Irvine Ranch Water District
Sewer System Management Plan

Appendices

June 2013

Preparation Supported By:

APPENDIX LIST

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APPENDIX A1

State Water Resources Control Board Order No. 2006-0003 Statewide General Waste Discharge Requirements for Sanitary Sewer Systems, California State Water Resources Control Board, May 2, 2006

STATE WATER RESOURCES CONTROL BOARD
ORDER NO. 2006-0003

STATEWIDE GENERAL WASTE DISCHARGE REQUIREMENTS
FOR
SANITARY SEWER SYSTEMS

The State Water Resources Control Board, hereinafter referred to as "State Water Board", finds that:

1. All federal and state agencies, municipalities, counties, districts, and other public entities that own or operate sanitary sewer systems greater than one mile in length that collect and/or convey untreated or partially treated wastewater to a publicly owned treatment facility in the State of California are required to comply with the terms of this Order. Such entities are hereinafter referred to as "Enrollees".

2. Sanitary sewer overflows (SSOs) are overflows from sanitary sewer systems of domestic wastewater, as well as industrial and commercial wastewater, depending on the pattern of land uses in the area served by the sanitary sewer system. SSOs often contain high levels of suspended solids, pathogenic organisms, toxic pollutants, nutrients, oxygen-demanding organic compounds, oil and grease and other pollutants. SSOs may cause a public nuisance, particularly when raw untreated wastewater is discharged to areas with high public exposure, such as streets or surface waters used for drinking, fishing, or body contact recreation. SSOs may pollute surface or ground waters, threaten public health, adversely affect aquatic life, and impair the recreational use and aesthetic enjoyment of surface waters.

3. Sanitary sewer systems experience periodic failures resulting in discharges that may affect waters of the state. There are many factors (including factors related to geology, design, construction methods and materials, age of the system, population growth, and system operation and maintenance), which affect the likelihood of an SSO. A proactive approach that requires Enrollees to ensure a system-wide operation, maintenance, and management plan is in place will reduce the number and frequency of SSOs within the state. This approach will in turn decrease the risk to human health and the environment caused by SSOs.

4. Major causes of SSOs include: grease blockages, root blockages, sewer line flood damage, manhole structure failures, vandalism, pump station mechanical failures, power outages, excessive storm or ground water inflow/infiltration, debris blockages, sanitary sewer system age and construction material failures, lack of proper operation and maintenance, insufficient capacity and contractor-caused damages. Many SSOs are preventable with adequate and appropriate facilities, source control measures and operation and maintenance of the sanitary sewer system.

SEWER SYSTEM MANAGEMENT PLANS

5. To facilitate proper funding and management of sanitary sewer systems, each Enrollee must develop and implement a system-specific Sewer System Management Plan (SSMP). To be effective, SSMPs must include provisions to provide proper and efficient management, operation, and maintenance of sanitary sewer systems, while taking into consideration risk management and cost benefit analysis. Additionally, an SSMP must contain a spill response plan that establishes standard procedures for immediate response to an SSO in a manner designed to minimize water quality impacts and potential nuisance conditions.

6. Many local public agencies in California have already developed SSMPs and implemented measures to reduce SSOs. These entities can build upon their existing efforts to establish a comprehensive SSMP consistent with this Order. Others, however, still require technical assistance and, in some cases, funding to improve sanitary sewer system operation and maintenance in order to reduce SSOs.

7. SSMP certification by technically qualified and experienced persons can provide a useful and cost-effective means for ensuring that SSMPs are developed and implemented appropriately.

8. It is the State Water Board's intent to gather additional information on the causes and sources of SSOs to augment existing information and to determine the full extent of SSOs and consequent public health and/or environmental impacts occurring in the State.

9. Both uniform SSO reporting and a centralized statewide electronic database are needed to collect information to allow the State Water Board and Regional Water Quality Control Boards (Regional Water Boards) to effectively analyze the extent of SSOs statewide and their potential impacts on beneficial uses and public health. The monitoring and reporting program required by this Order and the attached **Monitoring and Reporting Program No. 2006-0003**, are necessary to assure compliance with these waste discharge requirements (WDRs).

10. Information regarding SSOs must be provided to Regional Water Boards and other regulatory agencies in a timely manner and be made available to the public in a complete, concise, and timely fashion.

11. Some Regional Water Boards have issued WDRs or WDRs that serve as National Pollution Discharge Elimination System (NPDES) permits to sanitary sewer system owners/operators within their jurisdictions. This Order establishes minimum requirements to prevent SSOs. Although it is the State Water Board's intent that this Order be the primary regulatory mechanism for sanitary sewer systems statewide, Regional Water Boards may issue more stringent or more

prescriptive WDRs for sanitary sewer systems. Upon issuance or reissuance of a Regional Water Board's WDRs for a system subject to this Order, the Regional Water Board shall coordinate its requirements with stated requirements within this Order, to identify requirements that are more stringent, to remove requirements that are less stringent than this Order, and to provide consistency in reporting.

REGULATORY CONSIDERATIONS

12. California Water Code section 13263 provides that the State Water Board may prescribe general WDRs for a category of discharges if the State Water Board finds or determines that:

- The discharges are produced by the same or similar operations;
- The discharges involve the same or similar types of waste;
- The discharges require the same or similar treatment standards; and
- The discharges are more appropriately regulated under general discharge requirements than individual discharge requirements.

This Order establishes requirements for a class of operations, facilities, and discharges that are similar throughout the state.

13. The issuance of general WDRs to the Enrollees will:
    a) Reduce the administrative burden of issuing individual WDRs to each Enrollee;
    b) Provide for a unified statewide approach for the reporting and database tracking of SSOs;
    c) Establish consistent and uniform requirements for SSMP development and implementation;
    d) Provide statewide consistency in reporting; and
    e) Facilitate consistent enforcement for violations.

14. The beneficial uses of surface waters that can be impaired by SSOs include, but are not limited to, aquatic life, drinking water supply, body contact and non-contact recreation, and aesthetics. The beneficial uses of ground water that can be impaired include, but are not limited to, drinking water and agricultural supply. Surface and ground waters throughout the state support these uses to varying degrees.

15. The implementation of requirements set forth in this Order will ensure the reasonable protection of past, present, and probable future beneficial uses of water and the prevention of nuisance. The requirements implement the water quality control plans (Basin Plans) for each region and take into account the environmental characteristics of hydrographic units within the state. Additionally, the State Water Board has considered water quality conditions that could reasonably be achieved through the coordinated control of all factors that affect

water quality in the area, costs associated with compliance with these requirements, the need for developing housing within California, and the need to develop and use recycled water.

16. The Federal Clean Water Act largely prohibits any discharge of pollutants from a point source to waters of the United States except as authorized under an NPDES permit. In general, any point source discharge of sewage effluent to waters of the United States must comply with technology-based, secondary treatment standards, at a minimum, and any more stringent requirements necessary to meet applicable water quality standards and other requirements. Hence, the unpermitted discharge of wastewater from a sanitary sewer system to waters of the United States is illegal under the Clean Water Act. In addition, many Basin Plans adopted by the Regional Water Boards contain discharge prohibitions that apply to the discharge of untreated or partially treated wastewater. Finally, the California Water Code generally prohibits the discharge of waste to land prior to the filing of any required report of waste discharge and the subsequent issuance of either WDRs or a waiver of WDRs.

17. California Water Code section 13263 requires a water board to, after any necessary hearing, prescribe requirements as to the nature of any proposed discharge, existing discharge, or material change in an existing discharge. The requirements shall, among other things, take into consideration the need to prevent nuisance.

18. California Water Code section 13050, subdivision (m), defines nuisance as anything which meets all of the following requirements:
    a. Is injurious to health, or is indecent or offensive to the senses, or an obstruction to the free use of property, so as to interfere with the comfortable enjoyment of life or property.
    b. Affects at the same time an entire community or neighborhood, or any considerable number of persons, although the extent of the annoyance or damage inflicted upon individuals may be unequal.
    c. Occurs during, or as a result of, the treatment or disposal of wastes.

19. This Order is consistent with State Water Board Resolution No. 68-16 (Statement of Policy with Respect to Maintaining High Quality of Waters in California) in that the Order imposes conditions to prevent impacts to water quality, does not allow the degradation of water quality, will not unreasonably affect beneficial uses of water, and will not result in water quality less than prescribed in State Water Board or Regional Water Board plans and policies.

20. The action to adopt this General Order is exempt from the California Environmental Quality Act (Public Resources Code §21000 et seq.) because it is an action taken by a regulatory agency to assure the protection of the environment and the regulatory process involves procedures for protection of the environment. (Cal. Code Regs., tit. 14, §15308). In addition, the action to adopt

this Order is exempt from CEQA pursuant to Cal.Code Regs., title 14, §15301 to the extent that it applies to existing sanitary sewer collection systems that constitute "existing facilities" as that term is used in Section 15301, and §15302, to the extent that it results in the repair or replacement of existing systems involving negligible or no expansion of capacity.

21. The Fact Sheet, which is incorporated by reference in the Order, contains supplemental information that was also considered in establishing these requirements.

22. The State Water Board has notified all affected public agencies and all known interested persons of the intent to prescribe general WDRs that require Enrollees to develop SSMPs and to report all SSOs.

23. The State Water Board conducted a public hearing on February 8, 2006, to receive oral and written comments on the draft order. The State Water Board received and considered, at its May 2, 2006, meeting, additional public comments on substantial changes made to the proposed general WDRs following the February 8, 2006, public hearing. The State Water Board has considered all comments pertaining to the proposed general WDRs.

IT IS HEREBY ORDERED, that pursuant to California Water Code section 13263, the Enrollees, their agents, successors, and assigns, in order to meet the provisions contained in Division 7 of the California Water Code and regulations adopted hereunder, shall comply with the following:

A. DEFINITIONS

1. **Sanitary sewer overflow (SSO)** - Any overflow, spill, release, discharge or diversion of untreated or partially treated wastewater from a sanitary sewer system. SSOs include:
   (i) Overflows or releases of untreated or partially treated wastewater that reach waters of the United States;
   (ii) Overflows or releases of untreated or partially treated wastewater that do not reach waters of the United States; and
   (iii) Wastewater backups into buildings and on private property that are caused by blockages or flow conditions within the publicly owned portion of a sanitary sewer system.

2. **Sanitary sewer system** – Any system of pipes, pump stations, sewer lines, or other conveyances, upstream of a wastewater treatment plant headworks used to collect and convey wastewater to the publicly owned treatment facility. Temporary storage and conveyance facilities (such as vaults, temporary piping, construction trenches, wet wells, impoundments, tanks, etc.) are considered to be part of the sanitary sewer system, and discharges into these temporary storage facilities are not considered to be SSOs.

For purposes of this Order, sanitary sewer systems include only those systems owned by public agencies that are comprised of more than one mile of pipes or sewer lines.

3. **Enrollee** - A federal or state agency, municipality, county, district, and other public entity that owns or operates a sanitary sewer system, as defined in the general WDRs, and that has submitted a complete and approved application for coverage under this Order.

4. **SSO Reporting System** – Online spill reporting system that is hosted, controlled, and maintained by the State Water Board. The web address for this site is http://ciwqs.waterboards.ca.gov. This online database is maintained on a secure site and is controlled by unique usernames and passwords.

5. **Untreated or partially treated wastewater** – Any volume of waste discharged from the sanitary sewer system upstream of a wastewater treatment plant headworks.

6. **Satellite collection system** – The portion, if any, of a sanitary sewer system owned or operated by a different public agency than the agency that owns and operates the wastewater treatment facility to which the sanitary sewer system is tributary.

7. **Nuisance** - California Water Code section 13050, subdivision (m), defines nuisance as anything which meets all of the following requirements:
   a. Is injurious to health, or is indecent or offensive to the senses, or an obstruction to the free use of property, so as to interfere with the comfortable enjoyment of life or property.
   b. Affects at the same time an entire community or neighborhood, or any considerable number of persons, although the extent of the annoyance or damage inflicted upon individuals may be unequal.
   c. Occurs during, or as a result of, the treatment or disposal of wastes.

B. APPLICATION REQUIREMENTS

1. Deadlines for Application – All public agencies that currently own or operate sanitary sewer systems within the State of California must apply for coverage under the general WDRs within six (6) months of the date of adoption of the general WDRs. Additionally, public agencies that acquire or assume responsibility for operating sanitary sewer systems after the date of adoption of this Order must apply for coverage under the general WDRs at least three (3) months prior to operation of those facilities.

2. Applications under the general WDRs – In order to apply for coverage pursuant to the general WDRs, a legally authorized representative for each agency must submit a complete application package. Within sixty (60) days of adoption of the general WDRs, State Water Board staff will send specific instructions on how to

apply for coverage under the general WDRs to all known public agencies that own sanitary sewer systems. Agencies that do not receive notice may obtain applications and instructions online on the Water Board's website.

3. Coverage under the general WDRs – Permit coverage will be in effect once a complete application package has been submitted and approved by the State Water Board's Division of Water Quality.

C. PROHIBITIONS

1. Any SSO that results in a discharge of untreated or partially treated wastewater to waters of the United States is prohibited.

2. Any SSO that results in a discharge of untreated or partially treated wastewater that creates a nuisance as defined in California Water Code Section 13050(m) is prohibited.

D. PROVISIONS

1. The Enrollee must comply with all conditions of this Order. Any noncompliance with this Order constitutes a violation of the California Water Code and is grounds for enforcement action.

2. It is the intent of the State Water Board that sanitary sewer systems be regulated in a manner consistent with the general WDRs. Nothing in the general WDRs shall be:

   (i) Interpreted or applied in a manner inconsistent with the Federal Clean Water Act, or supersede a more specific or more stringent state or federal requirement in an existing permit, regulation, or administrative/judicial order or Consent Decree;
   (ii) Interpreted or applied to authorize an SSO that is illegal under either the Clean Water Act, an applicable Basin Plan prohibition or water quality standard, or the California Water Code;
   (iii) Interpreted or applied to prohibit a Regional Water Board from issuing an individual NPDES permit or WDR, superseding this general WDR, for a sanitary sewer system, authorized under the Clean Water Act or California Water Code; or
   (iv) Interpreted or applied to supersede any more specific or more stringent WDRs or enforcement order issued by a Regional Water Board.

3. The Enrollee shall take all feasible steps to eliminate SSOs. In the event that an SSO does occur, the Enrollee shall take all feasible steps to contain and mitigate the impacts of an SSO.

4. In the event of an SSO, the Enrollee shall take all feasible steps to prevent untreated or partially treated wastewater from discharging from storm drains into

flood control channels or waters of the United States by blocking the storm drainage system and by removing the wastewater from the storm drains.

5. All SSOs must be reported in accordance with Section G of the general WDRs.

6. In any enforcement action, the State and/or Regional Water Boards will consider the appropriate factors under the duly adopted State Water Board Enforcement Policy. And, consistent with the Enforcement Policy, the State and/or Regional Water Boards must consider the Enrollee's efforts to contain, control, and mitigate SSOs when considering the California Water Code Section 13327 factors. In assessing these factors, the State and/or Regional Water Boards will also consider whether:

   (i) The Enrollee has complied with the requirements of this Order, including requirements for reporting and developing and implementing a SSMP;

   (ii) The Enrollee can identify the cause or likely cause of the discharge event;

   (iii) There were no feasible alternatives to the discharge, such as temporary storage or retention of untreated wastewater, reduction of inflow and infiltration, use of adequate backup equipment, collecting and hauling of untreated wastewater to a treatment facility, or an increase in the capacity of the system as necessary to contain the design storm event identified in the SSMP. It is inappropriate to consider the lack of feasible alternatives, if the Enrollee does not implement a periodic or continuing process to identify and correct problems.

   (iv) The discharge was exceptional, unintentional, temporary, and caused by factors beyond the reasonable control of the Enrollee;

   (v) The discharge could have been prevented by the exercise of reasonable control described in a certified SSMP for:
   - Proper management, operation and maintenance;
   - Adequate treatment facilities, sanitary sewer system facilities, and/or components with an appropriate design capacity, to reasonably prevent SSOs (e.g., adequately enlarging treatment or collection facilities to accommodate growth, infiltration and inflow (I/I), etc.);
   - Preventive maintenance (including cleaning and fats, oils, and grease (FOG) control);
   - Installation of adequate backup equipment; and
   - Inflow and infiltration prevention and control to the extent practicable.

   (vi) The sanitary sewer system design capacity is appropriate to reasonably prevent SSOs.

(vii) The Enrollee took all reasonable steps to stop and mitigate the impact of the discharge as soon as possible.

7. When a sanitary sewer overflow occurs, the Enrollee shall take all feasible steps and necessary remedial actions to 1) control or limit the volume of untreated or partially treated wastewater discharged, 2) terminate the discharge, and 3) recover as much of the wastewater discharged as possible for proper disposal, including any wash down water.

   The Enrollee shall implement all remedial actions to the extent they may be applicable to the discharge and not inconsistent with an emergency response plan, including the following:

   (i) Interception and rerouting of untreated or partially treated wastewater flows around the wastewater line failure;
   (ii) Vacuum truck recovery of sanitary sewer overflows and wash down water;
   (iii) Cleanup of debris at the overflow site;
   (iv) System modifications to prevent another SSO at the same location;
   (v) Adequate sampling to determine the nature and impact of the release; and
   (vi) Adequate public notification to protect the public from exposure to the SSO.

8. The Enrollee shall properly, manage, operate, and maintain all parts of the sanitary sewer system owned or operated by the Enrollee, and shall ensure that the system operators (including employees, contractors, or other agents) are adequately trained and possess adequate knowledge, skills, and abilities.

9. The Enrollee shall allocate adequate resources for the operation, maintenance, and repair of its sanitary sewer system, by establishing a proper rate structure, accounting mechanisms, and auditing procedures to ensure an adequate measure of revenues and expenditures. These procedures must be in compliance with applicable laws and regulations and comply with generally acceptable accounting practices.

10. The Enrollee shall provide adequate capacity to convey base flows and peak flows, including flows related to wet weather events. Capacity shall meet or exceed the design criteria as defined in the Enrollee's System Evaluation and Capacity Assurance Plan for all parts of the sanitary sewer system owned or operated by the Enrollee.

11. The Enrollee shall develop and implement a written Sewer System Management Plan (SSMP) and make it available to the State and/or Regional Water Board upon request. A copy of this document must be publicly available at the Enrollee's office and/or available on the Internet. This SSMP must be approved by the Enrollee's governing board at a public meeting.

12. In accordance with the California Business and Professions Code sections 6735, 7835, and 7835.1, all engineering and geologic evaluations and judgments shall be performed by or under the direction of registered professionals competent and proficient in the fields pertinent to the required activities. Specific elements of the SSMP that require professional evaluation and judgments shall be prepared by or under the direction of appropriately qualified professionals, and shall bear the professional(s)' signature and stamp.

13. The mandatory elements of the SSMP are specified below. However, if the Enrollee believes that any element of this section is not appropriate or applicable to the Enrollee's sanitary sewer system, the SSMP program does not need to address that element. The Enrollee must justify why that element is not applicable. The SSMP must be approved by the deadlines listed in the SSMP Time Schedule below.

Sewer System Management Plan (SSMP)

(i) **Goal**: The goal of the SSMP is to provide a plan and schedule to properly manage, operate, and maintain all parts of the sanitary sewer system. This will help reduce and prevent SSOs, as well as mitigate any SSOs that do occur.

(ii) **Organization**: The SSMP must identify:

(a) The name of the responsible or authorized representative as described in Section J of this Order.

(b) The names and telephone numbers for management, administrative, and maintenance positions responsible for implementing specific measures in the SSMP program. The SSMP must identify lines of authority through an organization chart or similar document with a narrative explanation; and

(c) The chain of communication for reporting SSOs, from receipt of a complaint or other information, including the person responsible for reporting SSOs to the State and Regional Water Board and other agencies if applicable (such as County Health Officer, County Environmental Health Agency, Regional Water Board, and/or State Office of Emergency Services (OES)).

(iii) **Legal Authority:** Each Enrollee must demonstrate, through sanitary sewer system use ordinances, service agreements, or other legally binding procedures, that it possesses the necessary legal authority to:

(a) Prevent illicit discharges into its sanitary sewer system (examples may include I/I, stormwater, chemical dumping, unauthorized debris and cut roots, etc.);

(b) Require that sewers and connections be properly designed and constructed;

(c) Ensure access for maintenance, inspection, or repairs for portions of the lateral owned or maintained by the Public Agency;

(d) Limit the discharge of fats, oils, and grease and other debris that may cause blockages, and

(e) Enforce any violation of its sewer ordinances.

(iv) **Operation and Maintenance Program**. The SSMP must include those elements listed below that are appropriate and applicable to the Enrollee's system:

(a) Maintain an up-to-date map of the sanitary sewer system, showing all gravity line segments and manholes, pumping facilities, pressure pipes and valves, and applicable stormwater conveyance facilities;

(b) Describe routine preventive operation and maintenance activities by staff and contractors, including a system for scheduling regular maintenance and cleaning of the sanitary sewer system with more frequent cleaning and maintenance targeted at known problem areas. The Preventative Maintenance (PM) program should have a system to document scheduled and conducted activities, such as work orders;

(c) Develop a rehabilitation and replacement plan to identify and prioritize system deficiencies and implement short-term and long-term rehabilitation actions to address each deficiency. The program should include regular visual and TV inspections of manholes and sewer pipes, and a system for ranking the condition of sewer pipes and scheduling rehabilitation. Rehabilitation and replacement should focus on sewer pipes that are at risk of collapse or prone to more frequent blockages due to pipe defects. Finally, the rehabilitation and replacement plan should include a capital improvement plan that addresses proper management and protection of the infrastructure assets. The plan shall include a time schedule for implementing the short- and long-term plans plus a schedule for developing the funds needed for the capital improvement plan;

(d) Provide training on a regular basis for staff in sanitary sewer system operations and maintenance, and require contractors to be appropriately trained; and

(e) Provide equipment and replacement part inventories, including identification of critical replacement parts.

(v) **Design and Performance Provisions**:

(a) Design and construction standards and specifications for the installation of new sanitary sewer systems, pump stations and other appurtenances; and for the rehabilitation and repair of existing sanitary sewer systems; and

(b) Procedures and standards for inspecting and testing the installation of new sewers, pumps, and other appurtenances and for rehabilitation and repair projects.

(vi) **Overflow Emergency Response Plan -** Each Enrollee shall develop and implement an overflow emergency response plan that identifies measures to protect public health and the environment. At a minimum, this plan must include the following:

(a) Proper notification procedures so that the primary responders and regulatory agencies are informed of all SSOs in a timely manner;

(b) A program to ensure an appropriate response to all overflows;

(c) Procedures to ensure prompt notification to appropriate regulatory agencies and other potentially affected entities (e.g. health agencies, Regional Water Boards, water suppliers, etc.) of all SSOs that potentially affect public health or reach the waters of the State in accordance with the MRP. All SSOs shall be reported in accordance with this MRP, the California Water Code, other State Law, and other applicable Regional Water Board WDRs or NPDES permit requirements. The SSMP should identify the officials who will receive immediate notification;

(d) Procedures to ensure that appropriate staff and contractor personnel are aware of and follow the Emergency Response Plan and are appropriately trained;

(e) Procedures to address emergency operations, such as traffic and crowd control and other necessary response activities; and

(f) A program to ensure that all reasonable steps are taken to contain and prevent the discharge of untreated and partially treated wastewater to waters of the United States and to minimize or correct any adverse impact on the environment resulting from the SSOs, including such accelerated or additional monitoring as may be necessary to determine the nature and impact of the discharge.

