6 Preliminary Assessment of Construction Method and Constructability Issues

6.1 Construction Approach

Appendix C includes conceptual designs of the alternatives discussed below. Generally, the conceptual designs include a site map, tunnel plan and profile, tunnel inlet details, and typical tunnel and canal cross sections.

6.1.1 Alternative 1A – Beginning of Canal to New Outfall

The main feature to be constructed for Alternative 1A is a 13-foot-diameter, 4,500-foot-long tunnel. Based on preliminary geotechnical information, it is anticipated that soft ground tunneling methods would be appropriate. A digger shield or soft ground tunnel boring machine (TBM) would be launched from a shaft at the east end of the tunnel, near the intersection of Lake Merced Boulevard and John Muir Drive. Tunnel supports would be erected in the tail of the shield or TBM to support the ground. The supports could be circular steel ribs and timber lagging, expanded precast concrete segments, or a bolted and gasketed precast concrete segment lining.

Following the completion of the tunnel drive, the final lining would be constructed inside the tunnel. The final lining would most likely be cast-in-place concrete constructed using a traveling steel tunnel form. A bolted and gasketed precast concrete segment lining could be used, and could serve as a one-pass lining, providing both the tunnel support and final lining functions.

The mining shaft excavation (at the east end of the tunnel) would be about 25 to 30 feet in diameter. Various excavation support systems could be used, including steel sheet piles, soldier piles with timber lagging, and circular liner plates with steel rib bracing. The shield or TBM would exit the tunnel into a receiving shaft at the west end of the tunnel or into the excavation for the new outfall structure.

Most of the construction activities would take place at the mining shaft. A large crane (100 to 250 tons) would be situated at the edge of the shaft to lift the tunnel supports into the shaft and to remove muck boxes filled with the tunnel spoils. Space for loading and unloading trucks would be required, as tunnel spoils would be loaded into trucks at the shaft site and trucks hauling in the tunnel supports and other materials would need to be unloaded at the site. The contractor would also need space for storing materials and equipment, shop facilities, space for several containers with spare parts, office trailers, a change house for the miners, and parking. The minimum space required for efficient construction operation at the mining shaft would be about 2 acres.

Canal and Canal Tie-In

Construction of the connection between the screening device, the Vista Grande Canal, and the tunnel would involve constructing two short, open-cut pipelines from the end of the screening device to the mining shaft and the existing canal. The weir within the screening device would divert flow exceeding 170 cfs to the new tunnel by way of a vertical drop structure or an inclined section of pipeline connecting to the tunnel. Flows up to 170 cfs would be diverted at the weir to a pipeline which would bypass the mining shaft and reconnect to the existing canal north of the tunnel inlet. In either case, an access manhole would need to be constructed in the mining shaft at the start of the tunnel for inspection and maintenance. These modifications will not permanently affect the wetlands area under consideration by the City and County of San Francisco.

Outfall Structure

A new outfall structure would be required within the GGNRA. The construction site would require perimeter safety fencing. Sheet piling around the structure's foundation might be used to reduce the excavation limits and control groundwater seepage. Temporary construction sump pumps would be required during the initial construction stages to maintain the work zone. Concrete for the cast-in-place concrete structure would be brought to the site by concrete transit mixers and pumped into the formwork.

Construction Staging and Work Zones

Due to the mining shaft location, there would be limited options for construction staging. Some options are along the canal and John Muir Drive corridor or on leased Olympic Club land. The area along the first 1,000 feet of the canal ranges in width from 50 to 120 feet (about an acre) and the Olympic Club's maintenance area is approximately 1.25 acres. The intersection would be temporarily narrowed and diverted to the north so traffic could continue along John Muir Drive and Lake Merced Boulevard. During the construction period, the beginning of the canal would be diverted through a temporary culvert under John Muir Drive so the Vista Grande Tunnel could remain in service. Following the completion of the tunnel, the tunnel staging area would be used for staging the screening device and drop structure.

The primary staging area for the new beach outfall structure would be on lands leased from the GGNRA and a limited construction site on the beach. Access to the new outfall structure construction site would require using existing GGNRA roads, parking areas, and paths at the beach. However, the amount of disturbance could be significantly reduced if the tunnel were used for access to the beach construction site. Construction equipment, materials and supplies could be staged on nearby GGNRA lands or near the tunnel inlet portal.

6.1.2 Alternative 4 – South of County Line along Northgate Drive

This alternative involves construction of a 13-foot-diameter, 4,700-foot-long tunnel beneath Northgate Avenue from Westlake Park to a new outfall structure on the coast. Based on preliminary geotechnical information, it is anticipated that soft ground tunneling methods would be appropriate. A soft ground tunnel would be constructed from a mining shaft in Westlake Park to the new outfall using the same methods described above for Alternative 1A.

