APPENDIX E

PRELIMINARY WATER AND WASTEWATER MASTER PLAN

PRELIMINARY WATER AND WASTEWATER MASTER PLAN

FOR

POINT MOLATE

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Prepared for:
Winehaven Legacy LLC
2393 Morse Avenue
Irvine, CA 92614

BKF Engineers
255 Shoreline Drive, Suite 200
Redwood City, CA 94065
650.482.6313
Sravan Paladugu, P.E., Design Engineer
BKF Project Number – 20166080-12

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A. INTRODUCTION

The Winehaven Legacy LLC is proposing a mixed-use development project in the City of Richmond (City) on the former Point Molate Navy Fuel Depot and Winehaven Historic District (Point Molate Site or Project Site). The Point Molate Site is located on the San Pablo Peninsula and is bounded by the San Francisco Bay to the west, open space parcels to the north and south, and the Chevron Richmond refinery to the east, with Potrero Ridge's 480-foot hillsides separating these two sites. Approximately 138 acres of the roughly 413-acre of the Point Molate Site is submerged in the San Francisco Bay, leaving approximately 275 acres above water. The Point Molate Site is approximately 1.5 miles north of Interstate 580 (I-580) and the Richmond-San Rafael Bridge, and has direct freeway access through Stenmark Drive, a City-owned roadway. Refer to Figure A for Project Vicinity Map.

The Project Site is within East Bay Municipal Utility District (EBMUD) service area and potable water to Project Site is currently supplied by a 12-inch diameter EBMUD water main along Stenmark Drive. Water from the EBMUD line is then distributed throughout the Project Site through private water and fire distribution system that was installed by the Navy in the 1950s. Since the Navy ceased operations on Point Molate in 1995, there has been little demand for potable water *(NOP, 2019)*.

The Project Site is also within the City of Richmond Municipal Sewer District (RMSD) service area, but is not currently connected to the RMSD's wastewater collection system. During Navy operations, wastewater from the Project Site used to be treated onsite and discharged into the Bay. The wastewater collection system and onsite treatment is currently not in use. Instead, portable toilets are used onsite and some wastewater from the Project Site is trucked to the RMSD treatment plant *(NOP, 2019)*.

The proposed mixed-use development will include residential, commercial and retail uses that will significantly increase the demand for water and wastewater services. The purpose of this technical report is to document the existing water and wastewater systems, identify Project demands, and provide recommendations for the new and/or rehabilitated distribution and collection system to serve the proposed Project.

B. PROPOSED PROJECT

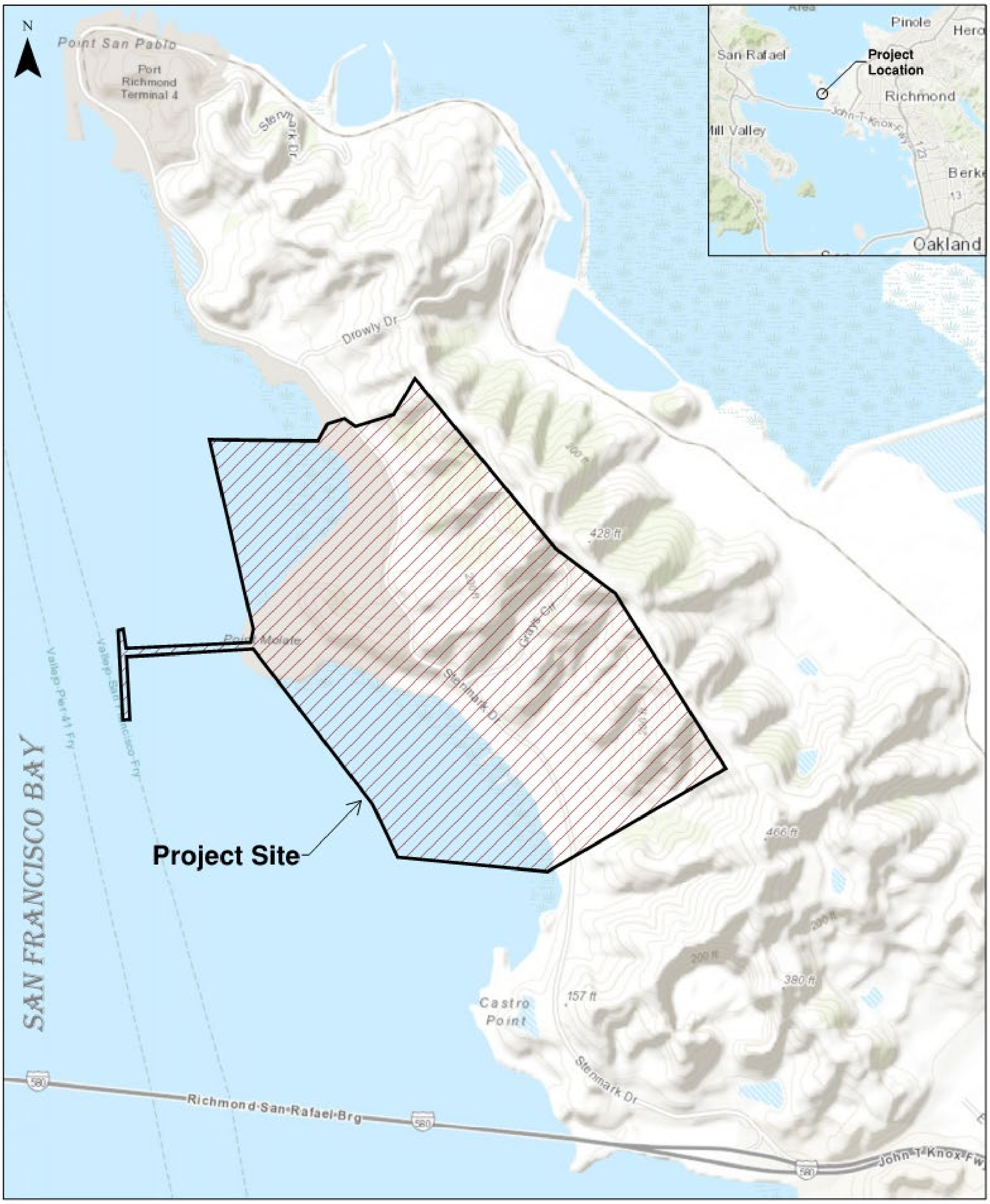
The Project will include a variety of residential and commercial uses, as well as supporting road and utility infrastructure.

The proposed Project would be divided into eight Development Areas A through H. Development Areas A through E would be developed with up to 910 residential units and Development Areas F through H would be developed with up to 1,130 new residential units and will include rehabilitation of existing historic buildings in Winehaven historic district for either commercial or residential uses, or a mix of the two. In total, up to 2,040 units could be developed on the Project Site. Table A below provides a summary of proposed land uses.

Table B – Proposed Project Land Use Summary

Land Use	Number	Unit
Residential (Areas A-E)	910	Units
Residential (Areas F–H)	1,130	Units
Office/Retail/Commercial/Restaurant (Area F-H)	40,000	Square Feet

Figure A – Vicinity Map



C. WATER SYSTEM EVALUATION

The potable water to Point Molate is currently supplied by EBMUD. EBMUD obtains approximately 90 percent of its water supply from the Mokelumne River Watershed in the Sierra Nevada Mountains. The remaining 10 percent is provided by local runoff collected in its five terminal reservoirs *(UWMP, 2015)*. The Project Site would be served by the Orinda WTP, which is sourced from the Pardee, Briones, and San Pablo Reservoirs.

EBMUD provides potable water to the Project Site through a 12-inch diameter water main along Stenmark Drive, which was installed in 1997. Water is currently distributed to the site via a number of metered connections to the 12-inch EBMUD line. The water is supplied to the site from EBMUD's Richmond and Potrero tanks. Potrero Tank, a 1,000,000-gallon welded steel tank northwest of the site near Point San Pablo, is at the end of EBMUD's Western Drive pipeline. EBMUD had plans to replace the welded steel tank with a 400,000-gallon prestressed aboveground concrete tank; however, this project has not been implemented to date. The 11,400,000-gallon Richmond Tank is south of the site at Point Richmond. Both tanks are part of the Central Pressure Zone. The tanks provide operational, emergency, and fire flow water storage in the Point San Pablo/Point Molate/1-580 area. *(HLA, 1999)*

C.1 EXISTING WATER SUPPLY SYSTEM

The existing water system at the Project Site was previously evaluated as part of the Reuse Plan in 1999 and again in 2008 as part of the Casino Project. The Utility Study-Master Utility Plan-Capital Improvement Plan prepared by HLA (HLA Study) as part of the 1999 Reuse Plan evaluated the system in great detail. As such, the information related to the existing system configuration, condition, and current and historic operations is directly taken from the HLA Study and was not field investigated or verified by BKF.

According to HLA's Study, the Navy's water distribution system was installed 70 to 75 years ago and comprised of pipelines ranging in diameter from 2-1/2 to 14 inches. The Navy system incorporated components installed prior to Navy occupation of the site. Modifications to the system were made from time to time by the Navy, including replacement or addition to the fire protection water pipelines in the 1980s. Most of the existing water distribution system is currently shut down.

There are two onsite water storage tanks constructed by the Navy. One is a 1,134,000-gallon storage tank (known as Tank A) at an approximate elevation of 500 feet MSL on top of a hill on Ridge Road. The other tank is a 200,000-gallon underground tank adjacent to Building 66 at an elevation of approximately 100 feet. These tanks are isolated from the piping network by manual isolation valves. Historically, water from the EBMUD pipe was received at Building 13 and pumped uphill to Tank A. Water was then redistributed onsite via the Navy's private water system, which comprises a main 14-inch line and several secondary lines *(HLA, 1999)*. According to HLA Study, there were two main Navy water distribution systems and four smaller systems.

The main systems were:

- A pumped system for fire protection for the higher elevations served by Tank A. The pumping facility includes two electric driven pumps rated at 1,000 gallons per minute (gpm) at 65-PSI TOH (total dynamic head) each and one standby gasoline-driven pump rated at 1,000 gpm at 50-PSI TOH. The pumps are in various states of disrepair, and have not been operated for several years and cannot be relied upon. The pumps are no longer required as the fuel storage tanks are empty and no longer in service.

- A non-pumped potable water/fire protection system served by Tank A and the 200,000-gallon tank that provided water for most of the lower elevations.

The smaller systems were:

- Three potable water systems providing water to the residential units and other areas not covered by the two larger systems. Fire protection for the structures served by the three potable water systems is provided by the gravity flow system from Tank A.

- A combined potable/fire protection system serving the Old Drum Storage Area 2.

Tank A is known to leak at 15,000 gallons per day based on Subtronics investigation done in 1995. Because the fuel storage tanks onsite are no longer in service, the City had once planned to abandon both water tanks, their associated pumping stations, and a portion of the water piping due to the expense of repairing and maintaining the tanks. *(HLA, 1999)*.

C.1.1 Existing Meters, Hydrants and Valves

The water mains have valves at major pipe intersections so segments can be isolated for maintenance and repair. Piping is arranged in loops and branches. According to the 1985 Bechtel report, the Navy water system was connected to the EBMUD line via five (5) metered connections. The 2-inch and 3-inch metered connections providing water to the residential units and Tank A, respectively, remain in place. The existence of the other three connections after replacement of the 12-inch line in 1997 was not verified. *(HLA, 1999)*.