(vii) **FOG Control Program:** Each Enrollee shall evaluate its service area to determine whether a FOG control program is needed. If an Enrollee determines that a FOG program is not needed, the Enrollee must provide justification for why it is not needed. If FOG is found to be a problem, the Enrollee must prepare and implement a FOG source control program to reduce the amount of these substances discharged to the sanitary sewer system. This plan shall include the following as appropriate:

(a) An implementation plan and schedule for a public education outreach program that promotes proper disposal of FOG;

(b) A plan and schedule for the disposal of FOG generated within the sanitary sewer system service area. This may include a list of acceptable disposal facilities and/or additional facilities needed to adequately dispose of FOG generated within a sanitary sewer system service area;

(c) The legal authority to prohibit discharges to the system and identify measures to prevent SSOs and blockages caused by FOG;

(d) Requirements to install grease removal devices (such as traps or interceptors), design standards for the removal devices, maintenance requirements, BMP requirements, record keeping and reporting requirements;

(e) Authority to inspect grease producing facilities, enforcement authorities, and whether the Enrollee has sufficient staff to inspect and enforce the FOG ordinance;

(f) An identification of sanitary sewer system sections subject to FOG blockages and establishment of a cleaning maintenance schedule for each section; and

(g) Development and implementation of source control measures for all sources of FOG discharged to the sanitary sewer system for each section identified in (f) above.

(viii) **System Evaluation and Capacity Assurance Plan**: The Enrollee shall prepare and implement a capital improvement plan (CIP) that will provide hydraulic capacity of key sanitary sewer system elements for dry weather peak flow conditions, as well as the appropriate design storm or wet weather event. At a minimum, the plan must include:

(a) **Evaluation**: Actions needed to evaluate those portions of the sanitary sewer system that are experiencing or contributing to an SSO discharge caused by hydraulic deficiency. The evaluation must provide estimates of peak flows (including flows from SSOs that escape from the system) associated with conditions similar to those causing overflow events, estimates of the capacity of key system components, hydraulic deficiencies (including components of the system with limiting capacity) and the major sources that contribute to the peak flows associated with overflow events;

(b) **Design Criteria:** Where design criteria do not exist or are deficient, undertake the evaluation identified in (a) above to establish appropriate design criteria; and

(c) **Capacity Enhancement Measures:** The steps needed to establish a short- and long-term CIP to address identified hydraulic deficiencies, including prioritization, alternatives analysis, and schedules. The CIP may include increases in pipe size, I/I reduction programs, increases and redundancy in pumping capacity, and storage facilities. The CIP shall include an implementation schedule and shall identify sources of funding.

(d) **Schedule:** The Enrollee shall develop a schedule of completion dates for all portions of the capital improvement program developed in (a)-(c) above. This schedule shall be reviewed and updated consistent with the SSMP review and update requirements as described in Section D. 14.

(ix) **Monitoring, Measurement, and Program Modifications:** The Enrollee shall:

(a) Maintain relevant information that can be used to establish and prioritize appropriate SSMP activities;

(b) Monitor the implementation and, where appropriate, measure the effectiveness of each element of the SSMP;

(c) Assess the success of the preventative maintenance program;

(d) Update program elements, as appropriate, based on monitoring or performance evaluations; and

(e) Identify and illustrate SSO trends, including: frequency, location, and volume.

(x) **SSMP Program Audits** - As part of the SSMP, the Enrollee shall conduct periodic internal audits, appropriate to the size of the system and the number of SSOs. At a minimum, these audits must occur every two years and a report must be prepared and kept on file. This audit shall focus on evaluating the effectiveness of the SSMP and the

Enrollee's compliance with the SSMP requirements identified in this subsection (D.13), including identification of any deficiencies in the SSMP and steps to correct them.

(xi) **Communication Program** – The Enrollee shall communicate on a regular basis with the public on the development, implementation, and performance of its SSMP. The communication system shall provide the public the opportunity to provide input to the Enrollee as the program is developed and implemented.

The Enrollee shall also create a plan of communication with systems that are tributary and/or satellite to the Enrollee's sanitary sewer system.

14. Both the SSMP and the Enrollee's program to implement the SSMP must be certified by the Enrollee to be in compliance with the requirements set forth above and must be presented to the Enrollee's governing board for approval at a public meeting. The Enrollee shall certify that the SSMP, and subparts thereof, are in compliance with the general WDRs within the time frames identified in the time schedule provided in subsection D.15, below.

    In order to complete this certification, the Enrollee's authorized representative must complete the certification portion in the Online SSO Database Questionnaire by checking the appropriate milestone box, printing and signing the automated form, and sending the form to:

    State Water Resources Control Board
    Division of Water Quality
    Attn: SSO Program Manager
    P.O. Box 100
    Sacramento, CA 95812

    The SSMP must be updated every five (5) years, and must include any significant program changes. Re-certification by the governing board of the Enrollee is required in accordance with D.14 when significant updates to the SSMP are made. To complete the re-certification process, the Enrollee shall enter the data in the Online SSO Database and mail the form to the State Water Board, as described above.

15. The Enrollee shall comply with these requirements according to the following schedule. This time schedule does not supersede existing requirements or time schedules associated with other permits or regulatory requirements.

Sewer System Management Plan Time Schedule

<table>
<tr><td><u>Task and
Associated Section</u></td><td colspan="4">Completion Date</td></tr>
<tr><td></td><td>Population > 100,000</td><td>Population between 100,000 and 10,000</td><td>Population between 10,000 and 2,500</td><td>Population < 2,500</td></tr>
<tr><td>Application for Permit Coverage
Section C</td><td colspan="4">6 months after WDRs Adoption</td></tr>
<tr><td>Reporting Program
Section G</td><td colspan="4">6 months after WDRs Adoption[1]</td></tr>
<tr><td>SSMP Development Plan and Schedule
No specific Section</td><td>9 months after WDRs Adoption[2]</td><td>12 months after WDRs Adoption[2]</td><td>15 months after WDRs Adoption[2]</td><td>18 months after WDRs Adoption[2]</td></tr>
<tr><td>Goals and Organization Structure
Section D 13 (i) & (ii)</td><td colspan="2">12 months after WDRs Adoption[2]</td><td colspan="2">18 months after WDRs Adoption[2]</td></tr>
<tr><td>Overflow Emergency Response Program
Section D 13 (vi)</td><td rowspan="4">24 months after WDRs Adoption[2]</td><td rowspan="4">30 months after WDRs Adoption[2]</td><td rowspan="4">36 months after WDRs Adoption[2]</td><td rowspan="4">39 months after WDRs Adoption[2]</td></tr>
<tr><td>Legal Authority
Section D 13 (iii)</td></tr>
<tr><td>Operation and Maintenance Program
Section D 13 (iv)</td></tr>
<tr><td>Grease Control Program
Section D 13 (vii)</td></tr>
<tr><td>Design and Performance
Section D 13 (v)</td><td rowspan="3">36 months after WDRs Adoption</td><td rowspan="3">39 months after WDRs Adoption</td><td rowspan="3">48 months after WDRs Adoption</td><td rowspan="3">51 months after WDRs Adoption</td></tr>
<tr><td>System Evaluation and Capacity Assurance Plan
Section D 13 (viii)</td></tr>
<tr><td>Final SSMP, incorporating all of the SSMP requirements
Section D 13</td></tr>
</table>

1. In the event that by July 1, 2006 the Executive Director is able to execute a memorandum of agreement (MOA) with the California Water Environment Association (CWEA) or discharger representatives outlining a strategy and time schedule for CWEA or another entity to provide statewide training on the adopted monitoring program, SSO database electronic reporting, and SSMP development, consistent with this Order, then the schedule of Reporting Program Section G shall be replaced with the following schedule:

Reporting Program ***Section G***	
Regional Boards 4, 8, and 9	8 months after WDRs Adoption
Regional Boards 1, 2, and 3	12 months after WDRs Adoption
Regional Boards 5, 6, and 7	16 months after WDRs Adoption

If this MOU is not executed by July 1, 2006, the reporting program time schedule will remain six (6) months for all regions and agency size categories.

2. In the event that the Executive Director executes the MOA identified in note 1 by July 1, 2006, then the deadline for this task shall be extended by six (6) months. The time schedule identified in the MOA must be consistent with the extended time schedule provided by this note. If the MOA is not executed by July 1, 2006, the six (6) month time extension will not be granted.

E. WDRs and SSMP AVAILABILITY

1. A copy of the general WDRs and the certified SSMP shall be maintained at appropriate locations (such as the Enrollee’s offices, facilities, and/or Internet homepage) and shall be available to sanitary sewer system operating and maintenance personnel at all times.

F. ENTRY AND INSPECTION

1. The Enrollee shall allow the State or Regional Water Boards or their authorized representative, upon presentation of credentials and other documents as may be required by law, to:

    a. Enter upon the Enrollee’s premises where a regulated facility or activity is located or conducted, or where records are kept under the conditions of this Order;

    b. Have access to and copy, at reasonable times, any records that must be kept under the conditions of this Order;

c. Inspect at reasonable times any facilities, equipment (including monitoring and control equipment), practices, or operations regulated or required under this Order; and

d. Sample or monitor at reasonable times, for the purposes of assuring compliance with this Order or as otherwise authorized by the California Water Code, any substances or parameters at any location.

G. GENERAL MONITORING AND REPORTING REQUIREMENTS

1. The Enrollee shall furnish to the State or Regional Water Board, within a reasonable time, any information that the State or Regional Water Board may request to determine whether cause exists for modifying, revoking and reissuing, or terminating this Order. The Enrollee shall also furnish to the Executive Director of the State Water Board or Executive Officer of the applicable Regional Water Board, upon request, copies of records required to be kept by this Order.

2. The Enrollee shall comply with the attached Monitoring and Reporting Program No. 2006-0003 and future revisions thereto, as specified by the Executive Director. Monitoring results shall be reported at the intervals specified in Monitoring and Reporting Program No. 2006-0003. Unless superseded by a specific enforcement Order for a specific Enrollee, these reporting requirements are intended to replace other mandatory routine written reports associated with SSOs.

3. All Enrollees must obtain SSO Database accounts and receive a “Username” and “Password” by registering through the California Integrated Water Quality System (CIWQS). These accounts will allow controlled and secure entry into the SSO Database. Additionally, within 30days of receiving an account and prior to recording spills into the SSO Database, all Enrollees must complete the “Collection System Questionnaire”, which collects pertinent information regarding a Enrollee’s collection system. The “Collection System Questionnaire” must be updated at least every 12 months.

4. Pursuant to Health and Safety Code section 5411.5, any person who, without regard to intent or negligence, causes or permits any untreated wastewater or other waste to be discharged in or on any waters of the State, or discharged in or deposited where it is, or probably will be, discharged in or on any surface waters of the State, as soon as that person has knowledge of the discharge, shall immediately notify the local health officer of the discharge. Discharges of untreated or partially treated wastewater to storm drains and drainage channels, whether man-made or natural or concrete-lined, shall be reported as required above.

   Any SSO greater than 1,000 gallons discharged in or on any waters of the State, or discharged in or deposited where it is, or probably will be, discharged in or on any surface waters of the State shall also be reported to the Office of Emergency Services pursuant to California Water Code section 13271.

H. CHANGE IN OWNERSHIP

1. This Order is not transferable to any person or party, except after notice to the Executive Director. The Enrollee shall submit this notice in writing at least 30 days in advance of any proposed transfer. The notice must include a written agreement between the existing and new Enrollee containing a specific date for the transfer of this Order's responsibility and coverage between the existing Enrollee and the new Enrollee. This agreement shall include an acknowledgement that the existing Enrollee is liable for violations up to the transfer date and that the new Enrollee is liable from the transfer date forward.

I. INCOMPLETE REPORTS

1. If an Enrollee becomes aware that it failed to submit any relevant facts in any report required under this Order, the Enrollee shall promptly submit such facts or information by formally amending the report in the Online SSO Database.

J. REPORT DECLARATION

1. All applications, reports, or information shall be signed and certified as follows:

   (i) All reports required by this Order and other information required by the State or Regional Water Board shall be signed and certified by a person designated, for a municipality, state, federal or other public agency, as either a principal executive officer or ranking elected official, or by a duly authorized representative of that person, as described in paragraph (ii) of this provision. (For purposes of electronic reporting, an electronic signature and accompanying certification, which is in compliance with the Online SSO database procedures, meet this certification requirement.)

   (ii) An individual is a duly authorized representative only if:

      (a) The authorization is made in writing by a person described in paragraph (i) of this provision; and

      (b) The authorization specifies either an individual or a position having responsibility for the overall operation of the regulated facility or activity.

K. CIVIL MONETARY REMEDIES FOR DISCHARGE VIOLATIONS

1. The California Water Code provides various enforcement options, including civil monetary remedies, for violations of this Order.

2. The California Water Code also provides that any person failing or refusing to furnish technical or monitoring program reports, as required under this Order, or

falsifying any information provided in the technical or monitoring reports is subject to civil monetary penalties.

L. SEVERABILITY

1. The provisions of this Order are severable, and if any provision of this Order, or the application of any provision of this Order to any circumstance, is held invalid, the application of such provision to other circumstances, and the remainder of this Order, shall not be affected thereby.

2. This order does not convey any property rights of any sort or any exclusive privileges. The requirements prescribed herein do not authorize the commission of any act causing injury to persons or property, nor protect the Enrollee from liability under federal, state or local laws, nor create a vested right for the Enrollee to continue the waste discharge.

CERTIFICATION

The undersigned Clerk to the State Water Board does hereby certify that the foregoing is a full, true, and correct copy of general WDRs duly and regularly adopted at a meeting of the State Water Resources Control Board held on May 2, 2006.

AYE: Tam M. Doduc
Gerald D. Secundy

NO: Arthur G. Baggett

ABSENT: None

ABSTAIN: None

Song Her
Clerk to the Board

APPENDIX A2

State Water Resources Control Board, Monitoring and Reporting Program No. 2006-0003-DWQ, Statewide General Waste Discharge Requirements for Sanitary Sewer Systems

STATE WATER RESOURCES CONTROL BOARD

MONITORING AND REPORTING PROGRAM NO. 2006-0003-DWQ
STATEWIDE GENERAL WASTE DISCHARGE REQUIREMENTS
FOR
SANITARY SEWER SYSTEMS

This Monitoring and Reporting Program (MRP) establishes monitoring, record keeping, reporting and public notification requirements for Order No. 2006-2003-DWQ, "Statewide General Waste Discharge Requirements for Sanitary Sewer Systems." Revisions to this MRP may be made at any time by the Executive Director, and may include a reduction or increase in the monitoring and reporting.

A. SANITARY SEWER OVERFLOW REPORTING

SSO Categories

1. Category 1 - All discharges of sewage resulting from a failure in the Enrollee's sanitary sewer system that:
   A. Equal or exceed 1000 gallons, or
   B. Result in a discharge to a drainage channel and/or surface water; or
   C. Discharge to a storm drainpipe that was not fully captured and returned to the sanitary sewer system.

2. Category 2 – All other discharges of sewage resulting from a failure in the Enrollee's sanitary sewer system.

3. Private Lateral Sewage Discharges – Sewage discharges that are caused by blockages or other problems within a privately owned lateral.

SSO Reporting Timeframes

4. Category 1 SSOs – All SSOs that meet the above criteria for Category 1 SSOs must be reported as soon as: (1) the Enrollee has knowledge of the discharge, (2) reporting is possible, and (3) reporting can be provided without substantially impeding cleanup or other emergency measures. Initial reporting of Category 1 SSOs must be reported to the Online SSO System as soon as possible but no later than 3 business days after the Enrollee is made aware of the SSO. Minimum information that must be contained in the 3-day report must include all information identified in section 9 below, except for item 9.K. A final certified report must be completed through the Online SSO System, within 15 calendar days of the conclusion of SSO response and remediation. Additional information may be added to the certified report, in the form of an attachment, at any time.

   The above reporting requirements do not preclude other emergency notification requirements and timeframes mandated by other regulatory agencies (local

County Health Officers, local Director of Environmental Health, Regional Water Boards, or Office of Emergency Services (OES)) or State law.

5. Category 2 SSOs – All SSOs that meet the above criteria for Category 2 SSOs must be reported to the Online SSO Database within 30 days after the end of the calendar month in which the SSO occurs (e.g. all SSOs occurring in the month of January must be entered into the database by March 1st).

6. Private Lateral Sewage Discharges – All sewage discharges that meet the above criteria for Private Lateral sewage discharges may be reported to the Online SSO Database based upon the Enrollee's discretion. If a Private Lateral sewage discharge is recorded in the SSO Database, the Enrollee must identify the sewage discharge as occurring and caused by a private lateral, and a responsible party (other than the Enrollee) should be identified, if known.

7. If there are no SSOs during the calendar month, the Enrollee will provide, within 30 days after the end of each calendar month, a statement through the Online SSO Database certifying that there were no SSOs for the designated month.

8. In the event that the SSO Online Database is not available, the enrollee must fax all required information to the appropriate Regional Water Board office in accordance with the time schedules identified above. In such event, the Enrollee must also enter all required information into the Online SSO Database as soon as practical.

Mandatory Information to be Included in SSO Online Reporting

All Enrollees must obtain SSO Database accounts and receive a "Username" and "Password" by registering through the California Integrated Water Quality System (CIWQS). These accounts will allow controlled and secure entry into the SSO Database. Additionally, within thirty (30) days of receiving an account and prior to recording SSOs into the SSO Database, all Enrollees must complete the "Collection System Questionnaire", which collects pertinent information regarding an Enrollee's collection system. The "Collection System Questionnaire" must be updated at least every 12 months.

At a minimum, the following mandatory information must be included prior to finalizing and certifying an SSO report for each category of SSO:

9. Category 2 SSOs:

   A. Location of SSO by entering GPS coordinates;
   B. Applicable Regional Water Board, i.e. identify the region in which the SSO occurred;
   C. County where SSO occurred;
   D. Whether or not the SSO entered a drainage channel and/or surface water;
   E. Whether or not the SSO was discharged to a storm drain pipe that was not fully captured and returned to the sanitary sewer system;

F. Estimated SSO volume in gallons;
G. SSO source (manhole, cleanout, etc.);
H. SSO cause (mainline blockage, roots, etc.);
I. Time of SSO notification or discovery;
J. Estimated operator arrival time;
K. SSO destination;
L. Estimated SSO end time; and
M. SSO Certification. Upon SSO Certification, the SSO Database will issue a Final SSO Identification (ID) Number.

10. Private Lateral Sewage Discharges:

A. All information listed above (if applicable and known), as well as;
B. Identification of sewage discharge as a private lateral sewage discharge; and
C. Responsible party contact information (if known).

11. Category 1 SSOs:

A. All information listed for Category 2 SSOs, as well as;
B. Estimated SSO volume that reached surface water, drainage channel, or not recovered from a storm drain;
C. Estimated SSO amount recovered;
D. Response and corrective action taken;
E. If samples were taken, identify which regulatory agencies received sample results (if applicable). If no samples were taken, NA must be selected.
F. Parameters that samples were analyzed for (if applicable);
G. Identification of whether or not health warnings were posted;
H. Beaches impacted (if applicable). If no beach was impacted, NA must be selected;
I. Whether or not there is an ongoing investigation;
J. Steps taken or planned to reduce, eliminate, and prevent reoccurrence of the overflow and a schedule of major milestones for those steps;
K. OES control number (if applicable);
L. Date OES was called (if applicable);
M. Time OES was called (if applicable);
N. Identification of whether or not County Health Officers were called;
O. Date County Health Officer was called (if applicable); and
P. Time County Health Officer was called (if applicable).

<u>Reporting to Other Regulatory Agencies</u>

These reporting requirements do not preclude an Enrollee from reporting SSOs to other regulatory agencies pursuant to California state law. These reporting requirements do not replace other Regional Water Board telephone reporting requirements for SSOs.

1. The Enrollee shall report SSOs to OES, in accordance with California Water Code Section 13271.

Office of Emergency Services
Phone (800) 852-7550

2. The Enrollee shall report SSOs to County Health officials in accordance with California Health and Safety Code Section 5410 et seq.

3. The SSO database will automatically generate an e-mail notification with customized information about the SSO upon initial reporting of the SSO and final certification for all Category 1 SSOs. E-mails will be sent to the appropriate County Health Officer and/or Environmental Health Department if the county desires this information, and the appropriate Regional Water Board.

B. Record Keeping

1. Individual SSO records shall be maintained by the Enrollee for a minimum of five years from the date of the SSO. This period may be extended when requested by a Regional Water Board Executive Officer.

3. All records shall be made available for review upon State or Regional Water Board staff's request.

4. All monitoring instruments and devices that are used by the Enrollee to fulfill the prescribed monitoring and reporting program shall be properly maintained and calibrated as necessary to ensure their continued accuracy;

5. The Enrollee shall retain records of all SSOs, such as, but not limited to and when applicable:

   a. Record of Certified report, as submitted to the online SSO database;
   b. All original recordings for continuous monitoring instrumentation;
   c. Service call records and complaint logs of calls received by the Enrollee;
   d. SSO calls;
   e. SSO records;
   f. Steps that have been and will be taken to prevent the SSO from recurring and a schedule to implement those steps.
   g. Work orders, work completed, and any other maintenance records from the previous 5 years which are associated with responses and investigations of system problems related to SSOs;
   h. A list and description of complaints from customers or others from the previous 5 years; and
   i. Documentation of performance and implementation measures for the previous 5 years.

6. If water quality samples are required by an environmental or health regulatory agency or State law, or if voluntary monitoring is conducted by the Enrollee or its agent(s), as a result of any SSO, records of monitoring information shall include:

a. The date, exact place, and time of sampling or measurements;
b. The individual(s) who performed the sampling or measurements;
c. The date(s) analyses were performed;
d. The individual(s) who performed the analyses;
e. The analytical technique or method used; and,
f. The results of such analyses.

C. Certification

1. All final reports must be certified by an authorized person as required by Provision J of the Order.
2. Registration of authorized individuals, who may certify reports, will be in accordance with the CIWQS' protocols for reporting.

Monitoring and Reporting Program No. 2006-0003 will become effective on the date of adoption by the State Water Board.

CERTIFICATION

The undersigned Clerk to the Board does hereby certify that the foregoing is a full, true, and correct copy of a resolution duly and regularly adopted at a meeting of the State Water Board held on May 2, 2006.

Song Her
Clerk to the Board

APPENDIX A3

State Water Resources Control Board Monitoring, Order No. 2008•0002 EXEC, Adopting Amended Monitoring and Reporting Requirements for Statewide General Waste Discharge Requirements for Sanitation Sewers, February 20, 2008

STATE OF CALIFORNIA
STATE WATER RESOURCES CONTROL BOARD

ORDER NO. WQ 2008-0002-EXEC

ADOPTING AMENDED MONITORING AND REPORTING REQUIREMENTS FOR STATEWIDE GENERAL WASTE DISCHARGE REQUIREMENTS FOR SANITARY SEWER SYSTEMS

The State of California, Water Resources Control Board (State Water Board) finds:

1. The State Water Board is authorized to prescribe statewide general waste discharge requirements for categories of discharges that involve the same or similar operations and the same of similar types of waste pursuant to Water Code 13263, subdivision (i).

2. The State Water Board on May 2, 2006, adopted Statewide General Waste Discharge Requirements for Sanitary Sewer Systems, Order No. 2006-0003-DWQ, pursuant to that authority.

3. The State Water Board on May 2, 2006, adopted Monitoring and Reporting Requirements to implement the General Waste Discharge Requirements for Sanitary Sewer Systems.

4. State Water Board Order No. 2006-0003-DWQ, paragraph G.2., and the Monitoring and Reporting Requirements, both provide that the Executive Director may modify the terms of the Monitoring and Reporting Requirements at any time.

5. The time allowed in those Monitoring and Reporting Requirements for the filing of the initial report of an overflow is too long to adequately protect the public health and safety or the beneficial uses of the waters of the state when there is a sewage collection system spill. An additional notification requirement is necessary and appropriate to ensure the Office of Emergency Services, local public health officials, and the applicable regional water quality control board are apprised of a spill that reaches a drainage channel or surface water.

