Advisian

WorleyParsons Group

Advisian
Suite 500, 151 Canada Olympic Rd SW
Calgary, AB T3B 6B7 CANADA
Phone: +1 403 247 0200
Toll-Free: 1 800 668 6772
Facsimile: +1 403 247 4811
www.worleyparsons.com

14 March 2018

Proposal. No.:
File Loc.: Calgary

Herwit Engineering
6200 Center Street
Suite 310,
Clayton, CA 945117

Attention: Gregory Harris

Dear Mr. Harris:

RE: SANITARY OUTFALL ASSESSMENT FOR THE TOWN OF DISCOVERY BAY

1. INTRODUCTION

Herwit Engineering (Herwit) on behalf of the Town of Discovery Bay California (TDBC) has requested WorleyParsons Group Inc. operating as Advisian (Advisian) to complete an assessment of their sanitary outfall (outfall). The outfall is used to discharge treated effluent from the TDBC wastewater treatment plant into the Old River and in past years has experience diminishing discharge capacity. In addition, concerns have been raised that discharge pumping capacity of the plant has been reduced; this could be either due to plugged sections of the outfall and/or reduced capacity of the pumps

The following assessment includes an evaluation of the outfall existing conditions, a review of the system hydraulic, site investigations including CCTV camera inspection, a review of underwater surveys, and provides recommendations for upgrades/repair measures.

2. BACKGROUND INFORMATION

2.1 Project Site

The project sanitary outfall is located in eastern Contra Costa County, California about 60 miles from San Francisco, in a section of the Old River flanked by earthen levees. The site is located adjacent to the west levee (left river bank) and south of the Contra Costa Water District (CCWD) Los Vaqueros Pump Station. Based on the Kleinfelder Inc. geotechnical report (2004) the Old River at the site location has the following tidal water level fluctuations:

- 100 year Flood Elevation – El. 7.5 ft.
- Mean High Water – El. 2.4 ft.

.Mean Higher High Water – El. 3.5 ft.

- Mean Lower Low Water – El. -0.5 ft.
- Extreme Low Water – El. -2.0 ft.
- Flow velocity – 3 to 4 ft./s

2.2 Original Design Specifications

The existing outfall diffuser is comprised of a multi-port diffuser system developed by Flow Science Inc., as noted in their Dye Study (December, 2002).

The concept approved by the Regional Water Quality Control Board (RWQCB) (Komex 2004), consisted of the following:

- Total outfall length 228.5 feet (actual pipe length from the levee connection point);
- HDPE Pipe Diffuser length 123 ft. including concentric reducer length;
- Outfall diameter 18 in., 10 in., and 6 in.;
- Number of diffuser ports 36;
- Port spacing average of 3 feet between ports; and
- Port diameter 2 in. Series 35 Longneck Tideflex Valve

2.3 Previous Site Investigations - 2013 Underwater Survey

On May 15, 2013, Bishop Diving & Salvage completed an underwater visual inspection of the outfall including 123 ft. of HDPE pipe comprised of 18 in.,10 in. and 6 in. pipeline segments. The result of the inspection revealed that, out of the 36 diffuser ports, 2 of them were missing and no flow (except for one port) was observed in the 6 in. pipeline segment (16.5 ft. long).

3. SITE VISIT

On December 7, 2017, WorleyParsons representatives visited the site to inspect the outfall condition. The site activities included visual inspection of the outfall (above water) and a CCTV camera inspection completed by Subtronic Corporation.

From the visual inspection no damage of the outfall was observed above water, and no erosion along the bank slope existed. Good vegetation growth was observed next to the outfall along the bank slope as shown in Photo 1.

