Emergency water supply system for Treasure Island will be supplied from a Wet Standpipe system. An intake pipe nearby Pier 1 will connect from the bay to a pump station that will pressurize the standpipe system. The system will include four hydrants, with one hydrant at each block along Second Street and California Avenue. The hydrants will be identified as non-potable water.

The Supplemental Fire Water System pump station will be located along the northern border of the Sailing Center and south of Second Street. Design of the intake pipe will be coordinated with SFPUC and SFFD.
5.7 JOINT TRENCH

LEGEND
- Existing Submarine Cable
- SP2,3 Proposed Joint Trench
- SPI Proposed Joint Trench
- Temporary Overhead Electrical
- Proposed Treatment Force Main

FIGURE 5.7 SUB-PHASE JOINT TRENCH

Existing Submarine Cable From East Bay

Existing Submarine Cable to Yerba Buena Island
A joint utility trench system is planned for the project and will include the following dry utilities: electric, gas, public street lighting, telephone, cable TV and other ancillary communication facilities required by SFPUC.

Joint utilities on site shall be placed in a common trench located in the franchised area, under the sidewalk for mechanical protection and will be installed to maintain utility standard clearances from wet utilities and other improvements. Vaults, boxes, manholes and enclosures housing equipment will be installed in the franchised area as well; their locations will be coordinated with wet utilities, other civil and architectural improvements and street lights. Joint utilities will be installed in Shared Public Ways as applicable.

The joint trench exhibit illustrates the general location of proposed joint trench facilities, an overhead line relocation and new switch gear at the eastern shore and identifies other joint utility source locations. General system elements for each dry utility are described briefly below.

Treasure Island is served by existing submarine cable from Oakland. These lines connect to existing switchgear in existing Building 3. This switchgear then feeds distribution on Treasure Island and a submarine cable to feed distribution facilities on Yerba Buena Island. For Sub-Phase 3, 12kV distribution facilities will be extended from existing facility locations installed within Sub-phases 1A, 1D, 1F, 1G, 1H and 1I. New 12kV, 600 and 200 amp distribution circuits will be installed throughout the new development.

Electric facilities provided by SFPUC will include conduits, boxes, vaults, cables and devices including, but not limited to, switches transformers, capacitor banks and metering. The electric distribution system will consist of 600 and 200 amp 12 kV underground primary distribution circuits throughout the project. Transformers placed in strategic locations will supply residential, commercial and support facilities with secondary voltage below 600V.

Where feasible, equipment will be placed subsurface. In some areas, subsurface transformers may not be allowed due to water table and soil characteristics. This will be determined by the electric utility on a case by case basis. Transformers supplying electricity to residential and commercial customers may be located either in the franchise area or on private property assuming that adequate operating clearance and access is provided. In areas where subsurface transformers are not feasible pad mounted equipment may be necessary.

Existing natural gas service comes to Treasure Island through an existing 10-inch submarine gas pipeline from Oakland. This line terminates at a large PG&E meter and service lines radiate out from this meter to serve existing uses on TI and YBI. New gas distribution will be provided to serve the proposed development. Gas facilities provided by PG&E will consist of plastic gas pipe, fittings, appurtenances and metering equipment.

Telephone and cable TV facilities provided by AT&T and Comcast will consist of conduits, boxes, vaults and amplifiers to facilitate the installation and operation of copper and fiber optic cables as proposed by the communication providers.

Joint Trench will be provided in streets and will be adjacent to proposed pump station locations. It is assumed that each pump station will connect to power available in joint trench and will have its own service point with a meter. Communication facilities will also be available adjacent to pump stations to allow for connection to the internet.

Street lighting systems will consist of steel conduits, boxes, wiring and lighting units. A lighting unit will consist of a foundation, pole, mast arm, luminaire(s) and photocell. The street lighting system will utilize LED type lighting and provide photometric and lighting characteristics that are defined in the Treasure Island & Yerba Buena Island Streetscape Master Plan.
The San Francisco Bay around Treasure Island is underlain by rocks of the Franciscan Complex of the Alcatraz Terrain, consisting mainly of interbedded greywacke sandstone and shale. Under Treasure Island, the Franciscan Complex bedrock is covered by Quaternary sediments and fill to depths ranging from 180 feet under the causeway to as deep as 280 feet near the north end of the island.