6. Further, the burden of providing a notification as soon as possible is de minimis and will allow response agencies to take action as soon as possible to protect public health and safety and beneficial uses of the waters of the state.

IT IS HEREBY ORDERED THAT:

Pursuant to the authority delegated by Resolution No. 2002-0104 and Order No. 2006-0003-DWQ, the Monitoring and Reporting Requirements for Statewide General Waste Discharge Requirements for Sanitary Sewer Systems No. 2006-0003-DWQ is hereby amended as shown in Attachment A, with new text indicated by double-underline.

Dated: February 20, 2008

Dorothy Rice
Dorothy Rice
Executive Director

ATTACHMENT A

STATE WATER RESOURCES CONTROL BOARD
MONITORING AND REPORTING PROGRAM NO. 2006-0003-DWQ
(AS REVISED BY ORDER NO. WQ 2008-0002-EXEC)

STATEWIDE GENERAL WASTE DISCHARGE REQUIREMENTS
FOR
SANITARY SEWER SYSTEMS

This Monitoring and Reporting Program (MRP) establishes monitoring, record keeping, reporting and public notification requirements for Order No. 2006-2003-DWQ, "Statewide General Waste Discharge Requirements for Sanitary Sewer Systems." Revisions to this MRP may be made at any time by the Executive Director, and may include a reduction or increase in the monitoring and reporting.

NOTIFICATION

Although State and Regional Water Board staff do not have duties as first responders, this Monitoring and Reporting Program is an appropriate mechanism to ensure that the agencies that do have first responder duties are notified in a timely manner in order to protect public health and beneficial uses.

1. For any discharges of sewage that results in a discharge to a drainage channel or a surface water, the Discharger shall, as soon as possible, but not later then two (2) hours after becoming aware of the discharge, notify the State Office of Emergency Services, the local health officer or directors of environmental health with jurisdiction over affected water bodies, and the appropriate Regional Water Quality Control Board.

2. As soon as possible, but no later then twenty-four (24) hours after becoming aware of a discharge to a drainage channel or a surface water, the Discharger shall submit to the appropriate Regional Water Quality Control Board a certification that the State Office of Emergency Services and the local health officer or directors of environmental health with jurisdiction over the affected water bodies have been notified of the discharge.

A. SANITARY SEWER OVERFLOW REPORTING

SSO Categories

1. Category 1 - All discharges of sewage resulting from a failure in the Enrollee's sanitary sewer system that:
   A. Equal or exceed 1000 gallons, or
   B. Result in a discharge to a drainage channel and/or surface water; or
   C. Discharge to a storm drainpipe that was not fully captured and returned to the sanitary sewer system.

2. Category 2 – All other discharges of sewage resulting from a failure in the Enrollee's sanitary sewer system.

3. Private Lateral Sewage Discharges – Sewage discharges that are caused by blockages or other problems within a privately owned lateral.

SSO Reporting Timeframes

4. Category 1 SSOs – Except as provided above, all SSOs that meet the above criteria for Category 1 SSOs must be reported as soon as: (1) the Enrollee has knowledge of the discharge, (2) reporting is possible, and (3) reporting can be provided without substantially impeding cleanup or other emergency measures. Initial reporting of Category 1 SSOs must be reported to the Online SSO System as soon as possible but no later than 3 business days after the Enrollee is made aware of the SSO. Minimum information that must be contained in the 3-day report must include all information identified in section 9 below, except for item 9.K. A final certified report must be completed through the Online SSO System, within 15 calendar days of the conclusion of SSO response and remediation. Additional information may be added to the certified report, in the form of an attachment, at any time.

   The above reporting requirements are in addition to do not preclude other emergency notification requirements and timeframes mandated by other regulatory agencies (local County Health Officers, local Director of Environmental Health, Regional Water Boards, or Office of Emergency Services (OES)) or State law.

5. Category 2 SSOs – All SSOs that meet the above criteria for Category 2 SSOs must be reported to the Online SSO Database within 30 days after the end of the calendar month in which the SSO occurs (e.g. all SSOs occurring in the month of January must be entered into the database by March 1st).

6. Private Lateral Sewage Discharges – All sewage discharges that meet the above criteria for Private Lateral sewage discharges may be reported to the Online SSO Database based upon the Enrollee's discretion. If a Private Lateral sewage discharge is recorded in the SSO Database, the Enrollee must identify the sewage discharge as occurring and caused by a private lateral, and a responsible party (other than the Enrollee) should be identified, if known.

7. If there are no SSOs during the calendar month, the Enrollee will provide, within 30 days after the end of each calendar month, a statement through the Online SSO Database certifying that there were no SSOs for the designated month.

8. In the event that the SSO Online Database is not available, the enrollee must fax all required information to the appropriate Regional Water Board office in

accordance with the time schedules identified above. In such event, the Enrollee must also enter all required information into the Online SSO Database as soon as practical.

Mandatory Information to be Included in SSO Online Reporting

All Enrollees must obtain SSO Database accounts and receive a "Username" and "Password" by registering through the California Integrated Water Quality System (CIWQS). These accounts will allow controlled and secure entry into the SSO Database. Additionally, within thirty (30) days of receiving an account and prior to recording SSOs into the SSO Database, all Enrollees must complete the "Collection System Questionnaire", which collects pertinent information regarding an Enrollee's collection system. The "Collection System Questionnaire" must be updated at least every 12 months.

At a minimum, the following mandatory information must be included prior to finalizing and certifying an SSO report for each category of SSO:

9. Category 2 SSOs:

    A. Location of SSO by entering GPS coordinates;
    B. Applicable Regional Water Board, i.e. identify the region in which the SSO occurred;
    C. County where SSO occurred;
    D. Whether or not the SSO entered a drainage channel and/or surface water;
    E. Whether or not the SSO was discharged to a storm drain pipe that was not fully captured and returned to the sanitary sewer system;
    F. Estimated SSO volume in gallons;
    G. SSO source (manhole, cleanout, etc.);
    H. SSO cause (mainline blockage, roots, etc.);
    I. Time of SSO notification or discovery;
    J. Estimated operator arrival time;
    K. SSO destination;
    L. Estimated SSO end time; and
    M. SSO Certification. Upon SSO Certification, the SSO Database will issue a Final SSO Identification (ID) Number.

10. Private Lateral Sewage Discharges:

    A. All information listed above (if applicable and known), as well as;
    B. Identification of sewage discharge as a private lateral sewage discharge; and
    C. Responsible party contact information (if known).

11. Category 1 SSOs:

A. All information listed for Category 2 SSOs, as well as;
B. Estimated SSO volume that reached surface water, drainage channel, or not recovered from a storm drain;
C. Estimated SSO amount recovered;
D. Response and corrective action taken;
E. If samples were taken, identify which regulatory agencies received sample results (if applicable). If no samples were taken, NA must be selected.
F. Parameters that samples were analyzed for (if applicable);
G. Identification of whether or not health warnings were posted;
H. Beaches impacted (if applicable). If no beach was impacted, NA must be selected;
I. Whether or not there is an ongoing investigation;
J. Steps taken or planned to reduce, eliminate, and prevent reoccurrence of the overflow and a schedule of major milestones for those steps;
K. OES control number (if applicable);
L. Date OES was called (if applicable);
M. Time OES was called (if applicable);
N. Identification of whether or not County Health Officers were called;
O. Date County Health Officer was called (if applicable); and
P. Time County Health Officer was called (if applicable).

Reporting to Other Regulatory Agencies

These reporting requirements do not preclude an Enrollee from reporting SSOs to other regulatory agencies pursuant California state law. These reporting requirements do not replace other Regional Water Board telephone reporting requirements for SSOs.

1. The Enrollee shall report SSOs to OES, in accordance with California Water Code Section 13271.

   Office of Emergency Services
   Phone (800) 852-7550

2. The Enrollee shall report SSOs to County Health officials in accordance with California Health and Safety Code Section 5410 et seq.

3. The SSO database will automatically generate an e-mail notification with customized information about the SSO upon initial reporting of the SSO and final certification for all Category 1 SSOs. E-mails will be sent to the appropriate County Health Officer and/or Environmental Health Department if the county desires this information, and the appropriate Regional Water Board.

B. Record Keeping

1. Individual SSO records shall be maintained by the Enrollee for a minimum of five years from the date of the SSO. This period may be extended when requested by a Regional Water Board Executive Officer.

[2. Omitted.]

3. All records shall be made available for review upon State or Regional Water Board staff's request.

4. All monitoring instruments and devices that are used by the Enrollee to fulfill the prescribed monitoring and reporting program shall be properly maintained and calibrated as necessary to ensure their continued accuracy;

5. The Enrollee shall retain records of all SSOs, such as, but not limited to and when applicable:

   a. Record of Certified report, as submitted to the online SSO database;
   b. All original recordings for continuous monitoring instrumentation;
   c. Service call records and complaint logs of calls received by the Enrollee;
   d. SSO calls;
   e. SSO records;
   f. Steps that have been and will be taken to prevent the SSO from recurring and a schedule to implement those steps.
   g. Work orders, work completed, and any other maintenance records from the previous 5 years which are associated with responses and investigations of system problems related to SSOs;
   h. A list and description of complaints from customers or others from the previous 5 years; and
   i. Documentation of performance and implementation measures for the previous 5 years.

6. If water quality samples are required by an environmental or health regulatory agency or State law, or if voluntary monitoring is conducted by the Enrollee or its agent(s), as a result of any SSO, records of monitoring information shall include:

   a. The date, exact place, and time of sampling or measurements;
   b. The individual(s) who performed the sampling or measurements;
   c. The date(s) analyses were performed;
   d. The individual(s) who performed the analyses;
   e. The analytical technique or method used; and,
   f. The results of such analyses.

C. Certification

1. All final reports must be certified by an authorized person as required by Provision J of the Order.
2. Registration of authorized individuals, who may certify reports, will be in accordance with the CIWQS' protocols for reporting.

Monitoring and Reporting Program No. 2006-0003 will become effective on the date of adoption by the State Water Board. The notification requirements added by Order No. WQ 2008-0002-EXEC will become effective upon issuance by the Executive Director.

CERTIFICATION

The undersigned Clerk to the Board does hereby certify that the foregoing is a full, true, and correct copy of an order amended by the Executive Director of the State Water Board.

Jeanine Townsend
Clerk to the Board

APPENDIX D

Contact Names and Numbers for Positions Responsible for SSMP Development and Implementation

IRVINE RANCH WATER DISTRICT
SEWER SYSTEM MANAGEMENT PLAN

Contact Names and Numbers of Position Responsible for SSMP Development and Implementation

WDR Reference	SSMP Element/Measure	Responsible Position	Dept.	Name	Telephone No. (949) 453-XXXX
D.13	Overall SSMP Development and Implementation	Executive Director of Operations	410	Patrick Sheilds	5720
D. 13(i)	Goal	Wastewater Operations, Director	510	Wayne Posey	5780
D.13(ii)	Organization	Wastewater Operations, Director	510	Wayne Posey	5780
D.13(iii)	Legal Authority	Wastewater Operations, Director	510	Wayne Posey	5780
D.13(iv)(a)	O&M Program – Mapping	Planning and Technical Services, Principal Engineer	710	Mike Hoolihan	5553
D.13(iv)(b)	O&M Program –Sewer Pipeline and Manhole Preventive and Routine Maintenance	Collection Systems Manager	570	Greg Springman	5815
D.13(iv)(b)	O&M Program –Lift Station Mechanical and Electrical Preventive and Routine Maintenance	Maintenance and Reliability Superintendent	540	Chris Fike	5816
D.13(iv)(c)	O&M Program – System Inspection	Collection Systems Manager	570	Greg Springman	5815
D.13(iv)(c)	O&M Program – Condition Assessment; Rehabilitation and Replacement Program	Engineering and Planning, Executive Director	300	Kevin Burton	5594
D.13(iv)(c)	O&M Program – Capital Program Funding	Engineering and Planning, Executive Director	300	Kevin Burton	5594
D.13(iv)(d)	O&M Program - Training	Collection Systems Manager	570	Greg Springman	5815
D.13(iv)(e)	O&M Program – Critical and Replacement Part inventory	Maintenance and Reliability Superintendent	540	Chris Fike	5816
D.13(v)	Design and Performance Provisions	Planning and Technical Services, Principal Engineer	710	Mike Hoolihan	5553
D.13(vi)	Overflow Emergency Response Plan	Collection Systems Manager	570	Greg Springman	5815
D.13(vii)	Fats, Oils, and Grease Control Program	Wastewater Operations, Analyst	510	Soha Vazirnia	5852
D.13(viii)	System Evaluation and Capacity Assurance Plan	Planning and Technical Services, Principal Engineer	710	Mike Hoolihan	5553
D.13(ix)	Monitoring, Measurement, and Program Modifications	Wastewater Operations, Director	510	Wayne Posey	5780
D.13(x)	SSMP Program Audits	Wastewater Operations, Director	510	Wayne Posey	5780
D.13(xi)	Communication Program – Public education	Public Affairs, Director	120	Beth Beeman	5320
D.13(xi)	Communication Program – Satellite agencies	Executive Director of Operations	410	Patrick Sheilds	5720

APPENDIX F1

Lift Station Weekly Inspection Form

Collection System Lift Station Inspection Sheet
Department 57/Collection Systems

Operator: ______________________________ **Station:** ____________________________________

Inspection Date: ____________________________

Completed	Control Panel	Notes
	Control Panel Lights	
	Control Panel Switches	
	Sump Pump Switches	
	Overhead Panel Lights	
	Pump Seal Test	
	Overhead Outside Lights	
Completed	**Pumps**	**Notes**
	Pump Operation	
	Sump Pump Floats	
	Packing	
	Seal Oil	
	Surge Tank Compressor	
	P.S.I. Gauge	
	Flow Output Acceptable	
	Pump Down Time	
	Bubbler Compressor	
	Leaking/Excessive Vibration	
Completed	**Generator**	**Notes**
	Generator Hours Recorded	
	Automatic Transfer Switch	
	Fuel Level	
	Radiator / Heater Block	
	Leaks, Rat Nest, Access	
	Paperwork	
Completed	**Wet Well / Dry Well**	**Notes**
	Emergency Level Floats	
	Coating	
	Well Washer	
	Cables	
	Pump Seating	
	Guide Rails	
	Ventilator	
	Gas Detection	
	Exhaust Fans	
	Gates	
	Ultra Sonic Sensor	
	Bio-Magic System and Shelter	

Main Pumps

Pump 1 Hours_________Pump 2 Hours________ Pump 3 hours_________Pump 4 Hours________

Pump 1 Hours_________Pump 2 Total_________Pump 3 Total__________Pump 4 Total________

Sump Pumps

Pump 1 Hours_________Pump 2 Hours________

Pump 1 Hours_________Pump 2 Total_________

APPENDIX F2

Daily Activity Field Report

Irvine Ranch Water District
Department 57
Daily Field Activity Report

Date: ____ Sheet: ____ Operators: ____ ____

Work : Cleaning (C) CCTV(T) (Circle one) Inspect (I) Equipment: ____

Item 1
Downstream: ____ Condition: Grease (G) Roots (R) Sand/Grit (S) H_2S (H) Rehab (D) Roaches (V) Traffic Control (T) Pipe Repair (P)
Upstream: ____ Street Name: ____ Atlas Revision (A)
Comments: ____

Item 2
Downstream: ____ Condition: Grease (G) Roots (R) Sand/Grit (S) H_2S (H) Rehab (D) Roaches (V) Traffic Control (T) Pipe Repair (P)
Upstream: ____ Street Name: ____ Atlas Revision (A)
Comments: ____

Item 3
Downstream: ____ Condition: Grease (G) Roots (R) Sand/Grit (S) H_2S (H) Rehab (D) Roaches (V) Traffic Control (T) Pipe Repair (P)
Upstream: ____ Street Name: ____ Atlas Revision (A)
Comments: ____

Item 4
Downstream: ____ Condition: Grease (G) Roots (R) Sand/Grit (S) H_2S (H) Rehab (D) Roaches (V) Traffic Control (T) Pipe Repair (P)
Upstream: ____ Street Name: ____ Atlas Revision (A)
Comments: ____

Item 5
Downstream: ____ Condition: Grease (G) Roots (R) Sand/Grit (S) H_2S (H) Rehab (D) Roaches (V) Traffic Control (T) Pipe Repair (P)
Upstream: ____ Street Name: ____ Atlas Revision (A)
Comments: ____

Item 6
Downstream: ____ Condition: Grease (G) Roots (R) Sand/Grit (S) H_2S (H) Rehab (D) Roaches (V) Traffic Control (T) Pipe Repair (P)
Upstream: ____ Street Name: ____ Atlas Revision (A)
Comments: ____

Item 7
Downstream: ____ Condition: Grease (G) Roots (R) Sand/Grit (S) H_2S (H) Rehab (D) Roaches (V) Traffic Control (T) Pipe Repair (P)
Upstream: ____ Street Name: ____ Atlas Revision (A)
Comments: ____

APPENDIX F3

Standard Measures for Observed Results for Sewer Cleaning

Standard Measures of Observed Results for Sewer Cleaning

Next to cleaning the sewer line, effective observation of results is the most important work product of the field crew. The information they provide is the basis for defining future maintenance activities. Consistency is important. The standards for "results" for small diameter [a] (six- and eight-inch) sewers are:

	Clear	Light	Moderate	Heavy
Sand/Grit	No observable sand or grit	**Code: SL** Minor amount of sand/grit 15 minutes or less to clean 1 pass	**Code: SM** Less than 5 gallons of sand/grit 15-30 minutes to clean 2-3 passes required Requires cleaning twice or less per year Only fine grit	**Code: SH** More than 5 gallons of sand/grit More than 30 minutes to clean More than 4 passes required Requires cleaning four times per year Operator concern for future stoppage
Grease	No observable grease	**Code: GL** Minor amounts of grease 15 minutes or less to clean 1pass	**Code: GM** Small chunks/no "logs" 15-30 minutes to clean 2-3 passes required Requires cleaning twice or less per year	**Code: GH** Big chunks/"logs" More than 30 minutes to clean More than 4 passes required Operator concern for future stoppage
Roots	No observable roots	**Code: RL** Minor amounts of roots 15 minutes or less to clean 1 pass	**Code: RM** Thin/stringy roots present No large "clumps" 15-30 minutes to clean 2-3 passes required	**Code: RH** Thick roots present Large "clumps" More than 30 minutes to clean More than 4 passes required Operator concern for future stoppage
Other	**Code: OTH** Other is any other item found in sewer that does not fall in categories listed above.			
Criteria for Action	Decrease maintenance frequency to next lower frequency after 2 consecutive CL results (with supporting CCTV results)	Continue maintenance frequency	Increase maintenance frequency to next higher frequency	Increase maintenance frequency to next higher frequency

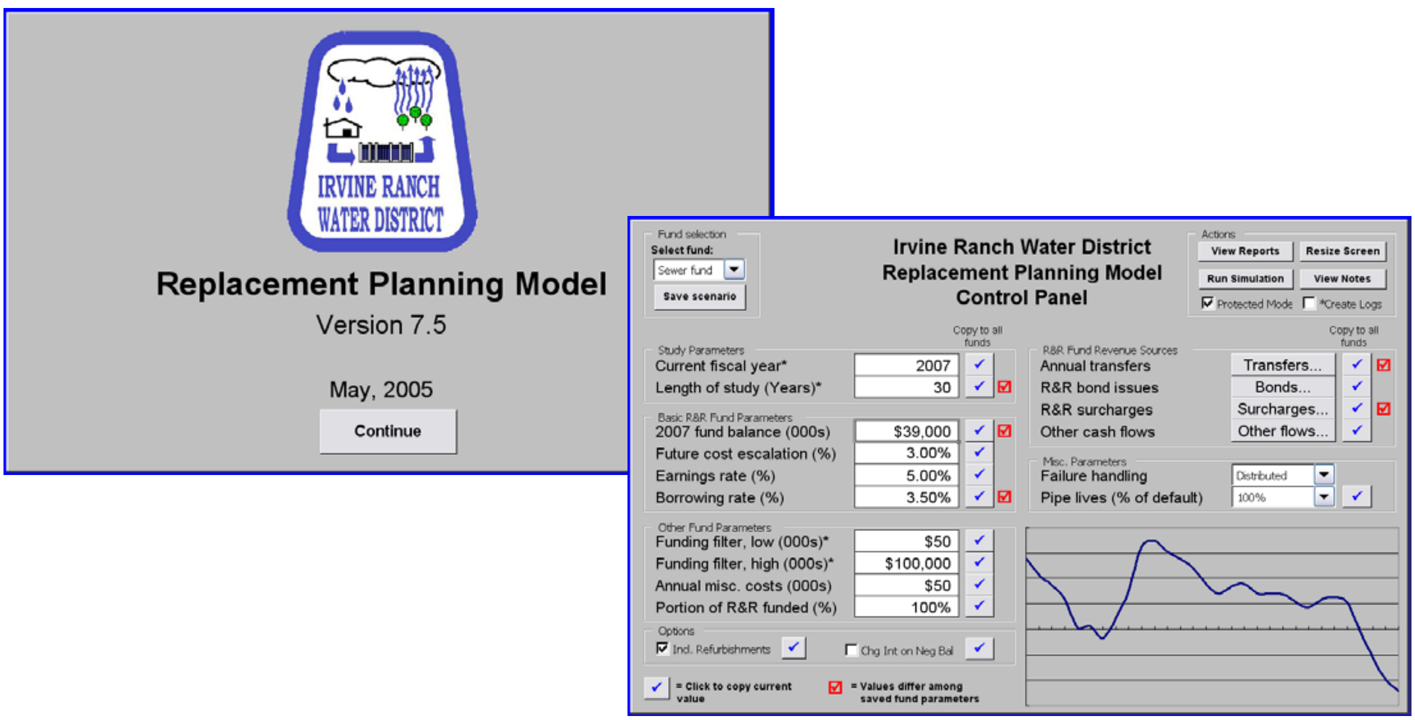
Footnote: (a) Times shown are for typical manhole to manhole distance of 250 feet. Longer runs will require longer cleaning times. Judgment will need to be applied by the field crews for varying lengths and pipe diameters.

APPENDIX F4

Replacement Planning Model User's Guide

IRVINE RANCH WATER DISTRICT

REPLACEMENT PLANNING MODEL
USER'S GUIDE



Prepared by:

BROWN AND CALDWELL

1099 Alakea Street, Suite 2400
Honolulu, HI 96813

May 2007

CONTENTS

FIGURES

IRVINE RANCH WATER DISTRICT
REPLACEMENT PLANNING MODEL

USER'S GUIDE

A. GENERAL DESCRIPTION

The Replacement Planning Model (RPM) is an automated model that manipulates the system inventory database to create various types of reports. The model has the capability of accepting a wide range of input parameters and displaying the effects that varying these parameters might have on future replacement funding requirements of the Irvine Ranch Water District (IRWD). Several reports and graphs are available, including:

+ Refurbishment and Replacement (R&R) Fund performance and related parameters
+ System R&R funding requirements
+ Asset values.

All reports and graphs are based on scenarios input by the user.

The RPM requires Microsoft Office 97 or later. Automated routines are written in Visual Basic for Applications (VBA). The RPM is designed to be displayed on a color monitor at a minimum resolution of 640 by 480 pixels. Higher resolutions will provide better displays.

The RPM is a single file. A database of the GWA asset inventory is built into the RPM.

Using the RPM—The RPM has two main purposes:

+ Understanding and communicating the magnitude of future replacement and refurbishment (R&R) needs over a long period of time, typically 20-50 years (the RPM will estimate R&R needs for up to 100 years); and

+ Enabling the formulation of finding policies to meet these needs that achieve the best balance between economic and political realities.

The RPM is not an optimizing or goal-seeking application. Rather, it allows the user to "build" a funding policy by varying the policy options that together make up such a policy. In the RPM's case, the policy is based on the establishment of an "R&R Fund," a reserve fund dedicated to paying for R&R costs from year to year.