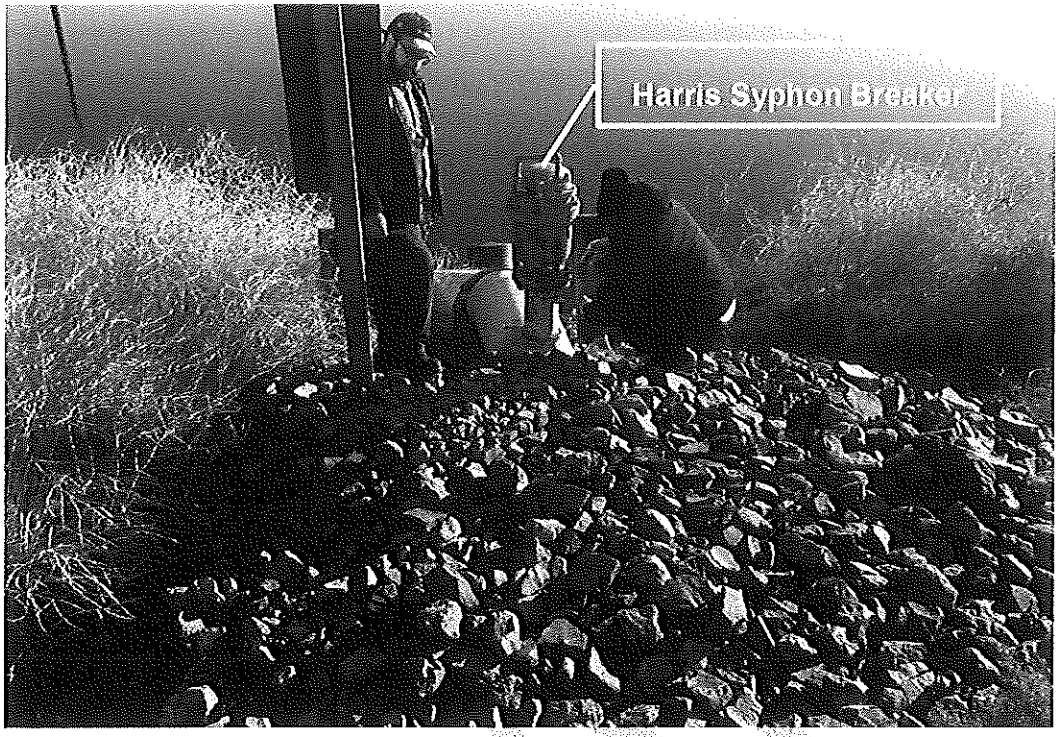

Photo 1 Old River West Bank (looking NW)

Due to reduced clearance at the entrance point (opening at the removed Harris syphon breaker) (Photo 1) the CCTV camera (CCTV) inspection was completed and televised using a push/rod reel with self leveling color camera and footage counter. The inspection did not reveal significant obstruction of the 18 in HDPE segment (70 ft.), except for algae growth along the walls of the pipe. Similar to the 18 in segment, algae growth was observed in the 10 in HDPE segment (30.5 ft.). At approximately 152 ft. (station 0+190 ft., C2 diffuser design drawing, Komex 2004) the CCTV camera experienced a blockage in the 10" segment and was not able to proceed further into the pipe. As a result, no footage was recorded beyond this point. No details of the 6 in HDPE segment were obtained, but it is assumed that this segment may be partially or fully obstructed (with reduced flow capacity) as described in the 2013 and 2017 (section below) underwater survey. Video files CCTV camera inspection were mailed to TDBC and Herwit.

Also, as part of the site visit, a pump test was completed for all of the five vertical turbine pumps (Photo 2) at the wastewater treatment plant. The test procedure was to allow the lift station sump to fill to its volume capacity and then activate the pumps to its maximum flow. Recording were made for approximately for 5 to 10 mins obtaining reading from the flow meter and pressure head for the pump gauges. It is important to note that one of pump gauges was not operating, so reading were obtained for 4 out of the 5 lift station pumps. The result of the pump test indicated an average flow of 3.11 MGPD for an approximate pumping head of 20 psig.

