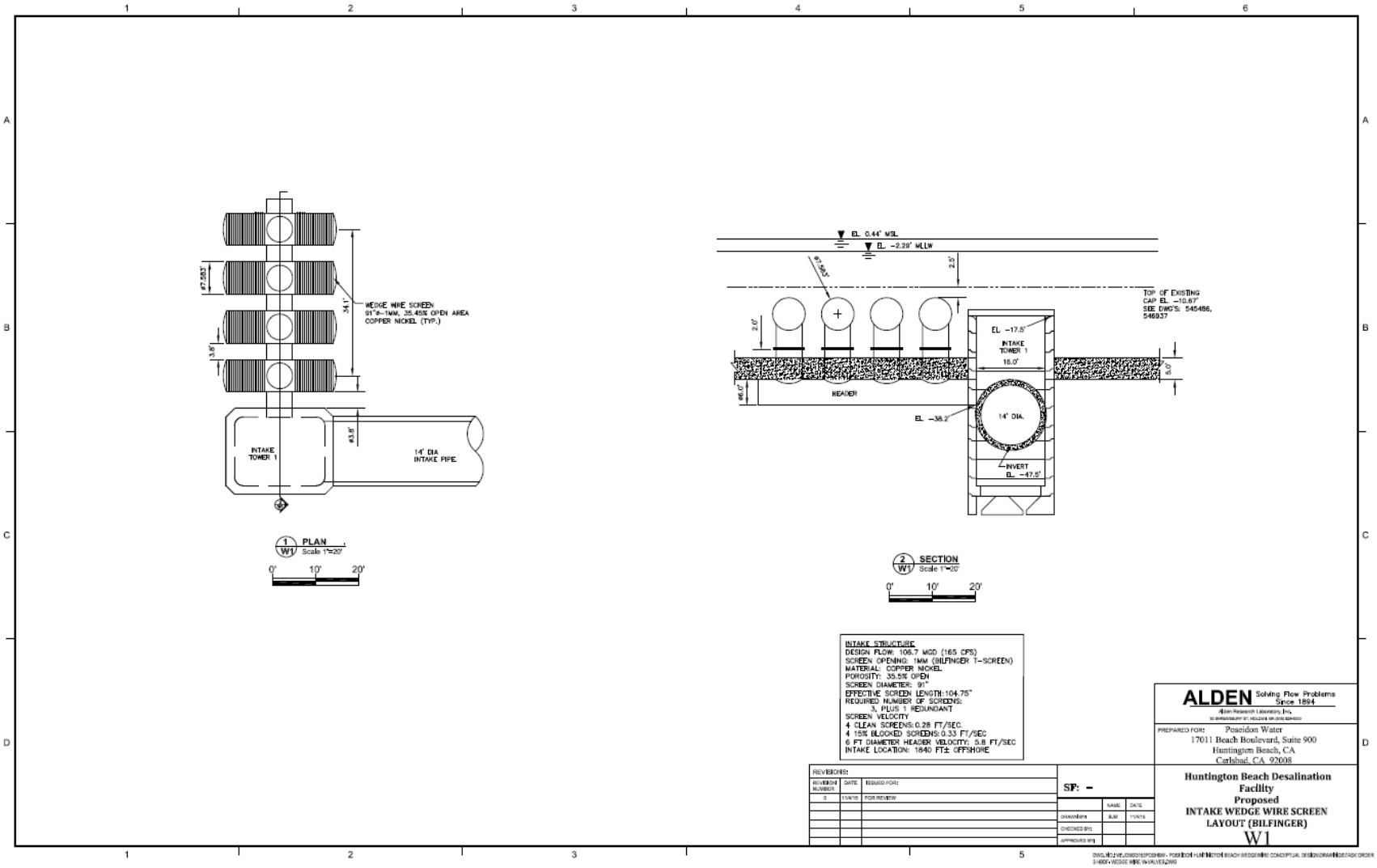

Figure 2. Plan and section views of 1-mm offshore wedgewire screens for long-term stand-alone operation.

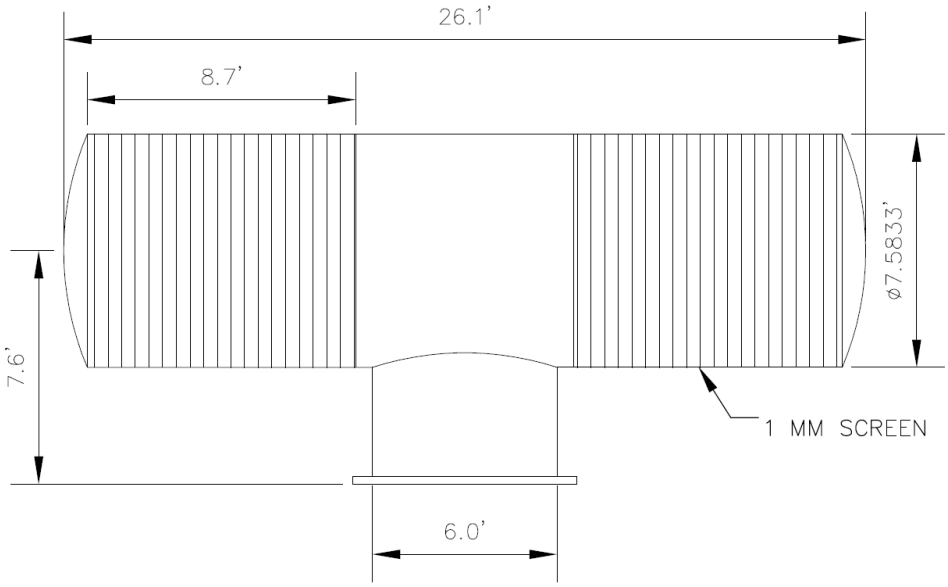

Figure 3. 91-in diameter cylindrical wedgewire screen.

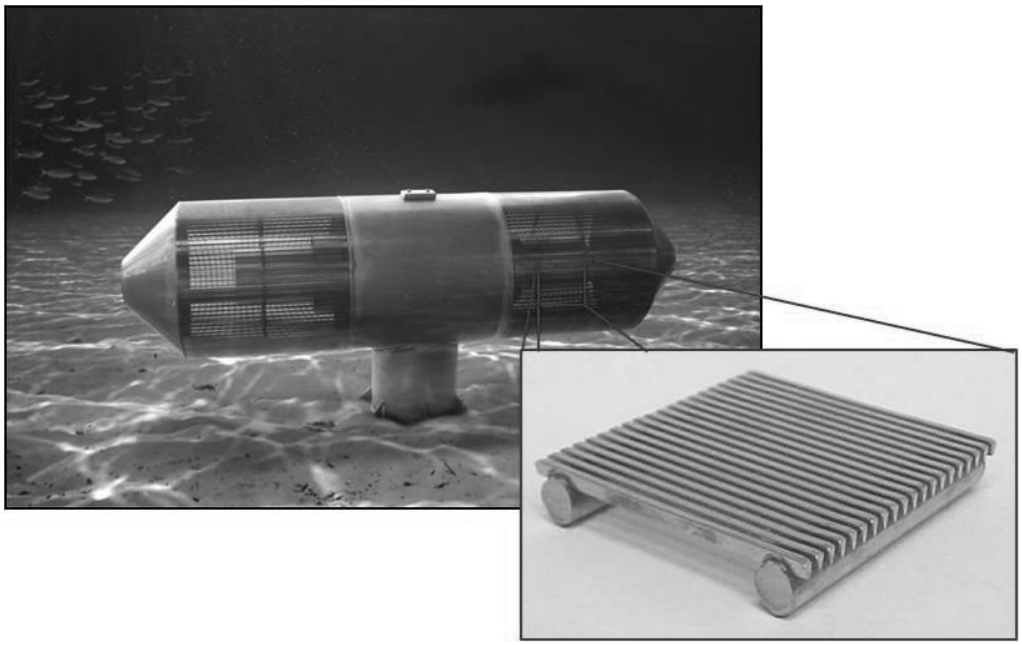

Figure 4. Cylindrical wedgewire screen, showing detail of v-shaped wedgewire (Image courtesy of Bilfinger Water Technologies, formerly Johnson Screens).

4 FEASIBILITY

4.1 Timing Feasibility

Implementation of an alternative intake site at either the U2 or the D2 sites would require various new permits and approvals including but not limited to:

- U.S Army Corps of Engineers (USACE) Section 404 permit
- National Environmental Policy Act (NEPA) and California Environmental Quality Act (CEQA) certifications including Section 7 (Endangered Species Act) consultations with U.S. Fish and Wildlife Service (USFWS) for California Least Tern, California Department of Fish and Wildlife (CDFW) for Grunion
- California State Lands Commission (CSLC) lease for portion of the new intake pipeline occupying lands held in public trust.
- Coastal Development Permit (CDP) issued by the California Coastal Commission (CCC)
- California Department of Park & Recreation easement for state beach impacts
- City of Huntington Beach easement for onshore and offshore construction
- Clean Water Act Section 401 permit and a Construction Dewatering permit issued by the Santa Ana Regional Water Quality Control Board

The applicability of each of these discretionary actions to the intake site E, U2, and D2 scenarios is presented in Table 1.

Table 1
Discretionary Actions per Intake Site E, U2, and D2

Agency	Action	Intake Site E	Intake Site U2	Intake Site D2
USACE	Section 404 permit	X	X	X
CSLC, USFWS, CDFW	NEPA and CEQA certifications and Section 7 consultations	_	X	X
CSLC	CSLC lease	X	X	X
CCC	Coastal Development Permit	X	X	X
California Department of Parks & Recreation	Easement for state beach impacts	X	X	X
City of Huntington Beach	Easement for onshore and offshore construction	_	X	X
Santa Ana Regional Water Quality Control Board	Clean Water Act Section 401 permit and a Construction Dewatering permit	X	X	X

Note: Intake sites marked with an "x" would be subject to the action. Intake sites marked with a dash would not be subject to the action. CSLC lease has already been obtained for Intake Site E.

The time frame for completion of these permits and approvals depends on the approach to processing that each of the responsible agencies selects, as well as the staffing, workload, and other processing issues with each of the agencies. For purposes of this analysis, we examine the best and worst-case scenarios for permit processing to provide context on overall time frame considerations.

Under the best-case (shortest) processing scenario, USACE may use a Nationwide Permit (NWP) to satisfy Clean Water Act Section 404 requirements. Use of a NWP would obviate the need to process an individual permit and to conduct a separate NEPA review. There are no exemptions that appear to be available for a CDP. Therefore, the alternatives would be subject to review by the CCC for consistency with the California Coastal Act. If found consistent, the CCC may issue a CDP, and may use the "CEQA-Equivalency" function of the CDP process to satisfy environmental review requirements under CEQA. If the CDP is issued prior to the CSLC's consideration of their action to grant a lease, the CDP may also satisfy CEQA requirements of the CSLC. Therefore, under the best-case scenario, the CDP process would drive the permitting schedule, and under a best-case processing schedule for a CDP, it is anticipated that CDP issuance would require one year, and as such, the best-case project permit processing schedule would be one year. However, it should be noted that an application for a CDP would require permission by the underlying property owner, which would include CSLC, State Parks, and/or the City of Huntington Beach in order for the CCC to deem the application complete. Actions by these agencies to approve such an application could be considered discretionary, and therefore subject to CEQA. As such, the option of relying on the CDP to satisfy CEQA would likely be infeasible because it would be out of sequence with actions related to approving the submittal of a CDP application.

The worst-case processing scenario would involve the following:

- USACE 404 Individual Permit, including NEPA Review and determination of Least Environmentally Damaging Alternative – Approximately 3-5 years
- CSLC Lease, or City of Huntington Beach easement preceding issuance of a CDP and CEQA Review – Approximately 1-2 year
- CDP Issuance – Additional 6 months to 1 year following CSLC action

It is likely that the federal and state processes could run concurrently, but would, in any case, likely take up to 5 years and possibly longer to complete. These time frames are based on in-water construction projects of similar scale and complexity. As shown in Table 2, the worst-case processing schedule for all necessary permits would be approximately 5 years.

The preliminary construction schedule for the installation of an alternative intake at the D2 or U2 sites is shown in Table 3. The preliminary schedule would commence after permits and approvals are granted. The schedule includes the timing for the onshore construction as well as the offshore work. The offshore work requires the use of vibratory hammers and limited impact pile driving equipment, and therefore the work has been restricted to comply with the whale migration requirements as described in the 2017 SEIR – June to November. The schedule also includes an 8-month schedule contingency to allow for unknowns and the risk of going past a whale migration work restriction season which would force work to stop until the next allowable work season. Additionally, onshore construction activities would not occur from mid-April to late September, because California least tern might be present in the vicinity of construction activities during these times.

Table 2
Processing Schedule

Phase	Duration (months)	Start	End
USACE 404 Individual Permit	60	Year 1 – Q1	Year 5 – Q4
CSLC Lease	24	Year 2 – Q1	Year 3 – Q4
CDP Issuance	12	Year 4 – Q1	Year 4 – Q4

Construction activities are described in detail in section 4.4.2 below. The construction schedule shown in Table 3 includes the timing for the onshore construction as well as the offshore work. The offshore work requires the use of vibratory hammers and limited impact pile driving equipment, and therefore the work has been restricted to comply with the whale migration requirements as described in the 2017 SEIR – July 1 through October 31. The schedule also includes an 8-month schedule contingency to allow for unknowns and the risk of going past a whale migration work restriction season which would force work to stop until the next allowable work season. The schedule also illustrates the relationship between the onshore desalination plant construction and construction of the new D2 intake system. The commissioning of the desalination plant can't begin until the intake system is installed. The removal of the trestle can, however, extend past the start of plant commissioning.

Table 3
Construction Schedule

Phase	Duration (months)	Start	End
Onshore: mobilization	1	Year 6 – Q1	Year 6 – Q1
Onshore: coffer dam construction and tie-in to existing 14 foot pipe	2	Year 6 – Q1	Year 6 – Q1
Onshore: placement of sheet piles, excavation, pipe laying, backfill	10	Year 6 –Q4 Year 7 – Q4	Year 7 – Q1 Year 8 – Q1
Offshore: mobilization	1	Year 6 – Q2	Year 6 – Q2
Offshore: trestle construction	9	Year 6 – Q3 Year 7 – Q3 Year 8 – Q2	Year 6 – Q4 Year 7– Q4 Year 8 – Q2
Onshore: construction of vault at pipe turn	1	Year 8 – Q1	Year 8 – Q1
Onshore: construction of manholes	2	Year 8 – Q1	Year 8 – Q1
Onshore: construction of 2,400 foot turn to trestle (placement of sheet	4	Year 8 – Q4	Year 9 – Q1

Table 3
Construction Schedule

Phase	Duration (months)	Start	End
piles, excavation, pipe laying, backfill)			
Onshore: demobilization	2	Year 9 – Q1	Year 9 – Q1
Offshore: construction of concrete tower, leveling piles	6	Year 8 – Q2 Year 9 – Q2	Year 8– Q3 Year 9 – Q3
Offshore: disassemble trestle	10	Year 9 – Q2 Year 10 – Q1 Year 11 – Q1	Year 9 – Q3 Year 10 – Q2 Year 11 – Q2
Offshore: set WWS and diffuser	2	Year 9 – Q3	Year 9 – Q3
Schedule contingency	6	Year 10 – Q1	Year 10 – Q2
Offshore: demobilization	2	Year 11 – Q2	Year 11 – Q2

The construction, demobilization, startup, and commissioning of the onshore desalination plant would take approximately 39 months. Commissioning would take 6 months and performance testing would take 1 month. The commissioning of the desalination plant cannot begin until the intake system is installed. The removal of the trestle can, however, extend past the start of plant commissioning.

Based on these estimates, and depending on the project development schedule variables, implementation of an alternative intake at either the U2 or D2 sites would require 11 to 13 years to complete, including five years for permitting and environmental clearances, and six to eight years for construction. In comparison, construction, startup, and commissioning of the desalination plant and intake E system would take approximately 39 months to complete and permitting would take approximately 15 months to complete, for a total of 4.5 years.

4.2 Technical Feasibility

4.2.1 Site Constraints

The construction and operation an intake that draws feedwater flow from either alternative intake site D2 or U2 would result in onshore constraints and offshore constraints that are described in the sections below. Figure 5 presents the general configuration of the components required for an intake at either of the sites.