To connect the culvert along Cliffside Drive, a new 48-inch stormwater intercept culvert would be driven from the mining shaft to the receiving shaft near Manhole No. 53. This culvert could be driven using trenchless methods to minimize impacts on the surrounding neighborhood. A receiving shaft, approximately 8 feet in diameter, would be required on Cliffside Drive. The connection to the existing 54-inch-diameter culvert would be accomplished from the receiving shaft.

The mining shaft and main staging would be at Westlake Park. The shaft would be constructed using methods similar to those described above for Alternative 1A.

Tie-in of the existing culverts to the new drop structure could be accomplished by diverting flows, blocking and temporarily using in-line storage, or performing the work during low flow periods.

Canal and Canal Tie-In

The canal modifications would include the construction of a 170 cfs screening device at the end of the canal. During construction of the screening device, a temporary pipeline would divert the existing flows in the canal around the construction and into the existing Vista Grande Tunnel inlet. These modifications will not permanently affect the wetlands area under consideration by the City and County of San Francisco.

Outfall Structure
The new outfall structure would be constructed at the coast similar to the approach described above for Alternative 1A.

Construction Staging and Work Zones
Due to the availability of public space at Westlake Park, there are multiple sites for construction staging. Four staging area options are the parking lots north and west of the baseball fields, the northern half of the baseball fields, and the tennis courts. These staging areas are: 1.5 acres, 0.6 acres, 2 acres, and 0.6 acres respectively.

The primary staging area for the new beach outfall structure would be on lands leased from the GGNRA and a limited construction site on the beach. Access to the new outfall structure construction site would require using existing GGNRA roads, parking areas, and paths at the beach. However, the amount of disturbance could be significantly reduced if the tunnel were used for access to the beach construction site. Construction equipment, materials and supplies could be staged on nearby GGNRA lands or near the tunnel inlet portal.

6.1.3 Alternative 5B – 1/3 up Canal to Existing Outfall

The main feature to be constructed for this alternative is a 15-foot diameter 5,200-foot-long tunnel. A soft ground tunnel would be constructed from a mining shaft located southwest of John Muir Drive, adjacent to the Vista Grande Canal, to the existing outfall. Construction would be by the same methods described above for Alternative 1A.

The mining shaft is in the area between John Muir Drive and the Olympic Club. There appears to be enough space for construction staging at this site, although the staging area ranges from 50 to 110 feet wide. The shaft would be constructed by methods similar to those described above for Alternative 1A.

Canal and Canal Tie-In
Construction of the connection between the new box culvert, the Vista Grande Canal, and the tunnel would involve the box culvert splitting at the mining shaft. The flows in the left two sections of the triple box culvert would drop into the mining shaft and continue down the new tunnel. The right section of the box culvert, which would carry flows up to 170 cfs, would divert around the mining shaft and reconnect with the existing Vista Grande Canal north of the new tunnel inlet. An access manhole would need to be constructed in the mining shaft at the start of the tunnel for inspection and maintenance.

Outfall Structure
The existing Vista Grande Outfall Structure could require extensive modifications to satisfy design, environmental, and regulatory requirements. Figures 6.1 and 6.2 present images of the existing outfall structure, circa October 2007. The construction site would require perimeter safety fencing. Construction equipment, materials, and supplies could be staged nearby on GGNRA lands. Sheet piling around the structure's foundation might be used to reduce the excavation size and control water seepage. Temporary construction sump pumps would be required during the initial construction stages to maintain the work zone. Bypass piping would also be required to pass Vista Grande Tunnel flows around the construction site to a temporary discharge structure. Concrete, for the cast-in-place concrete structure, would be brought to the site by concrete transit mixers and pumped into the formwork.

Construction Staging and Work Zones
Due to the mining shaft location, there are limited sites for construction staging. Two staging area options are along the canal or on leased Olympic Club land. The area along the first 1,000 feet of the canal ranges

in width from 50 to 120 feet (about 1 acre). To protect the construction workers from vehicular traffic, some lane restrictions or work-hour restrictions might be required. During the tunnel and canal construction periods, a portion of the canal might be diverted through a temporary culvert under John Muir Drive so the Vista Grande Tunnel could remain in service.

Following construction of the tunnel, the tunnel staging area would be used as the staging area for canal improvements. The staging area for the box structure would be between the canal and John Muir Drive and possibly include the right turn lane and shoulder of John Muir Drive heading south to Lake Merced Boulevard. Temporary traffic control modifications may be necessary during the canal construction.

The staging area for the rebuilding of the existing outfall structure would be a limited site on the beach and on GGNRA lands. Access to the new outfall structure construction site would require using existing GGNRA roads, parking areas, and paths at the beach. However, the amount of disturbance could be significantly reduced if the tunnel were used for access to the beach construction site. Construction equipment, materials and supplies could be staged on nearby GGNRA lands or near the tunnel inlet portal.