C.1.2 Existing Fire Protection System

The fire protection water systems include 2.5- to 14-inch diameter mains constructed of asbestos-cement (63 percent), steel (27 percent), and cast iron or ductile iron pipe (10 percent). Hydrants are installed in and around the residential area, Historic Area, pier, and several storage areas. There were originally 105 hydrants onsite. Most are associated with the fuel tanks in the hillside/open space area and are not considered for reuse. There is a non-functioning fire station [Building 63) at the site with a Navy-owned fire engine (pumper truck) and miscellaneous emergency equipment. Point Molate is currently served by the City Fire Department. *(HLA, 1999)*.

C.2 PROJECTED POTABLE AND FIRE FLOW DEMANDS

The Project water consumption occurs indoor and outdoor. Indoor water consumption primarily includes water used in restrooms, bathrooms, kitchen, laundry, cleaning and by cooling appliances. Outdoor uses include water used for irrigating landscaped areas and cleaning/washing-down hardscape areas. In addition to indoor and outdoor water uses, incidental water use occurs in an event of fire.

During Navy operations, EBMUD had supplied up to 55,000 gallons per day (gpd) to the site but currently there is very little demand onsite for potable water since the military operations ceased in 1996 *(WSA, 2008)*.

C.2.1 Indoor Water Demand

Indoor water consumption varies by land use density, geographic location, and, agency's water conservation measures. EBMUD Section 31 requires new developments to comply with water-efficiency requirements which include using high-efficiency or dual-flush toilets, dishwashers, and clothes washing machines, as well as low-flow showerheads and faucets.

EBMUD as part of their 2015 Urban Water Management Plan has developed per capita demand to assess their water resources needs and supplies to serve future population growth over the next 5-year period. The EBMUD's per capita demand is generally consistent with unit demand factors used by other water and wastewater districts in the Bay Area to plan for future growth and to evaluate infrastructure needs. We therefore used the EBMUD's daily per capita water use for indoor residential water use to estimate average daily water demand for the proposed project residential land uses.

Average water demand for commercial, retail, and restaurant uses was not published by EBMUD. Therefore, we used standard demand factors published by other agencies with similar land development projects to estimate flow for from these proposed uses. Table C.1 below presents the demand factors and assumptions made to estimate Project water demand.

Table C.1 – Indoor Potable Water Demand Factors

Land Use	**Potable Water Demand Factors**
Residential Units	Single-Family Homes: 220 gallons per day per unit (55 gallons per resident per day * 4 residents per unit) Townhomes: 165 gallons per day per unit (55 gallons per resident per day * 3 residents per unit) Condominiums or apartments: 110 gallons per day per unit (55 gallons per resident per day * 2 residents per unit)
Commercial/Retail	0.14 gallons per day per square foot
Restaurant	0.5 gallons per day per square foot

The maximum total average day indoor water demand for the Project based on the above factors is approximately 290,160 gpd [1]. Table C.2 below provides summary of breakdown by land use. Refer to Table 1 in Appendix A for detailed breakdown of indoor water demands by planning area.

Table C.2 – Total Average Indoor Water Demand

Land Use	**Number**	**Unit**	**Total Average Day Demand (gpd)**
Residential	2,040	Dwellings	270,160
Restaurant	40,000	Square Feet	20,000
Project Total			**290,160**

Note:

(1) The 2008 Water Supply Assessment (WSA) prepared by EBMUD as part of the Casino Project FEIR had a projected demand of 0.864 MGD for Alternative B.

C.2.2 Outdoor Water Demand

Outdoor water consumption is primarily associated with irrigating new landscaped areas. As such, outdoor water consumption is dependent on local climate and the type of landscape. The Project is

[1] The residential-heavy Project scenario represents the worst case (most water-intensive) demand scenario. On a per square foot basis, commercial uses use less water than residential uses.

anticipated to create approximately 35-acres of new landscaped areas which includes the newly created cut/fill areas, new roadway medians and landscape buffers, residential lot landscaping, open spaces within the newly developed area.

In general, the amount of water required for irrigation can be computed using evapotranspiration (ET) rate and precipitation. Using an annual ET rate of 37-inches for turf grasses in this region and an annual precipitation of 23-inches, the yearly average irrigation water demand is estimated to be approximately 2.6 inches per acre per month. Similarly, the peak irrigation demand, which occurs in July, is approximately 6.4 inches per acre per month. Based on these factors, the Project yearly average irrigation demand is estimated to be approximately 80,000 gallon per day. The peak irrigation water demand, which occurs during summer, will be approximately 196,000 gallons per day.

EBMUD Section 31 requires the project to comply with Assembly Bill 325 (AB 325), Model Water Efficient Landscape Ordinance which require new and retrofitted landscapes to use more efficient irrigation systems, graywater usage, and onsite storm water capture, and limit the portion of landscapes that can be covered in turf. Additionally, EBMUD requires landscape areas covered with lawn to be no more than 25% of the total irrigated area.

Irrigation water demand can be met with either through potable water or recycled water. Recycled water is highly-treated wastewater that is safe for many appropriate purposes. Currently, the City does not have designated areas for recycled water use. However, the Project is evaluating use of packaged wastewater treatment system onsite and if implemented, all of the irrigation demand can be met with the treated wastewater from the onsite treatment facility.

C.2.3 Fire Flow Demand

The sizing of the on-site water system is primarily controlled by the requirements for fire suppression because domestic water usage, i.e., indoor and outdoor usage, is significantly less than the required fire flow for any building/structure. The 2019 California Fire Code was used to estimate the fire flow requirement for different land uses based on gross area and the method of building construction. The required fire flow for each development type along with the assumptions made about size are presented in Table C.3. The maximum sizes were assumed to provide a conservative estimate.

Table C.3 – Projected Fire Demand

Land Use	Fire Flow Demand (gpm)	Sprinkler Reduction	Fire Flow Required & Duration
Residential	3,000	50%	1,500 gpm for 2hrs
Commercial [e]	8,000	50%	4,000 gpm for 4hrs

Notes:
a) Fire Demands are based on 2019 California Fire Code Table B105.1 of Appendix B.
b) Total Building Area includes corridors, stairs and walkways.
c) Condominiums and apartments are assumed to be of Type V-A construction.
d) Single family homes and townhomes are assumed to be of Type V-B construction.
e) Rehabilitated historic buildings, including Winehaven, are assumed to be Type IIIB construction retrofitted with automatic sprinkler systems.

C.3 DESIGN CRITERIA

The design criteria used for the development of the proposed water system is based upon established industry operations standards and EBMUD requirements for other similar developments in the Bay Area. New potable water systems are sized to serve both domestic water demand and fire water demand during under various demand scenarios including the maximum day demand and peak hour demands.

Maximum Day Demand (MDD) represents the maximum volume of water used in a 24-hour period for the entire year. A water system is typically evaluated under a maximum day demand plus fire flow demand condition as this condition allows the system to be stressed at a higher demand rate to ascertain if pipeline carrying capacities are adequate in a fire emergency. To develop MDD a peaking factor of 2.0 is applied to the average day demand (ADD).

Peak Hour Demand (PHD) represents the highest hourly demand for the entire system, and simulates the highest flow rate expected. To determine the PHD, a peaking factor of 2.4 is applied to increase the ADD. The criteria presented in Table C.4 and C.5 is used to size the proposed potable and firewater system.

Table C.4 – Potable Water System Demand and Peaking Factor

Parameter	Value
Domestic Water Average Day Demand (ADD)	Varies by Land Use; Refer to Table C.1
Fire Flow Demands (FF)	1,500 - 4,000 gallons per minute (gpm) for

	4 hours
Maximum Day Demand (MDD)	MDD = 2.0 x ADD
Peak Hour Demand (PHD)	PHD = 2.4 x ADD

Table C.5 presents the low pressure water system design criteria.

Table C.5 – Potable Water System Design Criteria

Parameter	**Value**
Pipe size	Pipe diameters of 6, 8, and 12 inches shall be used for all distribution and feeder mains unless otherwise approved by the Director with the consent of the PUC on a case-by-case basis. Pipe diameters of 10 inches shall not be used.
Pipe Material	6" to 8" – PVC 12" and larger – Steel
Hazen Williams C-value for proposed pipes	130
Maximum static pressure	130 pounds per square inch (psi)
Maximum velocity during PHD	8 feet per second (fps)
Minimum pressure during PHD	30 psi
Maximum velocity during MDD+FF	14 fps
Minimum system pressure during MDD+FF	20 psi

C.4 PROPOSED SYSTEM DESIGN

The existing water supply system is primarily made up of asbestos-cement pipe and is known to have water quality problems and the reliability of the system is doubtful *(HLA, 1999)*. Therefore, EBMUD will require all of the existing system to be replaced with new system. EBMUD also requires the site soils to be free from contamination prior to installation of new pipes.

In order to size the new water supply system to serve the Project Site, a hydraulic model was built to evaluate demand and pressure per the design criteria. The Fire Marshall generally requires that the flow required for firefighting be either supplied by a public water main or by a gravity system such as a tank. The use of booster pumps to meet flow and pressure required for firefighting is generally not acceptable.

As noted previously, the existing system is served by EBMUD's Central Pressure Zone. The Central Pressure Zone can serve pads up to elevation 100. However, since some of the proposed development pad elevations will extend beyond elevation 100, a new tank will be required to serve a portion of the Project site. Additionally, in a meeting with EBMUD on December 2, 2019, it was noted that the existing 12-inch pipe can provide only 500 gpm at 20 psi, which is lower than the required minimum fire flow for the Project. In order to provide the required fire flow, the Project will require a new water tank. The hydraulic model is set up to operate under one pressure zone provided by the new tank.

C.4.1 Hydraulic Model Development

The hydraulic model was developed using Bentley WaterCAD v8i Select Series 6 to determine the available fire flow and pressure at all hydrants on the project site. WaterCAD is a water distribution system analysis program that is based on the Hazen-Williams equation. A preliminary system layout with a new tank, backbone pipe, and hydrants were used to input the physical model parameters. New hydrants were set at the farthest point within each planning area to determine the lowest available flow and pressure and to adjust sizing of new pipes accordingly to meet required flow and pressure. Node elevations were assigned based on the existing topographic survey and proposed grades. The new tank pad was set at elevation 290 based on the anticipated highest pad elevation of 200. The tank overflow is set 30-feet above the tank at elevation 320. The extent of the modeled system is shown on Figure C.2.

C.4.2 Capacity Analyses

The system performance was evaluated based on the minimum pressure required during different demand scenarios. The Fire Marshall requires that the system to provide a minimum pressure of 40 psi during peak hour demands without fire flow and 20 psi during maximum day demand with fire flow.

The approach to evaluating and sizing the pipe to provide minimum pressure under different demand scenarios is by initially sizing for required residual pressure and velocity under fire flow condition. Since fire flow is significantly higher than the peak hour demand and because there is no dedicated water distribution system for fighting fire, if the residual pressure under fire flow demand scenario is greater than 20 psi and the velocity in pipe is less than 14 fps, then the system will generally meet the criteria for all other demand scenarios. As such, the analyses and sizing of the backbone system was performed using fire flow scenario.