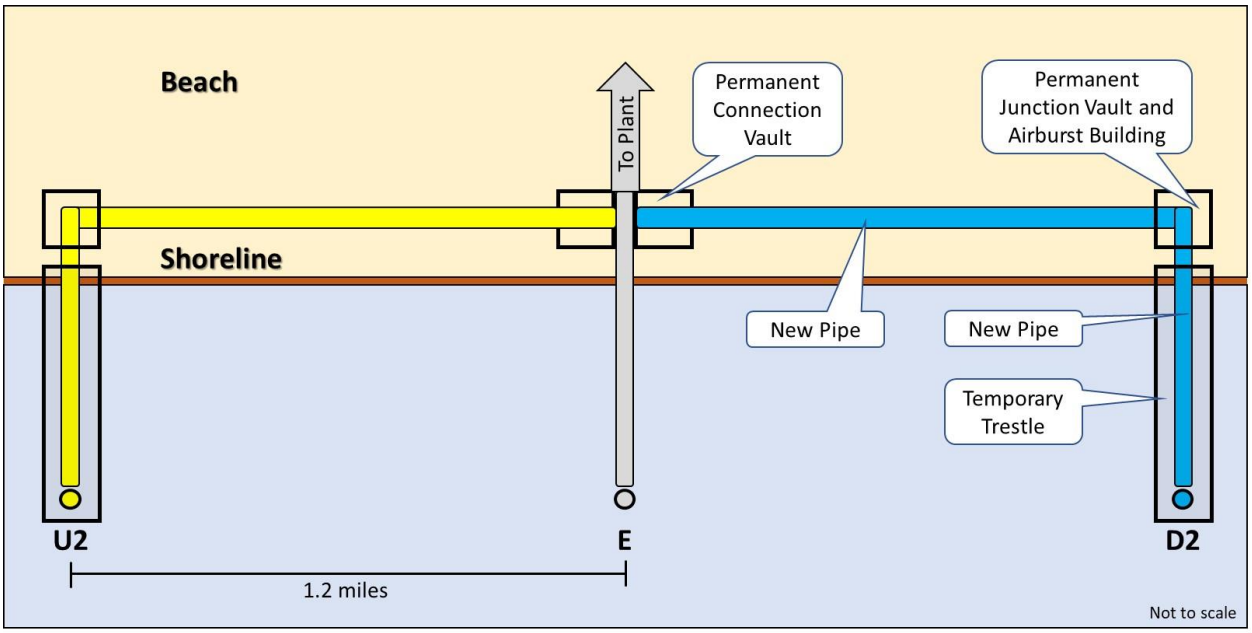

Figure 5. General configuration of the components required for an intake at alternative intake site D2 (blue) or U2 (yellow). Existing intake at E is shown in gray. Note: schematic not to scale.

Onshore Constraints

Installation of the 1.2-mile long intake pipeline under the State Beach would result in sequential closures of the beach and resulting loss of beach access and usage as the sheetpile cofferdams are advanced along the alignment in approximately 400-ft increments as the pipe sections are installed. The excavated trench for installing the 14-ft diameter pipe would be approximately 24 feet wide and 24 feet deep. The work area required for the 400-ft increments would be approximately 100 feet wide by 1,000 feet long.

In addition to the beach area required for pipe installation, an approximately 5-acre staging area would be required in close proximity to store/stage construction materials. These onshore construction-related impacts would be temporary but could persist for approximately 3 to 4 years. If seasonal access restrictions[1] are imposed in the permitting process, the duration of the onshore work could be extended beyond this estimate. During the construction work, access for large construction equipment would be required to move materials from the staging area to the construction zone.

The connection vault, junction vault (with associated aboveground airburst system structure), and series of manholes would constitute permanent losses of beach area which could include up to one acre including access roads. The desire to minimize the physical footprints and aesthetic impacts of these permanent structures represents another technical constraint to the design of an intake at either alternative intake sites. Figure 6 provides a general schematic of where the temporary and permanent beach impacts would occur for intakes located at D2 and U2.

[1] Seasonal access restrictions may include California Grunion spawning and California Least Tern avoidance. Additional recreational access restrictions are shown in Figure 7.

In a memo prepared by Geo-Logic Associates and submitted to the California Coastal Commission as part of the its 2015 Coastal Development Permit application, the HBDP would experience a total of 3.5 feet sea level increase over the 50-year project lifespan of the desalination project (Geo-Logic Associates 2015). More recent worst-case sea level rise projections from the California Ocean Protection Council suggest higher levels of sea level rise. The HBDP site is too far from intake sites D2 and U2 to accommodate an effective air burst system; therefore, the air burst system cannot be located at the HBDP site as an alternative.

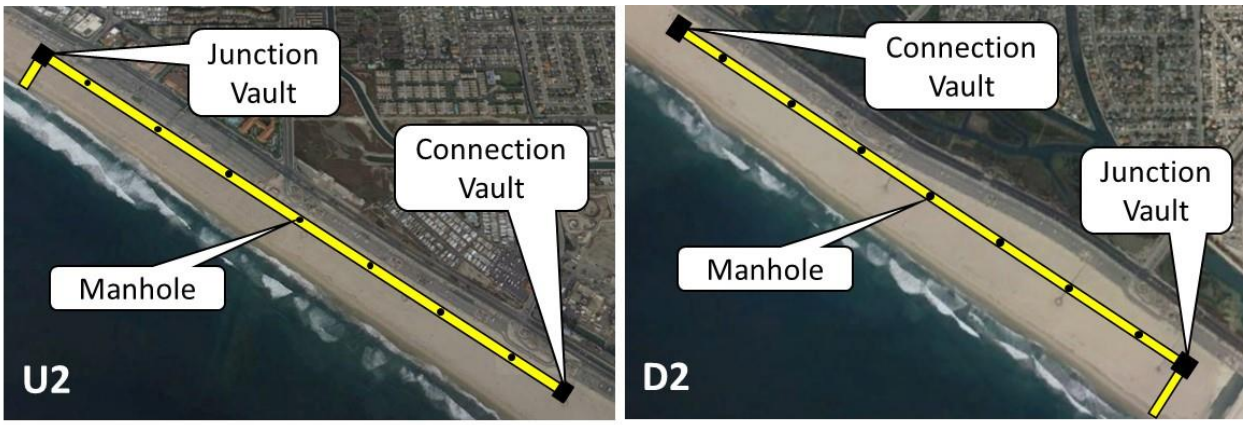

Figure 6. Temporary (yellow) and permanent (black) impact areas for the onshore portion of an alternative intake at Site U2 (left) and D2 (right). Note: schematic not to scale.

Huntington City Beach has 11 million visitors annually (https://www.surfcityusa.com/). Annual events would occur in the vicinity of or within the footprint of the construction area. The Great Pacific Airshow occurs in October and takes place in Huntington City Beach from Seapoint to Beach Boulevard. Additionally, the U.S. Open of Surfing takes place at the Huntington Beach Pier and occurs in late July to early August. Both of these events would occur during onshore and offshore construction activities. Onshore and offshore construction could create visual or noise impacts to these events. The construction footprint of intake site U2 may overlap with the U.S. Open, which could limit the event area or create hazards to U.S. Open participants or construction workers. Figure 7 provides a typical annual schedule of these events. While it is not anticipated that these events would significantly delay construction, the construction activities could impact the activities, some of which are major tourist-generating events for the City of Huntington Beach. Conflicts with these popular events raise questions about whether the City would issue the necessary permits and approvals for alternative intake sites.

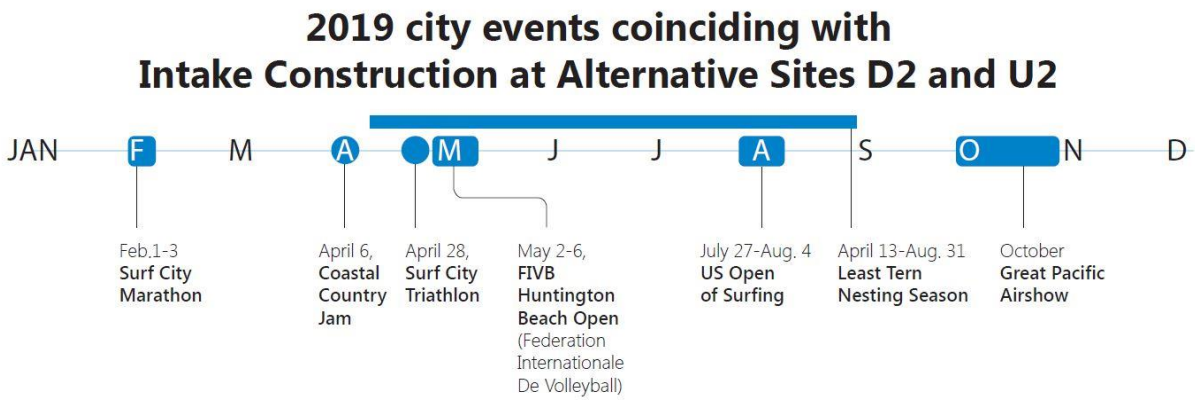

Figure 7. 2019 City of Huntington Beach events which would coincide with the construction of alternative intake sites D2 and U2.

Offshore Constraints

Construction of the offshore portion of the intake pipeline would occur in the high energy surfzone. To ensure the safe installation of a 14-ft diameter pipeline, a trestle would be required (Figure 8). Construction of the trestle would begin onshore by establishing and securing a construction work area adjacent to the beach parking lot. A ramp would be graded to transition from ground elevation to the trestle structure, extending the work area into the surf zone. The ramp would be constructed of engineered fill materials capable of supporting the cranes and other heavy equipment necessary to excavate and construct the intake structure. The engineered fill would be imported, placed, and removed at the termination of the construction activities.

The trestle would be constructed in a segmented fashion by driving piles, then securing the super-structure and deck, and would proceed from the shore to the intake site. The trestle would be approximately 1,900 feet long and would require the installation of temporary sheetpiles to provide shoring for the excavated pipe trench. The trestle construction and the sheet piles would be installed using a vibratory hammer, however, an impact pile hammer would be required on a portion of the piles to verify that structural members have reached refusal with the vibratory hammer (proofing the piles as described in the Technical Memorandum from HCSLLC regarding constructability considerations (GHD 2018)). Use of pile driving equipment would be limited to June-November to comply with the whale migration requirements. Additional seasonal restrictions may be imposed by the USFWS to protect the California Least Tern nesting season from pile driving noise, especially at the nearshore end of the trestle.

HCSLLC developed preliminary construction methods, sequencing, and schedule for an intake at alternative intake site D2; though the same methods and sequencing would apply to an intake at alternative intake site U2. These methods and sequencing are in detail in Section 4.2.2. The HCSLLC analysis is included as an appendix to the GHD Technical Memorandum (GHD 2018). The principal constraints affecting the installation of the offshore portion of the intake pipeline are the marine mammal, potential California Least Tern, and weather-related related delays. Commercial and recreational access to the offshore construction zone would not be allowed for safety reasons; therefore, any construction delays (e.g., storms) would extend the access closure period. Offshore construction could take 5 to 6 years.

Figure 8. Historic photograph of the trestle erected to support offshore construction of the Huntington Beach Generating Station

4.2.2 Constructability

HCSLLC developed preliminary construction methods and sequencing for an intake at alternative intake site D2; though the same methods and sequencing would apply to an intake at alternative intake site U2. These methods and sequencing are broadly discussed above in the Site Constraints section. This section provides greater detail on the constructability considerations.

Onshore construction would begin by excavating a connection vault (Figures 5 and 6) on the beach above and adjacent to the existing HBGS intake pipeline. The vault would need to be shored with sheetpiles driven by a vibratory hammer, a concrete base would be poured, and the vault would be dewatered. The existing HBGS 14-foot intake pipeline would be penetrated and the new 14-foot pipeline would be connected and sealed, a manhole access point would be added, and the excavation would be backfilled. Installation of the 1.2-mile long length of 14-ft diameter intake pipeline along the beach would be completed in 400-ft segments. A trench approximately 24 feet wide by 24 feet deep, and shored by sheetpiles and struts, would be excavated for the 400-ft length of each beach segment. The work area for each 400-ft beach segment would be approximately 100 feet by 1,000 feet. The new pipe would be installed in the trench (in-the-wet since the water table is higher than the bottom of the excavation) and backfilled. Once a 400-ft beach segment is backfilled, the sheetpiles would be removed, advanced, and reinstalled to begin installation of the next 400-ft segment. Manholes would be installed at 800-ft increments along the beach alignment (see black dots in Figure 6). At the end of the 1.2-mile alignment, a junction vault (Figures 5 and 6) would be constructed to accommodate a 90-degree bend. In addition, at the junction vault, air compressors and air

receivers would be located to supply air for the air burst system. The added distance from the plant site (HBGS) would require placement the air compressors and receivers closer to the WWS. The vault would be constructed in the same manner as the connection vault.

From the junction vault to the shoreline location where the trestle installation would begin, pipe would be installed as described for the onshore beach alignment.

Offshore construction would be accomplished with a marine trestle erected from a point on the beach to the offshore terminus where the WWS array would be located. The marine trestle would be approximately 30 feet wide, 30 feet above the water surface, and supported by piles spaced at 15-ft intervals. The trestle and sheetpiles would be installed with vibratory hammers and structural members would have to be checked for proper installation ("proofed") with an impact hammer. Sheetpiles would installed (via vibratory hammer) on either side of the trestle to shore the excavated trench for the new 14-ft intake pipeline and proofed with an impact hammer. The trench would be excavated with a clamshell from the trestle and the pipe would be installed, backfilled, and covered with riprap armoring. The actual depth of the trench would be determined at the design phase, but would need to be sufficient to ensure protection from scour. The trenching and pipeline installation would proceed in sequential stages such that the sheetpile shoring could be removed and cycled ahead to the next offshore installation segment. At the offshore terminus of the intake pipeline, a transition structure would be constructed to connect the new inlet pipeline and manifold for the WWS. For the constructability analysis, the transition structure was assumed to be pre-cast concrete of a similar size to the existing intake structure at site E. The transition structure would be supported on piles and the base of the structure would be sealed using tremie-placed concrete. The WWS array and manifold would then be installed by dredging, placing the subsurface manifold and then placing the WWS base structure. The WWS base would likely require pile supports. The WWS units would then be placed on top of the base structure as described in the 2017 SEIR (CSLC 2017).

Heavy construction (shoring, excavation, pipe installation) would occur both onshore (along the beach) and offshore. The equipment required to construct the onshore and offshore components of an intake at either alternative intake site (D2 or U2) is commercially available and HCSLLC has provided a preliminary cost estimate. As such, there are no real construction equipment-related constraints; however, due to the lack of operational performance data for narrow-slot WWS screens in a fully marine environment, there are technical concerns relative to the rate of fouling and potential for occlusion of the 1-mm WWS in a fully marine environment. In addition, the technical feasibility of using an airburst cleaning system for managing free floating debris for screens located 1,840 feet offshore is uncertain due to the challenges of delivering compressed air that distance. Instead, the screens may have to be manually cleaned periodically by divers. A redundant screen would provide the ability to remove a screen for repair without affecting the intake flow rate and without exceeding the 0.5 feet/sec through-slot velocity.

The constructability analysis provided by HCSLLC (GHD 2018) outlines a construction method and sequence that results in a long construction duration. Due to the extended construction duration resulting from seasonal restrictions and weather-related contingencies, construction of the onshore desalination plant would be completed approximately 1.5 years before the new intake at alternative intake site D2 or U2 is completed. While the technical methods are available to construct an intake at either site, the viability of doing so must take into account the other feasibility criteria, namely the economic, schedule, environmental, and social factors. Please refer to the other sections of this report for an analysis of these other feasibility criteria.

4.3 Economic Feasibility

The economic analysis for either alternative intake site is the same, because the costs of implementing either option would be similar, due to similar distances from the treatment facility and similar construction methods and site conditions.

This section presents the results of the construction cost analysis of an intake at either the U2 or D2 site. Direct construction costs are estimated at approximately $215,000,000. The analysis also addresses capitalized interest to account for financing costs.

The analysis compares the present value capital, and financing costs that occur over the lifetime of the desalination facility under two scenarios (i.e., high and low estimates). Costs are presented in the year of Financial Closing and include Capitalized Interest for bonds over the 6 to 8-year construction period. The analysis also assumes that interest expense costs are higher in the future years (6.0% in 2024). Based on the variable construction period assumptions, the analysis factors in additional Development costs of $10m per year, and Construction Management costs of $0.5m per year, during the extended development and construction periods. Additional assumptions include a Level Construction Draw of 20% drawn in Year 1 and 5% in the last year, and for increases in the O&M and Working Capital Reserves a percent of Capital Cost was assumed. Note that the 6-8 year construction time frame would commence after the estimated worst-case 5-year period necessary for permitting and environmental clearances.

Based on those assumptions, the cost estimate is $510,000,000 (2024). Assuming approximately $1 billion cost estimate for the proposed HBDP absent relocation of the intake, the relocation would add approximate 50% to the total project costs.

