ORANGE COUNTY SANITATION DISTRICT

Appendix E

PRELIMINARY DESIGN REPORT
AND
GEOTECHNICAL REPORT

(Preliminary Design Report prepared by RBF Consulting)
(Geotechnical Report prepared by Leighton Consulting, Inc.)

November 15, 2004 – Preliminary Design Report
June 30, 2003 – Geotechnical Report

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INTRODUCTION

The Orange County Sanitation District (OCSD) currently owns and operates the Carbon Canyon Pump Station. The Pump Station is located within the 124-acre Carbon Canyon Regional Park, which is located in the City of Brea, County of Orange. Approximately 12,300 acres of land are tributary to the Pump Station, including Carbon Canyon, Soquel Canyon and Telegraph Canyon. However, portions of the tributary area are located within Los Angeles and Riverside Counties. The remaining 8,600 acres are located within Orange County.

The OCSD presently provides service for areas immediately adjacent to, but outside of, its boundaries under separate sewer service agreements. In the past, the OCSD has entered into agreements with Los Angeles County Sanitation District Nos. 18 and 19, the Sandlewood Sewer Maintenance District, the community of Sunset Beach, the Seal Beach Naval Weapons Station, and the Santa Ana Watershed Project Authority.

In 1985, the OCSD adopted a resolution fixing the OCSD's service area as the then existing boundaries and/or spheres of influence. This policy was adopted in part because of concerns by the City of Fountain Valley that continued annexations or execution of sewer service agreements would require undue expansion of Reclamation Plant No. 1 in Fountain Valley. In 1999, this policy was revisited.

BACKGROUND

The Pump Station was originally built in 1974 and modified in 1984. The Pump Station consists of two 400-gpm submersible pumps (1750 rpm) located inside circular wet well with a diameter of 84-inches and a depth 16-feet and 5-inches. Each pump is equipped with a 25-hp motor and boosts a total dynamic head of 140 feet. The design capacity of the Pump Station is 0.54 million gallons per day (MGD). The Pump Station discharges flow through two cast iron force mains, a 4-inch main and 6-inch main, which travel in the southerly direction. Both force mains continue southerly through the park and connect to an existing OCSD manhole at the top of the Carbon Canyon Dam. The approximate length of each force main is 2,800 feet.

At the manhole at the top of the dam, flow transitions to gravity and travels through an existing 12-inch encased VCP gravity sewer line. The diameter of the gravity line increases as the pipeline travels along an access road down the face of the dam, terminating in an OCSD 27-inch VCP sewer pipe at the intersection of Rose and Vesuvius Drives. This pipeline is known as the Carbon Canyon Dam Interceptor. The approximate length of the gravity sewer pipe in the access road is 1,450 feet.

There is an existing 6-inch gravity wastewater line owned by Texaco (constructed by Unocal, this line is also referred to as the Olinda Lateral) that runs roughly parallel with the OCSD force mains. This Texaco line increases to 12-inches through the dam, then reduces back to 6-inches and diverges from the OCSD alignment north of the intersection of Rose and Vesuvius Drives. The approximate length of gravity sewer is 4,250 feet.

PROJECT PURPOSE

With the increasing development in the region tributary to the Pump Station, the Pump Station is expected to exceed its' capacity in the very near future. The District frequently operates both pumps at the Pump Station to equalize the influent flow. The original design of this Pump Station was to use one pump regularly and the second pump as stand-by.

By installing a gravity sewer pipeline, OCSD could abandon the Pump Station and force mains. By eliminating this Pump Station, the District can avoid the cost of having to upgrade the station, and also eliminate the operational and maintenance costs that go along with pump stations.

The purpose of this preliminary design report (PDR) is to evaluate the feasibility of constructing a gravity sewer pipeline to replace the existing Pump Station and force mains. This PDR will discuss the following:

- Design Parameters

- Pipeline Alignment
- Hydraulics
- Local Utilities and Agencies
- Construction Methods
- Odor Assessment and Odor Control Plan
- Implementation Plan
- Preliminary Drawings

I. DESIGN PARAMETERS

1.1 GENERAL

The design of the proposed gravity sewer pipeline will conform to the Orange County Sanitation District (OCSD) Design and Construction Requirements for Sanitary Sewer (Updated July 15, 2001). This section will summarize and discuss design parameters, criteria and assumptions that will be used in the design of the pipeline, and various other requirements as follows:

- Permit requirements
- Utility requirements
- Landscape requirements
- Stormwater handling requirements
- Pipe materials
- Seismic design criteria
- Preliminary table of contents for detailed specifications

1.2 DESIGN CRITERIA

The gravity pipeline will be designed to handle the ultimate peak flow condition with inflow and infiltration. The flow calculations are discussed in Section III. Pipeline design is based on the following design criteria:

A. Velocity

Velocity shall not be less than 2 ft./sec.