The fire flow scenario combines maximum day demands and fire demands at select nodes in the system. Maximum day water demands are uniformly distributed through the site using the anticipated water demands presented on Table 1 in Appendix A. The fire flow required for each land use as presented in Table 1 in Appendix A are logically assigned at nodes that simulate worst case.

C.4.3 Results

The pressure available from EBMUD's 12-inch line is inadequate to provide the required fire flow of 1,500 gpm at 20 psi. As such, a new tank is needed to supply fire flow for the Project. The capacity of the new tank must be at least 1 MGD to provide fire flow for the required duration. In lieu of one 1 MGD tank, EBMUD requires that two twin tanks, each with a volume of 0.5 MGD, be constructed. The twin tanks will require roughly 1 acre of land. A new booster pump will supply water to the new tanks and will require roughly 0.5 acres of land. The analyses show that 8-inch and 12-inch pipe sizes are needed to serve the fire flow from the new tanks. Figure C.2 shows preliminary pipe sizes for the new pipe lines required to meet fire flow scenario.

C.5 RECOMMENDATIONS

A majority of the existing water system was installed by the Navy in the 1940's and 1950's and a majority of the system is dedicated to serve the underground fuel storage tank fire protection needs. The Project will need to abandon all existing water lines within the development footprint for the following reasons, 1) the existing pipe lines do not align with the proposed development layout, 2) the existing system is primarily made up of asbestos cement pipe, and there are water quality issues, and 3) the existing system was installed 75 years ago and does not have adequate serviceable life left and is therefore not reliable. The existing system connected to Tank A outside the Project development footprint will also need to be removed for the same reasons and replaced with new pipes as shown on Figure C.2.

The new system will consist of water mains, laterals, hydrants, meters and backflow valves and pressure reducing valves. The potable water system will be designed and constructed in accordance with the City and Fire Department Standard Plans and Specifications and to applicable City, State, and Federal codes and standards unless otherwise permitted. Every effort will be made to locate the water facilities within the public right-of-way to allow for access and maintenance of facilities unless otherwise approved. Dedicated easements will be required for water facilities on private property accessible to City and EBMUD personnel, fire trucks, and equipment for maintenance, repair, and servicing. The following provides general recommendations based on other similar projects.

C.5.1 Water Distribution System Analyses

The layout and size of the proposed water distribution system is preliminary. EBMUD, in a meeting held on December 2, 2019, noted that major facilities such as tanks and pumps that will be required to serve the Project will need to be designed and constructed by EBMUD per Section 3B of EBMUD's regulations. A more detailed analysis will be conducted to confirm pipe sizes at tentative map stage. Such an analysis must be based on field tested flow and pressure information. Additionally, it is recommended to meet with EBMUD again to discuss Project-specific detailed requirements to design water mains in the distribution system. It should be noted that EBMUD requires the site soils to be free from contamination prior to installation of new pipes. As such, the areas where pipe will be needed will need to be fully remediated prior to installation.

C.5.2 Fire Protection System

Currently none of the buildings or structures onsite are equipped with any automatic or manually activated wet and/or dry suppression systems such as sprinkler and/or Halon/CO2 systems. No automatic and/or manual alarming devices were observed inside any of the buildings during HLA site investigation in 1999.

The analysis assumes that existing historic buildings that will be restored and new residential buildings will include automatic fire sprinkler systems. As part of this Project, fire suppression and alarm systems for all buildings will need to be designed and installed in accordance with NFPA Code Sections 13, 14, and 72, in addition to applicable City, county and state fire codes. Additionally, fire flow for all development areas must be provided by outdoor fire hydrants at the spacing required by the City Fire Marshall.

C.5.3 Onsite Storage Tank

Onsite storage tanks are needed to serve fire flow for development at higher elevations. The existing storage tank, Tank A, has adequate capacity to meet maximum fire flow for the required duration. However, Tank A was documented in 1994 to have leaks with an estimated loss of 15,000 gallons per day (HLA, 1999). In a meeting held on December 2, 2019, EBMUD noted that new twin tanks will be required regardless of the condition of the existing tank. The new tanks will need to follow EBMUD standards and criteria for Distribution Reservoir and Pumping Plant design. EBMUD noted that they will design and construct the new twin 0.5 MG tank system. The recommendation for two 0.5 MGD tanks is based on fire-fighting reserve to meet maximum fire flow of 4,000 gpm for 4-hours. Once more details about the Project's buildings and uses are known, it is recommended that the Project meet with EBMUD and the City Fire Marshall to confirm the tank storage criteria and design standards.

C.5.4 Pump Station

The water system will need a booster pump to feed the new storage tanks similar to the Navy's exiting booster pumps. The new pump station must have one spare pump to provide 100% redundancy and must be sized to pump at a rate equal to 1.5 times the projected Maximum Day Demand. It is recommended to confirm the requirements with the City Fire Marshal once there are more detailed Project designs. EBMUD will design and construct the pump station, paid by the applicant, as part of the Preliminary Work Agreement.

C.5.5 Water Meters, Pressure Reducing Valves, and Backflow Preventer

The Navy system is served by five (5) meters ranging from 5/8-inch to 4-inches that connect to the EBMUD 12-inch line in Stenmark Drive. EBMUD will require the proposed development to install a new meter for each dwelling unit. The location and size of the meter will be coordinated with EBMUD during the Project's design phase.

The Project will require pressure reducing valves due to close proximity to new storage tanks and the site terrain. During maximum day and peak hour demands, the residual pressures are significantly higher than normal operating pressure of 40 psi to 60 psi. With the new tank overflow set at elevation 320, pressure reducing valves will be need for lower level planning areas below elevation 180 to minimize leakage and to extend system performance.

If EBMUD were to use the water mains within the development areas for looping their offsite system, then they may require that each of the individual communities within the Project install a back flow preventer before connecting to the EBMUD's looped onsite water mains within the development area.

C.5.6 Water Conservation Measures

EBMUD Regulations Section 31 requires the district to review applications for new water service to determine the applicability of, and compliance with, water-efficiency requirements. District staff may inspect the installation of water efficiency measures and fixtures to verify that the items are installed and performing to the required water use levels. Among other requirements, residential service includes high-efficiency or dual-flush toilets, dishwashers, and clothes washing machines, as well as low-flow showerheads and faucets. Outdoor landscaping plans are required for any new or retrofitted landscaping greater than 5,000 square feet of irrigated area, and ornamental turf must be limited to no more than 25 percent of total irrigated area.

D. WASTEWATER SYSTEM EVALUATION

The Point Molate site is located within the Richmond Municipal Sewer District (RMSD) service area but the wastewater collection system that is currently onsite is not connected to the RMSD collection system. Instead, wastewater that was generated during Navy operations was collected and treated on the site and discharged to the San Francisco Bay through a 10-inch outfall. The onsite treatment plant had a design capacity of 24,000 gallons per day and a trickling filter capacity of 20,000 gallons per day. Neither the sewer collection system nor treatment plant is in use; portable toilets are currently used on-site. Some sewage from the Project Site is trucked to the RMSD WWTP. *(NOP, 2019)*

The RMSD, via an operations contract with Veolia Water North, operates a wastewater treatment plant (WWTP), located approximately three miles south of the Project Site. The nearest RMSD collection system pipe line to which the Project Site can connect to is roughly two miles south of the Project Site.

D.1 EXISTING WASTEWATER COLLECTION SYSTEM

The Navy wastewater system was comprised of the sanitary sewer collection system, a wastewater treatment plant (Building 125) and appurtenances, including a 10-inch-diameter steel outfall (offshore portion of outfall is 2,000 feet long), and two septic tanks with leach fields at Buildings 87 and former Building 75. A vacuum truck removed solid waste from the septic tanks periodically, and solids were emptied into the treatment plant. The aboveground equipment associated with the septic tank at former Building 75 has been removed, but the tank itself remains in place. Currently there is a temporary sanitary trailer at Building 123, and the septic tank remains at Building 87. In addition to Building 125, Building 127 utilized two large sand filters and a chlorination/dechlorination system. Just north of Building 127, three former aeration ponds were constructed over a former sump pond that was used in the 1940's to contain contaminated fuels, tank bottom sludge, bunker fuel, leaking drums, and other liquid wastes. These ponds were closed in 1975 and the liquids, sludge, and waste were removed. *(HLA, 1999)*. As part of the Phase 1 Environmental Site Assessment for Former Point Molate Naval Fuel Depot (RWQCB Order No. R2-2011-0087), site remediation efforts were performed following the 1999 HLA analysis. These efforts included the removal of Building 125, Building 127, and three aeration ponds.

The sewer collection system primarily served the Winehaven area, including Buildings 1 and 6, the worker housing units (cottages), and the administration area, including Building 123, Building 132, and the pier. Domestic sewage was collected through a combination of 4-, 6-, 8-, and 12-inch sanitary sewer lines. The approximately 9,000 feet of sewer piping is mainly 70-year-old vitrified clay pipe (VCP). Wastewater was collected and transported by gravity to the package sewage treatment plant at Building 125. Treated wastewater is then pumped by an effluent pump station to the 10-inch outfall. Operation of the sanitary sewer system was terminated by the Navy in conjunction with the cessation of fueling operation in 1995, and the sewer pipelines have been plugged and cement capped at manholes. The sanitary sewer collection system and the wastewater treatment plant are not currently in operation. *(HLA, 1999)*

D.2 PROJECTED WASTEWATER FLOW GENERATION

Wastewater flow generated is directly proportional to the potable water used for restrooms, bathrooms, kitchen, laundry, cleaning and by cooling appliances. As such, wastewater flow is derived from the projected indoor potable water use calculated under Section C.2. For this preliminary Master Plan, we have assumed that 95% of the water used will return as wastewater. The remaining 5% is assumed to be for other uses not connected to the wastewater system, i.e., indoor/outdoor washing cleaning, water related sports/play toys, drinking water, etc. Based on the projected potable water demand, the Project is anticipated to generate an average of up to 275,672 gallons per day of wastewater flow from indoor uses.

Table D.1 – Projected Wastewater Flow by Land Use

Land Use	Number	Unit	Total Average Day Demand (gpd)
Residential	2,040	Dwellings	256,672
Restaurant	40,000	Square Feet	19,000
Project Total			**275,672**

Wastewater generated indoor varies throughout the day, but typically follows predictable diurnal patterns depending on the type of land use. For example, residential dischargers tend to produce higher flows in the morning hours and in the evening hours, while commercial dischargers tend to have fairly steady discharge during business hours, but very low discharge outside of business hours.

Peak Dry Weather Flow (PDWF) is defined as the diurnal flow peak within the collection system during baseline dry weather conditions. PDWF factor is typically 1.2 to 2.0 times the Average Dry Weather Flow (ADWF), depending on the mixture of discharger types and the size and layout of the collection system. A PDWF factor of 1.50 is used for this Project because a majority of the demand is associated with residential use. Refer to Table D.1 for detailed breakdown of proposed uses, flow generation factors and the BWF/PDWF generated by individual Project components.