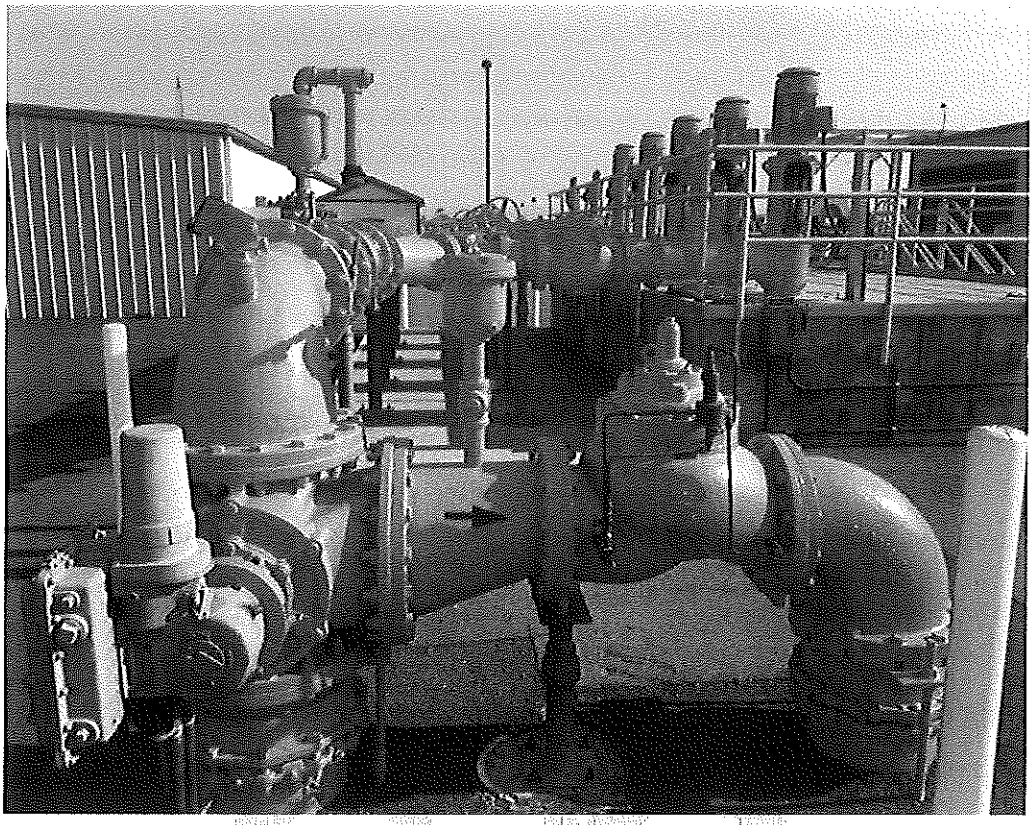

Photo 2 Discovery Bay Community Service District Sewage Treatment Plant Export Pump Station

4. 2017 UNDERWATER INSPECTION

On December 2, 2017, Bishop Diving & Salvage completed an updated underwater survey of the outfall including 123 ft. of HDPE pipe (comprised of 18 in., 10 in. and 6 in. pipeline segments). The inspection showed similar outcomes to the 2013 survey, with 2 out of the 36 ports missing and no flow observed in the 6 in pipeline segment (16.5 ft. long). Also some of the Tideflex valves appeared to have cracks and may not be sealing properly, therefore allowing for outside sediments into the diffuser (see Photo 3). These results confirmed the observations of the CCTV camera inspection, which inferred a partial blockage at the downstream end of the 10 in. segment (weak flow out of port 28) and a complete blockage of the 6 in. segment (with no flow observed out of port 31-36).