B. Requirements for Depth of Flow (d) Verses Diameter of Pipe (D)

Diameter of pipe (D)	Max d/D
8" – 18"	0.50
21" – 60"	0.75
Over 60"	0.75

C. Depth of Cover

Minimum depth of cover over mainline sewers shall be 7 feet.

D. Rim of Manhole in Unpaved Area

Upstream of Dam: 36-inches above ground surface
Downstream of Dam: 18-inches above ground surface

E. Manhole Criteria

Manhole locations:
- At changes in slope
- At changes in direction
- At changes in pipe size
- At termination of sewer
- At special locations as designated by the Engineer
- At changes in pipe material

Maximum distance between manholes:

Diameter of pipe (D)	Distance (ft) [1]
8" – 12"	400
15" – 18"	500
Over 18"	600

[1] Criteria will vary for pipe installed via trenchless methods.

F. Pipe Slope

The pipeline should be designed to maintain the minimum velocity criteria identified above. However, the minimum pipe slope should conform to the following criteria:

Diameter of pipe (D)	Slope (ft/ft)
8" – 12"	0.0040
15" – 18"	0.0028
Over 18"	0.0022

1.3 PERMIT REQUIREMENTS

The land, which is occupied by Carbon Canyon Regional Park, is owned by the United States Army Corps of Engineers (ACOE). The County of Orange (Harbors, Beaches and Parks Department) leases the land from the ACOE and operates and maintains the park. Located immediately south of the Pump Station, within the park boundary, is a small portion of land that is either owned or leased by Breitburn Energy (parcel maps indicate the land is owned by the ACOE, however the ACOE is currently researching the status of the property for verification). Aera Energy owns the property immediately west of the park. OCSD must obtain easements from each respective landowner which the pipeline will encroach upon.

The following permits will be required for this project:

- Orange County Harbors, Beaches, and Parks Construction Permit
- County of Orange Road Encroachment Permit
- Cal/OSHA Mining and Tunneling Permit
- United States Army Corps of Engineers – Right of Entry Permit
- United States Army Corps of Engineers – Section 404 Permit
- Santa Ana Regional Water Quality Control Board – National Pollution Discharge Elimination System (NPDES) Permit
- Santa Ana Regional Water Quality Control Board – Section 401 Certification
- California Department of Fish and Game – 1601 Streambed Alteration Agreement
- City of Brea Encroachment Permit (maybe).

1.4 UTILITY REQUIREMENTS

There are several agencies with active utility lines located near the proposed pipeline alignment. The design will attempt to avoid any conflict with an existing utility, however the design of a gravity sewer pipeline requires a positive slope throughout resulting in limitations of the vertical design. If conflicts with existing utilities are unavoidable, coordination with the utility agency will take place to relocate the utility.

Most agencies requested signed copies of the pipeline design plans. Prior to construction, agencies will locate and mark their active underground utilities. During construction, an agency representative will be present to ensure protection of their utilities. These agencies include, but are not limited to, the City of Brea, Exxon-Mobil, Southern California Gas Company, Southern California Edison, Verizon Wireless, Aera Energy and Metropolitan Water District.

Metropolitan Water District (MWD) has a 96-inch diameter Lower Feeder pipeline located in and adjacent to Rose Drive, in the vicinity of the project. MWD provided a detailed set of guidelines that they request to be followed for developments in the vicinity of their facilities. The proposed alignment discussed in Section II does not require a crossing of the MWD Lower Feeder.

1.5 LANDSCAPE REQUIREMENTS

A representative from the County of Orange, who was designated by the District Supervisor of Orange County Harbors, Beaches and Parks, described landscaping requirements for the project.

The pipeline alignment in Carbon Canyon Regional Park lies only in the "natural" areas. Vegetation types along the proposed pipeline alignment consist primarily of ornamental plants, annual grasslands, irrigated row/field crops, and a small amount of riparian, chaparral and coastal sage scrub. The proposed alignment will not alter any landscaped land. If, during construction of the pipeline, any part of the natural landscape is altered, then it must be restored to its original nature. If trees are removed during construction, then the rule applies to plant three new

trees for every tree that is removed. It is preferred to avoid the removal of any trees.