Water Code section 13142.5(b) requires an Owner/Operator of a desalination facility use the best available site, design, technology, and mitigation measures *feasible* to minimize the intake and mortality of all forms of marine life at new or expanded desalination facilities. Therefore, the purpose of this feasibility assessment is to examine whether the alternatives avoid or substantially lessen impacts at feasible costs.

A comparative analysis of entrainment effects and resulting mitigation in the form of Area of Production Forgone (APF) was conducted for the alternative intake sites and presented in a report entitled “Huntington Beach Desalination Plant Intake Site Determination: Multiple Lines of Evidence Analysis”, prepared by Miller Marine Science and Consulting, October 12, 2018. The report comprises analyses of existing data to determine which site sampled during the 2003-04 entrainment study offshore Huntington Beach, California represented the site likely to result in the least intake and mortality of all forms of marine life. A more complete discussion of the findings of this report is contained in Section 4.4 of this feasibility assessment. The report, and subsequent review by the Neutral Third-Party Reviewer (NTPR; Raimondi 2018), concluded the ETM/APF study design as applied to date by state regulatory agencies and described in the OPA was inappropriate for the D2 and U2 alternative intake site analysis. Alternative analyses using uniformly collected ecological data from all three intake sites (U2, D2, and E) concluded no significant difference in the estimated risk of intake and mortality to all forms of marine life existed between the three sites. Therefore, they do not avoid or substantially lessen impacts and no ecological benefit can be ascribed to relocating the intake to either alternative intake site. The additional $510M construction costs of the intake location alternatives to Site E cannot be associated with any significant benefits provided by the alternatives in reducing impacts on all forms of marine life.

4.4 Environmental Feasibility

4.4.1 Biological Resources

Terrestrial Life

Construction Impacts

Biological effects associated with onshore and offshore construction would be primarily associated with the temporary removal of habitat. Additionally, indirect effects associated with noise could occur. Increased noise levels can also have negative effects on sensitive biological species through the alteration of behavior that can reduce breeding activity, increase predation, and result in the abandonment of habitat. Additional construction windows may be imposed to protect California Least Tern breeding season, as discussed in Section 4.1.

Operational Impacts

Habitat loss may occur with the construction of the aboveground building, which would house the air compressors and receivers for an airburst system. Depending, on the location, this may result in the loss of California Least Tern habitat. During operation of an intake at D2 or U2, noise would be generated from the operation of the air burst system. Although this equipment would be properly housed and screened so that noise would be attenuated over a short distance, this could cause a nuisance to terrestrial species.

Aquatic Organisms

The most significant impacts to aquatic organisms caused by desalination intake structures are broadly categorized into: 1) construction impacts and 2) operational impacts (impingement and entrainment). Construction impacts relate to the temporary and permanent disturbances to the benthos and temporary turbidity generated by the construction. Operational impacts represent an interaction between the organisms in the source waterbody and the screening technology and each is dependent on organism and screen mesh size. A discussion follows that describes each of these impacts in greater detail for the two proposed intake sites considered.

Construction Impacts

Habitat Loss

Construction of the offshore site at any of the alternative intake sites would result in the permanent loss of a small amount of benthic habitat equivalent to 0.088 acres. Temporary disturbances associated with installation of the offshore portion of the intake pipeline for D2 or U2 may include the potential for increased turbidity and underwater noise. Increased noise levels can also have negative effects on sensitive biological species through the alteration of behavior that can reduce breeding activity, increase predation, and result in the abandonment of habitat. Although, it should be noted that the offshore construction work would be restricted to comply with the whale migration requirements as described in the 2017 SEIR and to comply with California Least Tern restrictions.

Operational Impacts

The seawater intakes under consideration at alternative intake site D2 or U2 would be located offshore in the Pacific Ocean. Feedwater for the proposed HBDP would be withdrawn through a new offshore 1-mm WWS

array. Organisms that could be potentially impacted by the seawater intake include those occurring near the water withdrawal point offshore. These are typically pelagic fishes commonly reported in the nearshore water-column habitat, including some species important to the commercial and sport fishing industries.

Because the siting of the intake correlates to the risk of entrainment (an operational impact), consideration must also be given to the distance of the intake from marine protected areas (MPAs), other sensitive habitats, and sensitive species. Furthermore, analyzing the location of the intake is an explicit requirement of section III.M.2.b, of the OPA.

Impingement

Impingement is the pinning of larger organisms against the screen mesh by the flow of the withdrawn water. The magnitude of impingement losses for any species from intake operation is a function of the involvement of the species with the intake (number or proportion impinged) and the subsequent mortality of those organisms (referred to as impingement mortality or IM).

Intake velocity is commonly accepted to be the strongest predictor of impingement. Furthermore, a through-screen velocity of 0.5 feet/sec or less has been identified for being protective of impingeable sized fish. Per the OPA, the State Water Resources Control Board (SWRCB) has prescribed a through-screen velocity no greater than 0.5 feet/sec in order to minimize impingement at seawater desalination intakes.

The WWS for the proposed HBDP intake structure are designed as passive screens with a through-screen velocity that is 0.5 feet/sec or less at all times including when up to 15% fouled. As passive screens, no active handling of fish is required. Based on the passive design and the low through-slot velocity, there would be no impingement (i.e., no APF mitigation acreage). This applies to both alternative intake sites D2 and U2.

Entrainment

Entrainment is the passage of smaller organisms through the screening mesh. The magnitude of entrainment losses for any species from intake operation is a function of the involvement of the species with the intake (number or proportion entrained) and the subsequent mortality of those organisms as they pass through the process equipment (referred to as entrainment mortality).

Per the OPA, the SWRCB has prescribed screens with 1.0-mm mesh in order to reduce entrainment at seawater desalination intakes. To comply with the OPA, Poseidon has selected a 1.0-mm slot width for the offshore WWS. Despite the narrow-slot width, some marine organisms will be entrained.

Poseidon has been engaged with the staff of the SWRCB, Santa Ana Regional Water Quality Control Board, and CCC (Agency Staff) since May 2017 in an effort to estimate the entrainment impacts at multiple proposed intake sites. Furthermore, since July 2018, Poseidon has been working with Agency Staff and a NTPR to identify the best available intake site absent feasibility considerations. Poseidon's final submittals and final draft NTPR report both conclude 1. It is not appropriate to apply the ETM/APF method to the intake site determination analysis because the study design is not meant to compare entrainment between and among different intake sites and; 2. Analyses of data collected uniformly across all potential intake sites to assess entrainment impacts found no statistically significant differences between the entrainment at alternative intake sites U2 and D2 in comparison to proposed intake site E.

Beyond the numerical analyses used to determine the potential intake and mortality of all forms of marine life, Section III.M.2.b. of the OPA requires the project applicant to address seven criteria to answer the

question of whether the best available intake site identified project. Perhaps the most critical among the siting criteria are those that address the site of the intake relative to MPAs, sensitive habitats, and sensitive species. Section III.M.2.b.(7) specifically states that surface intakes shall be sited so as to maximize the distance from a MPA or SWQPA. Potential intake site U2 is indisputably the closest to the nearest MPAs in Bolsa Chica Wetlands and should be eliminated from further consideration. Similarly, siting an intake at D2 would pose the maximum risk to sensitive species (Giant Sea Bass) that have been documented to occur in that area. Entrainment at proposed intake site E poses the minimal risk to sensitive species and sensitive habitats. Considering the homogeneity of the sandy, soft-bottom habitat in the offshore area near Huntington Beach, there is no ecological rationale to support moving the screened intake to alternative sites D2 or U2; the three sites are functionally indistinguishable. Given this, it is much more likely that any numerical differences in larval abundances, while statistically insignificant, are the result of natural inherent variation in plankton rather than differences in habitat.

4.4.2 Air Quality

Construction and operation of the alternative intake systems would produce criteria air pollutants for which the U.S. Environmental Protection Agency (EPA) and California Air Resources Board (CARB) have adopted ambient air quality standards (i.e., the National Ambient Air Quality Standards (NAAQS) and the California Ambient Air Quality Standards (CAAQS)). The HBDP is located within the South Coast Air Basin (SCAB) and is within the jurisdictional boundaries of the South Coast Air Quality Management District (SCAQMD). The SCAQMD sets forth quantitative significance thresholds for the maximum daily criteria air pollutant emissions (measured in pounds per day), which, if exceeded, would indicate the potential to contribute to violations of the NAAQS or CAAQS (SCAQMD 2015).

Construction Impacts

Criteria air pollutant emissions associated with construction of the alternative intake systems would occur from on-site and off-site sources. On-site sources of criteria air pollutant emissions primarily include the use of off-road construction equipment as well as soil and materials movement, while off-site sources include truck hauling of sand and bedding, vendor trucks delivering construction materials, and construction worker vehicles. Table 4 outlines the construction equipment required for construction of either the U2 or D2 alternative intake systems and Table 5 outlines the anticipated construction schedule for either scenario.

Table 4
Anticipated Construction Equipment

Equipment	Quantity
Onshore Work	
Crawler crane (150 ton)	2
Off road truck (30 ton)	3
Vibratory pile hammer	2
Hydraulic excavator (70 ton)	1
Wheel loader	1
Forklift	2

Table 4
Anticipated Construction Equipment

Equipment	Quantity
Portable generator	1
Welding machine	1
Air compressor	1
Offshore Work	
Crawler crane (150 ton)	2
Self-powered flat deck material cart	1
Gantry pipe-laying machine	1
Vibratory pile hammer	1
Impact pile hammer	1
Clamshell excavator	1

Source: GHD 2018.

Table 5
Anticipated Construction Schedule

Phase	Duration (months)	Start	End
Onshore: mobilization	1	Year 6 – Q1	Year 6 – Q1
Onshore: coffer dam construction and tie-in to existing 14 foot pipe	2	Year 6 – Q1	Year 6 – Q1
Onshore: placement of sheet piles, excavation, pipe laying, backfill	10	Year 6 –Q4 Year 7 – Q4	Year 7 – Q1 Year 8 – Q1
Offshore: mobilization	1	Year 6 – Q2	Year 6 – Q2
Offshore: trestle construction	9	Year 6 – Q3 Year 7 – Q3 Year 8 – Q2	Year 6 – Q4 Year 7– Q4 Year 8 – Q2
Onshore: construction of vault at pipe turn	1	Year 8 – Q1	Year 8 – Q1
Onshore: construction of manholes	2	Year 8 – Q1	Year 8 – Q1
Onshore: construction of 2,400 foot turn to trestle (placement of sheet piles, excavation, pipe laying, backfill)	4	Year 8 – Q4	Year 9 – Q1
Onshore: demobilization	2	Year 9 – Q1	Year 9 – Q1

Phase	Duration (months)	Start	End
Offshore: construction of concrete tower, leveling piles	6	Year 8 – Q2 Year 9 – Q2	Year 8– Q3 Year 9 – Q3
Offshore: disassemble trestle	10	Year 9 – Q2 Year 10 – Q1 Year 11 – Q1	Year 9 – Q3 Year 10 – Q2 Year 11 – Q2
Offshore: set WWS and diffuser	2	Year 9 – Q3	Year 9 – Q3
Schedule contingency	6	Year 10 – Q1	Year 10 – Q2
Offshore: demobilization	2	Year 11 – Q2	Year 11 – Q2

Construction of the alternative intake system would occur concurrently with the plant construction. As described in the 2010 Subsequent EIR, construction of the plant would result in an exceedance of the daily SCAQMD construction threshold for oxides of nitrogen (NOx). Therefore, the construction of the alternative intake system would contribute further to the exceedance of this SCAQMD construction threshold. Because a detailed construction scenario is not available at this time, it is not known if the emissions associated with the construction of the alternative intake systems combined with the plant construction would result in an exceedance of SCAQMD construction thresholds for volatile organic compounds (VOCs), carbon monoxide (CO), sulfur dioxide (SO_2), particulate matter with an aerodynamic diameter equal to or less than 10 microns (PM_{10}), and particulate matter with an aerodynamic diameter equal to or less than 2.5 microns ($PM_{2.5}$). However, it is possible that such an exceedance would occur, considering the amount of heavy construction equipment required for onshore and offshore construction that would operate concurrently.

Operational Impacts

Operation of the alternative intake system would generate criteria air pollutant emissions primarily from mobile sources such as worker and vehicle trips associated with maintenance. The operation of the alternate intake system would also require the use of area sources, which would result in direct emissions from the use of maintenance equipment and indirect emissions associated with electrical power generation associated with the energy requirements for pumping. Although operation of these area sources would be required for the intake site E system, the alternative intake system would result in additional emissions because the length of the intake pipeline would increase as compared to the intake site E system. This would result in a longer duration of maintenance equipment use and would require additional electricity for pumping.

4.4.3 Energy and Greenhouse Gas (GHG) Emissions

As described in the 2017 SEIR, short-term construction-related GHG emissions and changes in operational emissions would be subject to the SCAQMD threshold of 10,000 metric tons of carbon dioxide equivalent (MTCO2e) for annually recurring emissions from stationary sources (SCAQMD 2015). To compare against this threshold, emissions from construction activities are amortized over the presumed project's life, although construction activities are normally dominated by mobile sources rather than stationary sources.

For these reasons, 10,000 MTCO2e can be used to determine whether project-related GHG emissions would have a significant impact on the environment.

Construction Impacts

Construction activities would require the use of petroleum and would require small amounts of electricity, and thus would generate GHG emissions. Specifically, the use of off-road construction equipment as well as soil and materials movement, truck hauling of sand and bedding, vendor trucks delivering construction materials, and construction worker vehicles would require petroleum and would generate GHG emissions. Table 4 outlines the construction equipment required for construction of either the U2 or D2 alternative intake systems and Table 5 outlines the anticipated construction schedule for either scenario.

As described in the 2017 SEIR, installation of the screens and diffuser would cause an increase in GHG from marine vessels and construction equipment and construction emissions would total 71.64 MTCO2e, and these may be amortized over a presumed 50-year project life for the HBDP to arrive at an annual GHG emissions impact of 1.43 MTCO2e for construction of the intake and discharge modifications. These emissions would combine with HBDP construction emissions, which on their own would result in approximately 822 MTCO2e from on-site construction plus 1,233 MTCO2e from off-site construction activities (Poseidon 2017c). Construction-related GHG emissions would not represent a long-term source of GHG emissions, and the quantities would be small in relation to the 10,000 MTCO2e threshold. If the onshore and offshore construction activities associated with the alternative intake systems are similar in scale to the installation of the screens and diffuser and HBDP construction activities, then the alternative intake construction GHG emissions combined with the anticipated construction emissions associated with the HBDP would be significantly below the 10,000 MTCO2e threshold.

Operational Impacts

Operation of the alternative intake system would require petroleum and generate GHG emissions primarily from mobile sources such as worker and vehicle trips associated with maintenance. The operation of the alternative intake system would also require the use of maintenance equipment, which would require petroleum and pumps, which would require electricity. Although operation of these area sources would be required for the intake site E system, the alternative intake system would result in additional emissions because the length of the intake pipeline would increase as compared to the intake site E system. This would result in a longer duration of maintenance equipment use and would require additional electricity for pumping.

As described in the 2017 SEIR, over the longer-term period of operation of the intake and discharge structures, maintenance to manually clean the offshore wedgewire intake screens would involve a small number of worker vehicle trips and use of a crew boat during one or two days every two months. This would result in emissions that would recur at a rate of 6.62 MTCO2e per year and if the rotating screen option is implemented, the motors would consume electricity at a rate of approximately 52 MWh/year, resulting in 14.12 MTCO2e per year of additional indirect emissions for the power supply. These operation and maintenance GHG emissions would be small in relation to the 10,000 MTCO2e threshold. If the onshore and offshore maintenance and operation activities associated with the alternative intake systems are similar in scale to the installation of the screens and diffuser and HBDP operation activities, then the alternative intake operation GHG emissions combined with the anticipated operation emissions associated with the HBDP would be significantly below the 10,000 MTCO2e threshold.

4.4.4 Land Use

Construction Impacts

Loss of recreational land use access and usage would occur within the construction area by limiting or precluding access to the beach and shoreline in the onshore and offshore construction areas. Shoreline access restrictions may occur due to the presence of the trestle structure, and diversion of vehicular, bicycle and pedestrian traffic from the construction and staging areas may also occur. In addition to physical displacement of recreation opportunities within the construction zones, the placement of the construction areas could restrict access and circulation in and around the State Beach area. Furthermore, construction noise in the vicinity of beach areas could disrupt use of these areas by the public due to nuisance noise issues. Installation of sheet pile and trestle construction could have adverse effects on the shore break, affecting recreational activities, including surfing, which is an important recreational asset.