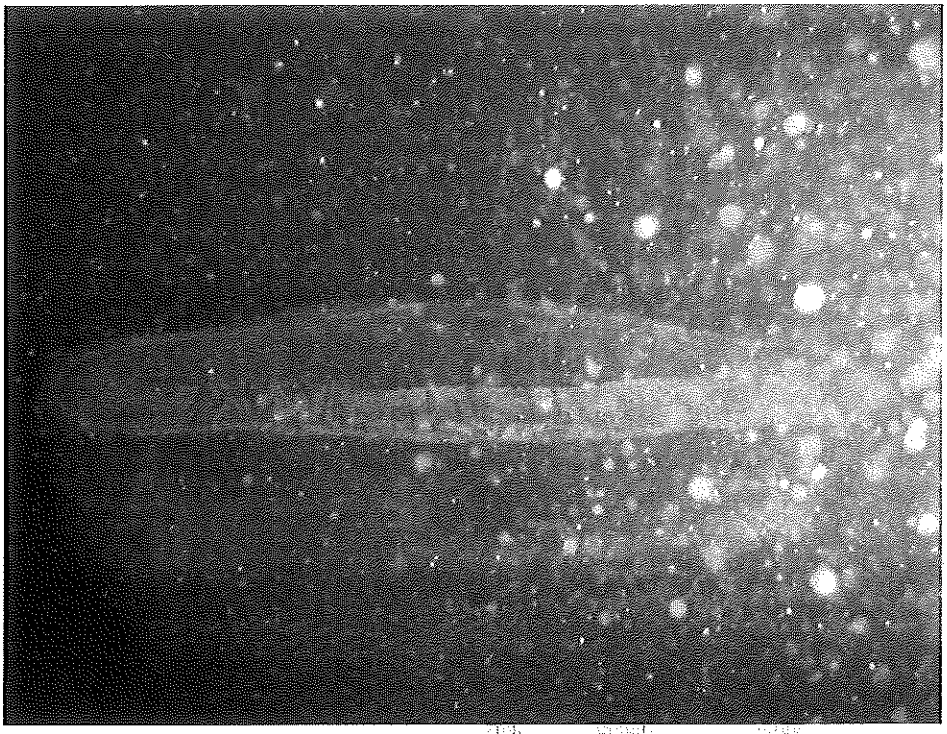

Photo 3 Discovery Bay Outfall Diffuser - Tideflex Valve Showing Crack Damage at its Opening

5. REVIEW OF THE HYDRAULICS OF THE OUTFALL AND PUMPING SYSTEM

In preparing this report, a hydraulics assessment of the TDBC pressurized effluent system was completed. This assessment included the lift station (five vertical turbine pumps), 4079 ft. of conveyance pipe (Steel 16 in. Pipe Schedule 40) and the Old River outfall diffuser (36 discharge ports). The configuration of the system was based on the Herwit Engineering design drawings (2004) for the Sewage Treatment Plan Export Pump Station, the Herwit Engineering Sewage Treatment Plant Export Pipeline Project design drawings (2004) and the Komex 18 in. Sanitary Sewer Outfall Old River design drawings (2004).

The hydraulic assessment was based on industry standard calculation methods, using a derivation of the Colebrook-White equation to define the Darcy Weisbach friction factors of the system relative roughness and associated Reynold's number. Head loss and fitting losses were calculated based on the derived friction factors and fitting loss coefficients. The system hydraulics were based on an aged pipeline system with a roughness of 3mm and river water EL 1.00 ft.

To simulate the results of the pumping test, the recorded flow of 3.11 MGPD (Mega Gallons per day) was used though the system and compared to recorded pumping head of approximately 19.9 psig (45.9 ft.). The assessment indicated that for a flow of 3.11 MGPD the head losses though the system will require a pumping head of 14.6 psi (33.6 Ft). These results indicate that the current system has

increased head losses and therefore the lift station has to operate at a higher pumping head to convey the flow through the system. The higher pressure head required is a result of additional losses encountered by flow being channeled through a lower number of diffusers which increases the jet velocity and the loss at each Tideflex valve. As expected, these head losses may be attributed to the obstruction observed in the outfall diffuser.