The idea is to establish a policy for managing this fund that keeps it in positive territory through a given "look-ahead" period, typically 30 to 50 years. As entries are made in the RPM, an always-visible graph of future fund balances is instantly updated, so the impacts of changing policy parameters are immediately apparent.

Major policy variables that are available include:

1. Annual transfers into the R&R Fund of normal operational revenues (see Section C5 of this User's Guide)

2. Revenues and outflows resulting from "R&R bond" issues, whose proceeds flow into the R&R Fund and whose debt service is paid from the Fund (see Section C5)

3. R&R surcharges, which are amounts detailed on customer bills as dedicated to asset replacement (see Section C5)

4. Other cash flows, which are dollar flows into or out of the R&R Fund that are not accounted for elsewhere in the RPM (see Section C5)

5. Low funding filter, specifying the minimum amount of an R&R expenditure that will be serviced from the R&R Fund, usually on the assumption that low cost transactions will be borne by the normal O&M budget (see Section C4)

6. High funding filter, specifying the maximum amount of an R&R expenditure that will be serviced from the R&R Fund, usually on the assumption that high-cost transactions will be funded by debt rather than an accumulation of ready money (see Section C4)

7. Portion of R&R funded, specifying what percentage or R&R costs will be funded from the R&R Fund (see Section C4).

Together, the values specified for these parameters will make up an R&R policy designed to sustain the infrastructure over the long-term.

B. STARTING THE RPM

The RPM is started by loading the model. Prior to loading the RPM, Excel's macro security level **must** be set to "medium" or lower. This is important to note because, by default, Excel's macro security is set to "high" and, unless changed, the RPM will not work correctly.

Upon loading the RPM, no additional actions are necessary because the RPM does not need access to other files. After a warning on macros (the user should respond "yes"), the first screen will appear, showing the name and version of the model and a *Continue* button:

Figure 1. RPM Introduction Screen

Pressing the *Continue* button brings up the *Control Panel*. This is the screen where most user input is entered.

C. USING THE RPM

The *Control Panel* includes all RPM direct user inputs or, in several cases, provides access to secondary screens where more detailed data may be entered. Controls on the *Control Panel* are in nine groupings, discussed in order below.

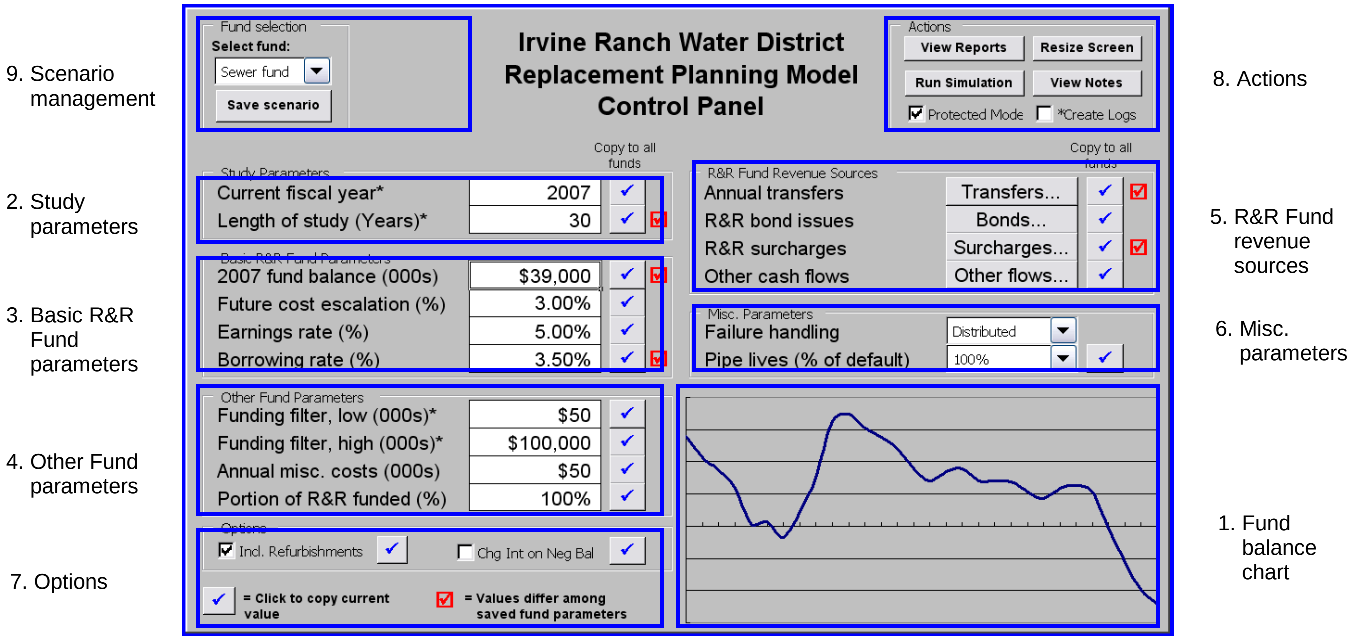


Figure 2. RPM Control Panel

☞**Note:** Asterisks are appended to some of the input field names on the Control Panel. If the values in any of these fields are changed, the model may not yield correct results until the *Run Simulation* button near the upper right-hand corner of the screen is clicked. For all other changes, model recalculation is automatic.

1. Fund Balance Chart

There is a "thumbnail" chart in the lower right-hand portion of the *Control Panel*. This chart shows, given all current inputs, the year-to-year balances in the R&R Fund over the period of time specified as the length of the study (see below). The graph, which appears on all major input screens, provides a "live update" as entries are made.

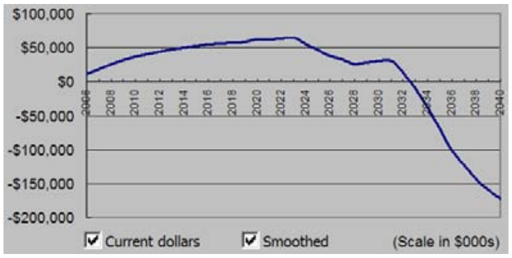


Figure 3. Fund Balances, Thumbnail Graph

The same graph, larger and in more detail, is available from the *Report Menu* (Report 2) (see below).

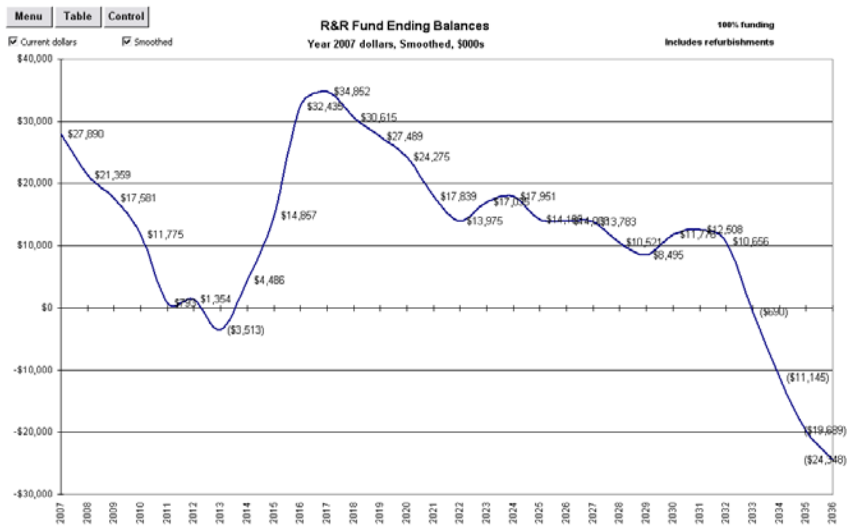


Figure 4. Fund Balances, Full Chart

2. Study Parameters

Two data items are critical to the R&R analysis—start year and "look-ahead" period.

+ *Initial Study Year* – Defines the starting year of the analysis; for instance, in this example, the user is examining R&R Fund performance beginning in the year 2006.

+ *Length of Study (Years)* – Defines the number of years in the analysis, starting with the *Initial Study Year*. The maximum study period is 100 years. Entering a shorter period of time in this field, however, will usually give a clearer presentation of near-term results when viewing the model's graphs.

The specified length of study, in some cases, affects only the graphical representation of results. Calculations are carried out for a minimum of 53 years and many tables will always display the first 50 years of results.

3. Basic R&R Fund Parameters

These data items govern the internal operations of the R&R Fund and provide for future cost escalation.

+ *2006 Fund Balance (000s)* – The cash balance of the R&R Fund at the beginning of the *Initial Study Year*. The *2006* in the label will reflect the year specified in *Initial Study Year* above.

+ *Future Cost Escalation (%)* – The expected general rate of cost inflation expected over the period of analysis. The rate should be that applicable to the types of assets that predominate in the physical system (excluding land, which need not be replaced).

+ *Earnings Rate (%)* – The assumed rate of interest accrued by positive balances in the fund over the period of analysis.

+ *Borrowing Rate (%)* – The assumed cost of borrowing money, applied to R&R bond issues (see below), and to charge the fund if its balance becomes negative.

4. Other Fund Parameters

These data items also affect accumulations in and disbursements from the R&R Fund:

+ *Funding Filter Low/High (000s)* – The RPM allows the option of excluding replacement and refurbishment costs below or above a given amount from funding from the R&R Fund. Any expenditure smaller or larger than the amounts entered here is assumed to be funded from normal operational funds or issuance of debt. In the latter case, any associated debt service comes from outside the R&R Fund.

+ *Annual Various Costs (000s)* – This entry is usually used to allow for R&R costs of assets that were not identified in the inventory process. It can also be used for special programs that will be funded from the R&R Fund.

+ *Portion of R&R Funded (%)* – This is the policy position of GWA regarding the percentage of the costs of R&R costs that will be funded from the R&R Fund as opposed to other sources. This percentage also applies to the various replacement costs discussed immediately above.

5. R&R Fund Revenue Sources

Aside from interest earnings on R&R Fund balances, the RPM allows specification of four additional revenue sources:

+ *Annual Transfers (000s)* – Transfers into the R&R Fund from operations are usually the primary method of replenishing the fund. This button brings up the screen used to enter the transfer amounts. The *Annual Transfers* entry screen is shown on the next page.

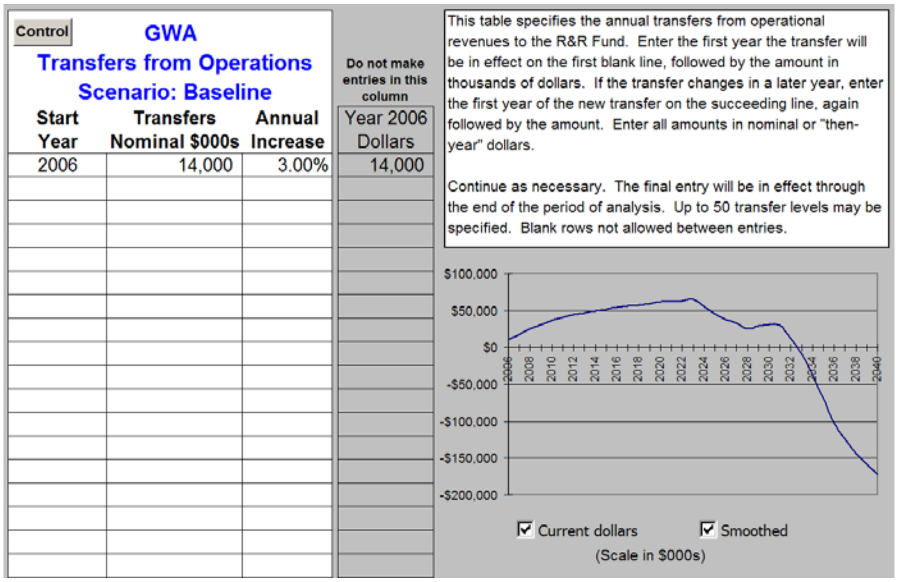


Figure 5. Annual Transfers Entry Screen

This table can have several entries on consecutive lines. Each entry must specify the starting year, amount, and subsequent rate of annual increase. Each defined level of annual transfer remains in effect until the year specified by the next entry.

This entry screen, like others, includes a "thumbnail" graph of future R&R Fund balances so that the user can immediately evaluate the effect of entries.

+ *R&R Bond Issues* – This button brings up the *R&R Bond Issues Table* for issuing bonds, discussed below. The *R&R Bond Issues* entry screen is shown below, with data entry instructions:

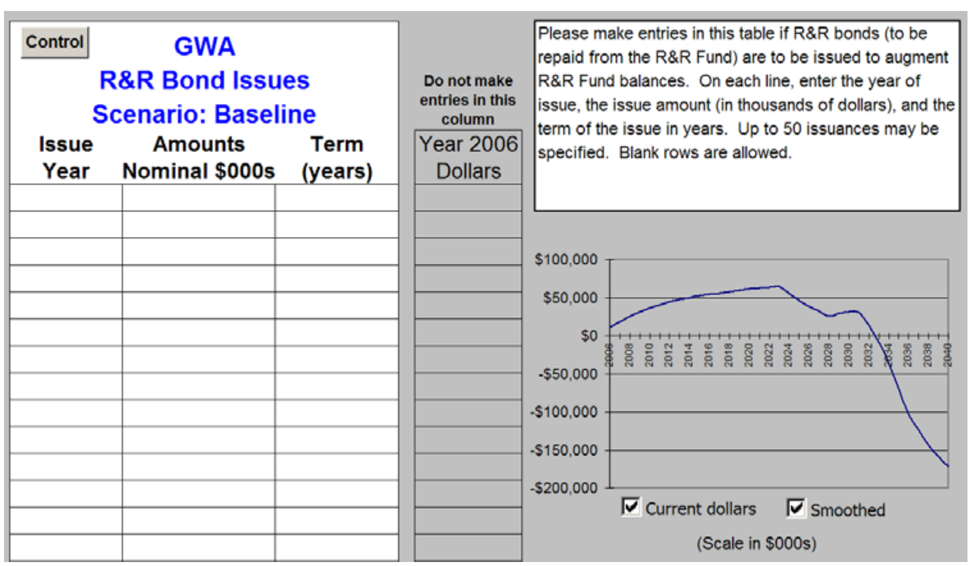


Figure 6. R&R Bond Issues Entry Screen

Whenever an amount is entered, the model will generate a cash infusion to the R&R Fund during that year equal to the issue amount, followed by level cash outflows representing the amortization of principal plus interest over the term of the bonds. The interest rate is as specified on the Control Panel as the *Borrowing Rate*. The model does not attempt to simulate semi-annual coupon payments, nor does it take issuance costs into account.

After entering the required information for any bond issues, the user may return to the *Control Panel* by clicking the *Control* button.

+ *R&R Surcharges* – This button brings up the *R&R Surcharges Table* for simulating rate surcharges to augment R&R Fund balances. The *R&R Surcharges* entry screen is shown below along with data entry instructions:

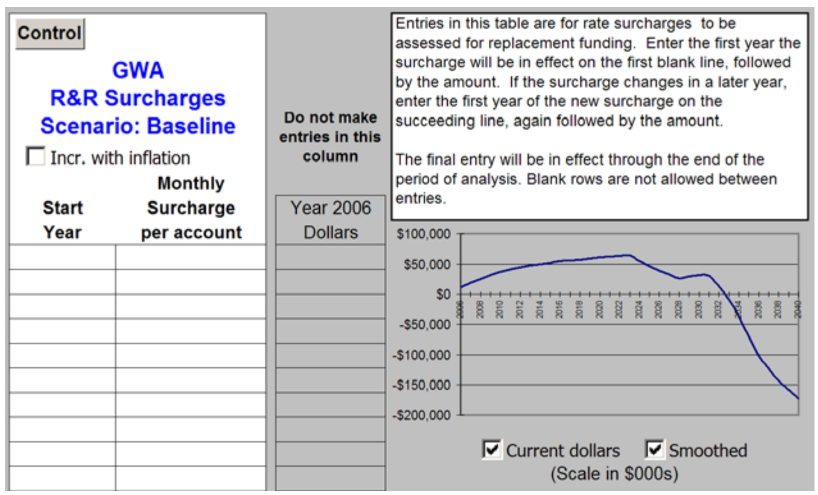


Figure 7. R&R Surcharges Entry Screen

The user may specify whether or not the surcharge grows with inflation by using the checkbox in the upper left.

+ *Other Cash Flows* – This button brings up the *Other Cash Flows* entry screen for specifying miscellaneous cash flows into and out of the fund other than user fee surcharges, operational transfers, or bond issues. Each entry has a start year, end year, initial amount (positive or negative) and annual growth rate. If the end year is not specified, the cash flow series continues throughout the period of analysis. The *Other Cash Flows Table* is shown below along with data entry instructions:

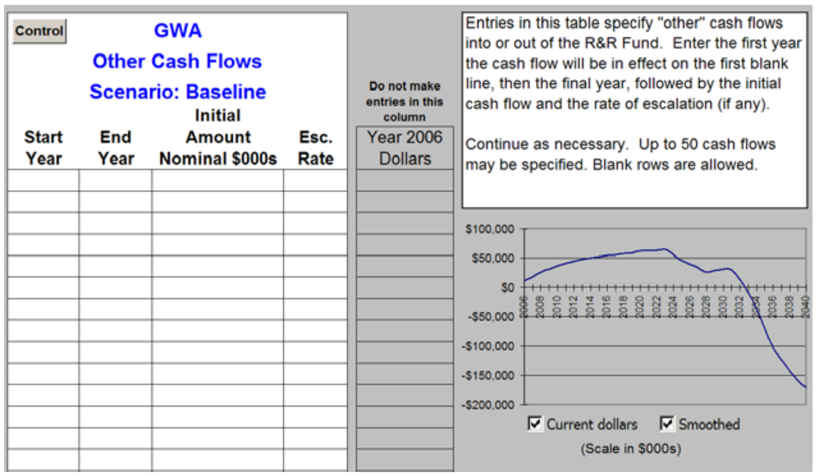


Figure 8. Other Cash Flows Entry Screen

After entering the required information for any other cash flows, the user may return to the *Control Panel* by clicking the *Control* button.

+ *Customer Accounts* – This accesses the underlying demographic data that is used to calculate the revenues arising from the R&R Surcharge. This table can be found by pressing the "Page down" key once or twice from the Control Panel until a button labeled Accounts…" is seen, and clicking that button. The screen is shown below:

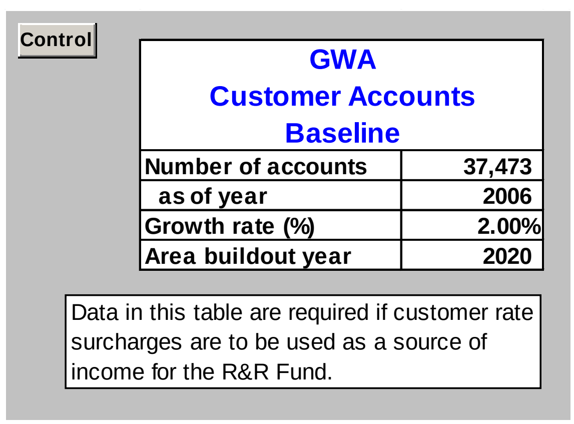


Figure 9. Customer Accounts Entry Screen

Note that these entries are used only when revenues from a customer R&R Surcharge are specified (see above). The entries on this table are:

- ✓ *Accounts in Year 2006* – This entry should be the number of equivalent customer accounts during the Initial Study Year. The *2006* in the label will reflect the year specified in *Initial Study Year*, above.

- ✓ *Growth Rate (%)* – The annual percentage rate at which new accounts are expected to be added.

- ✓ *Area Build-out Year* – The year after which growth in new accounts is expected to cease, for instance, when the service area is completely built out.

6. Miscellaneous Parameters

These data items affect the operation of the RPM and do not fit into the previous categories.

+ *Failure Handling* – The RPM lets the user select two methods of handling the replacement costs of certain asset classes: Discrete and Distributed.

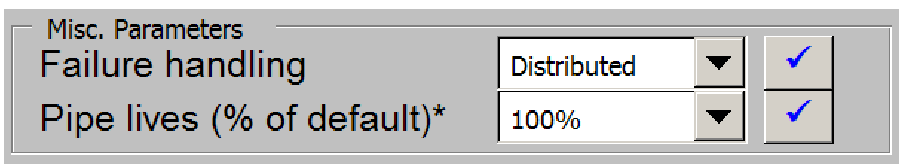


Figure 10. RPM Misc. Parameters

For each asset without a known or estimated replacement year, the RPM calculates the most likely replacement year based on the typical useful life of the asset class, the number of years the asset has already been in service, and (if available) assessments of the asset's condition, performance, utilization, and criticality. In most cases, the cost of the replacement will be assigned to that replacement year.

However, the replacement costs of some assets might well be incurred over a period of years. For example, GWA's lateral records are "grouped" by year; a typical asset record contains 321 laterals, all installed in 1969. The calculated replacement year of these laterals is 2050. It would seem unlikely, though, that all these laterals will fail simultaneously in one year; rather, they are likely to fail over a number of years arrayed around 2050, with 2050 being the year of peak failure rate.

Accordingly, the RPM offers the option of spreading the cost of failure of these laterals over several years. The failure distribution is a normal curve with a defined standard deviation—in this case, 15 percent of the class life of 75 years, or 11.25 years. This means that two-thirds of failure costs will be incurred within one standard deviation of the mean of 2050, or between 2039 and 2061.

In GWA's RPM, several asset classes are allowed the option of distributed failures: pipes (all types), water services, water valves, water meters, hydrants, sewer laterals, and manholes. If the "discrete" failure mode is chosen, the total replacement costs for assets in all classes will be assigned to the calculated replacement year. If the "distributed" mode is chosen, the replacement costs of assets with the distributed failure option will be spread around the calculated replacement years, as described in the preceding paragraph. Other asset classes will be unaffected.

In general, the user should consider the "distributed" failure mode to yield a more accurate representation of future replacement costs for two reasons:

1. It avoids unrealistic peaks in replacement costs, *e.g.*, replacing the entire length of a 5-mile pipeline in a single year.

2. It brings forward some replacement costs that are, in fact, incurred even though the asset class lives would not in themselves predict this. For example, based purely on the installation date of GWA's pipes and typical pipe lives, the utility would experience essentially *no* pipe replacements prior to 2038. This is obviously unrealistic; using the "distributed" failure mode accounts for the fact that pipes *do* experience early failures and ensures that near-term replacement cost forecasts accord with actual current experience.

+ *Pipe Lives (% of Default)* – Pipes are the largest asset class at GWA. Estimated useful lives of all classes of pipes can be adjusted from their default values by entering a value different from 100 percent by using this drop-down box: 50, 75, 100, 125, 150, and 200 percent of default useful lives may be selected. This is useful for evaluating replacement needs under assumptions of longer or shorter pipe lives than currently estimated.

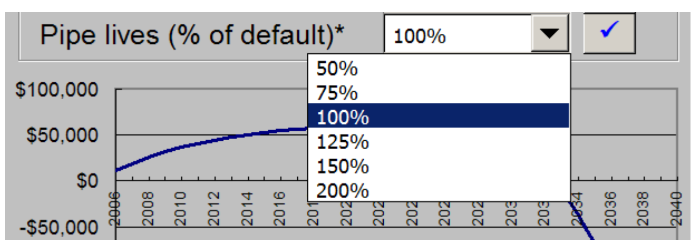


Figure 11. Pipe Lives Sensitivity Analysis Selector

This control affects useful lives of pipes, manholes, and laterals. You must click the *Run Simulation* button for any change to take full effect.

7. Options

There are two checkboxes in the lower left corner of the *Control Panel* setting which affects the R&R Fund balances:

+ *Include Refurbishments* – If checked, disbursements from the R&R Fund will include amounts for capital refurbishment of system assets as well as replacements. The percentage of refurbishments funded will be the same as that specified for replacements. If unchecked, the R&R Fund will only fund replacements, not refurbishments.