An exception to these requirements has to do with the Arundo (giant reeds) on the western side of the park. Arundo is an invasive plant species that pushes out the native plant species, does not allow for the nesting of local birds and requires up to three times as much water as other plant species. The County of Orange has received a $1 million grant for the removal of Arundo. In the areas of construction where the removal of Arundo is required, replacement is unnecessary. The area affected by this is approximately in the initial 1000 feet of pipe that runs south of the existing Pump Station.

1.6 STORMWATER HANDLING REQUIREMENTS

Orange County Sanitation District must comply with the existing California State Water Resources Control Board (SWRCB) General Construction Activity Storm Water Permit No. CAS000002 (general permit), for discharges of storm water associated with construction. This includes the development and implementation of a Storm Water Pollution Prevention Plan (SWPPP) and Monitoring Program (MP) by the Contractor.

A portion of the project is located behind the Carbon Canyon Dam, which is used for flood control purposes. The pipeline alignment is located within the 100-year flood plain. The contractor will be required to specifically address this issue in the SWPPP.

1.7 PIPE MATERIALS

The pipe material typically used for a gravity sewer main, especially one that may convey industrial and commercial wastes, is VCP. However, due to the fact that portions of this pipeline will be constructed via "trenchless" methods, various pipe materials were evaluated.

1.7.1 Vitrified Clay Pipe

Vitrified Clay Pipe (VCP) is the industry standard for gravity sewers. VCP is the only piping material exclusively designed to convey the full range of materials that a community or industry may discharge into it. It will not rust, shrink, elongate, bend, deflect, erode, oxidize or deteriorate. Several factors have made VCP the optimum pipe material for a gravity sewer:

- Life expectancy: over 100 years of proven performance.
- Chemically inert: resistant to internal and external attack from solvents, acids, alkalis, gases, etc.
- Flow characteristics: low friction coefficient.
- Structural integrity: inherent load bearing capacity.
- Joint tightness: resistant to root penetration and leakage.
- Abrasion resistance: exceptional resistance to abrasion and scour.
- Availability: available in a full range of sizes, fittings and adapters.
- Handling: easy to handle and install.
- Economics: best total value considering cost of material, installation, maintenance and useful life.

In microtunneling a sewer line, the most commonly used pipe is VCP. The clay pipe industry has developed a proven design for VCP that includes a special stainless steel joint sleeve configuration that provides a smooth single dimension outside diameter. VCP can be used in deep installations (excess of 100 feet).

1.7.2 Reinforced Concrete Pipe

Reinforced Concrete Pipe (RCP) is best suited for storm drains, culverts, and sanitary sewers, but RCP does not do well in aggressive environments. Microtunneling is a viable application with RCP. Several characteristics have made RCP an option with any type of infrastructure:

- Design life of at least 100 years in a normal, non-aggressive installation

- Available in diameters from 12" to 144," generally delivered in 8' sections.
- Design values for Manning's "n" are recommended between 0.011 to 0.013
- Less dependent on the care, skill, and knowledge of the installer.

1.7.3 Polymer Concrete Pipe

Polymer Concrete Pipe (polycrete) is best suited for sanitary sewer or industrial sewers in a corrosive environment. Polymer concrete pipe has a higher initial cost than VCP and RCP, but has a lower Manning's "n" value enabling a smaller pipe to be used in certain applications. Characteristics of polycrete are as follows:

- Projected 100-year plus service life
- Available in diameters from 8" to 102", delivered in 8' or 10' sections
- Designed to resist pH levels from 1.0 to 10.0
- Abrasion resistant
- Manning's "n" flow coefficient of 0.009

Polycrete is not as brittle as vitrified clay pipe, and therefore, well suited for microtunneling. It can easily withstand the loads of being deep underneath the ground. Polycrete is a relatively new technology, but local agencies are beginning to use PCP for sewer projects.