In 2015, the Coastal Commission's ISTAP Phase II report evaluate the environmental, economic and social feasibility of a subsurface intake for the Huntington Beach Desalination Plant (HBDP application appendix G)) – specifically a subsurface infiltration gallery (SIG). The construction methods for a SIG would be similar to that of constructing a new intake at either the U2 or D2 sites in that a trestle would be required for marine construction in either case. Specifically, construction of a trestle for marine work would involve disturbance and preclusion of access to an area of beach and parking lot of approximately four acres. The analysis of the ISTAP 2 is useful in assessing the impacts of the alternative intakes on land use and recreation because of the similarity in the nature and extent of construction activities. The ISTAP 2 determined that construction activities including preclusion of access to a 4-acre area of beach throughout the construction period would be a "Major concern". Therefore, in the context of this feasibility analysis, the construction of either the U2 or D2 alternative intake systems would result in a temporary land use conflict that would be considered significant.

Operational Impacts

Operational impacts would be similar to those of the intake site E, because the intake would be installed underground and below the sea floor, with the exception of the WWS array. For either the D2 or U2 intake sites an aboveground building would be constructed to house the air compressors and receivers for an airburst system. The location and approximate size of this aboveground building is not known, but it is estimated that the total area occupied by these facilities would be approximately one acre. Because some of this area (access roads, easements, etc.) would be available for joint uses such as parking, it is not anticipated that significant land use conflicts would result.

4.4.5 Aesthetics

Construction Impacts

Construction of either the D2 or U2 alternative intake system would result in visual effects during onshore construction activities. Sheet piles would be required to shore the trench required for the onshore pipeline. The sheet piles would be a few feet above grade after placement and would be provided to shore 400 feet of trench at a time. An external frame at the top of the sheet piles with horizontal struts at approximate 24 feet intervals would be needed to support the shoring system. Additionally, a work area of approximately 100-feet wide by 1000-feet long would include shoring, excavation, pipe laying, backfill, and shoring removal operations. Lastly, a staging area would be located in a footprint of approximately five acres on

the beach adjacent to the work area. The staging area would stage pipe, bedding materials, and shoring materials. Onshore activities would occur over a 1 year and 8-month period.

Construction of either the D2 or U2 alternative intake system would also result in visual effects during offshore construction activities and presence of construction trestle system. The trestle would be 1,900 feet in length and would be an open structure with steel pipe piles, cap beams, and rail beams to carry gantry-mounted equipment. The elevation of the top of the rail would be approximately 30 feet. Sheet pile shoring would also be required as part of offshore pipeline installation. The sheet pile shoring would be pulled in stages and moved ahead for use in the next pipe installation stage. Although construction activities would only occur outside of the whale migration work restriction season, the trestle would remain in place during the entirety of the offshore work construction period (except during mobilization and demobilization). Therefore, the trestle would be present for 6 years, although disassembly of the trestle would occur during the last 3 years of this period.

Lighting would be provided on the walkway of the marine trestle for safe access and to illuminate the trestle to reduce the potential for a hazard to mariners and members of the public. This would introduce new sources of light to the State Beach and could be considered a nuisance to visitors of the State Beach and nearby residents.

Although temporary, offshore and onshore construction would introduce significant visual changes to a visually sensitive area.

Operational Impacts

Visual impacts associated with the operation of either the D2 or U2 alternative intake would be similar to those of the intake site E, because the intake would be installed underground and below the sea floor. For either the D2 or U2 intake sites, an aboveground building would be constructed to house the air compressors and receivers for an airburst system. The location and approximate size of this aboveground building is not known, but it is not anticipated to result in significant visual impacts. Maintenance activities are not anticipated to result in significant visual impacts because these activities would be constrained to the area immediately surrounding the proposed vaults.

4.4.6 Hazards

Construction Impacts

Construction of either the U2 or D2 alternative intake systems would involve the use and transport of commonly used hazardous substances, such as gasoline, diesel fuel, lubricating oil, grease, and solvents. Chemicals and hazardous materials used during onshore and offshore construction would be used in quantities below the levels deemed to be significant hazards to the public or the environment, as defined by the applicable federal, state, and local hazardous materials handling and management regulations. Project-related construction does not generate or require disposal of hazardous materials, and would not create new hazards to the public or the environment.

The marine trestle required for offshore construction could experience structural damage from high wave energy, tsunami events, or seismic induced risks including damage or inoperability. Considering offshore

work would occur over multiple years this could expose offshore construction workers to risks associated with these events.

Operational Impacts

Operation of the alternative intake systems would not substantially change the potential environmental effects as compared to the intake site E system. In a worst-case scenario, maintenance activities could involve the use of common hazardous substances used for marine vessel operations such as gasoline, oil, and other chemicals. Chemicals and hazardous materials used during operation and maintenance would be used in quantities below quantities deemed to be significant hazards to the public or the environment, as defined by the applicable federal, state, and local hazardous materials handling and management regulations. Operation and maintenance activities do not include the generation or disposal of hazardous materials, and would not create new hazards to the public or the environment.

Operation of the alternative intake systems would not substantially change the potential environmental effects associated with high wave energy, tsunami events, and seismic induced risks as compared to the intake site E system. Although occasional maintenance would occur, maintenance workers are not anticipated to be exposed to additional risks as compared to the intake site E system.

4.4.7 Noise

Construction Impacts

Noise from construction activities associated with the alternative intake system would temporarily increase noise levels at nearby noise-sensitive receptors including recreational land uses for the D2 intake site and including residential, hotel, and recreational land uses for the U2 intake site. Noise can cause a nuisance to residents, workers, and visitors. Increased noise levels can also have negative effects on sensitive biological species through the alteration of behavior that can reduce breeding activity, increase predation, and result in the abandonment of habitat. This could restrict onshore construction windows to protect California Least Tern breeding at the two sites in the overall Huntington Beach Area. Further restrictions would likely be imposed to protect California Grunion spawning along the beach. However, it should be noted that the offshore construction work would be restricted to comply with the whale migration requirements as described in the 2017 SEIR and to comply with California Least Tern restrictions.

Noise would be generated by the use of heavy construction equipment throughout the entire construction period. Additionally, off-site noise along access routes to and from the site would increase due to movement of equipment, workers, and materials. The noise levels created by construction equipment could vary greatly depending upon factors such as the type and specific model of the equipment, the operation being performed, the condition of the equipment, and attenuation due to intervening topography and vegetation. Generally, construction-related noise would increase with the amount of heavy construction equipment that is operated simultaneously. Based on the construction equipment requirements previously described in the Air Quality analysis, the alternative intake system would require the simultaneous operation of construction equipment during onshore and offshore work. Construction for the alternative intake system would last longer than what would be required for the intake site E system. Therefore, sensitive receptors would be exposed to construction noise for a significantly longer amount of time as compared to the construction associated with the intake site E system. Additionally, the onshore and offshore construction work

associated with the alternative intake systems would be located in areas not originally anticipated in the 2017 SEIR, thus exposing additional sensitive receptors to nuisance construction noise.

Persons residing and working in the area surrounding the project could be exposed to the generation of excessive groundborne vibration or groundborne noise levels related to construction activities. The results from vibration can range from no perceptible effects at the lowest vibration levels, to low rumbling sounds and perceptible vibrations at moderate levels, to slight structural damage at the highest levels. Site ground vibrations from construction activities very rarely reach the levels that can damage structures, but they can achieve the audible range and be felt in buildings very close to the site. The primary source of high groundborne noise levels would be created by the use of vibratory and impact hammers, heavy-duty trucks, backhoes, bulldozers, and excavators. Groundborne vibration is typically attenuated over short distances; however, the alignment of the onshore pipe is not known. Therefore, depending on the alignment, the nearest sensitive receptors could be exposed to nuisance groundborne vibration and damage to buildings and structures could occur.

Operational Impacts

During operation of an intake at D2 or U2, noise would be generated from the operation of the air compressors required for air burst cleaning of the intake WWS. Although this equipment would generate operational noise, it is anticipated that the compressors would be properly housed and screened so that noise would be attenuated over a short distance and would not cause a nuisance to nearby sensitive receptors.

4.4.8 Transportation

Construction Impacts

Construction would result in an increase in the amount of worker, vendor, and haul truck vehicles traveling to and from the project site. The City of Huntington Beach's adopted City's General Plan Circulation Element Update: Traffic Study indicates that no existing deficient street intersections (level of service [LOS] D or worse) surround the subject site. The nearest deficient intersection is located along Pacific Coast Highway (PCH), at Goldenwest Street/Pacific Coast Highway, to the west of the alternative intake sites. The existing ADT levels for roadway segments in the vicinity of the project site and along potential truck routes are shown in the Table 6 below.

Table 6
Existing Traffic On Nearby Roadways

Roadway	ADT Without Project
Adams Avenue	36,000[1]
Bristol Street	48,000[2]
Brookhurst	34,000[1]
Del Mar Avenue	5,000[2]
Fair Drive	23,000[2]
Hamilton Avenue	17,000[2]
Harbor Boulevard	67,000[2]
Magnolia Street	23,000[1]
Newland Street	16,000[1]
Placentia Avenue	24,000[2]
Warner Avenue	40,000[1]
Victoria Street	31,000[2]

[1] City of Huntington Beach. 2017.
[2] Orange County Transportation Authority. 2018.

Given the capacity of, and existing traffic on local roadways, it is not anticipated that the minor increases that could be expected with construction of an alternative intake at the D2 or U2 locations would result in significant impacts on traffic and circulation.

Additionally, the placement of the construction areas could restrict access and circulation in and around the State Beach area and the diversion of vehicular, bicycle and pedestrian traffic from the construction and staging areas may occur. These activities have the potential to result in significant short-term impacts related to traffic congestion and traffic safety. A Traffic Management Plan would be required to minimize traffic impacts and minimize the potential to interfere with emergency response due to pipeline installation, such as the use of plating to reopen travel lanes during peak traffic hours as well as maintaining access to businesses and residences.

Work vessels would be required for the offshore work associated with the alternative intake sites. Vessel traffic offshore would be confined to the area directly surrounding the proposed marine trestle.

Vessels used on site during offshore construction must meet USCG requirements for navigation safety (e.g., navigation systems, minimum crew, and COLREGS [International Regulations for Preventing Collisions at Sea] day shapes and night lights) and vessel operators would communicate with the USCG and Vessel Traffic Service (VTS) where applicable. Alternative intake construction activities are not likely to reduce the existing level of safety for navigating marine vessels in and around the Port of Long Beach (POLB) due to the small vessel sizes and the small number of trips per day.

As described in the 2017 SEIR, vessel safety could be further increased with the publication of a Local Notice to Mariners to ensure that other vessels in the area, as well as the USCG and area harbor personnel, would be advised of the likely transit routes, and approximate dates, durations, and working hours. Noticing would provide for advanced planning and would ensure coordination with any other activities that are ongoing or planned. The USCG has a Local Notice to Mariners program and publishes weekly emails and notices for each USCG District (California is District 11). The Local Notice to Mariners addresses

discrepancies in navigational aids (charts, etc.), advanced notices of projects (such as dredging, etc.) and other areas of potential concern (surveys, fireworks displays, sunken ships, etc.). The absence of advanced planning and failure to provide adequate notification to affected mariners or the USCG could cause a significant impact. Therefore, notification would be required.

Operational Impacts

It is anticipated that maintenance activities not result in road closures, or significant amounts of worker trips.

Periodic maintenance trips, estimated at less than one per month or 11 dives per year, would be made to clean the intake screens. However, this would also be required for the intake site E system and would not result in a significant impact to marine vessel safety.

4.5 Social Feasibility

4.5.1 Commercial and Recreational Fishing

Construction Impacts

Commercial and recreational fishing would be directly affected by construction of either the U2 or the D2 intake systems by limiting or precluding surf fishing access along the shoreline, and precluding fishing vessel access within the work area of the offshore construction activities.

Construction of either the D2 or U2 alternative intake system would limit surf fishing (including California Grunion harvesting) access during onshore activities. A work area of approximately 100-feet wide by 1000-feet long would include shoring, excavation, pipe laying, backfill, and shoring removal operations. A staging area would be located in a footprint of approximately five acres on the beach adjacent to the work area. The staging area would stage pipe, bedding materials, and shoring materials. These areas would be fenced off to prevent public access. Onshore activities would occur over a 1 year and 8-month period.

Construction of either the D2 or U2 alternative intake system would also limit vessel access during offshore construction activities and during the presence of construction trestle system. The trestle would be 1,900 feet in length and would be an open structure with steel pipe piles, cap beams, and rail beams to carry gantry-mounted equipment. Although construction activities would only occur within designated windows to avoid impacts to biological resources, the trestle would remain in place during the entirety of the offshore work construction period (except during mobilization and demobilization). Therefore, the trestle would be present for 6 years, although disassembly of the trestle would occur during the last 3 years of this period.

Construction of the temporary sheet pile structures would result in indirect effects on fisheries from noise and vibration impacts from the use of a vibratory hammer and impact hammer. In addition, turbidity from construction could also affect fish behavior and cause avoidance within the affected area. As noted in previous CCC findings, noise impacts in the marine environment can have indirect effects on commercial and recreational fishing by precluding fishing and potentially affecting fish behavior and biology, such that catch opportunities are reduced (California Coastal Commission 2013).

Operational Impacts

Commercial and recreational fishing operational impacts would be similar to those of the intake site E, because the intake would be installed underground and below the sea floor, with the exception of the WWS array. However, operation of the WWS array would not affect access. For either the D2 or U2 intake sites, an aboveground building would be constructed to house the air compressors and receivers for an airburst system in the vicinity of the concrete vault where the inlet piping alignment turns 90 degrees to head offshore. The location and approximate size of this aboveground building is not known, but could affect access.

4.5.2 Recreation and Access

Construction Impacts

Huntington City Beach has 11 million visitors every year. It is perennially chosen as one of the most popular beaches in California and was voted California's #1 beach in 2018 by *USA Today*. October-May is the camping season. In addition, the U.S. Open of Surfing, Great Pacific Airshow, Surf City Escape Triathlon, AVP Volleyball Tournament, Fourth of July Firework Show, and more events all happen at Huntington City Beach. See Figure 9 and 10 for images of crowd dispersion during the Great Pacific Airshow and U.S. Open of Surfing, respectively.

Figure 9. Crowd dispersion during the Great Pacific Airshow.

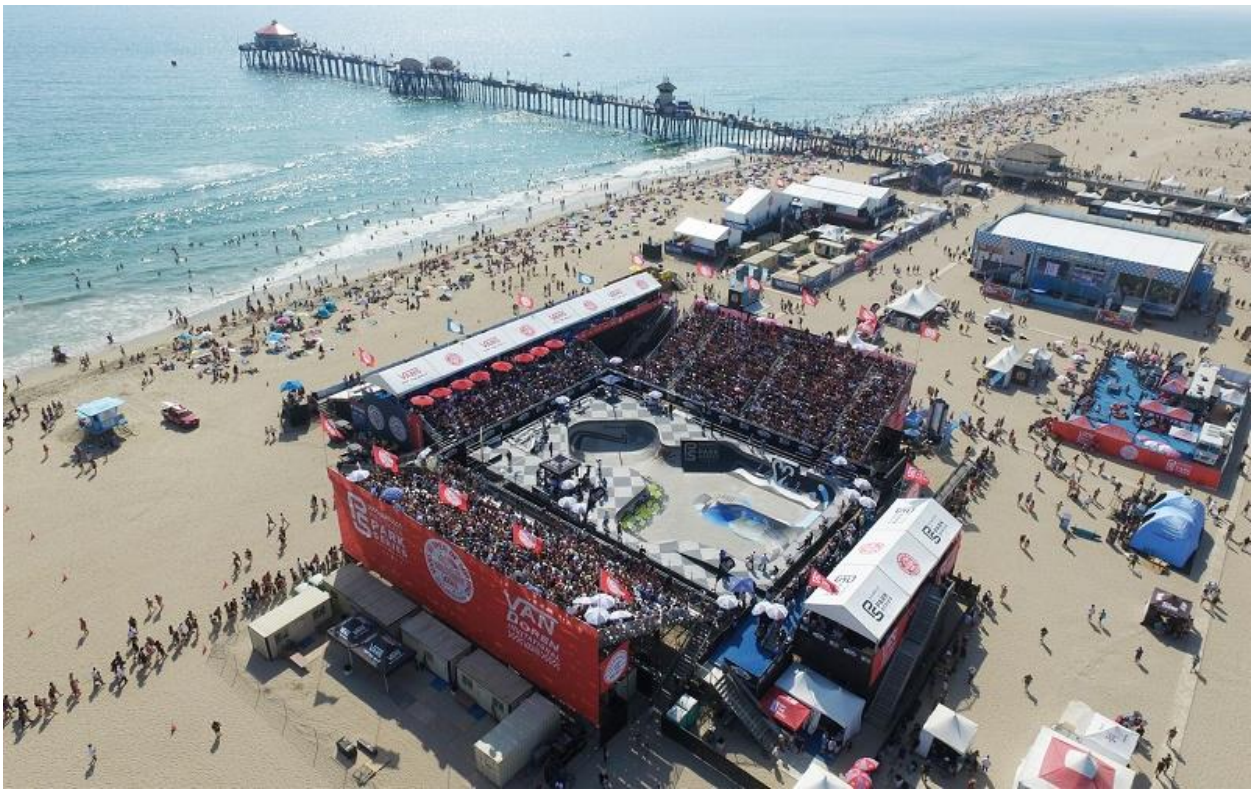

Figure 10. Crowd dispersion during the U.S. Open of Surfing.