+ *Chg Int on Neg Balances* – This checkbox specifies whether or not the R&R Fund will accrue interest charges during years when it has negative balances. It does not affect fund earnings in years when the balance is positive.

8. Actions

There are four buttons and two checkboxes at the upper-right corner of the *Control Panel*:

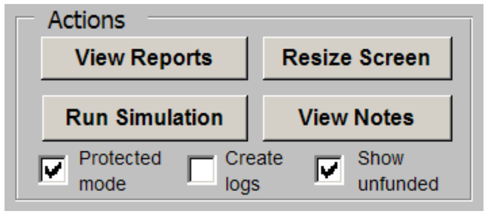


Figure 12. Action Controls

+ The *View Reports* button brings up a dialog that allows the user to view major RPM reports in graphical and tabular form. Choices are clearly indicated on the menu:

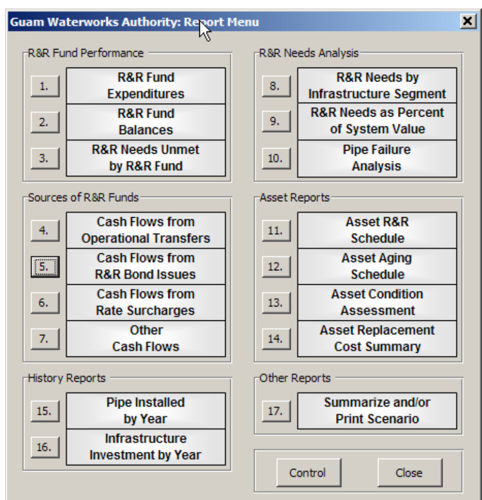


Figure 13. RPM Report Menu

The individual reports are discussed further below.

+ The *Resize Screen* button will resize most input and display screens to fit the monitor resolution currently being used. This is done automatically on start-up, but the user may want to click this button if he or she has changed screen resolution or window sizes during a session.

+ The *Run Simulation* button causes all R&R calculations to be run. As noted earlier, this is necessary when asterisked Control Panel entries are changed or the user wants to create certain reports (see further discussion below). This is often required because the RPM's calculations are split between normal Excel functions, which recalculate automatically, and calculations performed by code, which executes only when so instructed.

  This button must be clicked to update the model whenever a value has changed in an input field or control whose label is followed by an asterisk. These fields are listed below:

  - Whenever the *Initial Study Year* value is changed
  - Whenever the *Length of Study* value is changed
  - Whenever *Future Cost* Escalation is changed
  - Whenever *Funding Filters* are changed
  - Whenever *Pipe lives (% of default)* is changed
  - Whenever the *Asset Pricing Year* is changed
  - Whenever *Old Asset Replacement Factor* is changed
  - Whenever any inventory data contained within the model have been altered
  - Whenever the user wants to update the listings of R&R transactions and old assets (Reports 11 and 12).

  The last item requires that the Create Logs checkbox be checked (see below).

+ The *View Notes* button displays brief descriptions of each entry on the *Control Panel.*

+ *Protect* – If this checkbox is checked, all row and column headings will be hidden and worksheet tabs will not be visible. If unchecked, the user can see tabs, row and column headings, and can generally have access to all parts of the RPM. The experienced user may want to use the latter setting, but casual users should run the RPM in protected mode. Protected mode is also appropriate for using the RPM at meetings (Boards of Directors and City Councils, for example).

+ *Create Logs* – If this checkbox is checked, the RPM will create two special listings when the *Run Simulation* button is clicked: (1) a log of all R&R transactions during the study period; and (2) a listing of assets by percentage of useful lives expired (see descriptions of Reports 11 and 12 in the *Reports* section below). Because creating the logs slows down the simulation, it is suggested that this box be checked only when the user specifically desires updated listings.
+ *Show Unfunded* – If this checkbox is checked, all R&R transactions (even those below the Low Filter or above the High Filter) will be included on the Asset R&R Schedule next time the simulation is run with the Create Logs checkbox checked. If the checkbox is unchecked, only those transactions qualifying for funding from the R&R Fund will be shown.

9. Scenario Management

One strength of the RPM is its ability to create and manage up to six scenarios. At any point *all* user input variables can be saved as a named scenario and later recalled. Various scenarios can easily be compared. Data that are saved with a scenario include all *Control Panel* entries and all entries in subsidiary screens. Manual changes to the asset database or to asset class parameters (default useful lives, pricing tables, etc.) are *not* saved with scenarios but affect all scenarios.

Scenario management functions are handled by the group of controls in the upper-left of the *Control Panel.*

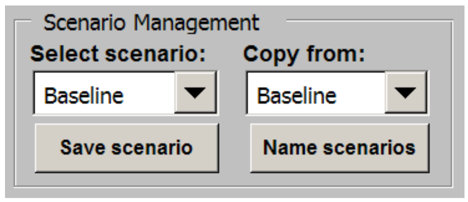


Figure 14. Scenario Management Controls

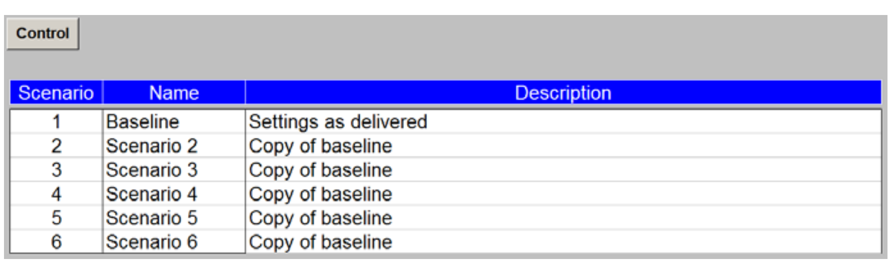
Here are descriptions of the four controls:

+ *Select scenario*— Use this drop-down box to exit the current scenario and select a new one. All user entry data in the RPM will be automatically updated to the selected scenario. If you have made changes in the current scenario, you will be prompted to save your changes (if desired).

+ *Copy from*—Use this drop-down box to copy all data from another scenario into the current scenario. All user entry data in the RPM's current scenario will be automatically updated from the selected scenario.

+ *Save scenario*—This button saves any changes you have made to the current scenario. You can do this at any time without exiting the scenario.

+ *Name scenarios*—Before saving a scenario, you should give it a short name and a description. To do this, click the *Name Scenarios* button. This will display an entry screen where you can enter the short name, which will appear in the *Select scenario* and *Copy from* drop-down boxes, and a longer description as well. You can freely edit the *Name* and *Description* entries for all scenarios here.


Control

Scenario	Name	Description
1	Baseline	Settings as delivered
2	Scenario 2	Copy of baseline
3	Scenario 3	Copy of baseline
4	Scenario 4	Copy of baseline
5	Scenario 5	Copy of baseline
6	Scenario 6	Copy of baseline

Figure 15. Entry Screen for Naming Scenarios

Managing Differences among Scenarios

Any changes to entries, either on the main *Control Panel* screen or within subsidiary screens, apply to the *active scenario only*. To help you keep track of differences among scenarios, a red checkbox will appear opposite any entry or subsidiary screen button where data in the six possible scenarios, as saved, are not equal. Here's an example:

Figure 16. Example Where Entries across Scenarios Are Not Equal

In this case, the *Length of study* of the current scenario, as last saved, is 40 years, but the red checkbox means that at least one other scenario has a *Length of study* of other than 40 years.

In some cases, this will be desirable—for example, you will likely have specified different R&R Fund transfer amounts in different scenarios. But in other cases, cost escalation rate for instance, you may want all scenarios to have the same value.

If that is the case, you can copy the current value across all scenarios by simply clicking the *blue checked ("Copy to all") button* between the entry and the red checkbox. If you do this, you will be prompted to make sure you really want to write the current value across all scenarios; if you click *Yes*, the red checkbox will disappear because the value will now be the same for all scenarios.

Managing Scenarios

A good way to manage scenarios is as follows:

+ Work on a scenario (let's say you are working on Scenario 1, *Baseline)*. When you have that scenario the way you like it, update the name and description using the *Name Scenario* button (if necessary) and select a new scenario. You will be prompted to save your changes if you have not done so, and you should answer *Yes*. The current scenario, *Baseline*, will be saved and you will be switched to the new scenario.

+ Now use the *Copy from Scenario* drop-down box to copy all the data from *Baseline* into your new current scenario:

+ Proceed to modify the data to create a second scenario, name and describe it as before, and save it by selecting yet a third scenario.

And so forth.

D. UNDERSTANDING RPM REPORTS

As noted previously, the *Report Menu* button brings up a dialog that allows the user to view major RPM reports in graphical and tabular form. Choices are clearly indicated on the menu:

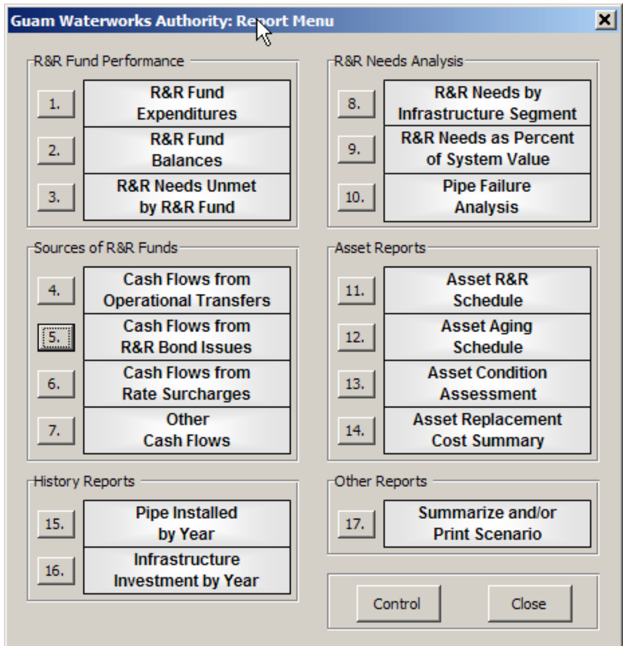


Figure 17. RPM Report Menu

The remainder of this section explains the graphs and associated tables in the order in which they appear on the *Report Menu*.

R&R Fund Performance (Reports 1 through 3)—*The first three reports help to analyze the simulated performance of the R&R Fund. The calculations underlying these graphs take into account all aspects of replacement needs and funding such as user fee surcharges, bond issuance, percentage limits of the Fund's payments for replacements, etc. The first two reports show fund expenditures and fund balances. The third report relates to R&R needs that are unmet by the R&R Fund given the fund contribution and other financial policies currently specified.*

Report 1: R&R Fund Expenditures

This chart shows the programmatic expenditures from the fund. Replacement, refurbishment, and miscellaneous categories are presented separately.

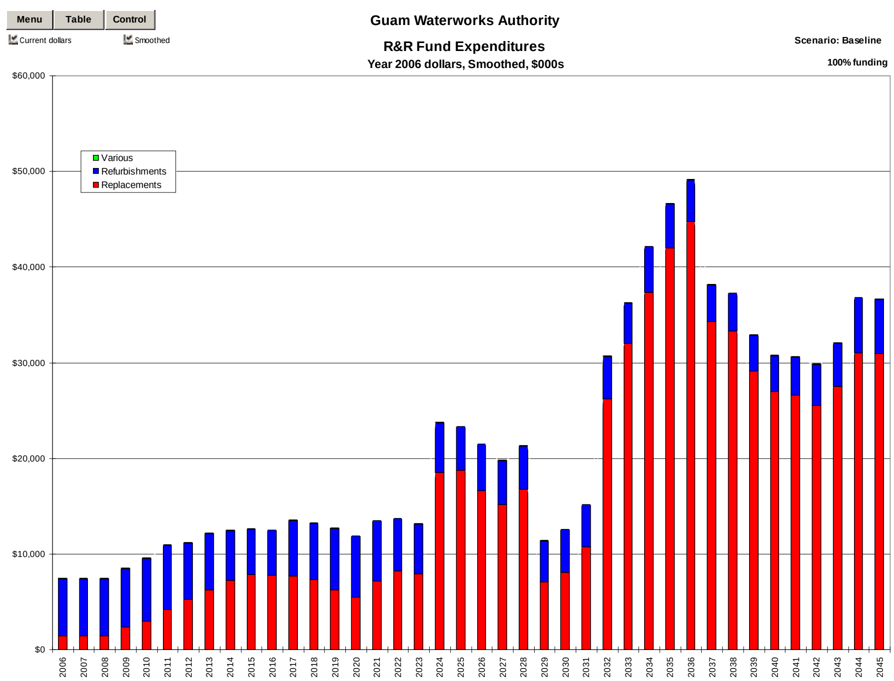


Figure 18. R&R Fund Expenditures Chart

This chart, like most others, includes three buttons in its upper-left corner:

+ The *Menu* button brings back the *Report Menu* dialog for further navigation.
+ The *Table* button displays the tabular data underlying the chart for further inspection.
+ The *Control* button returns the user directly to the *Control Panel*.

The chart also has two checkboxes that are available on many other charts as well:

+ *Current Dollars*—If checked, the chart will show all values in dollars applicable to the *Initial Study Year*. If unchecked, the chart will display then-period dollars, that is, including the effects of inflation. This option can be useful in eliminating the effects of general inflation from the displayed results.

+ *Smoothed*—If checked, graphs are "smoothed" using a 5-year center-weighted moving average technique. Years 1 through 3 of the display will all use the average of actual values for years 1 through 5. From that point forward, each year displayed will use the average of actual values of the 5-year period centered on that year. For instance, the value displayed for year 12 will be the average of actual values from year 10 through year 14.

Selecting the *current dollars* or *smoothed* options affects all charts and tables in the model that have these options.

Clicking the *Table* button shows the data underlying the chart.

Menu Control

☑ Current dollars

☑ Smoothed

Guam Waterworks Authority
Scenario: Baseline
R&R Fund Expenditures
Year 2006 dollars, Smoothed, $000s

	Replace	Refurb	Various	Total		Replace	Refurb	Various	Total
2006	1,465	5,956	50	7,471	2031	10,726	4,420	50	15,196
2007	1,465	5,956	50	7,471	2032	26,249	4,388	50	30,688
2008	1,465	5,956	50	7,471	2033	31,999	4,223	50	36,272
2009	2,342	6,129	50	8,522	2034	37,362	4,761	50	42,173
2010	3,009	6,548	50	9,607	2035	41,995	4,591	50	46,636
2011	4,217	6,679	50	10,946	2036	44,752	4,337	50	49,139
2012	5,264	5,887	50	11,201	2037	34,327	3,786	50	38,163
2013	6,285	5,837	50	12,172	2038	33,280	3,963	50	37,293
2014	7,264	5,182	50	12,496	2039	29,092	3,761	50	32,903
2015	7,828	4,786	50	12,664	2040	26,959	3,802	50	30,811
2016	7,760	4,713	50	12,523	2041	26,595	3,967	50	30,612
2017	7,725	5,797	50	13,572	2042	25,559	4,263	50	29,871
2018	7,291	5,890	50	13,231	2043	27,493	4,556	50	32,099
2019	6,278	6,398	50	12,726	2044	31,004	5,782	50	36,837
2020	5,474	6,396	50	11,921	2045	30,950	5,666	50	36,666
2021	7,131	6,343	50	13,524	2046	29,357	5,431	50	34,838
2022	8,216	5,470	50	13,735	2047	29,381	5,718	50	35,149
2023	7,917	5,188	50	13,155	2048	26,386	5,916	50	32,352
2024	18,556	5,172	50	23,778	2049	28,126	4,460	50	32,635
2025	18,727	4,575	50	23,352	2050	30,565	4,681	50	35,297
2026	16,606	4,872	50	21,528	2051	33,347	5,370	50	38,768
2027	15,186	4,566	50	19,803	2052	34,787	5,851	50	40,688
2028	16,747	4,562	50	21,358	2053	35,621	6,021	50	41,691
2029	7,116	4,270	50	11,437	2054	39,841	6,252	50	46,143
2030	8,078	4,476	50	12,604	2055	42,196	5,866	50	48,111

Figure 19. R&R Fund Expenditures

This, like most tabular reports, has two control buttons marked *Menu* and *Control*. The first button brings back the *Report Menu* dialog for further navigation, while the second returns the user to the *Control Panel*.

Report 2: R&R Fund Balances

The report shows the expected R&R Fund ending balances over the projection period, including all cash inflows and outflows. It is a larger and more detailed version of the "thumbnail" graph that appears on the *Control Panel* and other input screens.

Here is what the report looks like.

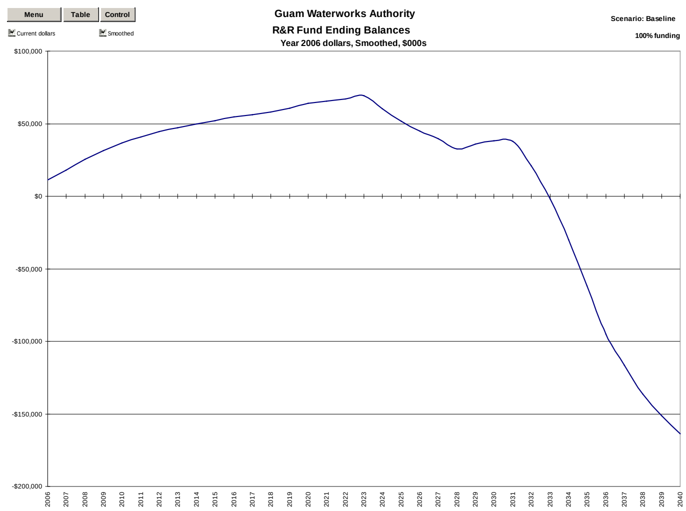


Figure 20. R&R Fund Ending Balances Chart

The associated tabular report describes all flows into and out of the R&R Fund, with beginning and ending balances by year. This is a 50-year table, only the initial years being shown in the table below.

Menu Control

Guam Waterworks Authority
Replacement Planning Model
Scenario: Baseline
R&R Fund Activity Summary (Nominal Dollars, Smoothed, $000s)

Please see note at bottom of schedule.

☑ Smoothed

	Beginning balance	Transfers from op'ns	Rate surcharges	Spl Bonds (net)	Interest earnings	Other cash flows	Repl. costs	Refurb. costs	Various costs	Ending balance	Current $ Balance
2006	4,000	14,000	0	0	526	0	(1,465)	(5,956)	(50)	11,055	11,055
2007	11,055	14,420	0	0	889	0	(1,509)	(6,134)	(52)	18,669	18,126
2008	18,669	14,853	0	0	1,280	0	(1,554)	(6,318)	(53)	26,876	25,333
2009	26,876	15,298	0	0	1,643	0	(2,560)	(6,698)	(55)	34,505	31,577
2010	34,505	15,757	0	0	1,972	0	(3,386)	(7,370)	(56)	41,422	36,803
2011	41,422	16,230	0	0	2,248	0	(4,888)	(7,743)	(58)	47,211	40,725
2012	47,211	16,717	0	0	2,528	0	(6,286)	(7,030)	(60)	53,080	44,454
2013	53,080	17,218	0	0	2,766	0	(7,730)	(7,179)	(61)	58,094	47,236
2014	58,094	17,735	0	0	3,000	0	(9,202)	(6,565)	(63)	62,999	49,732
2015	62,999	18,267	0	0	3,237	0	(10,214)	(6,244)	(65)	67,980	52,101
2016	67,980	18,815	0	0	3,498	0	(10,429)	(6,334)	(67)	73,463	54,663
2017	73,463	19,379	0	0	3,703	0	(10,694)	(8,024)	(69)	77,758	56,174
2018	77,758	19,961	0	0	3,943	0	(10,395)	(8,397)	(71)	82,798	58,073
2019	82,798	20,559	0	0	4,233	0	(9,220)	(9,396)	(73)	88,902	60,538
2020	88,902	21,176	0	0	4,602	0	(8,280)	(9,675)	(76)	96,650	63,897
2021	96,650	21,812	0	0	4,870	0	(11,110)	(9,882)	(78)	102,261	65,638
2022	102,261	22,466	0	0	5,134	0	(13,183)	(8,778)	(80)	107,820	67,190
2023	107,820	23,140	0	0	5,461	0	(13,085)	(8,575)	(83)	114,678	69,382
2024	114,678	23,834	0	0	4,902	0	(31,591)	(8,805)	(85)	102,933	60,462
2025	102,933	24,549	0	0	4,327	0	(32,838)	(8,023)	(88)	90,861	51,817
2026	90,861	25,286	0	0	3,863	0	(29,992)	(8,799)	(90)	81,129	44,919
2027	81,129	26,044	0	0	3,517	0	(28,251)	(8,494)	(93)	73,851	39,698

Figure 21. R&R Fund Activity (partial table)

Its logic is as follows:

+ Beginning balance is as of the *Initial Study Year* as specified in the *Control Panel.*
+ Inflows include:
  - ✓ Transfers from operations, based on the *Annual transfer* amount from the *Control Panel*, escalated by the *Future cost escalation*.
  - ✓ Interest accrued in each year based on the previous year's balance and the *Earnings rate* from the *Control Panel.*
  - ✓ Rate surcharge revenues based on the *Accounts in year 2006* from the *Control Panel*, escalating by the associated *Growth rate*, and on the entries in the *R&R Surcharge Table*.
  - ✓ Proceeds from the bond sales and debt repayments from the *R&R Bond Table*, accessed from the *Control Panel.*
  - ✓ Other cash flows from the *Other Cash Flows Table*, accessed from the *Control Panel.*
+ Outflows include:
  - ✓ Replacements or refurbishments due in any year based on costs calculated from the system inventory pages (see below), *Future cost escalation*, the *Pct of R&R funded*, and the inclusion or exclusion of refurbishment funding, all from the *Control Panel.*
  - ✓ Miscellaneous replacement costs, defined as the amount entered in the *Misc. Repl. Costs* field in the *Control Panel*, escalated by the *Future cost escalation* and modified by the *Pct of R&R funded.*
  - ✓ Interest paid by the fund on assumed borrowings when the fund balance is negative, based on the average fund balance for the preceding year, the *Borrowing Rate* from the *Control Panel*, and the status of the *Charge interest on negative balances* checkbox.
  - ✓ Calculation of the fund balance proceeds year-by-year. Each year's ending balance becomes the next year's beginning balance.

Report 3: Unmet Replacement Needs

This graph summarizes expected replacement expenditures, by year, that are not met by the R&R Fund. The graph differentiates between three types of unmet needs:

+ If the entry for *Pct replacements funded* entry on the *Control Panel* is less than 100 percent, then some replacement needs will be unmet by policy.
+ Based on the low or high *Funding filters* specified on the *Control Panel*, some small and/or large R&R expenditures may not be charged to the R&R Fund (again, due to policy).

+ Finally, depending on appropriation policies (defined on the *Operational Transfers* table) and other policies, the R&R Fund balance may still be negative in any given year. If so, some R&R needs during that year will be unmet due to fund inadequacy.