6. PROPOSED OUTFALL UPGRADE/REPAIR OPTIONS

Three proposed upgrade/repair options are presented for the TDBC outfall. These options include removal/replacement and abandoning/replacement of the existing HDPE sections of the diffuser. These options also include using the existing diffuser concept of 36 ports and using a new design of 3-5 ports. Details for the proposed options are provided below.

- Option 1 – Removal of the existing diffuser HDPE segments (123 ft.) of the existing diffuser and replacement with a similar HDPE diffuser design with 36 ports. This option will require removal of the HDPE pipeline, excavation of trench, new pipe installation and grading of the river bed (filled trench with granular material) per original design (an alternative option to the trench installation is to install of an articulated concrete block matt [ACBM]);
- Option 2 – Removal of the existing diffuser HDPE segments (123 ft.) of the existing diffuser and replacement with a single HDPE pipe diameter (e.g. 18 in.) and 3-5 discharge ports. This option will involve removal of the HDPE pipeline, excavation of trench, new pipe installation and grading of the river bed (filled trench with granular material) per original design (an alternative option to the trench installation is to install an articulated concrete block matt). In addition this option will require the preparation of a dispersion model and the design of a new diffuser with reduced discharge ports; and
- Option 3 – Abandonment of the existing diffuser HDPE segments (123 ft.) of the existing diffuser and replacement with a new diffuser design installed on top of the existing (at river bed level). This option will involve abandonment of the HDPE pipeline, removal of existing ports, grading of the river bed, installation of an articulated concrete block matt, installation of new diffuser with reduce ports, removal of a section of steel pipe, and anchoring. In addition this option will require the preparation of a dispersion model and the design of a new diffuser with a reduced number of discharge ports.

7. REVIEW OF SITE CONDITIONS, RIVER FLOW, AND PROPOSED SCOUR PROTECTION

7.1 Diffuser Scour

The geotechnical investigation (2004) indicated that the general soil profile on the river bottom consists of 1.5 to 2 feet of very loose silty sand and silty clay underlain by 2.5 to 5 feet of medium dense silty sand underlain by over 50 feet of medium stiff to stiff silty clay and sandy clay. Based upon the reported blow counts, the medium stiff to stiff silty clay and sandy clay layer provides firm bearing. The top of the medium dense silty sand layer is interpreted to represent the depth of general scour in the river, as the density of the medium dense sand layer exceeds that of river sand re-deposited on the bottom after a scour event.

Per the Komex report (Komex 2004a) The United States Geological Service (USGS) river flow data for the Old River at the Highway 4 Bridge was analyzed to determine the probability distribution of the mean velocity in the river channel. Due to limitations in how much data could be analyzed at that time (65,536 rows), the probability distribution is based upon data collected from October 13, 2001 through September 22, 2003 (data collected at 15-minute intervals). As the Old River is strongly tidal, the data were analyzed for the direction that had the highest mean velocities (the "negative" velocity direction towards the south meaning tidal inflow). Based upon an analysis of that data, the probability distribution of mean river velocity is presented in Figure 1.