In addition to the wastewater flow that is generated indoor, groundwater and rainfall dependent infiltration and inflow (RDII) also enter the pipe system through defects such as cracks and openings in the pipes and manholes, especially on older systems. The amount of RDII that enters wastewater collection system is dependent primarily on the age of the system, pipe material, installation methods, ground water depth and location within areas that are prone to flooding. Since the Project will be installing all new piping using current standards that require water tight joints, infiltration and inflow will be negligible. However, for this preliminary analyses, the industry standard factor of three (3) times the ADWF is used to estimate Peak Wet Weather Flow (PWWF).

Table D.2 – Projected Peak Dry and Wet Weather Flow by Land Use

Land Use	Number	Unit	Peak Dry Weather Flow (gpd)	Peak Wet Weather Flow (gpd)
Residential	2,040	Dwellings	385,008	770,016
Restaurant	40,000	SF	28,500	57,000
Project Total			**413,508**	**827,016**

D.3 DESIGN CRITERIA

The existing and proposed wastewater collection system evaluation and design is based on criteria set forth in the City of Richmond Sewer Collection System Master Plan. Table D.3 below presents a summary of the criteria used for this preliminary master plan.

Table D.3 – Wastewater System Design Criteria

Parameter	Value
Minimum pipe size	12-inch (nominal pipe size)
Pipe Material	6" – 21" Vitrified Clay Pipe 24" and larger RCP HDPE DR17
Manning's coefficient, n, for VCP and RCP pipes	0.013
Manning's coefficient, n, for HDPE pipes	0.010
PDWF Minimum Pipeline Velocity	2 fps
Maximum Pipeline Velocity – All Conditions	10 fps
Peak Wet Weather Flow (PWWF)	ADWF x 3
PWWF Maximum Pipe Flow Depth Ratio, *d/D*	< 0.80
Minimum Depth of Cover	5 feet
Sewer Generation	95% of indoor potable water

NOTES:
ADWF = Average Dry Weather Flow (ADWF is assumed to be equal to the daily sewage generation over a 24-hour period)
d/D = ratio of the depth of flow (d) to the pipe inside diameter (D). The d/D parameter is only applicable to circular pipes. The d/D parameter for existing elliptical pipe is shown as N/A in the tables.

D.3.1 Existing System Evaluation Criteria

For existing pipelines, the pipe is considered to have a capacity deficiency (surcharge) when it is under peak wet weather flow conditions for a 5-year recurrence interval, 24-hour duration storm, and the water level or hydraulic grade line (HGL) is located as follows:

1) For pipes 15-inches in diameter and smaller, the water level or HGL is greater than the crown of the pipe;
2) For pipes greater than 15-inches in diameter, the HGL is within five feet of ground surface. In some cases, the HGL may exceed the crown of the pipe;
3) For force Mains, a force main shall be considered capacity deficient if maximum velocity exceeds 8 feet per second (fps) during peak hourly flows; and
4) For lift stations, a lift station shall be considered capacity deficient if the station does not have sufficient firm capacity, i.e. capacity with the largest pump out of service, to convey peak hourly flows during the selected storm.

D.4 PROPOSED SYSTEM DESIGN

Currently there is no sewage collection system located in development areas A through E. As such, the Project will need to install new wastewater collection pipe system in those areas to serve the proposed development.

There is an existing collection system in the historic area (F through H), some of which can be reused if not in conflict with proposed development and if it is determined to be in acceptable based on condition assessment and hydraulic capacity analyses. A preliminary layout of the new collection system is presented in Figure D.2. The conceptual layout provides a sewer line in almost every street to allow flexibility for future sewer laterals for each building.

In addition to the collection system pipelines, the system will comprise of lift stations and force main to overcome the uneven terrain and potentially an onsite wastewater treatment plant. The Project is considering two possible options for wastewater treatment:

1) Option A – Connect to City Sewer System: Install a new force main along a proposed segment of the San Francisco Bay Trail or Stenmark Drive and Western Drive to bring sanitary sewer service to the Project Site from an existing 12-inch sanitary sewer line at the intersection of Tewksbury Avenue and Contra Costa Street in Point Richmond. A new sanitary sewer lift station may be required on Marine Street near the connection point to the existing system. Refer to Figure D.3 for sewer force main alignments previously studied for the Casino Project.
2) Option B – Onsite Wastewater Treatment Facility: Install a new sanitary sewer treatment facility onsite, which would operate as a standalone treatment system for the Project's sanitary sewer needs. The proposed facility, the MEMPAC-M500, is a two phased system. Each phase is designed to handle 250,000 gpd average day flows and peak day flows of 500,000 gpd. The MEMPAC-M500 uses conventional activated sludge coupled with biological nutrient removal followed by

membrane clarification to provide high quality effluent. This is followed by UV disinfection, which results in effluent that meets Title 22 requirements. The system would include the following components:

- Lift station- an approximately 10'x 20' structure with attached valve vault
- Underground storage tanks for influent storage (5 per phase; 50,000 gallons each)
- Operator's building – approximately 20' x 20'
- Room for sludge handling equipment – approximately 10'x45'
- An effluent pump system – approximately 6' x 8' if needed
- Thirty (30) underground storage tanks (50,000 gallons each for 1.5M gallons total) to accommodate five days of effluent storage (~300,000 gal/day).

The new treatment system, including underground storage tanks, would require roughly 2 acres of land. The treatment facility would be approximately 15' tall, and be screened by fencing, trees and shrubs. The storage tanks would be buried below-grade, with approximately 5 feet of cover, in the sloped area adjacent to the treatment facility. The area over the underground tanks would be graded at 2:1 for slope stability; and landscaped with vegetative groundcovers for ease of maintenance and repairs of the tanks. Refer to Figures D.4.1 and D.4.1a for onsite treatment system location and layout.

For Option B, the Project plans to reuse the treated wastewater for all outdoor irrigation needs and/or transfer remaining treated wastewater to the nearby Chevron facility via a recycled water line along Stenmark Drive, Western Avenue, and Petrolite Street. Refer to Figure D.4.1 and D.4.2 for alignment of the potential recycled water line to the Chevron facility. A booster pump is required with this option to pump recycled water to offsite user(s).

D.4.1 Hydraulic Model Development

A hydraulic model was used to design and optimize the proposed onsite sewer collection system. The sanitary sewer collection system was analyzed using the computer-modeling program, StormCAD by Haestad Methods. StormCAD is a collection system analysis program that evaluates gravity and pressurized pipe systems using Manning's equation. The proposed pipes will be High Density Polyethylene (HDPE) pipes with smooth interior. The manufacturer's recommended roughness coefficient for HDPE is 0.011 but the analyses uses 0.013 for all modeled pipes as recommended in the design criteria. For this preliminary analysis, the existing system in the historic district is considered usable.

D.4.2 Capacity Analyses

The existing and proposed pipes are evaluated per the design criteria set forth under Section D.3. The pipes are sized using two different scenarios:

- Peak Dry Weather flow (PDWD)
- Peak Wet Weather flow (PWWF)

D.4.3 Analyses Results

The analyses showed that the proposed development will require pipe sizes ranging from 6-inches to 12-inches in diameter to convey peak wet weather flow at less than 80% of the pipe diameter. In general, the study shows the main sewer lines have PDWF velocities above 2 fps. The short lengths of sewer lines at the upstream end of the system that only serve one block or a couple of buildings tend to have velocities less than 2 fps. These locations will need to be studied at each phase to determine solutions to try and achieve an ADWF velocity of 2 fps. Possible solutions could include:

1) Reducing the diameter of the pipe from 6-inch to 4-inch,
2) Using HDPE pipe which has a smaller pipe roughness factor,
3) Increasing the slope on the pipe,
4) Concentrating building sewers from a block to one point of connection to the sewer system,
5) Eliminating unnecessary sewer lines where they are not needed due to final building design.

The required pipe sizes and layout along with node identifiers area shown in Figure D.2. The results of the analyses are presented in Table 2 and 3 of Appendix B.

D.5 RECOMMENDATIONS

The following provide recommendations and next steps that will need to be carried out during the later phases of the Project's design.

D.5.1 Onsite Collection System Piping

The project will need to abandon the Navy's existing wastewater collections system that will not be used and install new collection system in areas that is not currently served by the Navy's system. The facilities that will need to be abandoned include the onsite treatment plant, holding tank, associated lift/pump stations, septic tanks and leach fields. Additionally, the Project will need to abandon all collection piping in conflict with the proposed development layout in the historic area (Development Areas F through H).

The Project will need to perform condition assessment of all existing pipes that are not in conflict and will be reused and replace defective pipes. All new collection system piping, lift station must be designed and constructed in accordance with the RMSD Standard Plans and Specifications. We recommend that the sanitary sewer facilities presented in Figure D.2 be implemented to serve the Project for both Options A and B.

D.5.2 Lift Station

Both Options A and B will require up to two lift stations onsite to overcome elevation difference in routing flow from one side of the site to the other. Our preliminary calculations show that these onsite lift stations will need to be fitted with roughly two 25 Horse Power pumps and a 4-inch force main to overcome existing terrain.

If Option A is implemented, one of the two onsite lift stations will need to be significantly larger with roughly two 100 Horse Power pumps and an 8-inch force main. Option A will also require a third lift station that will be located offsite to connect to the RMSD gravity system.

D.5.3 Option A – Connect to RMSD System

The RMSD wastewater treatment plant has capacity for dry weather flows but does not have capacity for RDII flows. The RMSD has been working to identify RDII problem areas and has been implementing capital improvements projects to reduce RDII to the wastewater treatment plant which is an ongoing effort. Although, the Project will not increase RDII, it may increase flow to the RMSD treatment during peak wet weather. As part of next steps, the Project team will meet with staff from RMSD to discuss receiving system capacity issues and identify improvement required. The Project team will also need to consider right-of-way acquisition costs and timeframe in evaluating the feasibility of implementing Option A in comparison to Option B.

D.5.4 Option B – Onsite Wastewater Treatment Plant

The existing and the proposed system collection system layout, components, and design depend on the feasibility of implementing an onsite packaged treatment facility. As part of the next step, the Project will need to conduct a detailed evaluation to compare feasibility of Option A and Option B. The evaluation should include, 1) potential options to reuse all of the treated wastewater flow, 2) identifying offsite recycled water users and the feasibility of conveying the treated wastewater to the end user, and, 3) identify operational and maintenance costs. A preliminary layout of the onsite treatment system and a potential layout of conveying unused treated flow to the Chevron Wastewater Treatment Plant is shown in Figure D.4.1. The Project team will further investigate the feasibility of this alternative during the design phase.

E. CONCLUSION

The proposed Project will increase EBMUD's potable water usage by approximately 0.370 Million Gallons per Day (MGD). The 2008 Water Supply Assessment (WSA) prepared by EBMUD as part of the Casino Project FEIR had a projected demand of 0.864 MGD for Casino Project Alternative B. The 2008 WSA confirmed that this additional demand was accounted by EBMUD in their 2005 UWMP. EBMUD is required to amend the WSA for this modified Project since the Project meets or exceeds the 500 dwelling unit threshold requirement set by Senate Bill 610, and the City has asked EBMUD to amend the WSA. The amended WSA will reconfirm if the projected demand is accounted in their updated Urban Water Management Plan water supply projections prepared in 2015.

The existing water, fire distribution system and the wastewater collection and treatment system was installed by Navy in 1950s and are near the end of its serviceable life. As such, a majority of the system will need to be replaced even if they are not in conflict with the proposed development footprint. If any of the existing water and wastewater systems is proposed to serve the Project, a condition assessment must be performed and corrective measures including rehabilitation will need to be identified.