1.7.4 Ductile Iron Pipe

Ductile Iron Pipe (DIP) is a strong and durable pipe. It is typically used in water applications, however it can be used for sanitary sewer. The pipe requires a cement mortar lining to prevent corrosion. Some DIP characteristics are as follows:

- Manufactured in 18 to 20-foot lengths
- Available in 3-inch to 64-inch diameter
- 100-plus year life expectancy

- Mannings "n" coefficient of n=0.011 for cement mortar lined pipe
- Various joint types

Based on the pipe material evaluation, it is recommended that the entire reach of the pipeline be constructed with extra strength VCP. VCP is recommended for the following reasons:

- Strong
- Durable
- Available
- Inexpensive
- Contractors are familiar with installing
- Smooth
- Corrosion resistant

1.8 SEISMIC DESIGN CRITERIA

Leighton Consulting, Inc. conducted a preliminary geotechnical investigation on the proposed alignment and concluded that the proposed project was feasible from a geotechnical standpoint, provided that their recommendations were incorporated into the design and construction of the pipeline.

Regarding seismically induced settlement, a potentially liquefiable soil layer was identified adjacent to the existing pump station. Estimated settlement of 3.5 inches could occur if groundwater levels rose 40 feet at the same time of a seismic event; the likelihood of this is quite low. The following three alternatives were identified in the geotechnical report:

1. Design the sewer line to allow for ½ of the total estimated settlement (approximately 2 inches of differential settlement.)
2. Completely remove the potentially liquefiable materials (a depth of 8 to 18 feet below existing ground in the vicinity of the pump station.)
3. Take no remedial action with the understanding that repair of the sewer line could be required in the event of a strong earthquake.

The project will accommodate for two inches of settlement near the Pump Station by constructing flexible joints that allow for the settlement to occur over a distance of forty (40) feet.

Conclusions and recommendations regarding other geotechnical considerations are presented below.

- Underlying subgrade soils must be prepared in such a manner that a uniform response to the applied loads is achieved.
- Onsite alluvial soil is in good working order. Oversized material was not encountered.
- Total and differential settlement will be within tolerable limits.
- All temporary excavations should be performed in accordance with project plans, specifications, and all OSHA requirements.
- Utility trenches can be backfilled with the onsite material, provided it's free of debris and/or significant organic material.
- Common Type I or II cement may be used.
- Onsite soil is considered corrosive to ferrous metals.

1.9 PRELIMINARY TABLE OF CONTENTS FOR DETAILED SPECIFICATIONS

The following is a preliminary table of contents of the specifications needed for this project, taken from the OCSD Master Specifications.

TABLE I-1

PRELIMINARY TABLE OF CONTENTS

II. ALIGNMENT STUDY

2.1 GENERAL

Over the past few years, several alignment studies have been conducted for this project. This section will discuss the previous alignments considered and the methodology for selecting the proposed alignment. This section will address the following issues:

- Traffic impacts
- Ability to access and maintain facilities
- Construction impacts on adjacent utilities
- Right-of-way, easement and/or permit requirements
- Other Agency concerns
- Excavation requirements
- Handling of existing sewage flows during construction
- Interference with public interests during construction

2.2 ALTERNATIVE ALIGNMENTS

An alternative alignment analysis is an important part of the preliminary design process. When choosing an alignment, there are several factors that make one alignment a better choice than another. Most important in any alignment is functionality. The ultimate goal of a successful design is a fully functional and low maintenance gravity sewer system. Another important consideration is cost. Staying within existing easements, using the fewest possible manholes, and maintaining an optimum depth, are all factors that affect the cost of the sewer system.

The starting and ending points of the proposed pipeline are the same throughout each alternative. The proposed pipeline will begin at the existing Pump Station and terminate with connection to the existing Carbon Canyon Interceptor, located in Rose Drive at the intersection with Vesuvius.

From the existing Pump Station, the pipeline must travel in a southerly direction. There are three boundary conditions that limit the initial direction of travel for the pipeline: a 66-inch/90-inch RCP storm drain pipeline located east of the Pump Station, a Park maintenance yard located west of the Pump Station, and a Breitburn Energy oil well located south of the Pump Station. There are three possibly routes the pipeline can take from the Pump Station:

Route 1: This alternative requires the proposed pipeline to connect to an existing manhole at the Pump Station and immediately head east to avoid the Breitburn oil well site, before turning to the south. If the pipeline were to take this route, the pipeline must cross beneath the existing 66-inch/90-inch storm drain line. By doing so, the gravity sewer line would have an immediate drop in elevation of 15-feet, which would significantly affect the slope of the pipeline throughout. The pipe would also traverse through an existing storm water retention basin.