6.1.4 Alternative 6 – 2/3 up Canal to Existing Outfall

This alternative is similar to Alternative 5B except that the tunnel is shorter and the length of the Vista Grande Canal that must be modified is greater.

The 4,200-foot-long soft ground tunnel would be constructed from a mining shaft located southwest of John Muir Drive, adjacent to the Vista Grande Canal, to the existing outfall using the same methods described above for Alternative 1A.

The mining shaft is located in the area between John Muir Drive and the Olympic Club. The staging area at this location is much wider than the staging area for Alternative 5B. The shaft would be constructed by methods similar to those described above for Alternative 1A.

Canal and Canal Tie-In

Construction of the connection between the Vista Grande Canal and the tunnel would be similar to Alternative 5B.

Outfall Structure

The existing Vista Grande Outfall Structure would require extensive modifications as described in Alternative 5B.

Construction Staging and Work Zones

Due to the construction shaft location, there are limited sites for construction staging. Three staging area options are along the canal, in the parking lot west of Impound Lake, or on leased Olympic Club land. The wide section along the canal ranges in width from 60 to 200 feet and is about 750 feet long (about 1.5 acres). The parking lot area is about 0.25 acres. To protect the construction workers from vehicular traffic, some lane restrictions or work-hour restrictions might be required. During this construction period, the canal would be diverted through a temporary culvert under John Muir Drive and connected to the existing Vista Grande Tunnel. The Vista Grande Tunnel and most of the canal would remain in service during the tunnel construction period.

Following the completion of the tunnel, the staging area for the canal improvements would be along the east shoulder of John Muir Drive. The staging area for the box structure would be between the canal and

John Muir Drive and possibly include the right turn lane and shoulder of John Muir Drive heading south to Lake Merced Boulevard. Temporary traffic control modifications may be necessary during the canal construction.

The staging area for the rebuilding of the existing outfall structure would be a limited site on the beach and on GGNRA lands. Access to the new outfall structure construction site would require using existing GGNRA roads, parking, and paths at the beach. However, the amount of disturbance could be significantly reduced if the tunnel were used for access to the beach construction site. Construction equipment, materials and supplies could be staged nearby on GGNRA lands or near the tunnel inlet portal inland.

6.1.5 Alternative 7 – Parallel Tunnel South of the Existing Tunnel

This alternative is similar to Alternatives 5B and 6 except the tunnel would be shorter and the length of the Vista Grande Canal that must be modified would be greater. The 3,200-foot-long soft ground tunnel would be constructed from a mining shaft located southwest of John Muir Drive, adjacent to the Vista Grande Canal, to the existing outfall using the same methods described above for Alternative 1A.

The mining shaft is in the area between John Muir Drive and the Olympic Club. The staging area at this location is fairly narrow, similar to Alternative 5B. The shaft would be constructed by methods similar to those described above for Alternative 1A.

Canal and Canal Tie-In

Construction of the connection between the Vista Grande Canal and the tunnel would be similar to Alternative 5B.

Outfall Structure

The existing Vista Grande Outfall Structure would require extensive modifications as described in Alternative 5B.

Construction Staging and Work Zones

Due to the mining shaft location, there are limited sites for construction staging. Three staging area options are along the canal between John Muir Drive and the canal edge, on leased GGNRA land, or on leased Olympic Club land. The area along the last 1,000 feet of the canal ranges in width from 50 to 100 feet (about 1 acres). The lands obtained from the Olympic Club or the GGNRA would be dependent on the respective agreements. To protect the construction workers from vehicular traffic along John Muir Drive, some lane restrictions or work-hour restrictions might be required. During this construction period, the canal would be diverted through a temporary culvert under John Muir Drive and connect to the existing Vista Grande Tunnel. The Vista Grande Tunnel and most of the canal would remain in service during the tunnel construction period.

Following construction of the tunnel, the staging area along John Muir Drive would be used as the staging area for the canal improvements. The staging area for the box structure would be between the canal and John Muir Drive and possibly include the right turn lane and shoulder of John Muir Drive heading south to Lake Merced Boulevard. Temporary traffic control modifications may be necessary during the canal construction.

The staging area for the rebuilding of the existing outfall structure would be a limited site on the beach and on GGNRA lands. Access to the new outfall structure construction site would require using existing GGNRA roads, parking areas, and paths at the beach. However, the amount of disturbance could be

significantly reduced if the tunnel were used for access to the beach construction site. Construction equipment, materials and supplies could be staged on nearby GGNRA lands or near the tunnel inlet portal.