The Quaternary sediments at Treasure Island can generally be divided into older, Pleistocene-age marine and alluvial deposits ("Older Bay Deposits"), young Holocene-age marine clay and sand deposits ("Young Bay Mud"), native sandy shoal deposits, and hydraulic sand fills. Under Treasure Island, the Young Bay Mud varies greatly in thickness from about 20 feet near the causeway to more than 120 feet near the northwest corner of the island. The Young Bay Mud varies in thickness because it was deposited on an eroded surface of Older Bay Deposits as sea level rose over the last 12,000 years. Under the southern portions of the island, the Young Bay Mud contains many interbedded layers of fine silty sand making up as much as one-third to one-half of the thickness of the deposit. The sand lenses thin and decreases in number to the north. Near the north end of the island, sand lenses within the Young Bay Mud are very thin or absent.

Extensive windblown sand deposits are believed to have formed across the bottom of San Francisco Bay when it was exposed during low stands of sea level. Just south of Clipper Cove, Yerba Buena Island is mantled with thick (100 to 120 feet) deposits of uniform fine silty sand interpreted to be windblown deposits. The thick sand deposit has been extensively eroded by wave action at the north side of Yerba Buena Island, forming a steep sand bluff that is over 200 feet high and is still periodically shedding sand into the Bay. The grain-size distribution of windblown sands on Yerba Buena Island is essentially the same as fine silty sands interbedded with Young Bay Mud below Treasure Island. The erosion of the windblown sand from Yerba Buena Island and...
surrounding areas is likely the source for both the historic sandy shoal deposits, and the fine silty sands interbedded with Young Bay Mud deposits.

Interpretations of the subsurface stratigraphy across the entire island along the north-south direction are illustrated on Figure 5.8.

**TREASURE ISLAND CONSTRUCTION**

Treasure Island and the causeway that connects it to Yerba Buena Island were constructed in the late 1930s by placing over 29 million cubic yards of fine- to medium-grained sand and silty sand over a natural sand shoal and a layer of weak, compressible clay (locally known as Young Bay Mud). The sand was dredged from the shoals south of the island and from other shoals to the east. The dredged sand fill was placed hydraulically. Where the Bay floor was lower than approximately Elevation -6 feet NAVD, a bed of hydraulic fill was placed to raise the Bay floor elevation to -6 feet. A rock dike was then constructed with crest elevations between 2 and 6 feet MLLW, and sand fill was deposited in place until the elevation reached the top of the dike. Another rock dike was placed on the previously constructed dike and filling continued. This process was repeated until the interior elevation reached approximately Elevation 13 feet NAVD. Filling started at the southwest corner and progressively proceeded to the east and north. The rock dikes were faced with riprap constructed with an outboard slope of 1:1 and extended to a final grade elevation of approximately Elevation 14 feet NAVD.

**SUBSURFACE STRATIGRAPHY**

**Sand Fill and Shoal Sands**

As described above, the hydraulic sand fills were deposited directly on native sandy shoals across most of the island footprint. In many CPT probes, the contact between the base of fill and top of shoal sand can be approximately distinguished by an increase in interbedded clays and silts. Determination of the base of fill deposits is difficult in many borings. The approximate base of the hydraulic fills can be estimated from the pre-filling bathymetry, plotted on the Cross Sections. The hydraulic fill and shoal sands both consist of loose to medium-dense silty to clayey fine sand with variable fines contents. The base of sand shoal deposits was selected as the contact between loose to medium-dense sand and soft clay or denser sand deposits interbedded with the younger Bay Mud. The combined thickness of the sand fill and shoal sands varies between approximately 30 and 50 feet.

**Young Bay Mud: Onshore Fine-Grained Deposits**

The sandy fill and shoal materials is underlain by Young Bay Mud consisting of soft to stiff silty clay deposits with occasional interbedded sand layers. The Young Bay Mud thickness varies from 20 to 120 feet with the greatest thickness occurring under the northwest corner of the island. The Young Bay Mud is also deeper under the southeast corner of the island. The Bay Mud is generally normally consolidated and moderately compressible. Where the Young Bay Mud has been consolidated under the weight of the existing fill, it has moderate shear strength.