Huntington State Beach is located south of Huntington City Beach spanning 2 miles with a wide swath of sand stretching with volleyball nets, basketball courts, bonfire pits, and a biking and walking trail. Numerous special events including Coastal Country Jam, Above & Beyond, and Back To The Beach Festival all happen at Huntington State Beach.

Loss of beach access and usage would occur within the construction area by limiting or precluding access to the beach and shoreline in the onshore and offshore construction areas. Shoreline access restrictions may occur due to the presence of the trestle structure, and diversion of vehicular, bicycle and pedestrian traffic from the construction and staging areas may also occur. In addition to physical displacement of recreation opportunities within the construction zones, the placement of the construction areas could restrict access and circulation in and around the State Beach area. Furthermore, construction noise in the vicinity of beach areas could disrupt use of these areas by the public due to nuisance noise issues. Installation of sheet pile and trestle construction could have adverse effects on the shore break, affecting recreational activities, including surfing, which is an important recreational asset.

In addition, annual events would occur in the vicinity of or within the footprint of the construction area. The Great Pacific Airshow occurs in October and takes place in Huntington City Beach from Seapoint to Beach Boulevard. Additionally, the U.S. Open of Surfing takes place at the Huntington Beach Pier and occurs in late July to early August. Both of these events would occur during onshore and offshore construction activities. Onshore and offshore construction could create visual or noise impacts to these events. The construction footprint of intake site U2 may overlap with the U.S. Open, which could limit the event area or create hazards to U.S. Open participants or construction workers.

Onshore and offshore construction of intake site U2 would occur in proximity to the Huntington Beach Pier. Construction activities would create noise and visual impacts which would affect visitor experience, and could result in a decline in tourism in the area.

Construction of either the D2 or U2 alternative intake system would limit beach access during onshore activities. A work area of approximately 100-feet wide by 1000-feet long would include shoring, excavation, pipe laying, backfill, and shoring removal operations. A staging area would be located in a footprint of approximately four acres on the beach adjacent to the work area. The staging area would stage pipe, bedding materials, and shoring materials. These areas would be fenced off to prevent public access. Onshore activities would occur over a 1 year and 8-month period.

Construction of either the D2 or U2 alternative intake system would also limit offshore access during offshore construction activities and during the presence of the construction trestle system. The trestle would be 1,900 feet in length and would be an open structure with steel pipe piles, cap beams, and rail beams to carry gantry-mounted equipment. Although construction activities would only occur outside of the work restriction season, the trestle would remain in place during the entirety of the offshore construction period (except during mobilization and demobilization). Therefore, the trestle would be present for 6 years, although disassembly of the trestle would occur during the last 3 years of this period.

Operational Impacts

Recreation and access operational impacts would be similar to those of the intake site E, because the intake would be installed underground and below the sea floor, with the exception of the WWS array. However, operation of the WWS array would not affect access. For either the D2 or U2 intake sites an aboveground building would be constructed to house the air compressors and receivers for an airburst system. The location and approximate size of this aboveground building is not known, but it is not anticipated to significantly affect access.

5 CONCLUSION

5.1 Feasibility of Intake Site U2

5.1.1 Technical Feasibility

The relocation of the intake to site U2 would be technically infeasible, due to site constraints. The HBDP would experience at least a total of 3.5 feet sea level increase over the 50-year project lifespan of the desalination project (Geo-Logic Associates 2015). Therefore, the aboveground airburst system would be located in an area effected by sea level rise. The HBDP site is too far from site U2 to accommodate an effective air burst system; therefore, the air burst system cannot be located at the HBDP site as an alternative.

5.1.2 Timing Feasibility

The relocation of the intake to site U2 would be infeasible from a scheduling perspective. Implementation of the intake relocation, which includes permitting and construction, would take approximately 13 years to complete, and therefore cannot be completed in a reasonable timeframe. In comparison, permitting, construction, startup, and commissioning of the desalination plant and intake E system would take approximately 4.5 years to complete.

5.1.3 Economic Feasibility

The relocation of the intake to site U2 would be economically infeasible, as it would add $510M in total construction costs as compared to the proposed intake site E, increasing the project construction costs by approximately one-half without any quantifiable environmental benefit to justify the added costs.

5.1.4 Environmental Feasibility

Construction of the offshore intake site at U2 would result in the permanent loss of a small amount of benthic habitat equivalent to 0.088 acres. Potential intake site U2 is indisputably the closest to the nearest MPAs in Bolsa Chica Wetlands and should be eliminated from further consideration as it conflicts with the specific direction in the OPA that screened intakes shall be located a maximum distance feasible from MPAs. Entrainment at proposed intake site E poses the minimal risk to sensitive species and sensitive habitats. Considering the homogeneity of the sandy, soft-bottom habitat in the offshore area near Huntington Beach, there is no ecological rationale to support moving the screened intake to alternative site U2; the three sites are functionally indistinguishable. Given this, it is much more likely that any numerical differences in larval abundances, while statistically insignificant, are the result of natural inherent variation in plankton rather than differences in habitat.

Construction of a trestle for marine work would involve disturbance and preclusion of access to beach and parking lots. The construction of the U2 alternative intake system would result in a temporary land use conflict that would be considered significant.

Offshore and onshore construction would introduce significant visual changes to a visually sensitive area.

The marine trestle required for offshore construction could experience structural damage from large high wave energy, tsunami events, or seismic induced risks including damage or inoperability. Considering offshore work would occur over multiple years this could expose offshore construction workers to risks associated with these events.

Sensitive receptors would be exposed to construction noise for a significantly longer amount of time as compared to the construction associated with the intake site E system. Additionally, the onshore and offshore construction work associated with the alternative intake system U2 would be located in areas not originally anticipated in the 2017 SEIR, thus exposing additional sensitive receptors to nuisance construction noise.

5.1.5 Social Feasibility

The construction of intake site U2 could create visual or noise impacts to annual events at Huntington Beach, including the Great Pacific Airshow and the U.S. Open of Surfing. The construction footprint of intake site U2 may overlap with the U.S. Open, which could limit the event area or create hazards to U.S. Open participants or construction workers. While it is not anticipated that these events would significantly delay construction, the construction activities could impact the activities, some of which are major tourist-generating events and revenue generating events for the City of Huntington Beach. Loss of beach access and usage would occur within the construction area by limiting or precluding access to the beach and shoreline in the onshore and offshore construction areas. It is unlikely the City of Huntington Beach would approve permits and agreements for an alternative intake site that would have such a significant social and economic impact.

5.2 Feasibility of Intake Site D2

5.2.1 Technical Feasibility

The relocation of the intake to site D2 would be technically infeasible, due to site constraints. The HBDP would experience at least a total of 3.5 feet sea level increase over the 50-year project lifespan of the desalination project (Geo-Logic Associates 2015). Therefore, the aboveground airburst system would be located in an area effected by sea level rise. The HBDP site is too far from site U2 to accommodate an effective air burst system; therefore, the air burst system cannot be located at the HBDP site as an alternative.

5.2.2 Timing Feasibility

The relocation of the intake to site D2 would be infeasible from a scheduling perspective. Implementation of the intake relocation, which includes permitting and construction, would take approximately 13 years to complete, and therefore cannot be completed in a reasonable timeframe. In comparison, permitting and construction, startup, and commissioning of the desalination plant and intake E system would take approximately 4.5 years to complete.

5.2.3 Economic Feasibility

The relocation of the intake to site D2 would be economically infeasible, as it would add $510M in total construction costs as compared to the proposed intake site E, increasing the project construction costs by approximately one-half.

5.2.4 Environmental Feasibility

Construction of the offshore intake site at D2 would result in the permanent loss of a small amount of benthic habitat equivalent to 0.088 acres. Siting an intake at D2 would put the intake adjacent to the opening of the restored Huntington Beach wetlands complex and pose the maximum risk to sensitive species (Giant Sea Bass) that have been documented to occur in that area. Entrainment at proposed intake site E poses the minimal risk to sensitive species and sensitive habitats. Considering the homogeneity of the sandy, soft-bottom habitat in the offshore area near Huntington Beach, there is no ecological rationale to support moving the screened intake to alternative sites D2 or U2; the three sites are functionally indistinguishable. Given this, it is much more likely that any numerical differences in larval abundances, while statistically insignificant, are the result of natural inherent variation in plankton rather than differences in habitat.

Construction of a trestle for marine work would involve disturbance and preclusion of access to beach and parking lots. The construction of either the D2 alternative intake systems would result in a temporary land use conflict that would be considered significant.

Offshore and onshore construction would introduce significant visual changes to a visually sensitive area.

The marine trestle required for offshore construction could experience structural damage from large high wave energy, tsunami events, or seismic induced risks including damage or inoperability. Considering offshore work would occur over multiple years this could expose offshore construction workers to risks associated with these events.

Sensitive receptors would be exposed to construction noise for a significantly longer amount of time as compared to the construction associated with the intake site E system. Additionally, the onshore and offshore construction work associated with the alternative intake systems would be located in areas not originally anticipated in the 2017 SEIR, thus exposing additional sensitive receptors to nuisance construction noise.

5.2.5 Social Feasibility

The construction of intake site D2 could create visual or noise impacts to annual events at Huntington Beach, including the Great Pacific Airshow and the U.S. Open of Surfing. While it is not anticipated that these events would significantly delay construction, the construction activities could impact the activities, some of which are major tourist-generating and revenue-generating events for the City of Huntington Beach. Loss of beach access and usage would occur within the construction area by limiting or precluding access to the beach and shoreline in the onshore and offshore construction areas. It is unlikely the City of Huntington Beach would approve permits and agreements for an alternative intake site that would have such a significant social and economic impact.

A summary of impacts for intake site U2 and D2 is shown in Table 7.

Table 7
Feasibility Summary for Intake Site U2 and D2 as Compared to Intake Site E

Feasibility Category	Intake Site U2	Intake Site D2
Technical Feasibility	The relocation of the intake to site U2 would be technically infeasible, due to site constraints. – The aboveground airburst system would be located in an area effected by sea level rise.	The relocation of the intake to site D2 would be technically infeasible, due to site constraints. –The aboveground airburst system would be located in an area effected by sea level rise.
Timing Feasibility	The relocation of the intake to site U2 would be infeasible from a scheduling perspective. Implementation of the intake relocation, which includes permitting and construction, would take approximately 13 years to complete, and therefore cannot be completed in a reasonable timeframe.	The relocation of the intake to site D2 would be infeasible from a scheduling perspective. Implementation of the intake relocation, which includes permitting and construction, would take approximately 13 years to complete, and therefore cannot be completed in a reasonable timeframe.
Economic Feasibility	The relocation of the intake to site U2 would be economically infeasible. Implementation would result in an additional $510M in total life cycle costs	The relocation of the intake to site D2 would be economically infeasible. Implementation would result in an additional $510M in total life cycle costs
Environmental Feasibility		
Biological Resources	Permanent loss of a small amount of benthic habitat equivalent to 0.088 acres would occur. Potential intake site U2 is indisputably the closest to the nearest MPAs in Bolsa Chica Wetlands and should be eliminated from further consideration.	Permanent loss of a small amount of benthic habitat equivalent to 0.088 acres would occur. Siting an intake at D2 would pose the maximum risk to sensitive species (Giant Sea Bass) that have been documented to occur in that area. D2 is located adjacent to the opening of the restored Huntington Beach Wetlands Complex

Table 7
Feasibility Summary for Intake Site U2 and D2 as Compared to Intake Site E

Feasibility Category	Intake Site U2	Intake Site D2
Air Quality	Construction of the alternative intake system would contribute further to the exceedance of the SCAQMD construction threshold for NOx.	Construction of the alternative intake system would contribute further to the exceedance of the SCAQMD construction threshold for NOx.
Energy and GHG Emissions	Operation would result in additional electricity demand and GHG emissions; however, no significant impact would occur.	Operation would result in additional electricity demand and GHG emissions; however, no significant impact would occur.
Land Use	Significant impacts associated with the temporary loss of recreational land use access and usage would occur.	Significant impacts associated with the temporary loss of recreational land use access and usage would occur.
Aesthetics	Significant temporary visual impacts would occur.	Significant temporary visual impacts would occur.
Hazards	Potential hazards associated with offshore construction would occur; however, this would not result in a significant impact.	Potential hazards associated with offshore construction would occur; however, this would not result in a significant impact.
Noise	Significant temporary noise and vibration impacts would occur.	Significant temporary noise and vibration impacts would occur.
Transportation	Additional construction traffic would occur; however, this would not result in a significant impact.	Additional construction traffic would occur; however, this would not result in a significant impact.
Social Feasibility		
Commercial and Recreational Fishing	Impacts would occur during up to 8-year construction period.	Impacts would occur during up to 8-year construction period.
Recreation and Access	Impacts would occur during up to 8-year construction period.	Impacts would occur during up to 8-year construction period.

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APPENDIX A

GHD Technical Memorandum

Technical Memorandum

August 7, 2018

To:	Patrick Crain - Poseidon	Ref. No.:	Poseidon, D2, Intake
From:	Gillian Millar	Tel:	949-648-5200
cc:	Paul Hermann (GHD), Scott Maloni (Poseidon)		
Subject:	**Poseidon, Huntington Beach Desalination Project, Intake Location D2, Feasibility Evaluation, Summary**		

1. Introduction

The Poseidon has requested that GHD provide a technical evaluation on the feasibility of moving the proposed intake for the Huntington Beach Desalination Plant to location D2 (located approximately 1.2 miles down coast from the existing intake tower). In order to assess the feasibility of utilizing intake location D2, GHD evaluated two options for the alignment of the new intake piping as follows:

1) Offshore alignment (connect the piping to the existing offshore intake tower and route the piping down coast either on the seabed or beneath the seabed)
2) Onshore alignment (connect to the existing 14 diameter pipeline at a location onshore and then route the piping down coast along the State Beach)

2. Offshore Alignment

For the offshore option, GHD evaluated the quickest and most cost-effective option of placing large diameter piping on the seabed from the existing intake tower to location D2. Typically, placing of large diameter piping on the seabed can be accomplished by sinking HDPE piping in long strings of pipe using concrete anchors to counteract the pipe buoyancy while flooding the pipeline. This approach minimizes the amount of time that large ocean-rated derrick barges are required to be offshore during the construction period. A GHD marine engineer assessed the potential for wave loading on the pipeline, the probable impact to wave characteristics caused by the presence of the pipeline, and the potential for scour beneath the pipeline. As described in the GHD Technical Memorandum prepared by Gillian Millar, the on-the-seabed alignment approach was determined to be unfeasible due to the potential for the large diameter pipeline (10 to 14 feet diameter), placed parallel to the shoreline at a depth of 30 ft, to affect the local hydrodynamic and wave characteristics. In addition, the large diameter pipeline aligned parallel to the shoreline would be subjected to a greater degree of wave loading (compared to a shore perpendicular option). The potential movement in the pipe, particularly in storm conditions, may require the pipeline to be installed on a piled structure to resist the forces. If piling were required, the construction schedule would be subject to whale migration restrictions as described in the 2017 SEIR for the Huntington Beach Desalination Project.

In order to evaluate the other offshore option (burying the large diameter pipeline), GHD contacted Bruce Patterson of Highlands Construction Solutions, LLC (HCSLLC). Bruce Patterson was involved in the cost estimating for the intake and discharge systems that were described in the 2017 SEIR, and he has also provided consulting to Poseidon on marine construction issues related to the Carlsbad Desalination Plant. GHD requested that HCSLLC evaluate the constructability issues related to placing a large diameter pipeline beneath the seabed parallel to shore from the existing intake structure to the proposed intake location D2. HCSLLC evaluated an open cut approach using a derrick barge with disposal of the dredge spoil via a dump scowl. The excavation assumed shallow side slopes typical for marine dredging and resulted in a quantity approaching 700,000 cy. Because of the flat side slopes, it would not be possible to side cast the material and reuse for backfill as the side casted material would migrate back into the excavation. HCSLLC also evaluated the option of placing an offshore trestle from the existing intake tower to the new intake position D2. The trestle option would require approximately 12,500 ft of trestle with sheet piling on both sides. Because of constructability restrictions, this trestle option would require approximately 10 years for construction which GHD believes is not practical.