Route 2: This alternative requires the proposed pipeline to connect to an existing manhole at the Pump Station and immediately head west to avoid the Breitburn oil well site, before turning to the south. If the pipeline were to take this route, the pipeline must be constructed through an existing park maintenance yard and at depths of 30-feet.

Route 3: This alternative requires the proposed pipeline to connect to an existing manhole at the Pump Station and head due south through the Breitburn oil well site. This alternative is the most direct and is the most favorable from an elevation stand point. It will require trenching through an existing oil well site.

Previous alignment studies considered constructing a gravity pipeline upstream of the Carbon Canyon Dam and connecting to an existing 12-inch gravity sewer pipeline that runs through the Dam. The pipeline through the Dam is owned by Texaco. However, negotiations between OCSD and Texaco did not result in an agreement for sale of the pipeline, therefore this alternative has been ruled out.

Other alignments were then evaluated to determine the best pipeline alignment while avoiding new construction through the Dam. In each alternative, the pipeline must turn to the west and traverse across the property owned by Aera Energy. There is a significant ridge-line that exists between the Park and Aera property, therefore construction of the pipeline must consider trenchless methods.

2.3 RECOMMENDED ALIGNMENT

The recommended alignment takes into consideration several factors such as functionality, construction constraints, future developments, hydraulics, and cost. Total length for the pipeline is 5,145 feet, and is shown on Exhibit 1.

The pipeline heads south from the existing Pump Station, through the Breitburn oil well site, following the alignment of the existing Texaco sewer line. After approximately 1400 feet, the pipeline heads west under the existing ridge. This portion of the pipeline will be constructed using trenchless technology; a length of approximately 1200 feet.

The trenchless portion of the pipeline will terminate on the Aera Energy property. The pipeline will then be trenched through an existing Christmas tree farm. However, Aera has plans to develop the Christmas tree farm into single-family housing, currently known as the Brea Central Development. Therefore, the pipeline is aligned such that it will be constructed beneath a future roadway (based on the most current Brea Central Development plans).

The final 300 feet of the pipeline is proposed to follow an existing access road before connecting into the Carbon Canyon Interceptor. The purpose of constructing the final 300 feet through the existing access road is to avoid construction in Rose Drive, which will require extensive traffic control, street repair and potential conflicts with the MWD 96-inch Lower Feeder.

2.4 EVALUATION CRITERIA

The functionality of the final pipeline alignment was evaluated for constructability, permitting, utility crossings, and coordination with other projects.

2.4.1 Constructability

For the first 1600 feet and the final 2345 feet, construction of the pipeline will be through standard trenching techniques in areas where only natural earth will be disturbed. The middle stretch of 1200 feet of pipe is proposed to be constructed using a microtunnelling process.

Since using the pipeline that goes through the dam has been ruled out, the only possible way to eventually reach Rose Drive through gravity flow is to tunnel through the ridge on the western side of the park. Microtunneling is accurate enough to keep our required slope until we can use standard trenching methods in the Aera Energy property. Microtunneling is a viable option and has been discussed further in Section V.

2.4.2 Permitting

Permits for the project as a whole have been discussed in Section I, but the recommended alignment connects to the OCSD trunk sewer line at the manhole located east of the intersection of Rose Drive and Vesuvius. By doing this, construction will not encroach into the City of Brea right-of-way and thus should not need an Encroachment permit from the City.

2.4.3 Utility Crossings

By connecting to the OCSD trunk sewer line at the manhole outside of the intersection at the downstream connection, the project avoids some critical utility crossings, specifically the 96-inch Metropolitan Water District Lower Feeder pipeline that runs beneath the intersection of Rose Drive and Vesuvius. Also, by not connecting in the street, the pipeline avoids City of Brea infrastructure that exists in Rose Drive.

2.4.4 Coordination With Other Projects

Adjacent to Rose Drive will be a future development known as Brea Central. Construction of this development has not begun yet, but a preliminary layout of the lots and streets has been completed. The alignment of our pipeline enters the development through an easement and follows beneath the future residential road and existing access road until it connects into the OCSD system.

INSERT EXHIBIT 1

III. HYDRAULICS

3.1 GENERAL

Potential tributary flows to the proposed pipeline were determined based on flow factors and land uses. Land uses were identified and confirmed using the most current general plans, master plans, and specific plans. Hydraulic analyses were conducted to determine pipeline diameter for the proposed project and an expanded service area alternative. Flow monitoring is currently being measured immediately upstream of the Pump Station. Flow monitoring results will be used to verify hydraulic calculations in this report and during the final design phase.