An example of this report is shown below:

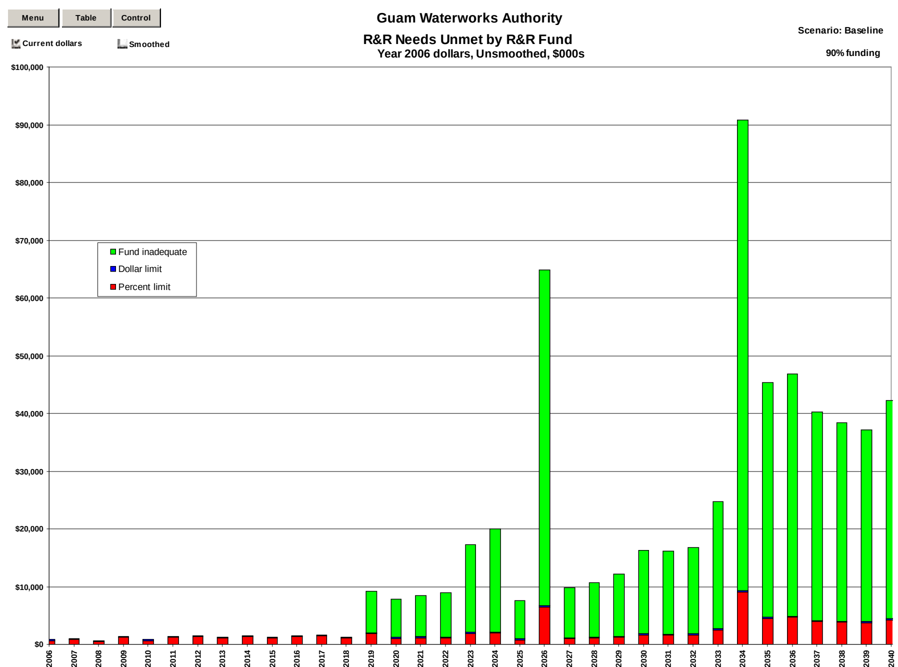


Figure 22. R&R Needs Unmet by Fund Chart

As is usually the case with graphical reports, a tabular representation of the same data is available via the *Table* button.

***Sources of R&R Funds (Reports 4 through 7)**—These four reports show R&R Fund cash sources as specified in the Control Panel sub-menus. These are cash flows from operational transfers, bond issues, from rate surcharges, and from other cash flows.*

Report 4: Cash Flows from Operational Transfers

This report shows cash flows resulting from annual operational transfers from GWA operational revenues to support the R&R Fund. These transfers are entered on the *Annual Transfers* entry screen, accessed from the *Control Panel*. This example shows the operational transfers resulting from a policy of annual inflationary increases to the transfer level.

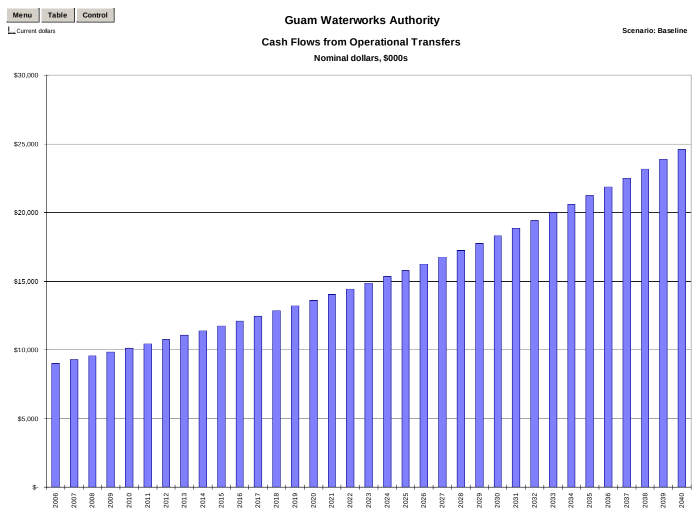


Figure 23. Cash Flows from Operational Transfers Chart

Report 5: Cash Flows from R&R Bond Issues

This report shows cash flows resulting from the bonds or notes that may be issued by GWA to support the R&R Fund. Those bonds or notes are entered on the *R&R Bond* entry screen, accessed from the *Control Panel*. The sample shown is based on two bond issues, the second issuance made before the first has come to term.

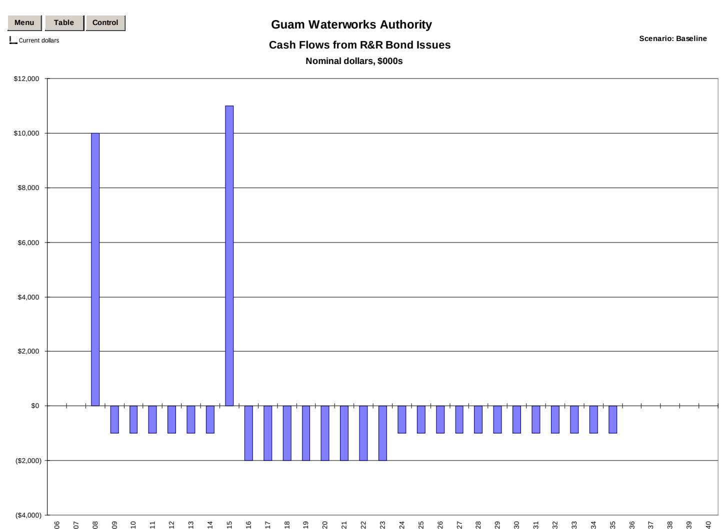


Figure 24. Cash Flows from R&R Bond Issues Chart

Report 6: Cash Flows from Rate Surcharges

This report shows the total value of user fee surcharges assessed to augment the R&R Fund. User fee surcharges are entered on the *R&R Surcharge* entry screen, accessed from the *Control Panel*. A sample report is not shown.

Report 7: Other Cash Flows

This report shows the annual value of "other cash flows" affecting the R&R Fund. For instance, an expected insurance settlement might be considered in this category if management intends to apply it to replacement needs. These cash flows are entered on the *Other Cash Flows* entry screen, accessed from the *Control Panel*. A sample report is not shown.

> ***R&R Needs Analysis (Reports 8 through 10)****—The next three graphs relate to R&R needs only and have no reference to the R&R Fund. Specifically, the Pct of R&R funded entry on the Control Panel has no effect on these graphs, nor do the funding filters; replacement needs are shown at 100 percent. Inclusion or exclusion of refurbishments is still in effect, however, and notations on each graph indicate the status of this option.*

Report 8: Replacement Needs by Infrastructure Segment

This report allows access to a set of graphs. Each graph shows replacement needs over the period of analysis of an infrastructure segment. Refurbishment costs are included if so specified in the *Control Panel*. An example is shown below:

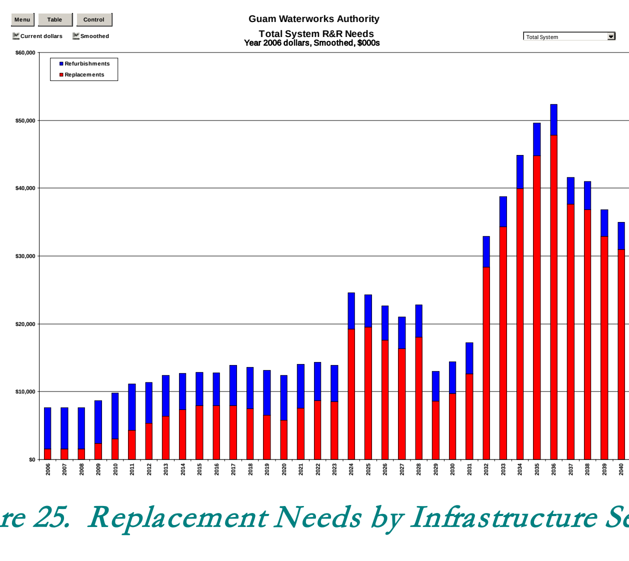


Figure 25. Replacement Needs by Infrastructure Segment

The drop-down box in the upper right allows the user to select the following infrastructure segments:

+ Water treatment plants/pump stations
+ Water pipes
+ Water system appurtenances (hydrants, valves, meters and services)
+ Wastewater treatment plants/pump stations
+ Wastewater pipes and force mains
+ Wastewater system appurtenances (laterals and manholes)
+ Various (from the *Annual Various Costs* entry on the Control Panel)
+ Total system.

The associated tabular report, accessed with the *Table* button, presents data for the infrastructure segment currently selected for the chart.

Report 9: R&R Needs as Percentage of System Value

This report shows the projected yearly R&R needs expressed as a percentage of the replacement value of GWA's assets. An example is shown below.

Menu Control

☑ Current dollars ☑ Smoothed

Guam Waterworks Authority
R&R Needs as Percentage of System Value
Year 2006 dollars, Smoothed, $000s

	System value	Repl.	Refurbs	Total R&R	Pct of value		System value	Repl.	Refurbs	Total R&R	Pct of value
2006	2,177,350	1,525	6,125	7,649	0.35%	2031	2,177,350	12,610	4,591	17,201	0.79%
2007	2,177,350	1,525	6,125	7,649	0.35%	2032	2,177,350	28,356	4,564	32,921	1.51%
2008	2,177,350	1,525	6,125	7,649	0.35%	2033	2,177,350	34,337	4,400	38,736	1.78%
2009	2,177,350	2,406	6,307	8,713	0.40%	2034	2,177,350	39,938	4,945	44,883	2.06%
2010	2,177,350	3,077	6,728	9,806	0.45%	2035	2,177,350	44,814	4,772	49,586	2.28%
2011	2,177,350	4,292	6,850	11,143	0.51%	2036	2,177,350	47,816	4,499	52,315	2.40%
2012	2,177,350	5,349	6,041	11,391	0.52%	2037	2,177,350	37,636	3,951	41,587	1.91%
2013	2,177,350	6,382	5,987	12,370	0.57%	2038	2,177,350	36,831	4,145	40,977	1.88%
2014	2,177,350	7,377	5,328	12,705	0.58%	2039	2,177,350	32,881	3,954	36,835	1.69%
2015	2,177,350	7,962	4,920	12,882	0.59%	2040	2,177,350	30,979	4,006	34,985	1.61%
2016	2,177,350	7,920	4,853	12,772	0.59%	2041	2,177,350	30,837	4,193	35,030	1.61%
2017	2,177,350	7,917	5,944	13,861	0.64%	2042	2,177,350	30,012	4,494	34,506	1.58%
2018	2,177,350	7,523	6,049	13,572	0.62%	2043	2,177,350	32,144	4,781	36,925	1.70%
2019	2,177,350	6,558	6,557	13,116	0.60%	2044	2,177,350	35,838	6,000	41,838	1.92%
2020	2,177,350	5,813	6,563	12,376	0.57%	2045	2,177,350	35,950	5,880	41,830	1.92%
2021	2,177,350	7,540	6,517	14,057	0.65%	2046	2,177,350	34,505	5,647	40,152	1.84%
2022	2,177,350	8,706	5,642	14,348	0.66%	2047	2,177,350	34,657	5,916	40,573	1.86%
2023	2,177,350	8,503	5,357	13,860	0.64%	2048	2,177,350	31,769	6,105	37,874	1.74%
2024	2,177,350	19,253	5,342	24,595	1.13%	2049	2,177,350	33,593	4,671	38,264	1.76%
2025	2,177,350	19,548	4,748	24,297	1.12%	2050	2,177,350	36,093	4,891	40,984	1.88%
2026	2,177,350	17,567	5,053	22,620	1.04%	2051	2,177,350	38,912	5,562	44,474	2.04%
2027	2,177,350	16,304	4,747	21,051	0.97%	2052	2,177,350	40,365	6,045	46,410	2.13%
2028	2,177,350	18,035	4,741	22,776	1.05%	2053	2,177,350	41,186	6,215	47,401	2.18%
2029	2,177,350	8,590	4,439	13,029	0.60%	2054	2,177,350	45,371	6,419	51,790	2.38%
2030	2,177,350	9,751	4,646	14,397	0.66%	2055	2,177,350	47,667	6,019	53,686	2.47%

Figure 26. R&R Needs as Percentage of System Value

Report 10: Pipe Failure Analysis

This report shows projected yearly R&R needs for pipes using both discrete and distributed failure handling. An example is shown below, using a 60-year time horizon for clarity. Discrete pipe failures would not normally be expected in the near term because of the typically long lives of pipes. Distributed failure curves bring the "leading edge" of failures (and the associated costs) into a nearer period of time, when we might actually expect to incur such costs.

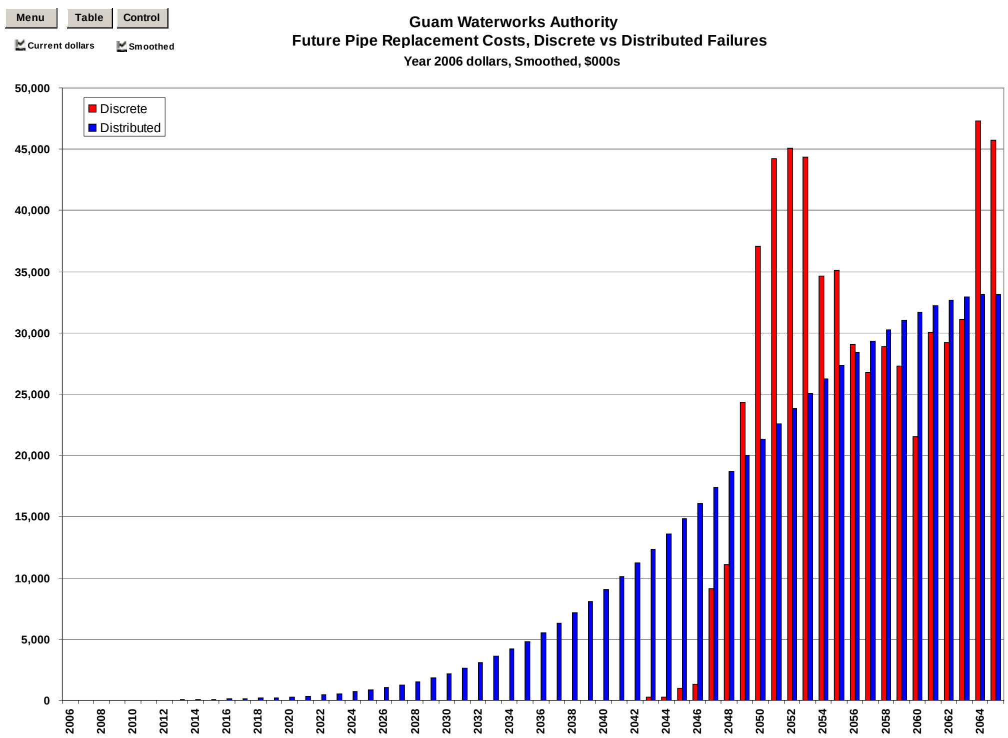


Figure 27. Pipe Failure Replacement Costs (discrete versus distributed)

> ***Asset Reports (Reports 11 through 14)***—*These reports present information on system value and condition. They also address details of the R&R transactions that underlie the RPM's calculations and presents data on the system's oldest assets. The first report lists the individual transactions used by the RPM to aggregate annual R&R expenditures. The second lists GWA assets by percentage of class-based useful life expended. The third shows asset condition and the fourth provides a summary of asset replacement value.*

Report 11: Asset R&R Schedule

This report displays a log of all asset replacements assumed by the RPM during the period of analysis. Note that to create this log, the *Run Simulation* button on the *Control Panel* must be clicked while the *Create a log* checkbox is checked.

Menu | Control

Guam Waterworks Authority
Replacement Planning Model
Asset R&R Schedule from 2006

Print this schedule from the "File"

Created: 1/10/2007 at 12:35:40 PM   Pipe lives: 100%   Cost escalation: 3.00%   Number of entries: 7,849

Segment	Year in Service	Year of R&R	Asset Number	Asset Class	Asset Description	Action	Action Source	Fund Source	Est Cost, 2006 $	Est Cost, esc. $
W_plant	1991	2006	1010072	RES	Kaiser Steel	Exterior painting, grouting	Cyclic	R&R fund	906,750	906,750
W_plant	1991	2006	821635	RES	Mangilao #1 Steel	Exterior painting, grouting	Cyclic	R&R fund	725,400	725,400
W_plant	1976	2006	821137	RES	Tumon #2 Steel	Exterior painting, grouting	Cyclic	R&R fund	390,600	390,600
W_plant	1996	2006	WELL243	WELL	Well M-20A, Well	Clean, upkeep	Cyclic	R&R fund	153,450	153,450
W_plant	1996	2006	1010567	WELL	Well F-17, Well	Clean, upkeep	Cyclic	R&R fund	152,578	152,578
W_plant	1996	2006	1010568	WELL	Well F-18, Well	Clean, upkeep	Cyclic	R&R fund	151,997	151,997
W_plant	1991	2006	1010072	RES	Kaiser Steel	Clean and Epoxy interior	Cyclic	R&R fund	151,125	151,125
W_plant	1996	2006	816870	RES	Yigo #2 Steel	Clean and Epoxy interior	Cyclic	R&R fund	151,125	151,125
W_plant	1981	2006	1010564	WELL	Well Y-5, Well	Clean, upkeep	Cyclic	R&R fund	140,372	140,372
W_plant	1966	2006	403101	WELL	Well Y-1, Well	Clean, upkeep	Cyclic	R&R fund	133,978	133,978
W_plant	1971	2006	1010571	WELL	Well D-12, Well	Clean, upkeep	Cyclic	R&R fund	133,688	133,688
W_plant	1971	2006	403150	WELL	Well D-13, Well	Clean, upkeep	Cyclic	R&R fund	132,234	132,234
W_plant	1996	2006	1010572	WELL	Well D-8, Well	Clean, upkeep	Cyclic	R&R fund	130,781	130,781
W_plant	1996	2006	604514	WELL	Well Y-14, Well	Clean, upkeep	Cyclic	R&R fund	129,909	129,909
W_plant	1996	2006	1010573	WELL	Well D-7, Well	Clean, upkeep	Cyclic	R&R fund	127,003	127,003
W_plant	1996	2006	WELL128	WELL	Well D-23, Well	Clean, upkeep	Cyclic	R&R fund	126,131	126,131
W_plant	1996	2006	604327	WELL	Well Y-12, Well	Clean, upkeep	Cyclic	R&R fund	124,969	124,969
W_plant	1966	2006	403094	WELL	Well D-6, Well	Clean, upkeep	Cyclic	R&R fund	122,644	122,644

Figure 28. Asset R&R Schedule (partial table)

Report 12: Asset Aging Schedule

This report lists GWA assets in descending order by percentage of presumed useful life expended. The report is useful in reviewing assets to see which are likely candidates for replacement and thus potential targets for further evaluation. This report, like the one immediately above, is re-created when the *Run Simulation* button on the *Control Panel* is clicked while the *Create a log* checkbox is checked.

Menu | Control

Guam Waterworks Authority
Replacement Planning Model
Asset Aging Schedule as of 2006

Print this schedule from the "File" menu.

Minimum Percentage: 75%

Old assets sorfted by percent of useful life passed

Created: 1/10/2007 at 12:35:40 PM   Number of entries: 525

Segment	Asset Number	Asset Class	Asset Description	Year in Service	Useful Life	Est. Yr of Repl	Pct of Life Exp.	Repl Cost, 2006 dollars
W_plant	WTP001	CSY	Ugum Chemical Systems	1900	10	1910	1060%	372,000
WW_plant	WWTP001	CHE	Agat-Santa Rita Chemical Addition	1972	10	1982	340%	73,124
WW_plant	WWTP044	CHE	Pago Socio Rita Chemical Addition	1972	10	1982	340%	2,437
WW_plant	WWTP011	CHE	Baza Gardens Chemical Addition	1975	10	1985	310%	58,499
WW_plant	WWTP018	CHE	Hagatna Chemical Addition	1979	10	1989	270%	930,000
WW_plant	WWTP034	CHE	Northern District Chemical Addition	1979	10	1989	270%	930,000
W_plant	WTP007	FWT	Ugum Finished Water Storage Tank	1900	40	1940	265%	5,146,000
W_plant	WTP015	YPI	Ugum Yard Piping	1900	40	1940	265%	1,550,000
W_plant	WTP006	FIL	Ugum Filters	1900	40	1940	265%	744,000
W_plant	WTP013	SED	Ugum Sedimentation Basins	1900	40	1940	265%	620,000
W_plant	WTP014	SOL	Ugum Solids Handling	1900	40	1940	265%	372,000
W_plant	WTP011	FLO	Ugum Rapid Mix and Flocculation Basins	1900	40	1940	265%	310,000
W_plant	WTP010	PAV	Ugum Pavement	1900	40	1940	265%	124,000
W_plant	WTP012	RPS	Ugum Raw Water Intake and Pump Station	1900	50	1950	212%	3,417,327
W_plant	WTP005	BLDG	Ugum Filter Building	1900	50	1950	212%	1,178,000
W_plant	WTP008	HSP	Ugum High Service Pump Station	1900	50	1950	212%	806,000
W_plant	WTP009	BLDG	Ugum High Service Pump Station Building	1900	50	1950	212%	558,000
W_plant	WTP002	BLDG	Ugum Chemical Systems Building	1900	50	1950	212%	372,000
W_plant	WTP003	CLO	Ugum Chlorination	1900	50	1950	212%	310,000

Figure 29. Asset Aging Schedule (partial table)

In this report the user may specify the cutoff point in terms of percentage of minimum presumed useful life expended. The cutoff point must be specified before the simulation is run.

Report 13: Asset Condition Assessment

This report displays the condition of system assets, grouped by the assets on each property sheet. In the version of the RPM, condition is calculated based on the age of each asset as a percentage of its estimated useful life. A value of one reflects a new asset; lower values reflect increasing ages. This information is provided primarily to support future asset reporting under GASB 34 and the pending CMOM regulations; some level of physical condition assessment will be required to meet reporting requirements under either of these measures.

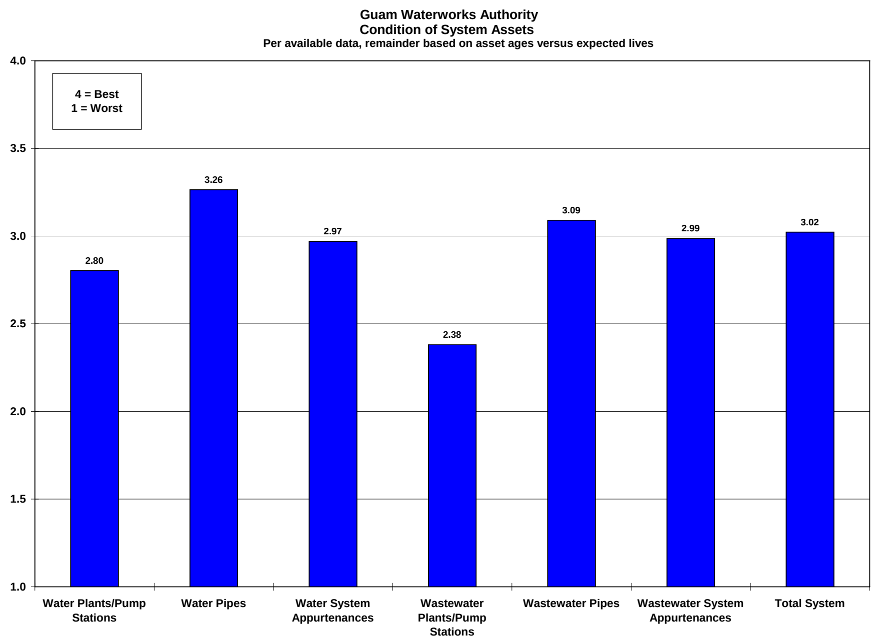


Figure 30. Condition of System Assets Report

Only some GWA assets have been assessed. In all other cases, asset condition is assumed from percentage of class useful life expended. For example, a new motor with an expected life of 20 years would be rated a "1." A similar motor that has been in place 20 years would be rated a "4."

Because the assets vary widely in cost, their aggregate condition must be calculated using a weighed average. This report averages asset conditions based on undepreciated replacement value.

Report 14: Asset Replacement Cost Summary

This report displays the current replacement value of the system. Replacement cost may be shown gross or net of depreciation using the button on the graph's upper-right hand corner.