3. Onshore Alignment

HCSLLC also evaluated a shore-based option. This approach would tie-in to the existing 14 feet diameter pipeline from the State Beach and would follow an alignment along the State Beach parallel to the shore for approximately 1.2 miles. Near the mouth of the Santa Ana River, the pipeline would turn at a 90 degree angle and traverse through the surf zone via a trestle with sheet piling on both sides. Because of the restrictions listed in the 2017 SEIR for pile driving during the whale migration season, this approach would result in a 4.5 year[1] construction schedule for the intake which would delay the Plant construction by 1.5 years as commissioning of the Plant would not be able to start until the intake construction was completed. Even with the 1.5 year delay in the Plant construction, GHD believes that the onshore option is the most viable constructability approach for the connecting the intake to location D2, and minimizes the potential for hydrodynamic and wave climate impacts. HCSLLC was then tasked to provide a rough order of magnitude cost estimate for the onshore option which is presented in the attached documents.

[1] There may be other schedule restraints due to permit conditions that would extend the schedule. This Technical Memorandum only considers the restrictions associated with whale migration. Also, it is assumed that all required permits are obtained prior to the start of construction.

Technical Memorandum

August 6, 2018

To:	Patrick Crain - Poseidon	Ref. No.:	Poseidon, D2, Intake
From:	Gillian Millar	Tel:	949-648-5200
cc:	Paul Hermann (GHD), Scott Maloni (Poseidon)		
Subject:	**Poseidon, Huntington Beach Desalination Plant, Revised Location Intake Location (D2) and Linear Diffuser, Preliminary Coastal Engineering Evaluation**		

1. Introduction

The Huntington Beach Desalination Plant (HBDP) is a 50-million gallon per day facility to be located adjacent to the AES Huntington Beach Power Station. The project proposes to use the Power Station existing ocean intake/outfall system which consists of buried 14 ft. diameter pipelines and concrete intake and discharge structures located approximately 1500 ft. from the shoreline. Poseidon has requested that GHD evaluate the feasibility of placing the intake approximately 1.2 miles down coast (in the direction of the Santa Ana River entrance) from a coastal engineering perspective potential impacts to coastal processes. In addition, Poseidon requested that GHD evaluate the feasibility, also from a coastal engineering perspective, of placing a linear diffuser in the vicinity of existing discharge structure.

2. Data Review

The following is a list of the data reviewed in the preparation of this memo:

Various PDF files:

1. Poseidon sketch showing the proposed location of Intake D2
2. Alden Research Laboratory, Inc, conceptual design, Brine Discharge Linear Diffuser
3. Huntington Beach Desalination Project Sea Level Rise Hazard Analysis, Moffatt and Nichol, January 2017

Videos and photographs from underwater inspection:

1. AES HB Offshore Inspection Reports
2. Condition Assessment, (report not yet completed) video files and diver's notes

Elements of the SEIR (2017)

1. Appendix W Diffuser Report

Nautical Chart 18746

3. Bathymetry & Coastal Processes

Coastal processes are impacted by the contours of the sea-bed. The bathymetry offshore of the proposed HBDP slopes away from the shore with the 30 ft contour approx. 3,000 yd from the beach. The figure shows the approx. location of the wastewater treatment plant outfalls, the outfall from the HB Power Station and the bathymetric contours. The blue shaded area is the 30 ft contour.

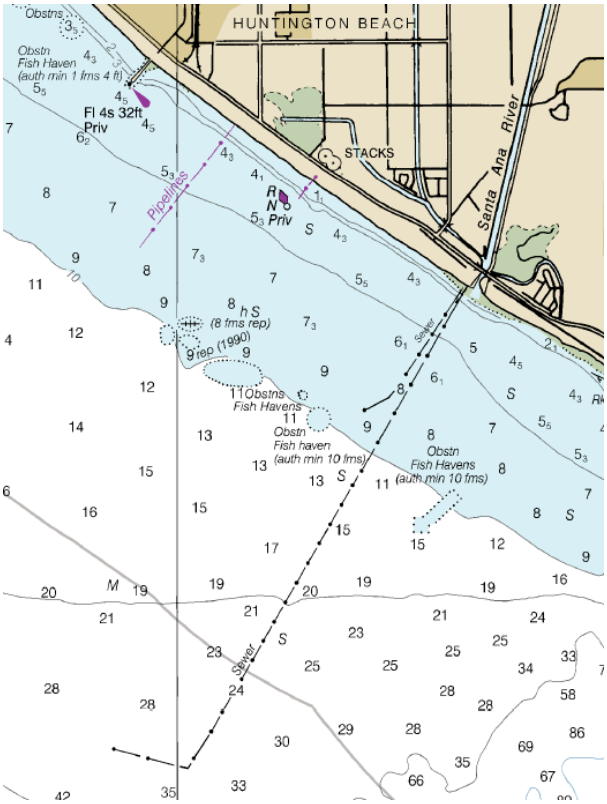

Figure 1: Bathymetry (NOAA Chart 18746)

3.1 Metocean Conditions

The following is a brief review of the Metocean conditions in Huntington Beach. All data used is public domain and general for the area or region. No modeling or site-specific studies were performed.

The climate in coastal Southern California is subtropical characterized by dry summers and wet winters. The seasonal temperature variation at the coast is not significant. Average temperatures range from approximately 44 degrees (average min. Dec/Jan) to 74 degrees (average max. Jul/Aug), with approximately 11 inches of rain (average total precipitation)[1].

Southern California experiences a prevailing land breeze at night and in the early morning from thermal cooling of land versus water. The region also experiences the opposite effect in the afternoon, a prevailing sea breeze in the daytime from thermal heating of land versus water. The sea breeze in the region is typically out of the northwest and its formation results in locally generated wind-waves. Other wind conditions can exist, such as onshore winds in the fall and winter months following storms, and a pre-frontal southwest wind during an approaching storm. “Santa Ana Winds” blow offshore and can form from establishment of a large-scale, high atmospheric pressure system inland causing airflow toward lower pressure areas along the coast.

Four main categories of ocean waves occur off the coast of Southern California:

1) Northern hemisphere swell:

Includes the most severe waves reaching the Orange County coast. Deep-water significant wave heights rarely exceed 10 feet, with wave periods ranging from 12 to 18 seconds. However, during extreme northern hemisphere storms, wave heights may exceed 20 feet with periods ranging from 18 to 22 seconds.

[1] Data for Oceanside, CA

2) Tropical swell:

Tropical storms develop off the west coast of Mexico during the summer and early fall. The resulting swell rarely exceeds 6 feet, but a strong hurricane in September 1939 passed directly over the Southern California area and generated waves 26.9 feet.

3) Southern hemisphere swell:

Southern hemisphere swell is generated by winds associated with winter storms in the South Pacific. Typical southern hemisphere swell rarely exceeds 4 feet in height in deep water, but with periods ranging up to 18 to 21 seconds, they can break at over twice that height.

4) Seas generated by local winds:

Sea state is the term applied to steep, short-period waves which are generated either from local storms, strong pressure gradients over the area of the Eastern Pacific Ocean (Pacific High), or from the diurnal sea breezes. Wave heights are usually between 2 and 5 feet with an average period of 7 to 9 seconds.

The figure[2] below shows a graphical representation of the categories of waves along the Southern California coastline.

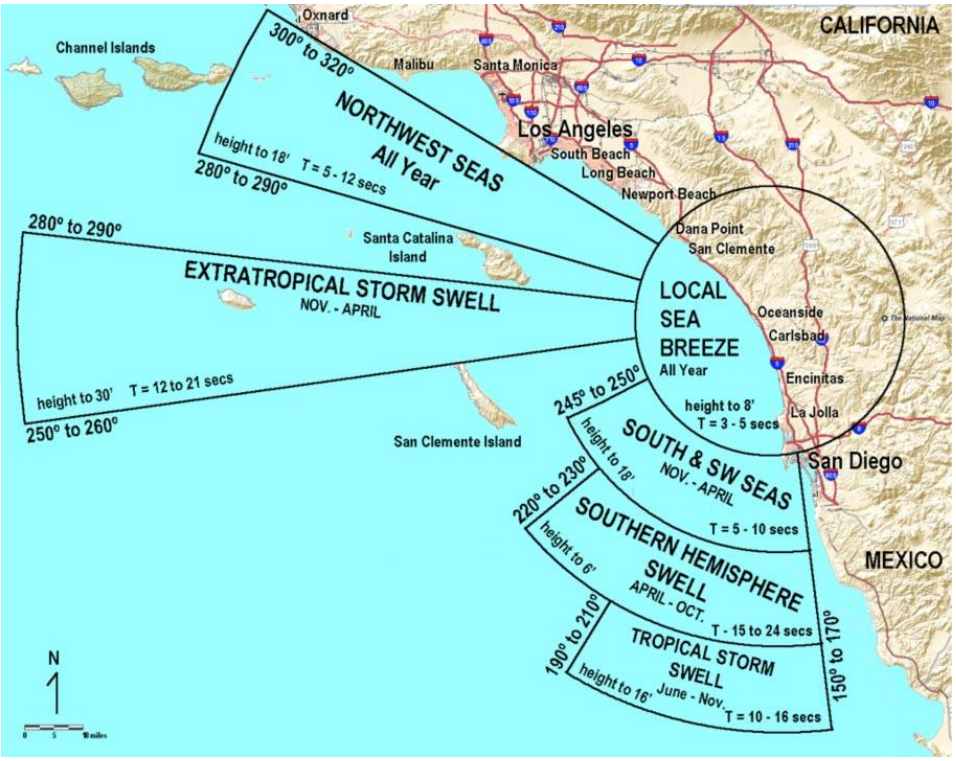

Figure 2: Southern CA Waves

Astronomical tides in the Southern California Bight are of the mixed, semi-diurnal type, with two highs and two lows of unequal height occurring each lunar day (the duration of which averages 24.4 hours). The largest water level excursion typically occurs as the tide falls from higher high to lower low water, a process that generally

[2] http://gotbooks.miracosta.edu/oceans/index.html

requires 7 to 8 hours. The closest tidal datum to the Project site is Newport Bay entrance. The elevation data from NOAA Station 9410580 is shown below:

Elevations on Mean Lower Low Water

Station: 9410580, NEWPORT BEACH, NEWPORT BAY ENTRANCE, CA
Status: Accepted (Apr 17 2003)
Units: Feet
Control Station: 9410660 Los Angeles, CA

T.M.: 120
Epoch: 1983-2001
Datum: MLLW

Datum	Value	Description
MHHW	5.41	Mean Higher-High Water
MHW	4.68	Mean High Water
MTL	2.80	Mean Tide Level
MSL	2.78	Mean Sea Level
DTL	2.71	Mean Diurnal Tide Level
MLW	0.92	Mean Low Water
MLLW	0.00	Mean Lower-Low Water
NAVD88	0.18	North American Vertical Datum of 1988
STND	-3.33	Station Datum
GT	5.41	Great Diurnal Range
MN	3.76	Mean Range of Tide
DHQ	0.74	Mean Diurnal High Water Inequality
DLQ	0.92	Mean Diurnal Low Water Inequality
HWI	5.08	Greenwich High Water Interval (in hours)
LWI	11.15	Greenwich Low Water Interval (in hours)
Max Tide	7.67	Highest Observed Tide
Max Tide Date & Time	01/28/1983 08:06	Highest Observed Tide Date & Time
Min Tide	-2.35	Lowest Observed Tide
Min Tide Date & Time	01/20/1988 16:30	Lowest Observed Tide Date & Time
HAT	7.18	Highest Astronomical Tide
HAT Date & Time	12/02/1990 16:06	HAT Date and Time
LAT	-1.92	Lowest Astronomical Tide
LAT Date & Time	01/01/1987 00:00	LAT Date and Time

Tidal Datum Analysis Periods

01/01/1980 - 12/31/1993

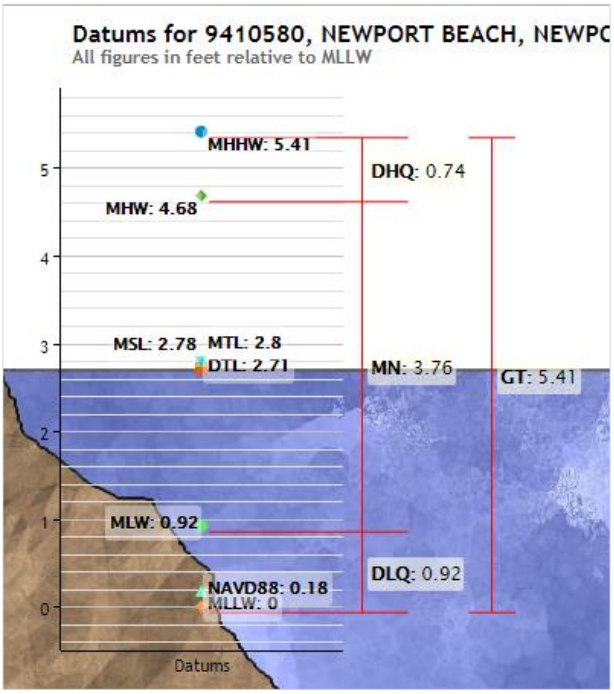

Figure 3: Tidal Datum at Newport Bay

Tidal currents dominate the nearshore coastal zone of Huntington Beach. These are not particularly strong, especially at the seabed, but will cause some turbulence. Beach sands in this area tend to be transported in a southeasterly direction by littoral currents.

Other components affect water elevations. Storm surge is the super-elevation of the water level that results from reduced barometric pressure and wind stress during storms. Unlike the Atlantic and Gulf Coasts, where storm surges can attain high amplitudes on the relatively wide, shallow, and gentle slopes of the Continental Shelf, surges on the southern Pacific Coast are comparatively small. Storm surge is typically less than one foot in southern California.

El Nino Southern Oscillation (ENSO) events represent global-scale climatic variations with a duration of one to several years. They are characterized by a decrease in atmospheric pressure in the eastern tropical Pacific Ocean, a decrease in the easterly trade winds, and an increase in sea level on the west coast of North and South America. Increased water levels resulting from ENSO events can be expected every four to seven years, with four or five strong events each century. During the major ENSO event in the 1997-1998 season, monthly mean sea levels in the Southern California Bight were increased by up to one foot (Flick 1998). The 2015 El Nino has elevated ocean water levels above predicted tides by one foot in the month of September when the effect peaked, with variations thereafter.

Poseidon commissioned Moffatt and Nichol to prepare a study to evaluate the sea level rise hazard at the proposed desalination project site. The conclusions from the study, Huntington Beach Desalination Project Sea Level Rise Hazard Analysis, (Moffatt and Nichol, January 2017) were used in this evaluation. The Moffatt and Nichol study presented a range of values of possible sea level rise that may be observed in the year 2100. The study determined that the expected sea level rise would range from 1.6 ft to 5 ft over the design life of the project.

Tsunami, a very long period wave caused by earthquake or volcanic eruptions on a sea floor is a potential risk in Huntington Beach. The emergency planning tsunami inundation map for Orange County shows the proposed project location as inundated. However, the likelihood of tsunami is very low and very difficult to predict, even with extensive modeling. In relation to the location and conceptual design of the intake and outfall, the water drawn-down is likely to be as much of a design control as the water surface super-elevation. Additionally, the current eddies are very high, particularly in shallow water. These can severely scour pipelines or structures on the seabed.

4. Intake Location

The Huntington Beach Power Station has an existing intake structure located immediately offshore from the power station. The 2017 SEIR described an intake system incorporating wedgewire screens installed immediately adjacent to existing intake structure. The Regional Water Quality Control Board has asked Poseidon to evaluate location D2 for the intake which is located approximately 1.2 miles down coast from the exiting intake structure. Refer to Figure 4, provided by Poseidon that illustrates the proposed location of D2.

In order to perform the coastal engineering evaluation, GHD has made the following engineering assumptions:

1) Intake location D2 would be connected to the existing intake structure.
2) The connecting piping from the existing intake structure to the intake location D2 should incorporate a solution that would minimize the timeframe required for floating offshore construction equipment.
3) If piles are required for the offshore construction work, the allowable work window would be limited to the timeframe described in the 2017 SEIR due to whale migration concerns – July through October.
4) The diameter of the piping should be sufficiently large to avoid NPSH restrictions for the intake pump station. While a NPSH evaluation of intake pump station is outside of the scope of this study, the diameter of the piping is assumed to be large diameter pipe (10 to14 ft diameter). Considerations for

reductions in internal pipe diameter caused by marine growth and the procedures for pigging the line have also not been considered in this Technical Memorandum.