F. REFERENCES

i) East Bay Municipal Utility District, *2015 Urban Water Management Plan*, July 2016.

ii) East Bay Municipal Utility District, *Updated Recycled Water Master Plan*, February 2019.

iii) Harding Lawson Associates, et al., *Utility Study – Master Utility Plan – Capital Improvement Plan, Point Molate, Californi*a, February 1999, Revision 1, May 1999.

iv) City of Richmond, *Notice of Preparation of a Subsequent Environmental Impact Report (SEIR) and Public Scoping Meeting for the Point Molate Mixed-Use Development Project*, July 12, 2019.

v) City of Richmond, *Sewer Collection System Master Plan*, November 2011.

vi) California Building Standards Commission, *2016 California Fire Code California Code of Regulations Title 24, Part 9*, July 2016.

vii) Dublin San Ramon Services District, *Waster System Master Plan*, March 2016.

viii) Dublin San Ramon Services District, *Wastewater Collection System Master Plan*, March 2018.

ATTACHMENTS

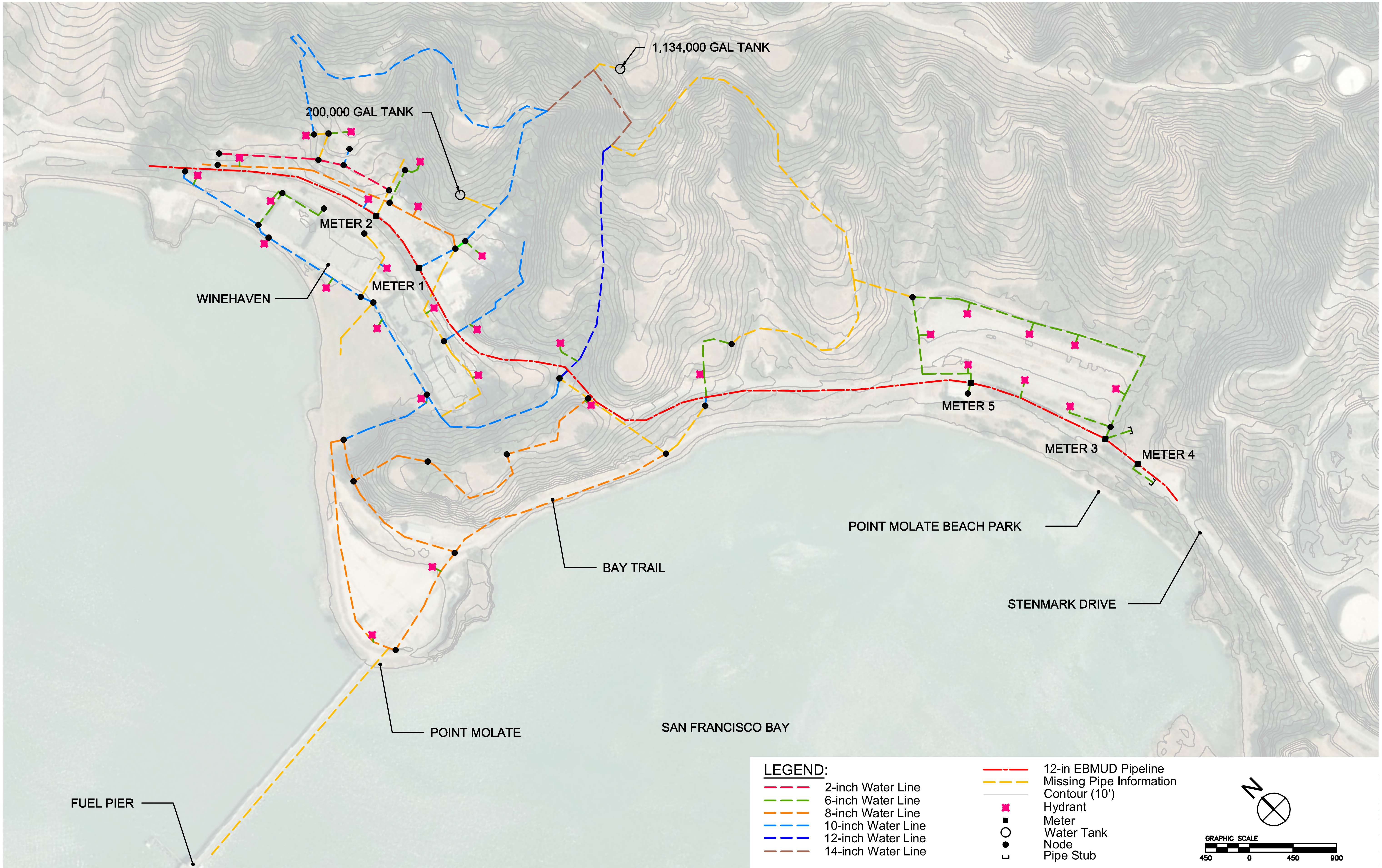


FIGURE C.1: EXISTING WATER DISTRIBUTION SYSTEM
POINT MOLATE DEVELOPMENT

DRAWING NAME: \\Bkf-rc\vol4\2016\166080_Point_Molate\DOCS\06-Design\E-Water_System\Figures\Fig-C.1_Ex_Water.dwg
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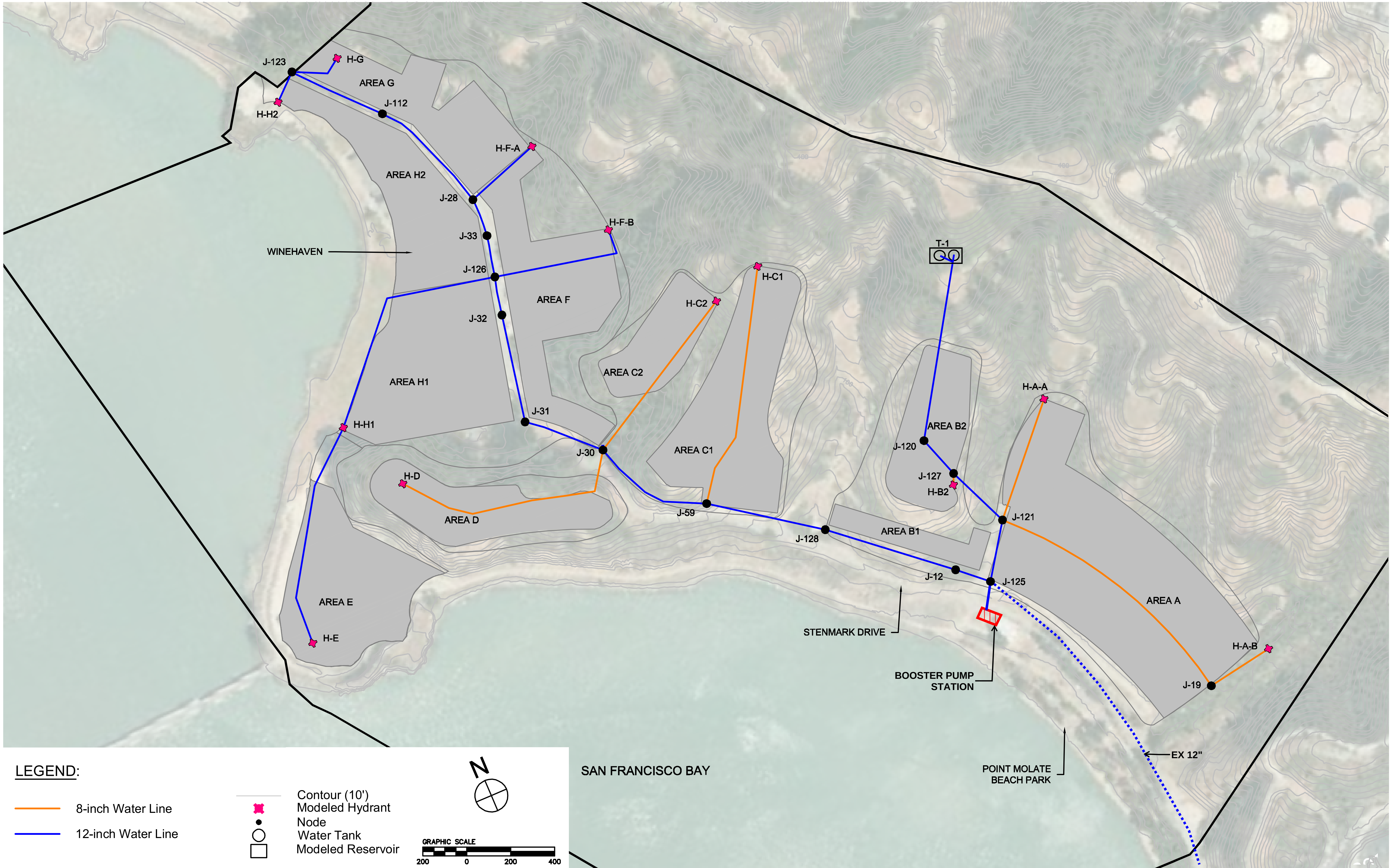