3.2 LAND USE

The tributary boundary for the sewer was determined after a Geographic Information System analysis of the ridgelines for the area. The area tributary to the existing Pump Station encompasses area outside of the Orange County boundary. Acreages and land uses were determined using the most current information available, such as general plans, master plans, and specific plans. RBF also consulted with local property owners, land developers, City and County staff to confirm the information provided. A summary of the land uses within the tributary area within Orange County is listed in Table III-1.

Table III-1

TRIBUTARY AREA AND LAND USES

Development Name	Land Use (P) = Proposed	Area (ac)
Olinda Alpha Landfill	Institutional	562
Olinda Heights	Estate	284
Olinda Village	Low Density Res.	96
Hollydale Mobile Home Park	Medium Density Res.	53
Canyon Crest	Estate (P)	368
Carbon Canyon	Estate (P)	1,240
Unincorporated	Estate (P)	1,470
Unincorporated	Estate (P)	810
Chino Hills State Park	Open Space	2,290
Brea Central	Low Density Res. (P)	43
Aera Oil Fields	Estate	130
Aera Master Planned Community in Orange County	Estate (P)	321
Tonner Hills	Estate (P)	800
Carbon Canyon Park and Dam	Open Space	124
Total within Orange County		**8,591**

3.3 WASTEWATER GENERATION

Wastewater generation factors used in this report were taken from Table 3-6 of the 1999 OCSD Strategic Plan. An extensive analysis was conducted by OCSD comparing different generation factors with actual monitored flows. Generation factors used in this report represent an appropriate level of planning conservatism for future growth and closely match actual field measurements. A peaking factor of 2.0 was for this analysis as identified in the OCSD Design Guidelines.

The Strategic Plan also conducted an extensive analysis of inflow and infiltration (I&I) into the sewer system. OCSD's system wide I&I factors generally fell in the range of 0.7-1.0%. For the purposes of this report, an I&I factor of 1.0% was assumed. A summary of the detailed flow projections is shown in Table III-2.

Table III-2
PROJECTED WASTEWATER GENERATION

Development Name	Land Use (P) = Proposed	Area (ac)	Wastewater Generation Factor [1] (gpd/ac)	Average Flow (MGD)	Peak Dry-Weather Flow [2] (MGD)	Peak Wet-Weather Flow [3] (MGD)
Olinda Alpha Landfill	Institutional	562	2,715	1.53	3.05	3.08
Olinda Heights	Estate	284	727	0.21	0.41	0.42
Olinda Village	Low Density Res.	96	1,488	0.14	0.29	0.29
Hollydale Mobile Home Park	Medium Density Res.	53	3,451	0.18	0.37	0.37
Canyon Crest	Estate (P)	368	727	0.27	0.54	0.54
Carbon Canyon	Estate (P)	1,240	727	0.90	1.80	1.82
Unincorporated	Estate (P)	1,470	727	1.07	2.14	2.16
Unincorporated	Estate (P)	810	727	0.59	1.18	1.19
Chino Hills State Park	Open Space	2,290	129	0.30	0.59	0.60
Brea Central	Low Density Res. (P)	43	1,488	0.06	0.13	0.13
Aera Oil Fields	Estate	130	727	0.09	0.19	0.19
Aera Master Planned Community in Orange County	Estate (P)	321	727	0.23	0.47	0.47
Tonner Hills	Estate (P)	800	727	0.58	1.16	1.17
Carbon Canyon Park and Dam	Open Space	124	129	0.02	0.03	0.03
Totals		**8,591**		**6.17**	**12.34**	***12.46***

[1] Per Table 3-6 of 1999 OCSD Strategic Plan (Vol. 3)
[2] Peaking factor = 2.0
[3] I&I Factor of 1% per OCSD Strategic Plan Section 5.4.3.1

The peak wet-weather flow expected to impact the proposed pipeline is approximately 12.46 MGD (8,653 gpm).

3.4 PIPELINING SIZING AND CAPACITY

Calculations for sizing the pipeline and determining capacity were conducted using Manning's Equation. Manning's Equation requires values of slope, roughness of the pipe (n), flow, and depth to diameter ratio (d/D) to accurately size a pipeline.