Figure 4: New Intake D2 Location

From a coastal processes perspective, the following can be observed and speculated for the existing intake structure and the new Intake location D2:

- Both intake locations are in the same depth of water
- Both locations are exposed to the same offshore swells and locally wind driven waves – i.e. it is not observed (from the data reviewed) that there are local variations between the intake locations that would impact wave action
- The ocean circulation patterns and assumed tidal currents will be the same for both locations
- The tidal elevations will be the same for both locations
- The risk of tsunami, scour and storm exposure is assumed the same for both locations

- The seabed contours start to bend towards the shore around the location of Intake D2, so this could result in some wave diffraction
- Intake D2 is sited closer to the entrance to the Santa Ana River. This is a more dynamic area than the location of the existing intake. It is possible that the turbidity is higher here due to sediments from the river (periodically). There is a dynamic sand bar and regular maintenance sand removal and nourishment of the surrounding beaches.
- Based on NOAA Chart 18746, Intake location D2 is also close to the secondary waste-water treatment outfall line

4.1 Connection of Intake D2 to Existing

If Alternate Intake D2 is selected, it will have to be connected to the existing intake infrastructure back to the proposed HBDP. D2 is approx. 1.2 miles from the existing intake structure. With reference to Figure 4, the following two options to connect the intake were identified as the most practical:

1. Connect to existing intake structure with new offshore piping placed parallel to the shoreline about 1.2 miles to location D2. The distance from the shoreline to the shore parallel pipe would range from approximately 1500 ft. to 1900 ft. The water depth is assumed consistent at about 30 ft.
2. Connect to the existing 14 ft. dia. pipe at a location onshore (within the State Beach).. The pipe would run downcoast onshore beneath the State Beach for approx. 1.2 miles. The new pipeline would then turn and traverse through the surf zone to a location approximately 2000 ft. offshore.

This Technical Memorandum only evaluates Option 1 – offshore piping from the existing intake structure to the new proposed location D2.

Option 1 (shore parallel pipe located at 30 ft depth) would require placement of a pipeline parallel to the shore for a distance of approximately 1.2 miles (perpendicular to the incoming wave direction). There are two approaches to construct Option 1 – a) placing the pipeline on the surface of the seabed or excavating the entire distance and burying the pipeline. Both of these approaches have constructability issues since the water depth is shallow enough to be a safety hazard to floating equipment, but too deep to be constructible from the intertidal zone. The approaching waves will be shoaling at the 30 ft. contour causing an increase in wave height and then breaking. The long wave periods transfer significant force, and the wave heights can be sufficiently large to be dangerous to a non-draft restricted vessel.

For the first option – placing the pipe on the seabed - laying the pipe perpendicular to the incoming wave direction exposes the whole length of pipe to forces from the incoming waves. Wave induced forces are typically calculated per unit length as a component of horizontal, uplift and buoyancy force. These forces will be significantly larger applied over 1.2 miles of pipe, compared to just the intake tower. The potential impacts from sea bed movement and scour are greater for a pipe laid parallel to the shore compared to perpendicular. Tidal currents and potentially sediment movement this close to shore are on/off-shore. At 30 ft. depth, the pipe could have an impact on the hydrodynamics. A rule of thumb used by the USACE in deep water, is that changes to the seabed bathymetry of less than 10% of the water depth are less likely to have an impact on the wave characteristics. For 30 ft. depth,

this rule of thumb would limit the height of the pipe to 3 ft or less. For pipe diameters in the 10 to 14 ft. diameter range particularly in shallow water (water depth / wave length < 0.04), this rule of thumb is exceeded. Therefore, it seems likely that the wave characteristics would be impacted by the shore parallel pipe. This could be unfavorably viewed by the permitting agencies, and potentially by the local surf community.

Burying the pipe would mitigate wave loading issues and would avoid changing wave characteristics, but there would be significant constructability issues in attempting to trench long sections up to 16 to 20 ft deep in essentially the surf zone. Given the dynamic nature of the surf zone, excavating to place the pipe would likely involve removal of a far larger volume of material than the pipe dia. and associated scour protection, since excavated slopes will be unstable. Much of the excavated sediments may become suspended causing a temporary turbidity issue. The constructability issues should be evaluated by a marine construction expert to determine if it is feasible to construct a buried pipeline in the surf zone using floating equipment or if a trestle parallel to the shore would be required.

4.2 Preliminary Recommendations – Intake Location

If the proposed D2 location is selected due to issues related to permitting, GHD does not believe that connecting the existing intake structure to the new D2 location can be accomplished by placing the pipe on the seabed. Placing large diameter piping parallel to shore line (exposing the greatest surface area to the incoming wave direction) will subject the pipe to horizontal forces. In addition, there is more of the pipe potentially exposed to scour and may interfere with on/off shore sediment movement in the surf zone. Because of the ratio of pipe diameter to water depth, there is a risk that the wave characteristics passing over the pipe could be impacted. GHD recommends that other options for connecting to the proposed location D2 be considered including placing a large portion of the pipeline onshore or perhaps burying the pipeline offshore. While the offshore buried pipeline approach would mitigate many of the concerns raised in this Technical Memo, the constructability issues associated with trenching a large diameter pipeline parallel to the shore within the surf zone are significant and should not be discounted. GHD recommends that that a marine construction expert be consulted to evaluate the feasibility of both the offshore with trenching approach using floating equipment and/or working off of a trestle and the onshore approach.

5. Diffuser Orientation

As part of this Technical Memorandum, Poseidon requested that GHD evaluate the feasibility of installing a linear diffuser directly adjacent to the existing discharge structure. Based on a conceptual design prepared by Alden Research Laboratory, Inc. (Alden), the diffuser would consist of a 4 ft diameter pipe anchored directly to the seafloor. The pipe would have an orientation perpendicular to the shore to minimize wave loading. There would duckbill check valves in 14 locations on the 4 ft pipe. Poseidon indicated that, if possible, it would prefer to avoid anchoring solutions that involve pile foundations. The top of the existing tower is at an elevation -14.2 ft. (Alden conceptual design drawing) and is located at a water depth of 27 ft. at MSL. Based on as-built drawings for the intake structure, the outside dimensions of the existing concrete structure is 25 ft x 20 ft and is connected to the existing discharge tunnel (14 ft. dia.) which is buried beneath the seafloor. The proposed diffuser, in comparison, is 4 ft. diameter and 194 ft. in length. The location of the diffuser is unlikely to have a significant impact on the hydrodynamic conditions surrounding the existing discharge tower. Due to the small size of the pipe, it would be

feasible to secure the pipeline using gravity anchors instead of a pile foundation, and protection against scour could be provided by riprap as the surface area of pipe exposed to wave forces is very small. The conceptual design prepared by Alden shows concrete pipe saddles. The pipe saddles would need to be properly sized to provide a secure, gravity anchor foundation for the diffuser.

Burying the diffuser below the existing seabed is an option, but there is a risk that the pipe could silt up and sediment could interfere with the effectiveness of the nozzles. An underwater inspection of the discharge tower was conducted in February 2018 as part of a condition assessment of the structure and the 14 ft diameter pipeline. During the condition assessment, divers performed a cursory inspection of the riprap around the structure. There were no indications from the divers regarding missing riprap or scour around the structure. Videos were taken during the inspection but the visibility was poor so review of the video footage was unclear. Typically, significant scour results in structural failures, as the foundation of a structure becomes compromised. There did not appear to be any evidence of significant structural failures. Therefore, based on the notes of the underwater survey, scour of the discharge tower does not appear to be an issue. However, this was not the primary objective of the survey.

Installation of riprap and properly sized concrete gravity anchors is recommended to provide scour protection and if necessary additional resistance to buoyancy or uplift forces.

Rotating the diffuser to be shore parallel will expose the structure to more force. However, given the size and diameter of the pipe, this may not be significant. If it is possible to maintain the alignment of the linear diffuser to be perpendicular to the shoreline which would reduce the area exposed to head of wave forces, this alignment would be preferred.

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6 August 2018

To: Patrick Crain, Poseidon
Paul Hermann, GHD

From: Bruce Patterson

Subject: Technical Memorandum, Constructability Consideration for Utilizing D2 Intake

Poseidon is considering moving the intake location for the Huntington Beach Desalination Plant from the existing intake concrete structure to a new location, D2, located approximately 1.2 miles down coast. Intake D2 is situated approximately 1,900 ft from the shoreline.

Poseidon has further advised that the preferred approach to connect to the new location D2 is to extend an offshore pipeline from the existing intake tower. Preliminary pipeline sizing prepared by Poseidon's engineering consultant, GHD, has determined that the pipeline would likely have a diameter of between 10 to 14 ft. due to NPSH requirements for the future onshore intake pump station and taking into account future marine growth.

Poseidon had originally considered an option in which large diameter HDPE piping could be pre-assembled in large strings at the Port of Long Beach and sunk into position with concrete anchors which is a proven method for placement of submarine pipelines that can be mounted on the seabed. Coastal engineers from GHD performed a preliminary evaluation for the option of placing a large diameter pipe, parallel to shore on the seabed, to connect the existing intake structure to the new location D2. Based on the preliminary evaluation by the coastal engineers, the option of placing the pipeline on the seabed has been eliminated.

Poseidon has requested that Highlands Construction Solutions, LLC, (HCSLLC) evaluate other options including placing an offshore pipeline from the existing intake structure to the new location D2 by placing the large diameter in a trench below the seabed. Poseidon also requested that HCSLLC evaluate the feasibility of placing the majority of the pipeline onshore and then extend the pipeline to its new location 1,900 ft offshore by installing a trestle through the surf zone.

This Technical Memorandum evaluates both options from a constructability perspective only. Issues such as permitting requirements or access issues along the proposed alignment are not addressed in this evaluation. For the option determined to be the most feasible, ROM cost estimate and construction schedule is provided.

Background Information:

1. The existing intake piping from the Power Generating Station to the existing intake tower is 14 ft diameter pre-cast concrete piping. Poseidon indicated preliminary sizing of the pipe would

range from 10 to 14 ft without taking into account marine growth. For the purpose of this evaluation, a pipe diameter of 14 ft was considered as this would provide an allowance for marine growth. If further design refinements are performed and it is determined that a smaller diameter pipe can be used, the conclusion reached in this Technical Memorandum would not materially change.

2. For the offshore option, the installation of the large diameter pipe would entail trenching an excavation approximately 20 ft deep by 20 ft wide for a distance of nearly 6,500 ft in a depth of water of approximately 30 ft. Alignment of the pipeline would be parallel to the shore and would be located between 1,500 to 2,000 from the shoreline.
3. For the onshore option, the pipeline would tie-in to the existing 14 ft diameter pipeline and would be placed along the State Beach for a distance of approximately 8,500 ft of which approximately 1,900 ft. would be installed through the surf zone by using a steel trestle. The onshore option would also include two beach structures at the tie-in point to the existing pipeline and the turning point where the pipeline heads offshore. It is assumed that the structures would allow for maintenance of the pipeline.
4. Both of the options presented above would include the installation of wedgewire screens (WWS) at the end of the pipeline (at the D2 location). The details of the installation of the WWS is described in the SEIR (2017). In addition, it is assumed that a concrete intake structure similar to the existing intake structure would be required for both options to connect the pipeline to the WWS.
5. Offshore work involving pile driving is limited to working between July 1 to October 31 due avoid impacts to whale migration. In addition, pile driving is further limited to the work hours starting 30 minutes after sunrise and 30 minutes before sunset.

Feasibility of Options

Option 1 – Offshore Pipeline: There are two approaches for installing an offshore pipeline that requires burial beneath the seabed. The first approach is to utilize floating equipment such as derrick barges to excavate and dump scows to dispose of the dredge spoil and along with a secondary barge to place bedding material and lay the pipe. It is assumed that the scour protection will be required on top of the pipeline using riprap armor which will require that the pipe trench is backfilled. In some jurisdictions, offshore pipe trenches are allowed to fill in naturally from sediment transport that normally is present along the coast line, however, such an approach may not be allowed off of Huntington Beach and is not considered feasible for the purpose of this evaluation.

For a 14 diameter pipeline, the trench depth would be approximately 20 ft deep. As the pipe alignment is located in the surf zone, it is expected that the side slopes of the excavation will be flat – approximately 6:1. For a 20 ft deep excavation with 6:1 side slopes, 103 cy of material must be removed for every linear ft of trench. For the estimated 6,500 feet length of the pipeline, approximately 670,000 cy of material would be excavated. In addition, excavations that are performed near the surf zone are

often subject to filling in via natural sand/sediment transport and it must be assumed that a quantity greater than 670, 000 cy would be excavated to maintain the required trench depth. It is further assumed that the excavated material (when performing an open cut) would need to be loaded on dump scows for offshore disposal. Because of the size of the excavation with the flat side slopes, attempting to side cast the material would result in the excavated material sliding back into the excavation. It is unclear if permits could be obtained for ocean dumping for this quantity of materials.

For the offshore option, the quantity of the excavated material using an open cut approach is not considered viable. If the alignment were outside of the surf zone and located in calmer waters, an open cut approach using floating equipment could be considered. For connecting the existing intake structure to the new D2 location, HCSLLC does not consider the open cut approach a viable option.

An alternative approach for the offshore pipeline installation is to build a trestle and install the 6,500 ft length of large diameter pipe from the trestle. The trestle approach would allow for sheet piles to be placed along the alignment on both sides of the trestle which would significantly decrease the amount of material that would need to be excavated. The sheet pile walls would also prevent material from sluffing into the excavation and would eliminate the need to re-excavate to maintain the trench profile. The trestle with the sheet pile walls could be installed in sections to allow the trestle material and sheet piles to be re-used after the accompanying pipe section is placed. For each section, a connecting trestle from the shore would be required to provide access for personnel, equipment and materials for the pipeline installation. (In addition, each trestle would require a temporary construction haul road from the State Beach parking area to the beginning of the trestle at the shoreline).

Assuming that a beach access trestle is placed approximately every 2,200 feet along the 6,500 ft alignment, three approach trestles would also be required. Each approach trestle would be approximately 2,000 ft in length resulting in a total of 12,500 feet of trestle construction. Trestle construction would require the use of vibratory hammers (with at least 10% of the piles finished with impact hammer to prove that the piles are properly seated). This would restrict the construction operation to work from July 1 to October 31 each year (120 calendar days). The production rate for installing a trestle and sheet piles is assumed to be 10 linear feet of trestle per day. It is further assumed that sheet piles would all be removed for the section being constructed during the same whale season. A trestle that is installed parallel to the shore with sheet pile walls would be subject to a substantial wave loading and therefore sheet piles should be removed before the winter storm season. Because the sheet pile walls and the trestle are parallel to the beach and a large surface area is exposed to wave action there is a significant risk that a storm event could cause major damage to the sheet pile walls and the trestle. Assuming a production rate of 10 linear feet per day, the time required to install the pipe using the trestle/sheet pile approach subject to the whale season limitations is 10 years. While it may be possible to reduce the schedule by having several trestle sections and pipe laying operations running in parallel, the shore impact for laydown and access roads under an expedited schedule would also be a

factor. One could believe that the State Beach would allow one access road running from the State Beach parking to the shore line but it is unlikely that multiple access roads would be approved.

Because of the multi-year construction timeframe required to install the offshore pipeline 1.2 miles down coast, parallel to the shoreline, the offshore option does not appear to be a viable option. Besides the public nuisance aspect (visual, noise and public beach access limitation), there is also a significant safety concern. A trestle that is installed parallel to the shoreline is subject to severe wave loading especially caused by winter storms. If a trestle needs to be installed, it should be installed perpendicular to the shore and the timeframe for having the trestle exposed in the ocean should be reduced. For these reasons, HCSLLC recommends that the offshore trestle option is also eliminated for consideration.

Option 2: Onshore Installation

The onshore option to connect to D2 involves laying new 14-foot diameter pipe approximately 1.2 miles down coast along the beach from the existing seawater intake pipeline and then offshore approximately 1,900 feet to the D2 location where a new intake structure and screens will be installed. Construction would proceed as follows:

- A sheet pile cofferdam will be constructed over and South of the existing 14 feet diameter pipeline to create access to open up the side of the existing pipe and install a stub for the new pipe. After the cofferdam is excavated a concrete seal will be placed to allow dewatering of the cofferdam.
- An opening will be cut in the side of the existing pipe and the new 14 feet diameter stub will be installed and sealed to the existing pipe.
- The end of the stub will be protected, the cofferdam will be backfilled and the South wall of sheets will be removed to allow installation of sheet piles for the alignment downcoast along the beach to start.
- An access manhole for future maintenance will be provided at the tie in to the existing pipe.
- The trench for installation of the new 14 feet diameter pipe will be 24 feet wide and 24 feet deep. It is anticipated that approximately the bottom 14 feet of the trench will be below the ambient water table so this pipe installation will be done “in the wet”.
- Sheet piles will be used to shore the trench to avoid collapse of the trench and the need to open up the trench with wide side slopes. Sheets will be provided to shore 400 feet of trench at a time. An external frame at the top of the sheet piles with horizontal struts at approximate 24 feet intervals will be needed to support the shoring system.
- A work area of approximately 100 feet wide and 1000 feet long will be required for the shoring, excavation, pipe laying, backfill, and shoring removal operations.
- A staging area of approximately five acres on the beach adjacent to the work area will be required to stage pipe, bedding materials, and shoring materials.