6.1.6 Alternative 9 – Detention Basins at Westlake Park

This alternative develops stormwater detention capacity beneath Westlake Park. For simplicity, the north softball field area within Westlake Park was considered for the structure. The area impacts up to about 93,000 square feet depending upon the selected capacity. The depth of the structures varies by the amount of desired storage capacity.

Generally, the construction of the stormwater detention basin would include excavating to depths from 26 to about 65 feet below the ground surface. Geotechnical investigations should be performed to evaluate the soil and groundwater conditions at the site and perform engineering analyses to develop recommendations for excavation, temporary shoring and bracing/tie-backs, dewatering, design lateral earth pressures, foundation design criteria, tiedowns to resist hydrostatic uplift, and other geotechnical and foundational issues, as deemed appropriate. Figures 6.3 through 6.6 present construction progress images of a similar underground detention basin. Other construction considerations should include appropriate environmental assessment of the soil and groundwater that will be generated as part of the excavation. This is necessary for proper disposal of the excavated soil and for dewatering groundwater.

Option to Store 3.9 MG

To provide approximately 3.9 MG of storage, Area 1 would be excavated approximately 36 feet below the ground surface. To maximize public access and use of the park during construction, a near-vertical excavation could be accomplished using soldier piles and lagging. Approximately 4,700 10-wheel dump truck loads would be required to transport the excavated material to a disposal site. The reinforced concrete storage structure would be constructed with columns, beams, and shear walls to create a structure that would provide both structural integrity and interconnected wet wells. A screening device would be placed near the inlet to the structure. An operating platform would provide access to pumps, instrumentation, and other electrical/mechanical equipment. A concrete roof would enclose the structure. Access hatches and ventilation would be provided outside of limits of the softball field playing surface.

A trench would be excavated through a portion of the parking lot to construct an intercept with the nearby box culvert. This connection would allow water to drain from the existing box culvert into the detention structure. A pump discharge line would pump the stormwater back into the existing box culvert on the downstream side of a hydraulic control. After construction, the tennis courts and playground would be restored to their pre-project condition.

This option could provide for groundwater recharge using the percolation method. If the soil beneath the storage structure had suitable percolation characteristics, and the stored water met water quality requirements, the structure could be designed with an open floor system.

Option to Store 16.2 MG

To provide approximately 16.2 MG of storage, Areas 1 and 2 would be excavated approximately 43 feet below the field surface. To maximize public access and use of the park during construction, a near-vertical excavation could be accomplished using soldier piles, lagging, and tie-backs. Figures 6.3 to 6.6 illustrate this construction sequence for a 30 MG water storage tank. Approximately 16,000 10-wheel dump truck loads would be required to transport the excavated material to a disposal site. The reinforced concrete storage structure would be constructed with columns, beams, and shear walls to create a structure that would provide both structural integrity and interconnected wet wells. A screening device

would be placed near the inlet to the structure. An operating platform would provide access to pumps, instrumentation, and other electrical/mechanical equipment. A concrete roof would enclose the structure. Access hatches and ventilation would be provided outside of limits of the softball field playing surface.

A trench would be excavated through a portion of the parking lot to construct an intercept with the nearby box culvert. This connection would allow water to drain from the existing box culvert into the detention structure. A pump discharge line would pump the stormwater back into the existing box culvert on the downstream side of a hydraulic control. Once completed, the affected areas of the park would be restored to their pre-project condition.

This option could provide for groundwater recharge using the percolation method. If the soil beneath the storage structure had suitable percolation characteristics, and the stored water met water quality requirements, then the structure could be designed with an open floor system.

Option to Store 30.8 MG

To provide approximately 30.8 MG of storage, Areas 1 and 2 would be excavated approximately 63 feet below the field surface. To maximize public access and use of the park during the construction, a near-vertical excavation could be accomplished using soldier piles, lagging, and tie-backs. Figures 6.3 to 6.6 illustrate this construction sequence for a 30 MG water storage tank. Approximately 23,500 10-wheel dump truck loads would be required to transport the excavated material to a disposal site. The reinforced concrete storage structure would be constructed with columns, beams, and shear walls to create a structure that would provide both structural integrity and interconnected wet wells. A screening device would be placed near the inlet to the structure. An operating platform would provide access to pumps, instrumentation, and other electrical/mechanical equipment. A concrete roof would enclose the structure. Access hatches and ventilation would be provided outside of limits of the softball field playing surface.

A trench would be excavated through a portion of the parking lot to construct an intercept with the nearby box culvert. This connection would allow water to drain from the existing box culvert into the detention structure. A pump discharge line would pump the stormwater back into the existing box culvert on the downstream side of a hydraulic control. Once completed, the affected areas of the park would be restored to their pre-project condition.

This option could provide for groundwater recharge using the percolation method. If the soil beneath the storage structure had suitable percolation characteristics, and the stored water met water quality requirements, then the structure could be designed with an open floor system.