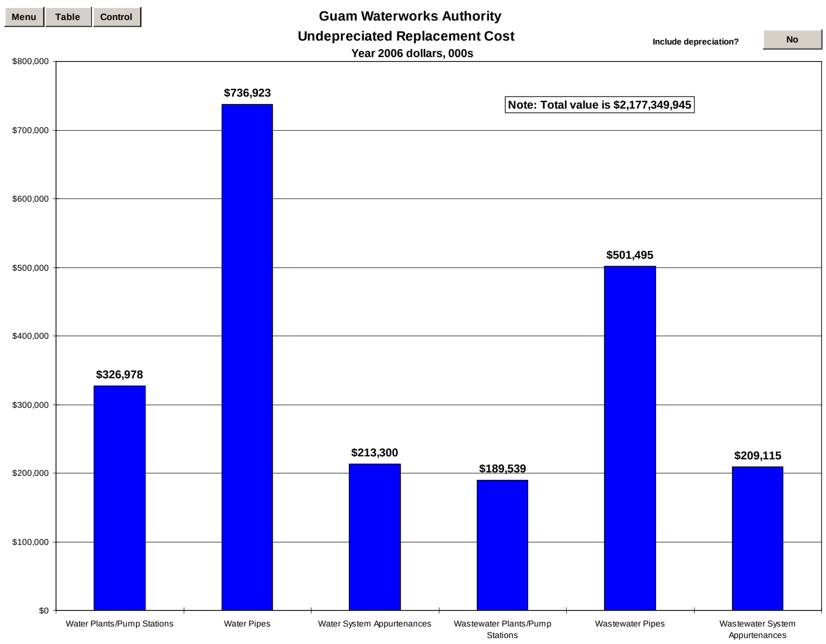


Figure 31. Asset Replacement Cost Summary Report

- Depreciation is straight-line and assumes no salvage value.
- The cost basis is the replacement cost new as of the year of analysis.
- Depreciation period is the number of years of useful life of each asset.
- Some assets may not be depreciable—land, for example. These assets are flagged by the entry of the value FALSE in the *Depreciate* column of the facility property sheets. In these cases, no depreciation is charged against the value of the asset.
- Some assets may be planned to be taken out of service (demolished) before the end of their calculated useful lives. Such assets are noted by the entry of a year in the *Demo Year* column in the facility property sheets. In these cases, depreciation period is the number of years from the time the asset was placed in service until its planned demolition.

Replacement cost is the cost of replacing assets in the system with the same types and sizes of assets already in place, except as policies exist to, for example, replace small-diameter pipe with 8" pipe as a minimum. .

The Asset Replacement Cost Summary is supported by a tabular presentation of system value. In the title of this table, "RCNLD" is an abbreviation for "Replacement Cost New Less Depreciation."

Menu Control

RCNLD of GWA Assets
as of 2006, in 2006 dollars

	Replacement Cost New	Less: Depreciation	Depreciated Replacement Cost New	Percent of Total Assets
Water Plants/Pump Stations	$326,977,681	$129,024,350	$197,953,331	15.02%
Water Pipes	736,923,148	180,653,851	556,269,298	33.84%
Water System Appurtenances	213,300,061	73,226,345	140,073,716	9.80%
Wastewater Plants/Pump Stations	189,538,930	102,258,043	87,280,887	8.71%
Wastewater Pipes	501,494,975	152,086,181	349,408,794	23.03%
Wastewater System Appurtenances	209,115,150	70,679,044	138,436,106	9.60%
Totals	$2,177,349,945	$707,927,815	$1,469,422,130	100.00%

Figure 32. RCNLD Valuation Table

History Reports (Reports 15 through 16)*—The first report shows total pipe lengths installed per year as a percentage of the total pipe in the system. The second report shows a history, based on installed cost, of development of the entire infrastructure system.*

Report 15: Pipe Installed by Year

This report displays the historical pattern of pipe investment, expressed in miles of pipes installed per year. The information is useful to get an idea of how new or old the pipe system is and when the bulk of pipe installation activity took place.

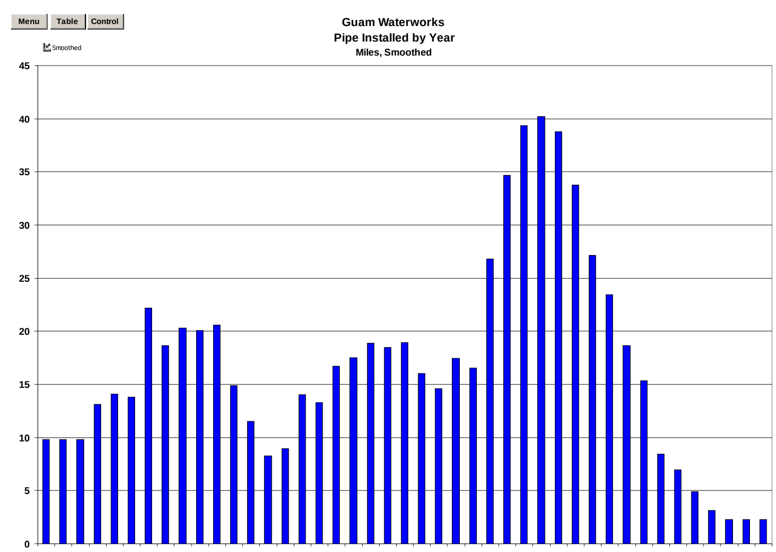


Figure 33. Pipe Installed by Year Report

Report 16: Infrastructure Investment by Year

This report displays the historical pattern of infrastructure investment, expressed in replacement value in current dollars. The information is useful to get an idea of how new or old a system is and when the bulk of development took place.

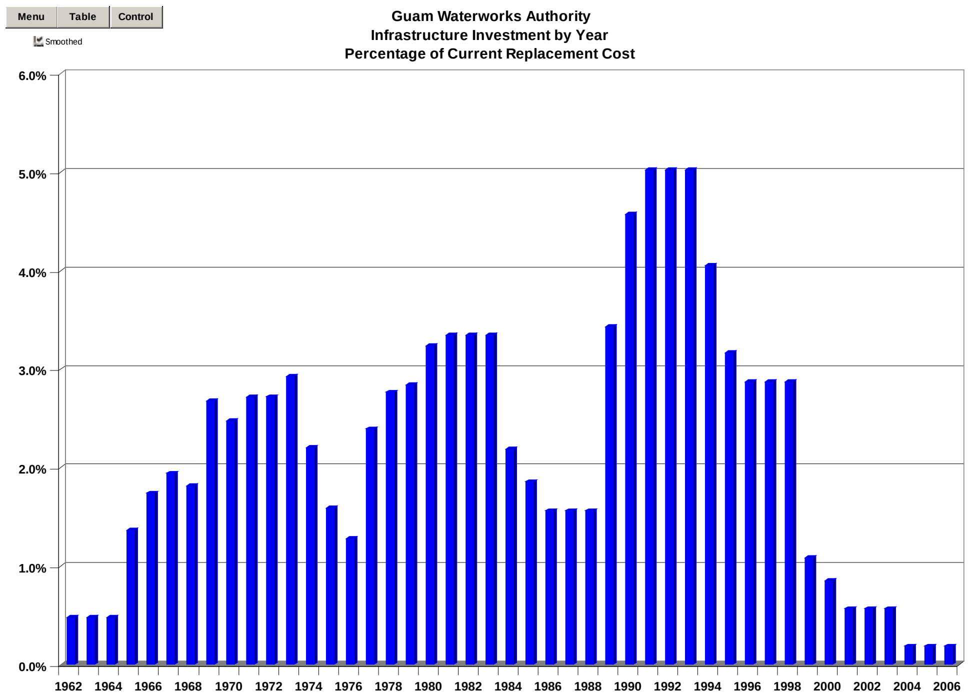


Figure 34. Infrastructure Investment by Year Report

> ***Other Reports (Report 17)—****Report 17 provides a convenient way to print out all parameters associated with a given scenario.*

Report 17: Summarize and Print Scenario

Because of its typical role in a policy-making situation, users tend to perform sensitivity analyses with the RPM. Selecting this option makes it easy to record the assumptions and policy choices used in a specific scenario and to record the results.

Selecting this option displays a page, formatted for printing that summarizes the entries in the Control Panel, displays tabular and graphical data concerning the resulting performance of the R&R Fund, and allows free-form user entry of comments. The page is protected except for the scenario title and the text box at the bottom of the page for comments.

Clicking the Print button near the top of this page prints a three-page summary of the scenario. In addition to page one, described in the paragraph above, the button prints a complete detail of all specified cash flows and assumptions as well as a 50-year table of R&R Fund cash flows.

The first page of the report is shown below.

Menu | Control | Print

Use "Page Up" and "Page Down" to navigate.
Print all pages by clicking the "Print" button.

Guam Waterworks Authority
Replacement Planning Model
Scenario: Baseline
Assumptions Page 1 (dollar amounts in $000s)

Financial assumptions:

Initial Fund Balance:	$4,000	Interest on neg. balances:	No
Fund earnings rate:	5.00%	Annual various repl. cost:	$50
Fund borrowing rate:	5.50%	Low funding limit:	$5
Cost escalation rate:	3.00%	High funding limit:	$50,000

Other assumptions:

Initial study year:	2006	Pipe failure handling:	Distributed
R&R funding:	90%	Old asset replacement factor:	5.00%
Refurbishments included:	Yes	Initial Accounts:	126,908
Pipe lives:	100%	Account Growth Rate:	2.00%
Year of Price Data:	2006	Estimated Buildout Year:	2010

Figure 35. Summarize and Print Scenario

E. MANAGING VERSIONS OF THE RPM

You may have a need to keep different versions of the RPM with different input parameters, different databases, etc. If so, you can save the RPM as many times as you want under separate file names and even in separate directories. Because the asset database is contained in the RPM file, there will be no problems of lost links.

However, you should keep clear documentation of the specific important characteristics of each version to avoid later confusion.

Very important! Remember that the RPM is not like Word; it does not "save" a data file. If you change the database or anything else and want to have the changes available to you next time, you need to save the entire RPM using Excel's File menu. It is suggested that you use File/Save as… and save the RPM under a new name so that the previous version will not be overwritten.

F. UPDATING THE RPM

1. Basic Updates

Many RPM updates can be made from the Control Panel, as explained in the prior section.

The most basic update, when using the RPM to forecast R&R needs for a new year, is to enter the year in the Initial Study Year cell. Expected escalation rates, earnings and borrowing rates, appropriation levels, and so forth are all available from the Control Panel and associated entry screens.

Be sure to update entries for Annual transfers, R&R Bonds, and Other cash flows as required. Note: Any existing entry with a start year prior to the year entered in the Control Panel's Initial study year cell will be ignored. So when you update the *Initial Study Year*, make sure you don't have entries in any of these three entry screens starting in the previous year.

2. Updating Useful Live and Cost Information

Useful lives for GWA assets, by asset class, may be found on the Class Table on tab *Class table*. This tab also contains all other information specific to each asset class. It is shown in the figure below.

						Refurbishment Type 1			Refurbishment Type 2			Refurbishment Type 3		
Asset Class	Description	Life (years)	Std Dev	Cond Gp	Perf Gp	Activity	Interval (years)	% of Repl. Cost	Activity	Interval (years)	% of Repl. Cost	Activity	Interval (years)	% of Repl. Cost
BLDG	Office-type buildings and improvements (headquarter, admin offices, etc.)	50		CA	PC	Repair/replace roof, minor building repair / HVAC	15	10%	Refresh tenant improvements	10	2%			
CHE	Wastewater Chemical Addition	10		CB	PC	Minor mech/pipe	5	5%	Minor elec	5	10%			
CLO	Chlorination	50		CB	PC	Recoat	15	10%						
CSY	Chemical Systems	10		CB	PC	Minor mech/pipe	5	5%	Minor elec	5	10%			
CWE	Clearwell	75		CB	PB	Minor mech/elec	5	3%	Maj struc/recoat	25	10%			
DIG	Digestion	50		CB	PB	Recoat structural supports	25	5%	Rehab pumps and piping	15	5%			
EJEC	Ejectors	20		CC	PB									
ELEC	Electrical service (MCC, transformers, motorized circuit breakers, etc.)	20		CC	PB									
FIL	Filters	40		CB	PC	Minor mech/pipe	5	5%	Major replace media	10	20%			
FLO	Rapid Mix and Flocculation Basins	40		CC	PB	Minor mech/pipe	5	5%	Major struc/recoat	20	8%			
FSC	Fine Screen	30		CB	PC	Service Auger and Motor	15	20%	Service Travelling Mechanism	15	10%			
FWT	Finished Water Storage Tank	40		CB	PB	Minor mech/pipe	10	5%	Major struc/recoat	20	8%			
GEN	Generators	30		CC	PB	Minor Refurbishment (Replace bearings, rewind, varnish, bake, etc.)	10	15%	Upgrade transfer switch and disconnects	20	20%	Major Overhaul	20	40%
HSP	High Service Pump Station	50		CB	PC	Replace motors and pumps	25	15%	Replace electrical service + instruments and controls (MCC, VFD. Transformers, etc)	20	20%	Misc. structural refurbishments (e.r. paint new roof, etc.)	20	5%
HWK	Headworks	40		CB	PB	Minor mech/pipe	5	5%	Major struc/recoat	20	8%	Major struc/recoat	20	8%
HYD	Hydrants	50	7.5	CF	PE	valve seal/seat replacement	10	5%						
LAT	Sewer laterals	75	11.25	CE	PD									
LEA	Lagoons and overland flows	100		CB	PC									
MANH	Manholes	60	9	CE	PD									
MECH	Mechanical piping	45		CE	PD									
METR	Meters	20	3	CC	PB									
MOTR	Motors	25		CC	PB	Minor refurbishment (Replace bearings.)	5	10%	Major refurbishment (Replace bearings, rewind, varnish and back)	20	50%			
NOS	Non-office structures and improvements (pump station buildings, utility buildings, etc.)	40		CA	PC	Misc. rehab: Paint, fix up stucco, etc.	15	10%	Structural refurbishment: New roof, etc.	25	15%			
PAB	Packaged Biological Treatment Plant	40		CB	PC	Minor mech/pipe	5	5%	Minor elec	5	10%			
PAV	Pavement	40		CF	PE	Misc rehab	10	10%						
PRY	Primary Treatment	40		CB	PB	Minor mech/pipe	5	3%	Major struc/recoat	20	8%	Major struc/recoat	20	8%
PSEW	Sewer pipe	75	11.25	CE	PD									
PUMP	Pumps	20		CF	PE	Minor refurbishment (Impeller trim, balance, bearings. etc.)	5	15%	Major refurbishment (Seal replacement, bearing replacement, shaft sleeve repair, etc.)	10	30%			
PWAT	Water pipe	80	12	CE	PD									
REC	Reservoirs (concrete)	75		CB	PC	Interior & external surface repairs	10	1%	Major Interior refurbishment	30	30%			
RES	Reservoirs (steel)	60		CD	PA	Clean and Epoxy interior	5	5%	Exterior painting, grouting	15	30%			
RPS	Raw Water Intake and Pump Station	50		CB	PC	Replace motors and pumps	25	15%	Replace electrical service + instruments and controls (MCC, VFD. Transformers, etc)	20	15%	Misc. structural refurbishments (e.r. paint new roof, etc.)	20	5%
SDB	Sludge Drying Beds	40		CF	PC	Minor mech/pipe	10	5%	Major struc/recoat	20	8%	Major struc/recoat	20	8%
SED	Sedimentation Basins	40		CB	PB	Minor mech/pipe	5	5%	Major struc/recoat	20	8%			
SITE	Site Improvements (fencing, lighting, landscaping, security system, etc.)	30		CF	PF	Misc. rehab: Repair fencing, Painting, etc.	5	5%	Update landscaping, Modify lighting, update Security System.	15	25%			
SOL	Solids Handling	40		CB	PC	Minor mech/pipe	5	5%	Minor elec	5	10%	Major struc/recoat	30	20%
SPMP	Submersible pumps	20		CF	PE									
SVC	Water services	80	12	CE	PD									
TANK	Tanks (fiberglass chemical storage tanks)	20		CD	PA									
TDE	Thickening and Dewatering	40		CB	PB	Minor mech/pipe	10	5%	Minor elec	20	5%			
VALV	Valves	40	6	CF	PE	Minor refurbishment (change packing)	10	5%						
WCL	Wastewater Chlorination	50		CB	PC	Recoat	25	10%						
WELL	Wells	60		CC	PB	Clean, upkeep	5	5%						
WPS	Wastewater Pump Station (at plant)	50		CB	PC	Replace motors and pumps	25	15%	Replace electrical service + instruments and controls (MCC, VFD. Transformers, etc)	20	15%	Misc. structural refurbishments (e.r. paint new roof, etc.)	20	5%
YPI	Yard Piping	40		CE	PD	Minor mech	10	3%	Major mech	20	12%			

Figure 36. RPM Class Table

Other information on this table includes:

+ Condition group and Performance group, which determine the tables used to adjust asset remaining useful life based on assessed condition and performance.

+ Capital refurbishments, with characteristic intervals and costs expressed as percentages of asset replacement costs.

Failures (and thus replacements) for certain asset classes may be distributed over time, if so specified on the Control Panel. The mean useful lives and standard deviations are shown in yellow in the Class Table and should *not* be changed on this table, but rather on the table directly below on the same tab:

Default lives and SDs, distributed failure asset classes

		Life	S.D.
HYD	Hydrants	50	15%
LAT	Sewer laterals	75	15%
MANH	Manholes	60	15%
METR	Meters	20	15%
PSEW	Sewer pipe	75	15%
PWAT	Water pipe	80	15%
SVC	Water services	80	15%
VALV	Valves	40	15%

As adjusted by pipe life adjustment

HYD	Hydrants	50	8
LAT	Sewer laterals	75	11
MANH	Manholes	60	9
METR	Meters	20	3
PSEW	Sewer pipe	75	11
PWAT	Water pipe	80	12
SVC	Water services	80	12
VALV	Valves	40	6

Figure 37. RPM Distributed Asset Useful Lives

Change only the uncolored cells (the top table), as the yellow cells below are calculated based on the setting of the *Pipe lives (% of default)* dropdown box on the *Control Panel*.

Asset prices for GWA assets are generally determined by unit values or look-up tables based on pricing attributes. These are contained on tab *Price table*, the top part of which is shown in the figure below.

Guam Waterworks Authority

GWA Asset Pricing Table (2006 dollars) — 155% USA West Coast to Guam Pricing Multiplier

USA West Coast Prices

Buildings (office-type)

	Cost/SF
BLDG	$222

Ejectors

	Unit cost
EJEC	$25,000

Electical service

	Unit cost
ELEC	$83,500

Generators

	From (kw)	To (kw)	Cost each
GEN	1	100	$12,000
	101	200	$35,000
	201	300	$58,000
	301	400	$81,000
	401	500	$104,000
	501	600	$127,000
	601	700	$150,000
	701	800	$173,000
	801	900	$196,000
	901	1000	$219,000
	1001	1500	$300,000
	1501	2000	$400,000
	2001	and above	$500,000

Guam Prices

Buildings (office-type)

	Cost/SF
BLDG	$344

Ejectors

	Unit cost
EJEC	$38,750

Electical service

	Unit cost
ELEC	$129,425

Generators

	From (kw)	To (kw)	Cost each
GEN	1	100	$18,600
	101	200	$54,250
	201	300	$89,900
	301	400	$125,550
	401	500	$161,200
	501	600	$196,850
	601	700	$232,500
	701	800	$268,150
	801	900	$303,800
	901	1000	$339,450
	1001	1500	$465,000
	1501	2000	$620,000
	2001	and above	$775,000

Figure 38. Cost Tables (partial)

Prices are based on USA West Coast prices as of 2006, and are escalated to Guam prices at 155 percent. Again, price updates should be made in unshaded cells only, as values in shaded cells are calculated. The pricing tables on tab *Price table* are extensive and include:

+ Buildings (office-type)
+ Ejectors
+ Electrical services
+ Generators
+ Hydrants
+ Laterals (sewer customer connections)
+ Manholes
+ Mechanical/piping (at pump stations)
+ Meters
+ Motors
+ Buildings (non-office structures)
+ Sewer pipes
+ Pumps
+ Water pipes
+ Reservoirs, concrete
+ Reservoirs, steel
+ Site improvements
+ Submersible pumps
+ Services (water customer connections)
+ Valves
+ Wells.

All underlying asset prices in the RPM are stated in dollars of a particular year, the *Price Year*. In GWA's current RPM, that year is 2006. If the pricing year changes, *all* data entries that depend on the price year will need to be updated. This means that all asset prices on tab *Price table* will need to be updated. Be sure also to update the *Asset pricing year* on the *Control Panel* (line 53 on tab *Parameters*).

Updating prices to a new price year should be required only at long intervals—say, every five years. In the interim, GWA assets are priced by escalation to the current year, so no pricing updates are required. However, the *Engineering News-Record* Construction Cost Index (CCI) series used to bring original acquisition costs forward should be updated annually. This is done on the *CCI* tab (only the bottom of the table is shown).

	2004	7115	0.9277	
	2005	7446	0.9709	
	2006	7669	1.0000	(est.)
	2007	7899	1.0300	(est.)
	2008	8136	1.0609	(est.)
	2009	8381	1.0927	(est.)
	2010	8632	1.1255	(est.)
	2011	8891	1.1593	(est.)
	2012	9158	1.1941	(est.)
	2013	9432	1.2299	(est.)
	2014	9715	1.2668	(est.)
	2015	10007	1.3048	(est.)
	2016	10307	1.3439	(est.)
	2017	10616	1.3842	(est.)
	2018	10935	1.4258	(est.)
	2019	11263	1.4685	(est.)
	2020	11601	1.5126	(est.)
Price yr:	2006	7669		
Test yr.	2006	7669		
	1.0000	Escalation to test year		

Figure 39. Construction Cost Index Data Series

The next entry required (in the second column) will be the average annual CCI for 2006, which will become available during 2007. The 2006 CCI should be entered directly over the formula in the cell that currently shows 7669, and the word "est." off to the right should be deleted. Note that in the absence of the actual CCI, the value is calculated by multiplying the cell directly above by the assumed future escalation rate from the Control Panel.

No other entries in the CCI table should be changed.

4. A Guide to the Inventory Tabs

GWA's asset inventory is contained on the following tabs:

+ *W_plant*—Water system treatment plants, pump stations, wells, and reservoirs
+ *W_pipe*—Water system distribution piping
+ *W_app*—Water system hydrants, valves, meters, and services
+ *WW_plant*—Wastewater system treatment plants and pump stations
+ *WW_pipe*—Wastewater system collection gravity and force mains
+ *WW_app*—Wastewater system manholes and laterals.

Each of these tabs is constructed identically. They are simply listings of GWA assets with various associated attributes, some entered directly and some calculated.