FIGURE C.2: PROPOSED WATER SYSTEM MODEL NODES
POINT MOLATE DEVELOPMENT

BKF

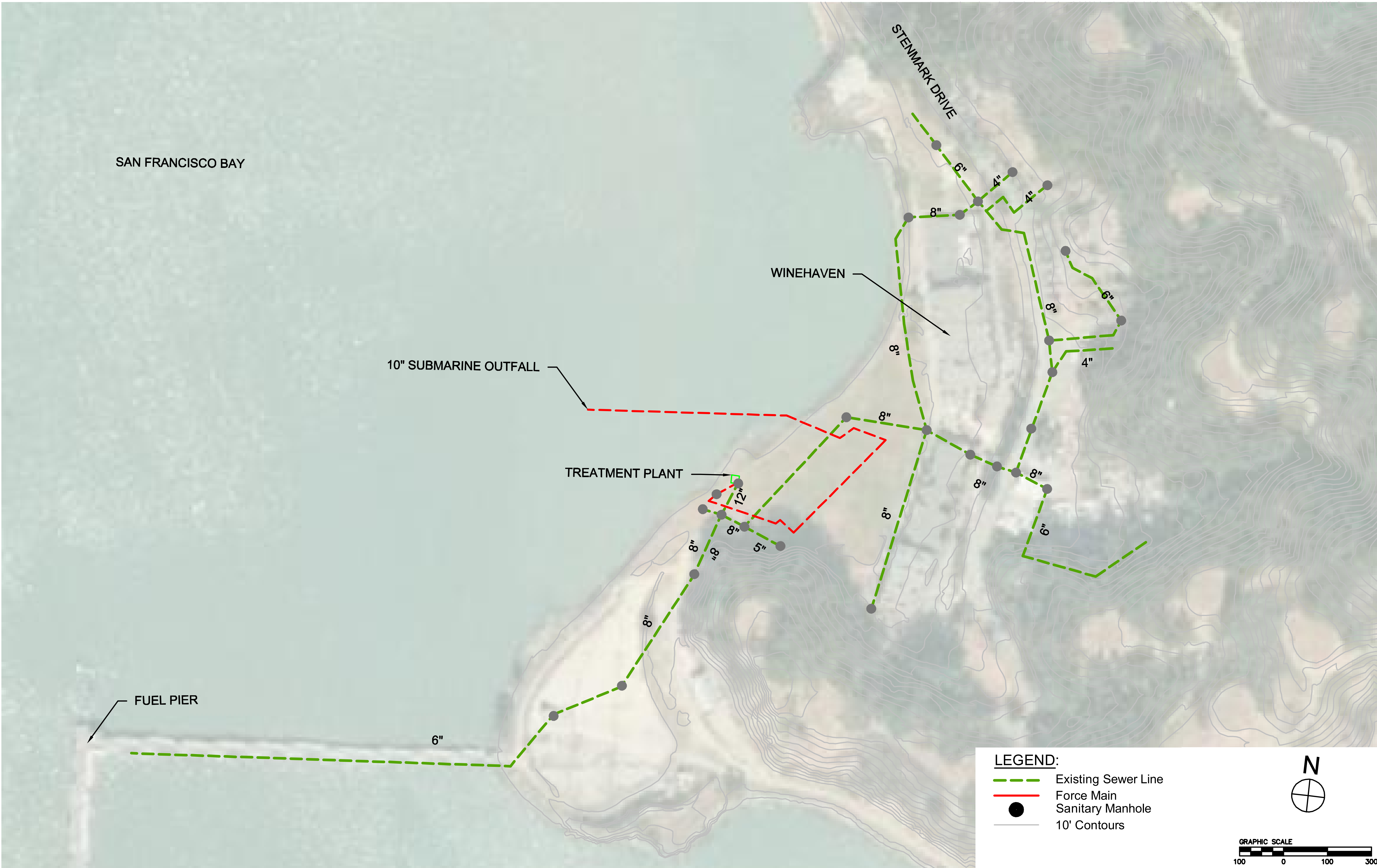

FIGURE D.1: EXISTING WASTEWATER COLLECTION SYSTEM
POINT MOLATE DEVELOPMENT

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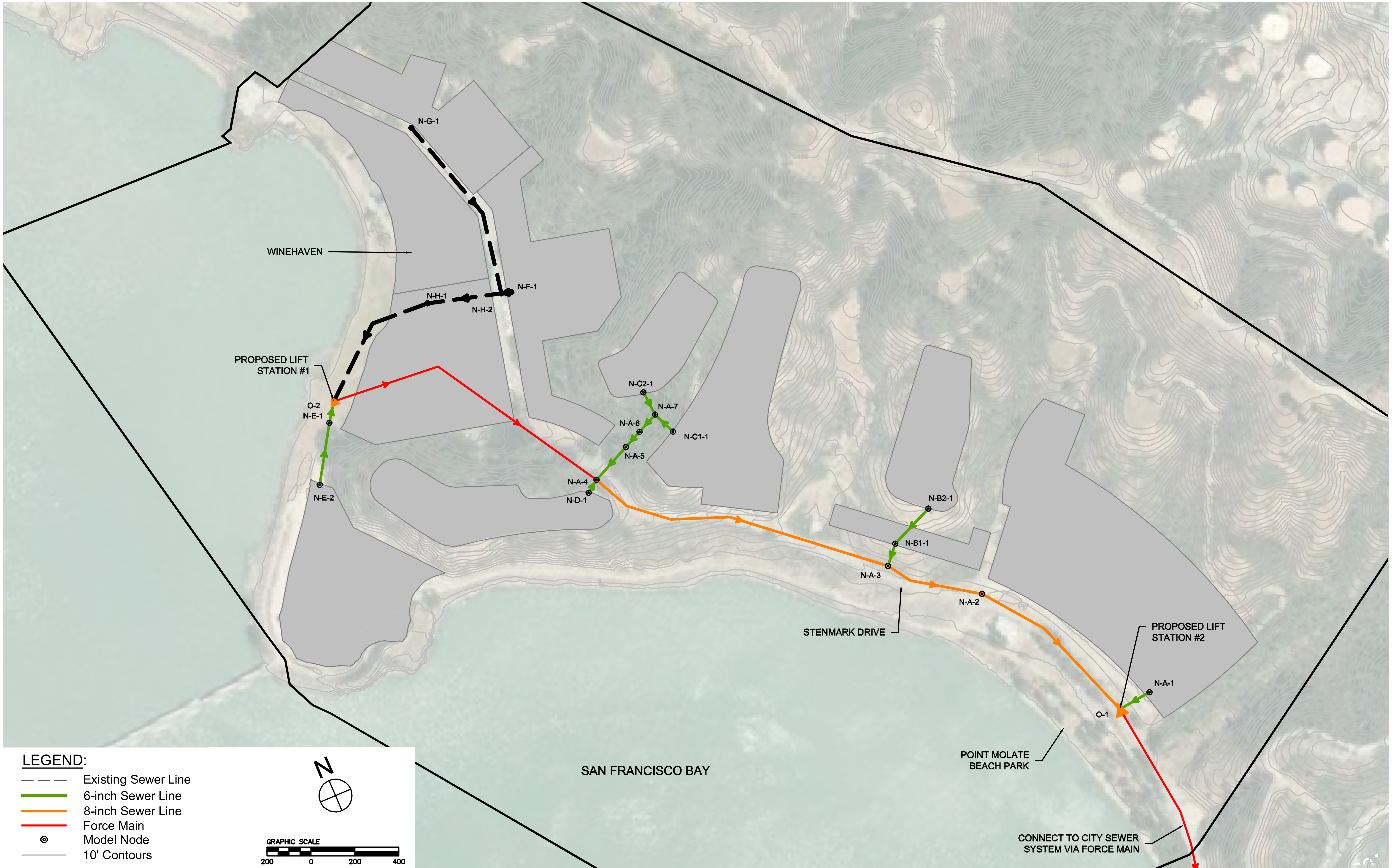

FIGURE D.2.1: PROPOSED SEWER SYSTEM MODEL PIPES WITH CONNECTION TO CITY SEWER SYSTEM (OPTION A)
POINT MOLATE DEVELOPMENT

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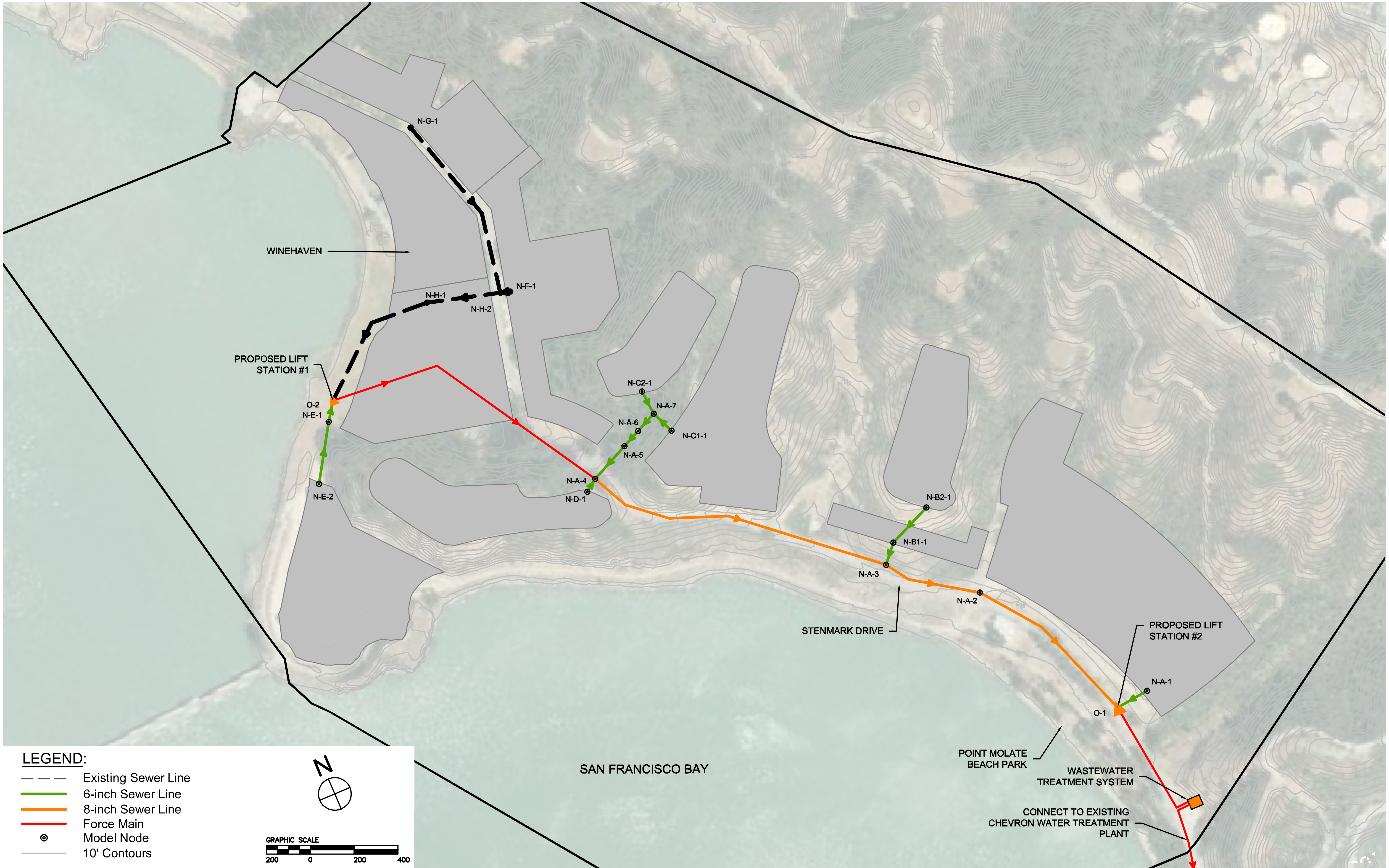