- Shoring installation will be performed with a crawler crane and a vibratory pile hammer ahead of the excavation operation.
- A 70 ton class hydraulic excavator will be used to dig the trench. The external frame for the shoring system will be installed along the sheet pile walls. Prior to installation of the struts the excavator will work between the sheets and dig the first 8 feet of excavation keeping above the ambient water table. The excavator will then dig to final grade and the struts will be installed as the excavation proceeds. The excavator will load all-wheel drive articulated trucks which will drive back down the beach to dump the material behind the pipe laying area for backfill. It is anticipated that enough trench for two joints of pipe (32 feet) per day will be excavated.
- A crawler crane will be used to lay the 14 feet diameter pipe. The pipe will be RCP or mortar lined and coated steel pipe with bell and spigot joints. The joints will be fitted with a double "O" ring and a test port between the O rings so that the joint may be pressure tested for leaks after each section has been laid. It is anticipated that the sections of pipe will be 16 feet long. Two sections of pipe will be installed per day.
- Pipe will be bedded with approximately one foot of bedding material placed in the bottom of the trench.
- Pipe will be delivered by truck to the laydown yard and staged. As needed the pipe will be loaded onto an off-road truck and hauled to the pipelaying crew.
- Pipe will be backfilled with beach sand that has been hauled back from the excavation operation and watered down for consolidation.
- As the backfill is placed the struts will be removed from the shoring system and the frames and sheets will be removed and cycled ahead to the sheet pile driving crew.
- The following equipment is anticipated for use on the pipelaying operation and includes:
    - Two crawler cranes of approximately 150-ton capacity. One to drive the sheet piles and a second crane to lay the pipe and pull the sheet piles.
    - Two 30-ton capacity articulated off road trucks to haul sand and bedding.
    - One off road truck to haul the pipe.
    - Two APE 200 or equivalent vibratory pile hammers to drive and pull the sheets.
    - A 70-ton class hydraulic excavator to perform the excavation.
    - A wheel loader to place the bedding and backfill.
    - A large forklift in the laydown area to unload and handle pipe sections.
    - A 20,000-pound capacity forklift to handle and move sheet piles ahead on the beach.
    - Various small equipment including generators, welding machines, and compressors.
- Access manholes will be installed at approximate 800 feet intervals along the pipeline.
- A vault will be required at the Southern limit of the onshore alignment where the pipe turns out to sea. The vault will be constructed within a shored cofferdam similar to that at the existing pipe tie in.

- Construction of the pipeline from the vault to the inshore end of the trestle will be similar to the work described above.
- A marine trestle approximately 1,900 feet in length will be constructed for access to install the offshore leg of the pipeline. The trestle will be an open structure with steel pipe piles, cap beams, and rail beams to carry gantry mounted equipment. The trestle will also have wales on each side to support the top of temporary sheet piles to shore the trench for the pipe installation.
- The trestle will be supported with steel pipe piles at approximate 15 feet spacing longitudinally with pile caps at 30 feet intervals. Rail beams will be fastened to the pile caps and to the intermediate piles between the caps so the rail beams are supported at 15 feet intervals. The rail beams will be approximately 30 feet apart. A walkway will be provided on one side of the trestle for crew access. The elevation of the top of the rail will be approximately +30 feet. Air and electric utilities will be run along the walkway for use in trestle and pipeline construction. Lighting will be provided on the walkway for safe access and to illuminate the trestle to reduce the potential for a hazard to mariners and members of the public.
- Equipment supported by the trestle will include one (perhaps two) 150-ton capacity cranes mounted on gantries, a self-powered flat deck material cart to haul material, and possibly a pipe laying gantry.
- Pile driving for the trestle will be performed with a combination of vibratory and impact pile hammers. It may be feasible to drive the pipe piles to tip elevation with a vibratory hammer but an impact hammer will be required, at a minimum, to “proof” the piles so that pile capacity can be assured.
- As the trestle construction proceeds sheet piles will be installed on each side of the trestle and secured to the wale system. The sheet piles will provide shoring for excavating the pipe trench.
- It is anticipated that the trestle, sheet piles, excavation, pipe laying, and backfill will progress in stages scheduled to maximize the length of pipe that can be installed within the allowable work window each year. As the pipe is laid and backfilled the sheet piles will be pulled and advanced forward for the next phase of excavation.
- Excavation will be performed with a clamshell and the material will be side cast outside the sheet pile shoring.
- Pipe installation will then proceed as the excavation is completed. The pipe will be transported out the trestle using a crane or pipe gantry, lowered into position, and pulled into place to make the joint with the previously laid pipe. A diver will assist with alignment and to test the joint after it has been completed. The pipe will be held in position and bedding will be placed around the pipe with diver assistance.
- Backfill and armor stone will then be placed over the completed portion of the pipeline.
- Sheet pile shoring will then be pulled in stages and moved ahead for use in the next pipe installation stage.

- When the pipeline has reached the end of the trestle, trestle equipment may be used to install the precast intake structure.
- A similar intake structure to the existing intake is contemplated. The seabed will be excavated, possibly with the use of sheet pile shoring. Steel piles will be driven to support the precast elements of the intake structure. The precast segments of the structure will then be lowered onto the steel piles. Tremie concrete will then be placed to seal the structure at the bottom and lock it to the steel piles. After the intake header and screen system has been installed a precast concrete lid will be installed on top of the intake structure.
- After all elements of the intake system are complete the sheet piles and trestle may be removed progressively back to the shore.

The WWS will require an air burst system to keep the debris from clogging the screens. For the WWS option based on using the existing intake structure, the air compressor/receivers could be placed by the forebay of the existing power generating station. Individual air piping could then be routed through the existing 14 ft diameter intake line. For the D2 intake option, it would no longer be possible to place the air compressors/receivers at the power generating site as the total distance that the air piping would need to be routed is nearly 9,000 ft. The air compressors/receivers would need to be located on-shore in the vicinity of the piping where it turns to go offshore. This would reduce the distance air piping distance to approximately 2600 ft, which is manageable. This would require that Poseidon is able to obtain land on the state beach to build an aboveground structure to house the compressor/air receivers. For purpose of this Technical Memo, it is assumed that Poseidon would be able to lease land for the air compressor building.

Preliminary Schedule: The preliminary construction schedule for the installation of alternative intake at the D2 location is shown in Attachment 1. The preliminary schedule includes the timing for the onshore construction as well as the offshore work. The offshore work requires the use of vibratory hammers and limited impact pile driving equipment, and therefore the work has been restricted to comply with the whale migration requirements as described in the 2017 SEIR – July 1 through October 31. The schedule also includes schedule contingency risk for both the offshore and onshore work. Onshore work may be impacted by Least Tern nesting restrictions which would prolong the pipe laying operation. For the offshore work, schedule contingency was added to account for delays caused by sea conditions. Least Tern nesting also impacts offshore work as materials for the offshore work are moved from the onshore staging area to the trestle, and this risk is included in the schedule. The schedule also illustrates the relationship between the onshore desalination plant construction and construction of the new D2 intake system. The commissioning of the desalination plant can't begin until the intake system is installed. The removal of the trestle can, however, extend past the start of plant commissioning.

Budgetary Pricing: A rough order magnitude cost has been prepared for the onshore option and is presented in Attachment 2.

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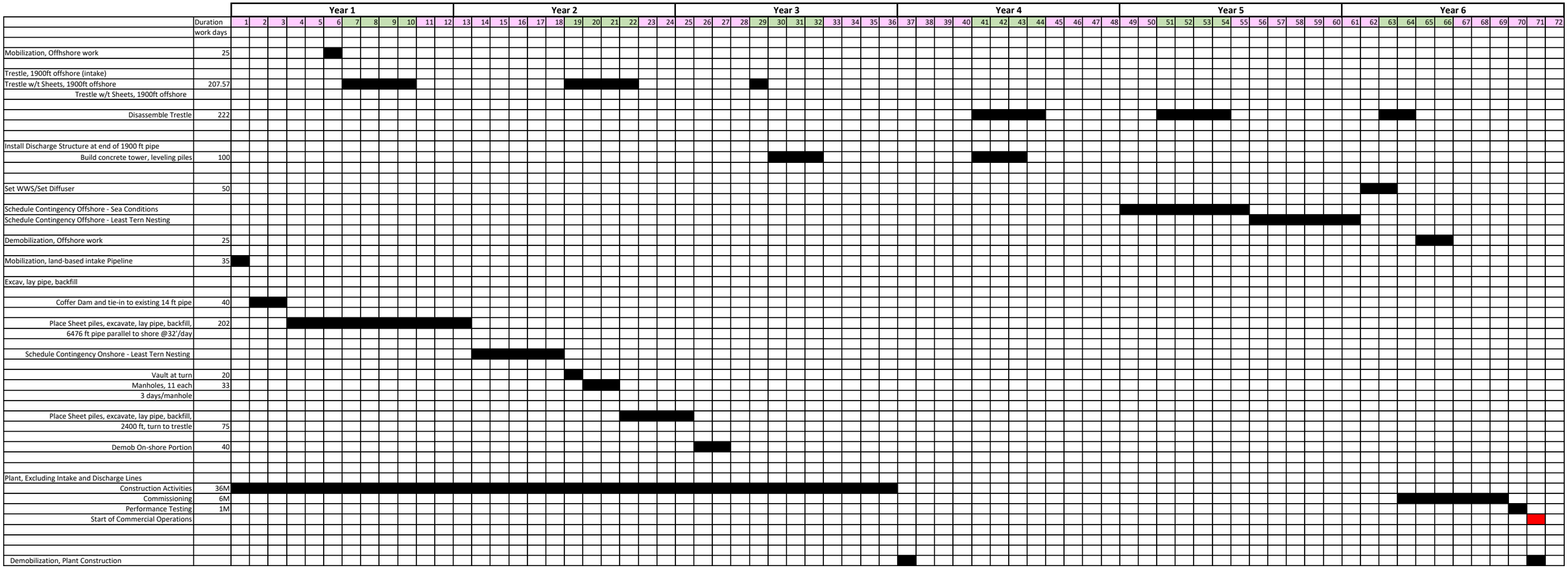
Poseidon

Alternate Intake D2



Months highlighted in Green not subject to whale migration restrictions

Revision 2

PROJECT: Huntington Beach Desal
ITEM: Onshore Alignment to D2

ESTIMATOR: BP
DATE: August 6, 2018

DESCRIPTION	QUANTITY		EQUIPMENT RENTAL				OPERATING EXPENSE								LABOR EXPENSE											
			CO. OWNED		OTHER		TIRES & TRACKS		EQUIP REPAIR		FUEL-OIL-GREASE		SERVICES TOOLS & SUPPLIES		WAGES		ADD-ONS		SUBTOTAL		PERMANENT MATERIALS		SUB CONTRACTS		TOTAL DIRECT COST	
			U.P.	TOTAL	U.P	TOTAL	U.P.	TOTAL	U.P.	TOTAL	U.P.	TOTAL	U.P.	TOTAL	U.P.	TOTAL	U.P.	TOTAL	U.P.	TOTAL	U.P.	TOTAL	U.P.	TOTAL	U.P.	TOTAL
c'dams @ tie-in & corner	3,200	mh													110	352,000				352,000						352,000
sheets for cofferdams	108,000	lb											0.90	97,200						97,200						97,200
frame for cofferdams	30,000	lb											1.50	45,000						45,000						45,000
seal concrete	500	cy											200.00	100,000						100,000						100,000
pipe run on beach	47,250	mh													110	5,197,500				5,197,500						5,197,500
sheets for beach run	669,900	lb											0.90	602,910						602,910						602,910
frame and struts @ beach	206,000	lb											1.50	309,000						309,000						309,000
pipe for beach run	6,876	lf																		0	1,000	6,876,000				14,989,680
bedding for beach run	14,000	tn												0						0	40	560,000				560,000
vault at South turn	1	ls												0						0	200,000	200,000				200,000
trestle/sheets/pipe	109,440	mh												0	110	12,038,400				12,038,400						12,038,400
erect/strip trestle equip.	4,000	mh												0	110	440,000				440,000						440,000
trestle vertical pile	17,780	lf											126.00	2,240,280						2,240,280						2,240,280
trestle batter pile	5,120	lf											63.00	322,560						322,560						322,560
dive crew	545	dy																		0			7,000	3,815,000		3,815,000
trestle caps	321,600	lb											1.50	482,400						482,400						482,400
trestle rail beams	372,000	lb											1.50	558,000						558,000						558,000
trestle rail	114,000	lb											1.00	114,000						114,000						114,000
trestle walkway	7,600	sf											25.00	190,000						190,000						190,000
trestle wale beams	206,000	lb											1.50	309,000						309,000						309,000
sheets for trestle	2,296,800	lb											0.90	2,067,120						2,067,120						2,067,120
trestle template	1	ls											50,000.00	50,000						50,000						50,000
trestle crane gantries	2	ea											1,000,000.00	2,000,000						2,000,000						2,000,000
trestle pipe gantry	1	ea											1,000,000.00	1,000,000						1,000,000						1,000,000
trestle material cart	1	ea											750,000.00	750,000						750,000						750,000
pipe for trestle run	1,900	lf																			2180	4,142,000				4,142,000
bedding for trestle run	4,200	tn																			40	168,000				168,000
rip rap pipe protection	15,200	tn																			40	608,000				608,000
utilities on trestle	1,900	lf											10.00	19,000						19,000						19,000
precast intake structure	1	ls																			300000	300,000				300,000
equip. move in/out beach	1	ls											200,000.00	200,000						200,000						200,000
equip. move in/out trestle	1	ls											200,000.00	200,000						200,000						200,000
trestle seasonal moves	1	ls											1,000,000.00	1,000,000						1,000,000						1,000,000
trestle crane down time rent	80	mo			20000	1600000														1,600,000						1,600,000
beach cranes	106	wk			7665	812490														812,490						812,490
beach articulated trucks	159	wk			5595	889605														889,605						889,605
beach welding machines	159	wk			333	52947														52,947						52,947
beach 185 cfm air comp	106	wk			619	65614														65,614						65,614
beach 20,000 lb forklift	53	wk			2538	134514														134,514						134,514
beach yard 50,000 lb fork	53	wk			6018	318954														318,954						318,954
beach APE 200 vibrohammer	106	wk			8437	894322														894,322						894,322
beach excavator	53	wk			7744	410432														410,432						410,432
beach 980 loader	53	wk			5906	313018														313,018						313,018
trestle cranes	176	wk			7665	1349040														1,349,040						1,349,040
trestle pipe gantry op cost	88	wk			1400	123200														123,200						123,200
trestle material cart op cost	88	wk			1200	105600														105,600						105,600
trestle vibrohammers	176	wk			8437	1484912														1,484,912						1,484,912
trestle impact hammer	88	wk			1512	133056														133,056						133,056
trestle service forklift	88	wk			2538	223344														223,344						223,344
trestle welding machines	264	wk			333	87912														87,912						87,912
trestle 185 cfm comp.	264	wk			619	163416														163,416						163,416
pickups - all	438	wk			653	286014														286,014						286,014
misc. outside equip. rent	1	ls				675000														675,000						675,000
mechanic for down time	6,400	mh													110	704,000				704,000						704,000
crew consumables	170,290	mh											10.00	1,702,900						1,702,900						1,702,900
Installation of WWS Assembly	1	ls																					17,000,000	17,000,000		17,000,000

Airburst																										
Bldg onshore (State Beach)	1	ls																					500,000	500,000		500,000
Compressors/Air Receivers	1	ls																					1,200,000	1,200,000		1,200,000
Electrical Service, setup	1	ls																					250,000	250,000		250,000
Air Piping	10,400	lf																					150	1,560,000		1,560,000
Allowance for leasing land	1	ls																					1,000,000	1,000,000		1,000,000
SUBTOTAL	1	ls				3,555,170				0				11,502,360		18,027,900				34,239,540				3,815,000		89,507,340
Indirects (25% of subtotal)																										22,376,835
Insurance & enviro (5%)																										4,475,367
Overhead & profit (25%)																										22,376,835
SUBTOTAL																										138,736,377
engineering (15%)																										20,810,457
contingency (40%)																										55,494,551
TOTAL ESTIMATED COST																										215,041,384