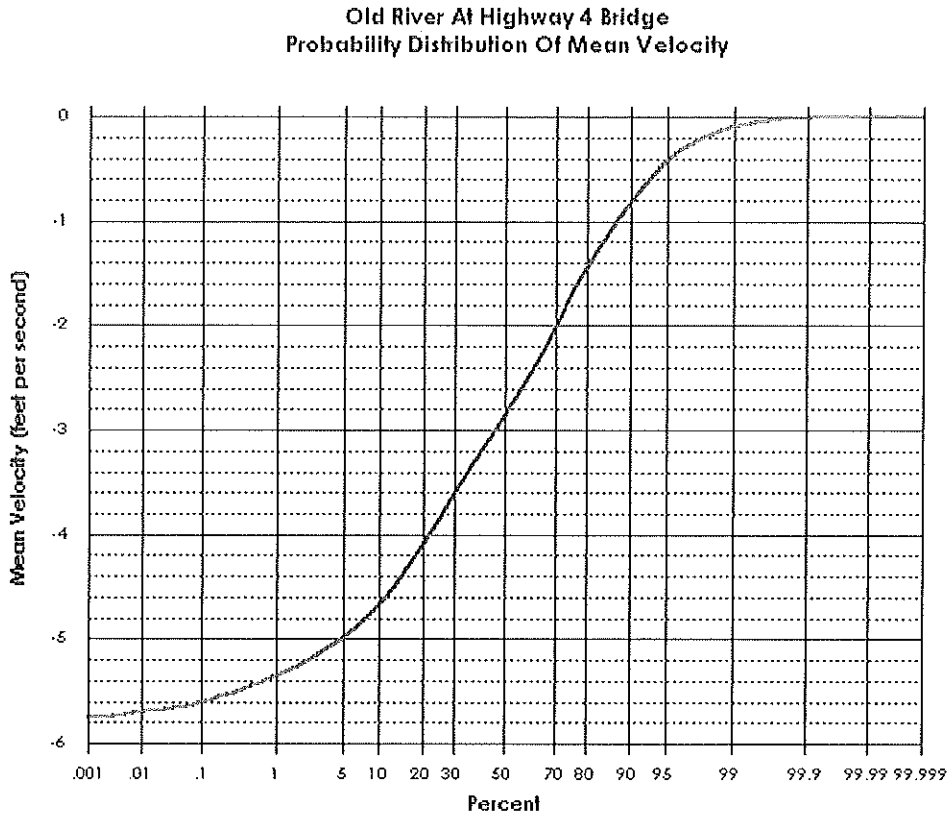

Figure 1 Old River At Highway 4 Bridge – Probability Distribution of Mean Velocity

The probability distribution of mean river velocity indicates that scour is an important criterion that must be considered in the riverbed diffuser support design. Therefore, it is recommended that for Options 1, and 2 the diffuser be placed in an excavated trench below the depth of scour, approximately 2.5 feet below the existing riverbed, and for all three options, an articulated concrete block matt (ACBM) should be installed above the header at the level of the existing bed to prevent scour in the region of the diffuser. Since the ACBM is porous, it would be important to incorporate a geotextile into the design to prevent bed material loss through the interstitial spaces.

8. COST ESTIMATE

A preliminary cost estimate was prepared for the upgrade/repair of the three diffuser options described above. The cost for each option is presented in Table A and includes supply and installation of the material, on-site disposal of stripped and excavated material, mobilization and de-mobilization to and from the Site. Details pertaining to the construction cost include: 2% insurance, 20% contractor

overhead and profit (OH+P), a contingency of 15% and excludes tax. Costs in Table A do not include Engineering and Construction inspection costs for Advisian as outlined below.

Advisian estimated cost to support the design, dispersion modeling, water quality monitoring, bathymetric survey and construction support is $120,000. Details of the items included for this cost are the following:

- design of the selected diffuser option and dispersion modeling for Options 2 and Option 3;
- water quality monitoring and bathymetric survey (7- 12 hr. days, 2 – 8hr. days mob/demob);
- construction support (7- 12 hr. days, 2 – 8hr. days mob/demob);
- specifications and issued for construction drawings;
- Regulatory Support
- construction completion report (including daily field activities, water quality monitoring and as-built drawings); and
- Tax excluded

Table A Cost Estimate for TDBC Diffuser Upgrade/Repair Options

Activity/Material	Estimated Cost
Option 1 – Removal and Replacement of Similar Diffuser Design	$268,500
Option 2 – Removal and Replacement of Diffuser with New Design	$266,900
Option 3 – Abandonment and Replacement of Diffuser with New Design	$304,000

9. CONCLUSIONS AND RECOMMENDATION

9.1 Conclusions

Based on the results of this assessment, the following conclusions were made:

- Sections of the diffuser appear to be damage, either partially operating (downstream end of the 10 in. segment) or non-operating (6 in. segment). Based on the 2017 underwater survey prepared by Bishop Diving & Salvage, the 6 in. segment of the diffuser is non-operational with no flow observed in any of its ports. Also, per the underwater survey the 10 in. segment appears to have weak flow at the downstream end. The CCTV camera inspection completed by Subtronic Corporation indicated that a blockage was present at the downstream end of 10 in. segment, verifying the flow observations made by the underwater survey.
- The hydraulic assessment completed for the TDBC sanitary system (from the lift station to the outfall) indicated that the current system is operating with higher head loss compared to its original design. Therefore, the lift station has to deliver a higher pumping head to convey flow through the system. The results showed that to deliver a flow of 3.11 MGPD the lift station

required a pumping head of 19.9 psi, while under normal conditions the expected pumping head should be of approximately 15 psi. The higher pressure head required is a result of additional losses encountered by flow being channeled through a lower number of diffusers which increases the jet velocity and the loss at each Tideflex valve. This increased head losses are in agreement with 2017 results of the underwater and the CCTV camera inspection.

- To improve the overall system performance, the existing diffuser should be repaired or upgraded. To this point three repair /upgrade options have been prepared as described in Section 7.

9.2 Recommendations

Based on the results of this assessment, the following recommendations were made:

- To verify that there are no significant issues with the performance of the Lift Station (5 pumps), it is recommended to complete a pumping test using the lift station recirculation system. The result of this pump test should be then compared to the original performance result of the system to confirm no loss in original pumping performance.
- To assist the outfall repair/upgrade design, a bathymetric survey of the outfall area is recommended. This survey will provide details of the river bed, and indicate if scour or sedimentation has occurred near the outfall area and inform the bed preparation design for the selected option.
- The probability distribution of mean river velocity indicates that scour is an important criterion that must be considered in the riverbed diffuser support design. Therefore, it is recommended that for Options 1, and 2 the diffuser be placed in an excavated trench below the depth of scour, approximately 2.5 feet below the existing riverbed, and for all three options, an articulated concrete block matt (ACBM) should be installed above the header at the level of the existing bed to prevent scour in the region of the diffuser. Since the ACBM is porous, it would be important to incorporate a geotextile into the design to prevent bed material loss through the interstitial spaces.
- Out of the three repair/upgrades presented in this document, Advisian recommends Option 3, as it will require less disturbance of the outfall area and may require an easier installation. This option will also use reduced number of ports, which will reduce maintenance and lower the chances of obstruction damage. In addition, this option will involve shorter ports compared to the original design therefore, allowing for sufficient water depth above it without restricting boating activities in the river.
- It is recommended that for all design options a protection (cage is installed) be considered to prevent damage from boating activities (e.g. vessel anchors)
- As part of the construction activities and per the State of California requirements it is recommended to implement a turbidity monitoring program for the duration of the construction activities.

10. REFERENCES

Herwit Engineering, 2004. Design drawings, Sewage Treatment Plant Export Pump Station Project.

Herwit Engineering, 2004. Design drawings, Sewage Treatment Plant Export Pipeline Project.

Flow Science, 2002. Dye Study of the Discovery Bay Wastewater District Outfall Diffuser in Old River, Final Draft.

Kleinfelder, Inc., 2004. Preliminary Geotechnical Services Report Discovery Bay Outfall Diffuser in Contra Costa County, California.

Komex, 2004. 100% design drawings, Town of Discovery Bay Community Services District 18" Diameter Sanitary Sewer Outfall Old River

Komex, 2004. Tow of Discovery Bay Community Services District & Contra Costa Water District 20% outfall design submittal.

11. CLOSURE

We trust that this letter proposal satisfies your current requirements and provides suitable documentation for your record. This work plan is based on our current understanding of your requirements for a baseline assessment of three water wells. If you have any questions or require further details, please contact the undersigned at any time.

Sincerely,

Efrain Giron, Ph.D., P.Eng.
Senior Water Resources Engineer

Senior Reviewed by

Jeff Crofton, M.A.Sc., P.Eng.
Director, Surface Water Engineering, Americas