FIGURE D.2.2: PROPOSED SEWER SYSTEM MODEL PIPES WITH ONSITE TREATMENT PLANT (OPTION B)
POINT MOLATE DEVELOPMENT

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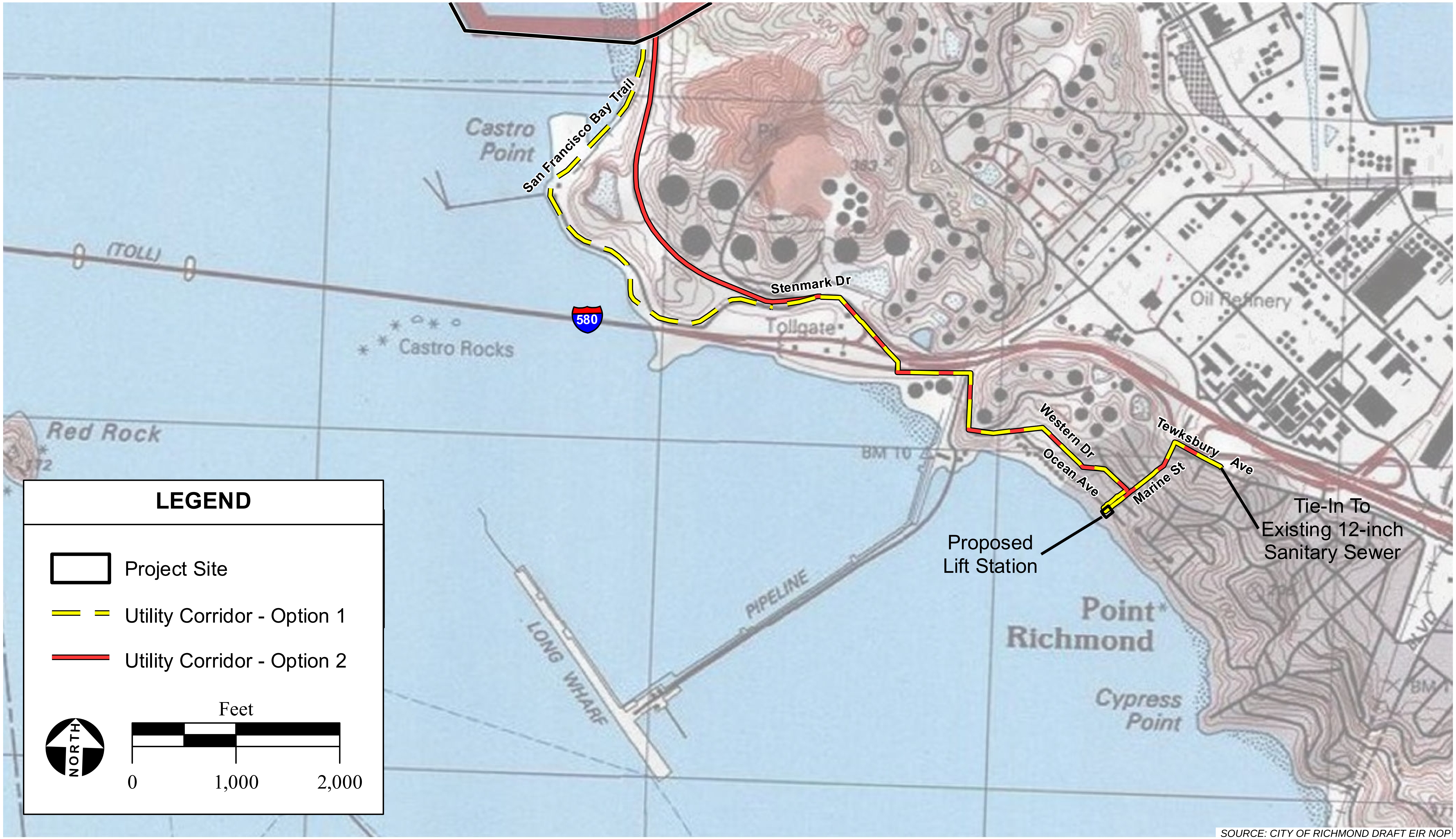

FIGURE D.3: OPTION A - WASTEWATER FORCEMAIN ALIGNMENT
POINT MOLATE DEVELOPMENT

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FIGURE D.4.1: OPTION B - ONSITE TREATMENT PLANT AND RECYCLED WATER ALIGNMENT
POINT MOLATE DEVELOPMENT

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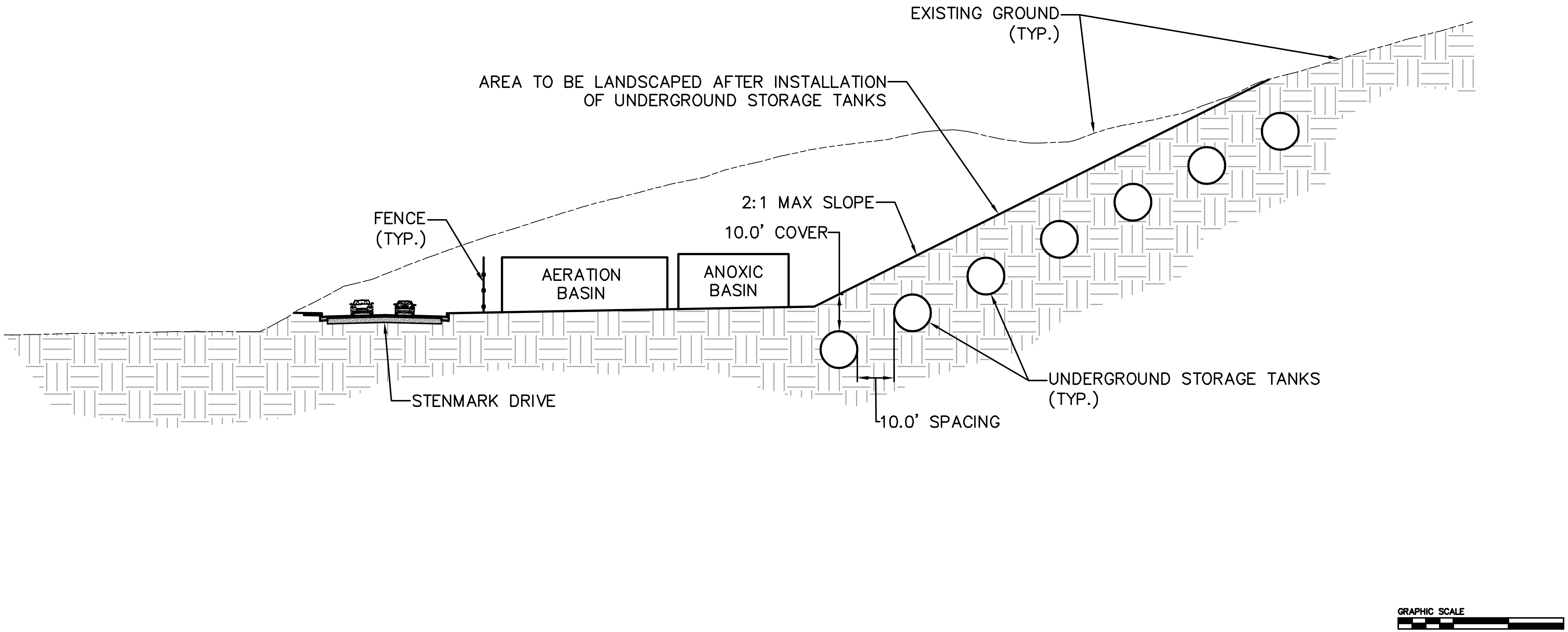

FIGURE D.4.1a: CONCEPTUAL SITE SECTION: ONSITE TREATMENT PLANT
POINT MOLATE DEVELOPMENT

DRAWING NAME: \\Bkf-rc\vol4\2016\166080_Point_Molate\DOCS\06-Design\G-Wastewater_System\Figures\FIGURE-D.4.1a_WWTP-Section.dwg
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FIGURE D.4.2: OPTION B - RECYCLED WATER ALIGNMENT
POINT MOLATE DEVELOPMENT

DRAWING NAME: \\bkf-rc\vol4\2016\166050_Point_Molate\DOCS\06-Design\0-Wastewater_System\Figures\Option_1.dwg
PLOT DATE: 08-19-19 PLOTTED BY: pala

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APPENDIX A

Table 1. Summary of Projected Indoor Water Demand

Planning Area	Buildings	Land Use Data			Maximum Building Area, sq ft	Maximum Units per Building	Residential Demand Factor, gpd per unit	Average Day Demand, gpd	Maximum Day Demand, gpd	Maximum Day Demand, gpm	Peak Hour Demand, gpd	Peak Hour Demand, gpm	Fire Demand, gpm	Flow Duration (hours)
		Res. Unit	Commercial Use Area, sq ft	Restaurant Area, sq ft										
A	Townhomes	192	-	-	12,500	5	165	31,680	63,360	44	76,032	53	3,000	3
	1-Story Townhomes	22	-	-	7,500	3	165	3,630	7,260	5	8,712	6	2,250	2
							Sub-total	35,310	70,620	49	84,744	59		
B	1-Story Townhomes	13	-	-	7,500	3	165	2,145	4,290	3	5,148	4	2,250	2
	Court Homes	77	-	-	5,000	1	220	16,940	33,880	24	40,656	28	2,000	2
							Sub-total	19,085	38,170	27	45,804	32		
C	1-Story Townhomes	26	-	-	7,500	3	165	4,290	8,580	6	10,296	7	2,250	2
	Alley SFD	129	-	-	5,000	1	220	28,380	56,760	39	68,112	47	2,000	2
							Sub-total	32,670	65,340	45	78,408	54		
D	Court Homes	68	-	-	5,000	1	220	14,960	29,920	21	35,904	25	2,000	2
	Townhomes	31	-	-	7,500	3	165	5,115	10,230	7	12,276	9	2,250	2
							Sub-total	20,075	40,150	28	48,180	33		
E	Condominiums	702	-	-	687,000	702	110	77,220	154,440	107	185,328	129	8,000	4
F	Apartments	397	-	-	448,000	397	110	43,670	87,340	61	104,808	73	8,000	4
	Historic/Rehab	-	-	-	-	-	-	-	-	-	-	-	2,250	2
							Sub-total	43,670	87,340	61	104,808	73		
G	Existing Cottages	28	-	-	3,000	1	110	3,080	6,160	4	7,392	5	1,500	2
	Apartments	200	-	-	86,000	200	110	22,000	44,000	31	52,800	37	5,250	4
	Historic/Rehab	-	-	-	-	-	-	-	-	-	-	-	3,750	3
							Sub-total	25,080	50,160	35	60,192	42		
H	Condominiums	115	-	-	170,000	115	110	12,650	25,300	18	30,360	21	7,500	4
	Historic District	40	-	40,000	40,000	-	110	24,400	48,800	34	58,560	41	8,000	4
							Sub-total	37,050	74,100	51	88,920	62		
							Total	**290,160**	**580,320**	**403**	**696,384**	**484**		

274

Total Residential Units = **2,040**
Total Commercial Area (sq.ft.) = **-**
Total Restaraunt Area (sq.ft.) = **40,000**

Water Demand Factors:

Court Homes	220	gpd per unit
Alley SFD	220	gpd per unit
Townhomes	165	gpd per unit
Condos\Apartments	110	gpd per unit
Commercial	0.14	gpd per square foot
Restaurant	0.50	gpd per square foot
Maximum Day Peak Factor	2.00	
Peak Hour Peak Factor	2.40	
gpd - gallons per day		
gpm - gallons per minute		

Notes:
1. Residential water demands are based on EBMUD 2015 Urabn Water Management Plan.
2. Fire Demands are based on 2016 California Fire Code Table B105.1 and BB105.1
3. Condominiums and apartments are assumed to be of Type V-A construction. Single family homes and townhomes are assumed to be of Type V-B construction.
4. Fireflow required does not inlcude 50% sprinkler reduction.