**Young Bay Mud: Soft Offshore Deposits**

The Young Bay Mud deposits encountered in offshore borings are very soft to soft. The difference between onshore and offshore Young Bay Mud may be due to consolidation effects from the shoal sands and from consolidation due to placement of the island hydraulic fills. Comparison of 1926 to modern bathymetry shows that areas immediately offshore along the west margin of Treasure Island are at nearly the same elevation as 1926. Somewhat further offshore, up to approximately 25 feet of recent sedimentation may have occurred. In Clipper Cove, soft organic clays up to 20 feet thick have accumulated since 1949.

**Older Bay Deposits**

Older Bay deposits encountered below the Young Bay Mud deposits consist of interbedded very stiff to hard, low to high plasticity clays, silts, and dense to very dense fine silty and clayey sands. In many borings, the deep stiff/dense deposits are described as containing shell fragments or peat, suggesting that they are mainly old Bay or Bay margin deposits. Many borings note color changes from gray or dark gray to light greenish gray or brown or note mottling suggestive of oxidation and weathering. Borings just east of Sub-phase 1A note thick layers of brown gravelly sand and clay that may be of alluvial origin. The variation in thickness of these older sediments is not generally known because only a few exploratory borings on the island have penetrated to bedrock.

**Bedrock**

The Franciscan-Formation bedrock encountered in deep borings has been described as moderately weathered dark gray sandstone and shale. Bedrock was encountered under the south end of the causeway at an elevation of -10 feet NAVD and at an elevation of -180 feet NAVD near the middle of the causeway. Under Treasure Island, bedrock was encountered at an elevation of -255 NAVD. Under the middle of the island bedrock was encountered at an elevation of -271 NAVD.

**GEOTECHNICAL CONCERNS**

There are three primary geotechnical issues that influence shoreline and site improvements at Treasure Island: liquefaction, settlement, and seismic stability.

**Liquefaction of Sand Layers**

The combined thickness of the sand shoal and the dredged sand fill ranges from about 30 to 45 feet. These sands are generally loose to medium dense and are susceptible to liquefaction and seismic recompression settlement.
**Settlement of Young Bay Mud**
Beneath the sands are layers of compressible Young Bay Mud that ranges in thickness across the site from approximately 20 to 140 feet. The Young Bay Mud is generally normally consolidated and the settlement rate due to the weight of the dredged sand fill is now small. However, increases in loads due to placement of new fill or the construction of buildings will initiate a new cycle of consolidation settlements. The Young Bay Mud is underlain by dense to very dense sands and stiff to hard clays, which extend to bedrock at depths of 180 to 270 feet.

**Seismic Stability of Perimeter and Causeway**
The perimeter of the island and the causeway connecting Treasure Island to Yerba Buena Island are susceptible to earthquake-induced lateral spreading due to liquefaction of the fill and shoal sands. In addition, deeper lateral deformations are expected within the underlying Young Bay Mud layer.

**GEOTECHNICAL MITIGATION**

**Mitigation of Liquefaction and Lateral Spreading**
Numerous ground improvement techniques are available to mitigate the potential for liquefaction and its consequences. Some of these techniques considered in Sub-phase 1A include Vibro-compaction, and Deep Soil Mixing.

**Mitigation of Young Bay Mud Consolidation Settlements**
Surcharging or preloading can be used both to speed primary consolidation under the weight of additional fill and to reduce the settlement caused by subsequent building loads. Surcharging is often coupled with the installation of pre-fabricated vertical drains, commonly known as wick drains, which allow excess pore pressures to drain laterally, shortening the drainage path and taking advantage of the fact that the horizontal permeability of soils is normally much greater than the vertical permeability. The rate of consolidation can be controlled by selecting the type of drain and the spacing between the drains. A horizontal drainage system can also be installed at the ground surface to collect and divert water expelled from the wicks. Wick drain and surcharge test sections can be used to confirm and refine the surcharge design.

**Shoreline Stabilization**
As discussed previously, the shoreline may be susceptible to earthquake-induced deformation and, possibly, deep-seated slope failures in areas of deep Young Bay Mud. Lateral spreading of the island perimeter can be mitigated using vibro replacement methods, or deep soil mixing to improve approximately a zone around the island perimeter.

A conceptual geotechnical mitigation plan for Treasure Island Sub-Phase 3 is illustrated in Figure 5.8.
SUB-PHASE APPLICATION 3: SUB-PHASES 1A, 1D, 1F, 1G, 1H, 1I