TABLE 2

Model Demand Scenario: Maximum Day Demand + Fire Flow

Label	Phase	Demand (gpm)	Required Fire Flow (gpm)	Available Fire Flow with System-wide Constraint* (gpm)	Total Flow (Available FF) (gpm)	Residual Pressure @ Required FF (psi)	Max. Pipe Velocity System-wide @ Required FF (ft/s)	Meets Criteria?
H-A-A	Proposed	0	1,500	2,193	2,193	132	14.0	TRUE
H-A-B	Proposed	0	1,500	2,193	2,193	133	14.0	TRUE
H-B2	Proposed	0	1,500	2,193	2,193	148	14.0	TRUE
H-C1	Proposed	0	1,500	2,193	2,193	57	14.0	TRUE
H-C2	Proposed	0	1,500	2,193	2,193	76	14.0	TRUE
H-D	Proposed	0	1,500	2,193	2,193	111	14.0	TRUE
H-E	Proposed	0	4,000	4,001	4,001	117	11.4	TRUE
H-F-A	Proposed	0	4,000	4,001	4,001	94	11.4	TRUE
H-F-B	Proposed	0	4,000	4,001	4,001	91	11.4	TRUE
H-G	Proposed	0	4,000	4,001	4,001	84	11.4	TRUE
H-H1	Proposed	0	4,000	4,001	4,001	128	11.4	TRUE
H-H2	Proposed	0	4,000	4,001	4,001	119	11.4	TRUE

* Available fire flow reported is based on system-wide constraint of 20 psi and 14 fps applied every where in the system. During simulation, if the pressure were to drop below 20 psi or velocity exceed 14 fps at any location system-wide due to demand placed at that specific node in question, then the simulation ends and the resulting fire flow calculated at the end of that simulation is reported for that node in question.

APPENDIX B

Table 1. Summary of Projected Wastewater Flow										
Planning Area	Buildings	Land Use Data			Residential Demand Factor, gpd per unit	Base Wastewater Flow, gpd	Peak Dry Weather Flow, gpd	Peak Dry Weather Flow, gpm	Peak Wet Weather Flow, gpd	Peak Wet Weather Flow, gpm
		Res. Unit	Commercial Use Area, sq ft	Restaurant Area, sq ft						
A	Townhomes	192	-	-	157	30,096	45,144	31	90,288	63
	1-Story Townhomes	22	-	-	157	3,449	5,173	4	10,346	7
					Sub-total	33,545	50,317	35	100,634	70
B	1-Story Townhomes	13	-	-	157	2,038	3,057	2	6,113	4
	Court Homes	77	-	-	209	16,093	24,140	17	48,279	34
					Sub-total	18,131	27,196	19	54,392	38
C	1-Story Townhomes	26	-	-	157	4,076	6,113	4	12,227	8
	Alley SFD	129	-	-	209	26,961	40,442	28	80,883	56
					Sub-total	31,037	46,555	32	93,110	65
D	Court Homes	68	-	-	209	14,212	21,318	15	42,636	30
	Townhomes	31	-	-	157	4,859	7,289	5	14,578	10
					Sub-total	19,071	28,607	20	57,214	40
E	Condominiums	702	-	-	105	73,359	110,039	76	220,077	153
F	Apartments	397	-	-	105	41,487	62,230	43	124,460	86
	Historic/Rehab	-	-	-	-	-	-	-	-	-
					Sub-total	41,487	62,230	43	124,460	86
G	Existing Cottages	28	-	-	105	2,926	4,389	3	8,778	6
	Apartments	200	-	-	105	20,900	31,350	22	62,700	44
	Historic/Rehab	-	-	-	-	-	-	-	-	-
					Sub-total	23,826	35,739	25	71,478	50
H	Condominiums	115	-	-	105	12,018	18,026	13	36,053	25
	Historic District	40	-	40,000	105	23,200	34,800	24	69,600	48
					Sub-total	35,218	52,826	37	105,653	73
					Total	**275,672**	**413,508**	**287**	**827,016**	**574**

Total Residential Units =	**2,040**
Total Commercial Area (sq.ft.) =	**-**
Total Restaraunt Area (sq.ft.) =	**40,000**

Flow Generation Factors:

Court Homes	209	gpd per unit
Alley SFD	209	gpd per unit
Townhomes	157	gpd per unit
Condos\Apartments	105	gpd per unit
Commercial	0.13	gpd per square foot
Restaurant	0.48	gpd per square foot
Dry Weather Peak Flow Factor	1.50	
Peak Wet Weather Peak Flow Factor	3.00	
gpd - gallons per day		

11/11/2019

Table 2
POINT MOLATE SANITARY SEWER STUDY
Peak Dry Weather Flows
Pipe Flow Characteristics, Proposed Project

Pipe # (1)	Start Node	Stop Node	Total Discharge (gpm)	Capacity @ Constructed Slope (gpm)	% of Capacity	Pipe Size (1) (inches)	Run Length (feet)	Slope (ft/ft)	Invert Elevation Upstream	Invert Elevation Downstream	Ground/Rim Elevation Upstream	Ground/Rim Elevation Downstream	HGL Elevation Upstream	HGL Elevation Downstream	Upstream Cover (feet)	Velocity (ft/s)
P-H-2	N-H-2	N-H-1	68.0	433.4	16%	6.0	338	0.030	40.0	30.0	50.0	40.0	40.2	30.2	9.5	1.6
P-H-1	N-H-1	O-2	105.0	534.0	20%	6.0	665	0.045	30.0	0.1	40.0	15.0	30.2	0.2	9.5	4.7
P-E-2	N-E-2	N-E-1	76.0	332.9	23%	6.0	286	0.017	16.0	11.0	20.0	20.0	16.2	11.2	3.5	3.1
P-E-1	N-E-1	O-2	76.0	837.4	9%	6.0	99	0.111	11.0	0.1	20.0	15.0	11.2	0.2	8.5	5.9
P-D-1	N-D-1	N-A-4	20.0	1665.0	1%	6.0	69	0.437	130.0	100.0	140.0	110.0	130.1	100.3	9.5	0.3
P-C2-1	N-C2-1	N-A-7	16.0	579.4	3%	6.0	113	0.053	130.0	124.0	135.0	130.0	130.1	124.1	4.5	0.9
P-C1-1	N-C1-1	N-A-7	16.0	1423.5	1%	6.0	113	0.320	160.0	124.0	170.0	130.0	160.1	124.1	9.5	0.9
P-B2-1	N-B2-1	N-B1-1	19.0	932.8	2%	6.0	219	0.137	100.0	70.0	110.0	80.0	100.1	70.1	9.5	4.2
P-B1-1	N-B1-1	N-A-3	19.0	1440.2	1%	6.0	107	0.327	70.0	35.0	80.0	40.0	70.1	35.4	9.5	0.3
P-A-7	N-A-7	N-A-6	32.0	489.4	7%	6.0	106	0.038	124.0	120.0	130.0	125.0	124.1	120.1	5.5	3.1
P-A-6	N-A-6	N-A-5	32.0	739.3	4%	6.0	93	0.086	120.0	112.0	125.0	120.0	120.1	112.1	4.5	4.2
P-A-5	N-A-5	N-A-4	32.0	615.0	5%	6.0	201	0.060	112.0	100.0	120.0	110.0	112.1	100.3	7.5	0.5
P-A-4	N-A-4	N-A-3	233.0	1162.8	20%	8.0	1414	0.046	100.0	35.0	110.0	40.0	100.3	35.4	9.3	2.8
P-A-3	N-A-3	N-A-2	252.0	764.1	33%	8.0	453	0.020	35.0	26.0	40.0	30.0	35.4	26.4	4.3	2.7
P-A-2	N-A-2	O-1	252.0	786.0	32%	12.0	828	0.002	26.0	24.0	30.0	30.0	26.4	24.3	3.0	2.7
P-A-1	N-A-1	O-1	35.0	405.8	9%	6.0	154	0.026	28.0	24.0	35.0	30.0	28.1	24.1	6.5	2.8
E-P-3	N-G-1	N-H-2	25.0	207.9	12%	6.0	881	0.007	46.0	40.0	50.0	50.0	46.1	40.2	3.5	0.8
E-P-2L-1	N-F-1	N-H-2	43.0	1191.6	4%	6.0	45	0.224	50.0	40.0	60.0	50.0	50.2	40.2	9.5	1.4

Table 3
POINT MOLATE SANITARY SEWER STUDY
Peak Wet Weather Flows
Pipe Flow Characteristics, Proposed Project

Pipe # (1)	Start Node	Stop Node	Total Discharge (gpm)	Capacity @ Constructed Slope (gpm)	% of Capacity	Pipe Size (1) (inches)	Run Length (feet)	Slope (ft/ft)	Invert Elevation		Ground/Rim Elevation		HGL Elevation		Upstream Cover (feet)	Velocity (ft/s)
									Upstream	Downstream	Upstream	Downstream	Upstream	Downstream		
P-H-2	N-H-2	N-H-1	136.0	433.4	31%	6.0	338	0.030	40.0	30.0	50.0	40.0	40.3	30.4	9.5	2.1
P-H-1	N-H-1	O-2	209.0	534.0	39%	6.0	665	0.045	30.0	0.1	40.0	15.0	30.4	0.3	9.5	5.7
P-E-2	N-E-2	N-E-1	153.0	332.9	46%	6.0	286	0.017	16.0	11.0	20.0	20.0	16.3	11.2	3.5	3.7
P-E-1	N-E-1	O-2	153.0	837.4	18%	6.0	99	0.111	11.0	0.1	20.0	15.0	11.3	0.2	8.5	7.2
P-D-1	N-D-1	N-A-4	40.0	1665.0	2%	6.0	69	0.437	130.0	100.0	140.0	110.0	130.2	100.5	9.5	0.5
P-C2-1	N-C2-1	N-A-7	33.0	579.4	6%	6.0	113	0.053	130.0	124.0	135.0	130.0	130.1	124.2	4.5	1.1
P-C1-1	N-C1-1	N-A-7	33.0	1423.5	2%	6.0	113	0.320	160.0	124.0	170.0	130.0	160.1	124.2	9.5	1.1
P-B2-1	N-B2-1	N-B1-1	38.0	932.8	4%	6.0	219	0.137	100.0	70.0	110.0	80.0	100.1	70.1	9.5	5.2
P-B1-1	N-B1-1	N-A-3	38.0	1440.2	3%	6.0	107	0.327	70.0	35.0	80.0	40.0	70.1	35.5	9.5	0.4
P-A-7	N-A-7	N-A-6	66.0	489.4	13%	6.0	106	0.038	124.0	120.0	130.0	125.0	124.2	120.1	5.5	3.9
P-A-6	N-A-6	N-A-5	66.0	739.3	9%	6.0	93	0.086	120.0	112.0	125.0	120.0	120.2	112.1	4.5	5.2
P-A-5	N-A-5	N-A-4	66.0	615.0	11%	6.0	201	0.060	112.0	100.0	120.0	110.0	112.2	100.5	7.5	0.8
P-A-4	N-A-4	N-A-3	468.0	1162.8	40%	8.0	1414	0.046	100.0	35.0	110.0	40.0	100.5	35.5	9.3	3.7
P-A-3	N-A-3	N-A-2	506.0	764.1	66%	8.0	453	0.020	35.0	26.0	40.0	30.0	35.5	26.6	4.3	3.5
P-A-2	N-A-2	O-1	506.0	786.0	64%	12.0	828	0.002	26.0	24.0	30.0	30.0	26.6	24.5	3.0	3.3
P-A-1	N-A-1	O-1	70.0	405.8	17%	6.0	154	0.026	28.0	24.0	35.0	30.0	28.2	24.1	6.5	3.4
E-P-3	N-G-1	N-H-2	50.0	207.9	24%	6.0	881	0.007	46.0	40.0	50.0	50.0	46.2	40.3	3.5	1.0
E-P-2L-1	N-F-1	N-H-2	86.0	1191.6	7%	6.0	45	0.224	50.0	40.0	60.0	50.0	50.2	40.3	9.5	1.7