At the top are areas for accumulation of R&R costs by year; these should not be touched, no rows should be inserted, etc. Here is an example of the area, left-hand portion only shown:

		1	2	3	4	5	6	7	8
	2006	2007	2008	2009	2010	2011	2012	2013	2014
Annual Funded Replacement									
		1,991,623		11,625	614,963	1,574,025	1,917,350	1,047,413	1,588,835
Annual Funded Refurbishment									
	353,052	1,086,457	67,619	5,585,378	1,002,365	334,285	2,412,519	71,552	873,097
Annual Unfunded Replacement									
Annual Unfunded Refurbishment									
	67,549	39,226	43,295	126,106	101,065	78,098	47,702	30,376	63,383

Note: [yellow] = formula, do not accidentally overwrite [dark grey] = written by code, make no entries

Figure 40. Top Area of Typical Inventory Tab (partial)

The upper left-hand portion of the data section of the inventory tab looks like this:

	Basic Input Data													
	Asset Number	Asset Class	Description		Yr in Service	Quantity	Size	Unit	Cond. Rating 1-5	Perf. Rating 1-5	Util. Default =100%	Criticality 1-5	Depreciate?	Replace?
Totals:	570	assets listed	570	records processed		570								
Start														
*	1010184	EJEC	Ejector Station #2 Ejector		1980	1	n/a	n/a	3		100%		TRUE	TRUE
*	621197	EJEC	Ejector Station #3 Ejector		1980	1	n/a	n/a	3		100%		TRUE	TRUE
*	1023764	EJEC	Ejector Station #4 Ejector		1980	1	n/a	n/a	3		100%		TRUE	TRUE
*	1010187	EJEC	Ejector Station #5 Ejector		1980	1	n/a	n/a	3		100%		TRUE	TRUE
*	621336	EJEC	Ejector Station #6 Ejector		1980	1	n/a	n/a	2		100%		TRUE	TRUE
*	621344	EJEC	Ejector Station #7 Ejector		1980	1	n/a	n/a	2		100%		TRUE	TRUE
*	1024710	EJEC	Maite Ejector		1989	1	n/a	n/a			100%		TRUE	TRUE
*	608718	ELEC	Agana Main (Agana Springs) Electrical service		1996	1	n/a	n/a			100%		TRUE	TRUE
*	621181	ELEC	Alupang Electrical service		1990	1	n/a	n/a			100%		TRUE	TRUE
*	614061	ELEC	Asan Electrical service		1971	1	n/a	n/a			100%		TRUE	TRUE
*	802779	ELEC	Astumbo #1 Electrical service		1993	1	n/a	n/a			100%		TRUE	TRUE
*	803387	ELEC	Astumbo #2 Electrical service		1993	1	n/a	n/a			100%		TRUE	TRUE
*	618496	ELEC	Barrigada Electrical service		1975	1	n/a	n/a			100%		TRUE	TRUE
*	609642	ELEC	Bayside Electrical service		1967	1	n/a	n/a			100%		TRUE	TRUE
*	1004206	ELEC	Cabaras Electrical service		2001	1	n/a	n/a			100%		TRUE	TRUE
*	1006296	ELEC	Casimero (Mongmong) Electrical service		1972	1	n/a	n/a			100%		TRUE	TRUE
*	1006296	ELEC	Chalan Pago #3 (Huegon) Electrical service		1992	1	n/a	n/a			100%		TRUE	TRUE
*	616426	ELEC	Chalan Pago #5 Electrical service		1999	1	n/a	n/a			100%		TRUE	TRUE
*	1013049	ELEC	Chaligan Electrical service		1995	1	n/a	n/a			100%		TRUE	TRUE

Figure 41. Asset Listing Portion of Typical Inventory Tab (partial)

Some things to note:

+ The cell in the upper left with the word "Start" is where the program begins its processing. Do not modify that cell or any cell above it or to the right of it.

+ Each cell below in the first column must have an asterisk or other entry. The program processes inventory data row-by-row; when it comes to a row with no entry in the first column, it assumes that it has processed all records on the tab. Therefore, make sure every row below the word "Start" has an asterisk or other entry in the first column, all the way to the last valid asset record on the tab. You can check this by clicking the Run Simulation button on the Control Panel and then inspecting the two entries "assets listed" and "records processed" directly above and to the left of the "Start" cell. The numbers should be the same.

+ Any cell on the inventory tabs with yellow shading contains a formula. Overwrite these formulas with care and remove the shading if you do. For instance, you can enter a known replacement year or known replacement cost and override the RPM's default calculations. Non-shaded (white) cells are for direct data entry

5. Adding a New Asset Record

The easiest way to add an asset is to copy an existing asset and then modify the copy. Here's an example, assuming the addition of a 1,000-foot length of 8-inch water pipe (PWAT) in 2006.

+ Choose the tab for the asset type or infrastructure segment that is appropriate. Here, we'll choose the *W_pipes* tab.

+ Find on that tab an asset of the same asset class (easy in this case because all assets on this tab are of the same class). In this case, we'll choose asset PWAT005 (row 24) which records a length of pipe laid in 1965.

+ Select the entire row directly beneath that asset and insert a new row. Now the screen should look like this, with a blank row beneath the asset you want to copy.

	Basic Input Data													
	Asset Number	Asset Class	Description	Location	Yr in Service	Quantity	Size	Unit	Cond. Rating 1-5	Perf. Rating 1-5	Util. Default =100%	Criticality 1-5	Depreciate?	Replace?
Totals:	205	assets listed	205	records processed		2,106,951								
Start														
*	PWAT001	PWAT	6-inch pipe, 1953		1953	17	6	inch			100%		TRUE	TRUE
*	PWAT002	PWAT	8-inch pipe, 1953		1953	34	8	inch			100%		TRUE	TRUE
*	PWAT003	PWAT	12-inch pipe, 1953		1953	32	12	inch			100%		TRUE	TRUE
*	PWAT004	PWAT	24-inch pipe, 1953		1953	1,885	24	inch			100%		TRUE	TRUE
*	PWAT005	PWAT	6-inch pipe, 1965		1965	429	6	inch			100%		TRUE	TRUE
*	PWAT006	PWAT	8-inch pipe, 1965		1965	315	8	inch			100%		TRUE	TRUE
*	PWAT007	PWAT	10-inch pipe, 1965		1965	604	10	inch			100%		TRUE	TRUE
*	PWAT008	PWAT	12-inch pipe, 1965		1965	11,021	12	inch			100%		TRUE	TRUE
*	PWAT009	PWAT	14-inch pipe, 1965		1965	22,329	14	inch			100%		TRUE	TRUE

Figure 42. Inserting a New Row in Preparation for Adding an Asset

+ Select the entire row of asset PWAT005 and copy it. Then select the cell in column A of the new blank row and paste. Now you will have two identical assets, like this.

	Basic Input Data													
	Asset Number	Asset Class	Description	Location	Yr in Service	Quantity	Size	Unit	Cond. Rating 1-5	Perf. Rating 1-5	Util. Default =100%	Criticality 1-5	Depreciate?	Replace?
Totals:	206	assets listed	205	records processed		2,107,380								
Start														
*	PWAT001	PWAT	6-inch pipe, 1953		1953	17	6	inch			100%		TRUE	TRUE
*	PWAT002	PWAT	8-inch pipe, 1953		1953	34	8	inch			100%		TRUE	TRUE
*	PWAT003	PWAT	12-inch pipe, 1953		1953	32	12	inch			100%		TRUE	TRUE
*	PWAT004	PWAT	24-inch pipe, 1953		1953	1,885	24	inch			100%		TRUE	TRUE
*	PWAT005	PWAT	6-inch pipe, 1965		1965	429	6	inch			100%		TRUE	TRUE
*	PWAT005	PWAT	6-inch pipe, 1965		1965	429	6	inch			100%		TRUE	TRUE
*	PWAT006	PWAT	8-inch pipe, 1965		1965	315	8	inch			100%		TRUE	TRUE
*	PWAT007	PWAT	10-inch pipe, 1965		1965	604	10	inch			100%		TRUE	TRUE
*	PWAT008	PWAT	12-inch pipe, 1965		1965	11,021	12	inch			100%		TRUE	TRUE
*	PWAT009	PWAT	14-inch pipe, 1965		1965	22,329	14	inch			100%		TRUE	TRUE

Figure 43. Existing Asset Has Been Pasted into the Blank Inserted Row

+ Manually edit the non-shaded cells of the new asset record as required. In this case you might need to edit:
    - ✓ Asset number
    - ✓ Asset class
    - ✓ Year in service
    - ✓ Quantity (length in feet)
    - ✓ Size (diameter)

The new asset might then look like this:

	Basic Input Data													
	Asset Number	Asset Class	Description	Location	Yr in Service	Quantity	Size	Unit	Cond. Rating 1-5	Perf. Rating 1-5	Util. Default =100%	Criticality 1-5	Depreciate?	Replace?
Totals:	206	assets listed	205	records processed		2,107,951								
Start														
*	PWAT001	PWAT	6-inch pipe, 1953		1953	17	6	inch			100%		TRUE	TRUE
*	PWAT002	PWAT	8-inch pipe, 1953		1953	34	8	inch			100%		TRUE	TRUE
*	PWAT003	PWAT	12-inch pipe, 1953		1953	32	12	inch			100%		TRUE	TRUE
*	PWAT004	PWAT	24-inch pipe, 1953		1953	1,885	24	inch			100%		TRUE	TRUE
*	PWAT005	PWAT	6-inch pipe, 1965		1965	429	6	inch			100%		TRUE	TRUE
*	PWAT206	PWAT	8-inch pipe, 2006		2006	1,000	8	inch			100%		TRUE	TRUE
*	PWAT006	PWAT	8-inch pipe, 1965		1965	315	8	inch			100%		TRUE	TRUE
*	PWAT007	PWAT	10-inch pipe, 1965		1965	604	10	inch			100%		TRUE	TRUE
*	PWAT008	PWAT	12-inch pipe, 1965		1965	11,021	12	inch			100%		TRUE	TRUE
*	PWAT009	PWAT	14-inch pipe, 1965		1965	22,329	14	inch			100%		TRUE	TRUE

Figure 44. Pasted Asset Has Been Modified to Reflect New Asset Attributes

If the asset is not priced from pricing tables, then you will need to enter the replacement cost manually. You will need to do this if the asset is other than a pipe, pump station, valve, manhole, or lateral. The replacement cost should be expressed in price year dollars—currently 2006.

In all cases, yellow-shaded cells are calculated exactly the same for any given asset class. That's why you can simply copy an existing record and modify a few parameters to create a new asset record. But be sure not to copy from a record that has manual entries for replacement cost, replacement year, and so forth.

6. Modifying an Asset Record

To modify an existing asset record, simply enter new information into the non-shaded cells. Year in service and other physical attributes are easily changed as illustrated above. There are some entries, however, that you may wish to change but are not so obvious. These will be referred to by row title and column letter.

+ *Depreciate? (column N)*—If (for instance) land is included as an asset, you may not want to depreciate it. FALSE should then be entered in this column as opposed to the more common TRUE.

+ *Replace? (column O)*—If you do not plan to replace an asset when its useful life ends, enter FALSE in this column.

+ *Demo year (column P)*—Some assets may be slated for demolition prior to the expiration of their useful lives. You should enter the demolition year in this column to prevent accruing R&R charges beyond that point.

+ *Known Repl. year (column Q)*—The known or estimated replacement year of an asset (as opposed to a replacement year calculated based on the expected useful life of the asset class).

Some other fields, currently calculated, can be overwritten with actual values if known. These might include:

+ *2006 repl cost (column T)*—The cost in the current year of a like-kind replacement.

+ *Repl useful life (column U)*—The expected useful life of a like-kind replacement.

+ *Adjusted 2006 repl cost (column X)*—The cost in the current year of an actual replacement (for example, if a 6-inch pipe were to be replaced by an 8-inch pipe due to GWA's replacement policies).

+ *Repl useful life (column Y)*—The expected useful life of an actual replacement.

If you overwrite any existing formulas with direct entries, remember to remove the yellow shading from the cell to leave a record of the edit. You can also freely add comments to cells to document changes, raise questions, or for any other reason that will help maintain the database.

7. Deleting an Asset Record

To delete an asset record, simple select the entire row and then execute the Delete command from the Edit menu. This will delete the row and close up the inventory listing, as opposed to using the Delete key which simple removes data from the row but leaves the row in place.

APPENDIX A

CALCULATING THE REPLACEMENT YEAR FOR A SPECIFIC ASSET

Calculating the Replacement Year for a Specific Asset

Introduction—One of the key functions of the Replacement Planning Model (RPM) is to estimate the replacement years of existing GWA assets. Replacement years are based on the remaining useful lives (RULs) of the assets at the current time. To calculate RULs, the RPM employs methodologies developed in New Zealand and documented in Version 1.1 of the *New Zealand Infrastructure Management Manual*, with certain modifications and additions by Brown and Caldwell. Note that the methodologies are not available in the current *International Infrastructure Management Manual*, the New Zealand manual's successor. The earlier manual must be referred to if more information is required.

The methodology used to estimate RUL is shown graphically in the figure below and discussed in some detail in the paragraphs following using a hypothetical example asset for illustration.

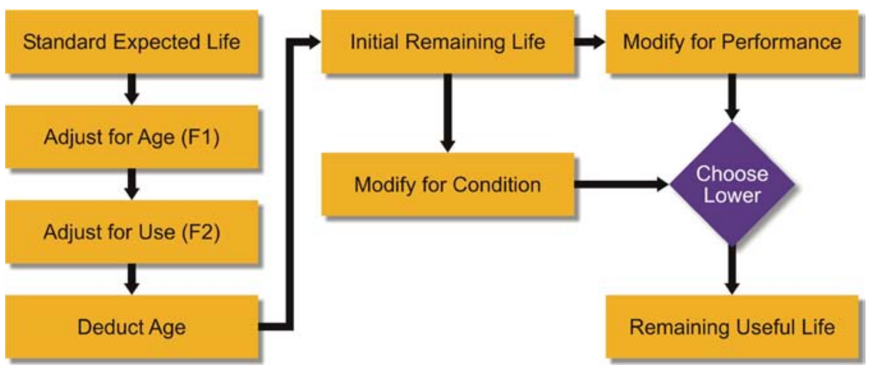


Figure 45. Remaining Useful Life Logic Flow

The general approach to each of these adjustments is as follows:

+ *Age*—Adjustment by formula. This is an actuarial calculation that will increase the total expected useful life if an asset has been in place for some time (and survived early failure).

+ *Use (utilization)*—Adjustment by formula. A utilization of 100% means that an asset is utilized per its "normal" duty cycle. Numbers below 100% will increase total useful life.

+ *Condition*—Adjustment by lookup table, based on which of six condition groups this asset is assigned to. The scale used at GWA is from 1 to 4, with 1 being worst and 4 being best. See the table below.

+ *Performance*—Adjustment by lookup table, based on which of six performance groups this asset is assigned to. The scale used at GWA is from 1 to 5, with 1 being best and 5 being worst. See the table below.

The condition and performance lookup tables are on the RPM's tab *RUL adjustments* and are shown in the figure below.

Range Type_table

Range Cond_table

RUL Multipliers for Assessed Condition

Per GWA scale:

		0	1	2	3	4
CA	2	100%	50%	56%	80%	100%
CB	3	100%	50%	57%	82%	100%
CC	4	100%	50%	60%	83%	100%
CD	5	100%	55%	67%	83%	100%
CE	6	100%	55%	69%	85%	100%
CF	7	100%	60%	72%	85%	100%

RUL Multipliers for Performance

Per NZ scale:

		0	1	2	3	4	5
PA	2	100%	100%	80%	20%	5%	0%
PB	3	100%	100%	80%	30%	5%	0%
PC	4	100%	100%	90%	40%	10%	0%
PD	5	100%	100%	90%	50%	20%	5%
PE	6	100%	100%	90%	60%	30%	10%
PF	7	100%	100%	90%	70%	40%	20%

Range Perftype_table

Range Perf_table

Figure 46. Condition and Performance Lookup Tables

Example—The estimation begins with the class life of the asset class to which the asset belongs and proceeds in several steps, as described below. Each step will be illustrated by an example, in this case a hypothetical pump installed in 1990. The pump has an assessed condition of 3 on a four-point scale, assessed performance of 3 on a five-point scale, and is being utilized at a level of 50 percent.

Step 1: Adjust for Age – If an asset has been in service for an appreciable portion of its class life, then its expected useful life is extended. This is done on the principle that early failures within that class will have already occurred, and surviving assets are thus members of a group of assets with average useful lives longer than the class life (which is the life expected when the asset is placed in service). The adjustment is made using a cubic curve developed for this purpose.

Example: The RPM assigns a class life of 20 years to pumps. As of 2006, this VFD has been in place for 16 years, about 80 percent of its class life. The actuarial adjustment curve indicates that its expected total useful life is now 24.7 years, 4.7 years longer than its class life.

Step 2: Adjust for Use – The useful life from step 1 is further adjusted by a consideration of utilization. If an asset is *utilized* less than its planned utilization, its useful life is extended to a degree determined by a quadratic curve, again developed for this purpose.

Example: The expected total useful life is further extended because the pump is not being 100 percent utilized. The utilization adjustment curve indicates a 7.4 percent extension at a utilization level of 50 percent, so the expected total useful life is now 26.6 years.

Step 3: Deduct Age – The age of the asset is subtracted from its useful life from step 2 to gain a first approximation of its RUL.

Example: Subtracting the asset age of 16 years from the useful life of 26.6 years yields an RUL of 10.6 years.

Step 4: Modify for Performance – The RUL from step 3 is modified based on the asset's assessed performance as represented on *a five-point scale (no adjustment is made if the asset is not assessed). This adjustment is based on a s*eries of six performance curves developed for this purpose. Each of the RPM's *asset* classes is assigned to one of these six curves.

Example: Pumps are assigned to performance curve PE, one of the six performance curves available. That curve indicates that an asset with performance assessed at a 3 should have an RUL of 60% of that otherwise expected. So the condition-adjusted RUL of the VFD is 60 percent of 10.6 years, or 6.3 years.

Step 5: Modify for Condition – The RUL, again from step 3, is modified based on the asset's assessed condition as represented on a four-point scale (no adjustment is made if the asset is not assessed). This adjustment is based on a series of six condition curves developed for this purpose. Each of the RPM's asset classes is assigned to one of these six curves.

Example: Pumps are assigned to condition curve CF, one of the six condition curves available. That curve indicates that an asset assessed at condition 3 should have an RUL of 85% of that otherwise expected. So the condition-adjusted RUL of the VFD is 85 percent of 10.6 years, or 9.0 years.

Step 6: Choose Lower/Remaining Useful Life – The lower of the two RULs from steps 4 and 5 is selected for further treatment.

Example: The condition-adjusted RUL is 9.0 years, while the performance-adjusted RUL is 6.3 years. The lower of these, 6.3 years, is chosen as the final RUL.

Step 7: Final Replacement Year Calculation – The RUL from step 6 is added to the current year to yield the expected year of first replacement of the asset. Subsequent replacements then occur at intervals equal to the asset class useful life.

Example: The RUL of 6.3 years, when added to the current year of 2006, yields the expected year of asset replacement, 2012 (rounded).

In summary, the RPM's methodology for determining each asset's replacement year starts with the typical asset class life and then considers asset age, utilization, condition, and performance. Consideration of these factors, to the extent that the required assessments are available, results in improved accuracy in the estimate of remaining useful life.

APPENDIX H1

Spill Response Field Report

IRVINE RANCH WATER DISTRICT - SPILL RESPONSE - FIELD REPORT

PROBLEM REPORTED BY

Address: ____

Name: ______________________________ Phone: ______________ ______________

Date: ____/____/____ Time: ____:____ ☐ AM ☐ PM Received By: ______________

CSR ID: ______________

EVENT START TIME NOTES

Time Caller First Observed Spill: ____:____ ☐ AM ☐ PM Comments: ______________

____

Caller Interview: Is sewage currently spilling? ☐ Yes ☐ No

If Yes, From: Manhole ☐ IRWD C/O ☐ Private C/O ☐ Inside Building ☐ Wet Well ☐

If Yes: Last time Caller observed NO Spill occurring: ____:____ ☐ AM ☐ PM Date: ____/____/____

Comments: ____

Ask Caller to Describe Spill: ____

____

Suggested Questions: How would you compare the spill to a garden hose running full? How big would you say the wet stain is – compared to your driveway? What else can you tell me?

Additional Interviews** (these may occur afterwards or during SSO Response)

On Site Interview 1: Name/Address: ____

Observation Description: ____

______________________________ Time Observed Spill: ____:____ ☐ AM ☐ PM ☐ N/A

On Site Interview 2: Name/Address: ____

Observation Description: ____

______________________________ Time Observed Spill: ____:____ ☐ AM ☐ PM ☐ N/A

**** Attempts should be made to interview at least two (2) others in addition to the Caller.**
If nobody is available, document attempts (by address or passer-by) **

FIRST RESPONDER ARRIVAL

First Responder Name: ________________________ Time Notified: : _____:_____ ☐ AM ☐ PM

Arrival Time: _____:_____ ☐ AM ☐ PM IRWD SSO Discovery: _____:_____ ☐ AM ☐ PM

Is Spill Active? ☐ Yes ☐ No Notes: ____

____

____

SPILL LOCATION

Observed: Spill from: ☐ Manhole ID_________________________ ☐ Lift Station ID _________________________

☐ MH/Clean Out Address ____

Comments: ____

☐ Building Address ____

Comments: ____

GPS Lat (e.g. 33.664867) __________________________ GPS Long (e.g. -117.838644) ___________________________

Sewer System: ☐ Los Alisos WRP ☐ Michelson WRP ☐ OCSD ☐ Private ☐ Other: ___________________

Spill Destination: ☐ Building ☐ Paved Surface ☐ Storm Sys ☐ Street/Curb/Gutter ☐ Unpaved ☐ Water

Spill Reached: ☐ Drainage Channel ☐ Surface Water ☐ Exceed 1000 Gals ☐ ++Storm System ☐ N/A
(If Yes, this is a Category 1 Spill, ++ unless fully captured/returned)

Terrain: : ☐ Flat ☐ Steep ☐ Mixed

Discovered Enter Waterway ____:____ AM PM ☐ N/A

Determined Spill Category to be: ________ ____:____ AM PM **** If Cat.,1 Contact Supervisor ****

SPILL RATE NOTES

If Currently Spilling: Take photos of spilling structure, Use Measuring Totem as Point-of-Reference
** NOTE: Photograph prior to clearing the blockage or removing the MH lid.
*** If Mainline blockage - inspect first **MANHOLE DOWNSTREAM** of blockage and note flow rate below ***

☐ No Flow in Channel ☐ Trickle flow in Channel ☐ Depth of flow in Channel ___________ inches

Time: _____:_____ ☐AM ☐PM Describe how measurement was taken: ________________________________

____

Estimate Spill Rate (if applicable): ________________________

CAUSE OF SPILL

Failed at: ☐ Mainline ☐ Lower Lat. ☐ Upper Lat. ☐ Force Main ☐ Lift Station Wet Well ☐ ________________

Failed Asset (e.g. UpMH-DnMH): ____________________________ Dia: _____ Material:___________ Age: ______

Spill Cause: ☐ Roots ☐ Grease ☐ Debris ☐ Vandalism ☐ Capacity ☐ Design ☐ Lift Sta. Fail ☐ ___________

☐ Spill cause to be determined by CCTV inspection (Attach TV Report to this form)

SPILL CONTAINMENT

Containment Implemented: ____:____ AM PM

Containment Measures: ☐ DI Mat ☐ Sandbags ☐ Hydro-Vac

☐ Other: ____

Containment Description: ____

____

____

____

Clean Up begin: ____:____ AM PM Gallons Used for Clean Up _______ Gallons Retrieved ________

Clean Up Complete: ____:____ AM PM Gallons of Sewage Retrieved _________

If Spill Reached Storm System, was sewage fully captured and returned to sewer? ☐ Yes ☐ No ☐ N/A

Describe Clean Up Operations: ____

____

____

____

____

____

Method Used to Determine Gallons Retrieved: ____

____

SSO VOLUME

Estimated Spill Volume: ____________________ Estimate Volume of Spill Recovered: ______________________

Est. Spill Volume Reaching Surface Water, Drainage Channel, or Not Recovered from Storm System: _____________

Est. Method (Attach documentation): ☐ Eyeball ☐ Measured ☐ Duration/Flowrate ☐ Single Home ☐ Other

OTHER IMPORTANT MILESTONES

Contacted Supervisor: ____:____ AM PM ____

Requested Additional People/Equip: ____:____ AM PM ____

Spill End Time: ____:____ AM PM ____

Departure Time: ____:____ AM PM ____

Water Sampling Requested ____:____ AM PM ____

__________________________ ____:____ AM PM ____

__________________________ ____:____ AM PM ____

__________________________ ____:____ AM PM ____

EXTERNAL NOTIFICATIONS

Cal-EMA: ____:____ AM PM (Category 1 Only) **(800) 852-7550** By: _____________

Control Number provided by Cal-EMA: ____

Name of Person Contacted: ____ or Left Message: ☐

RWQCB, Region 8: ____:____ AM PM (Category 1 Only) **(951) 320-6362** By: _____________

(951) 782-4130 (main number)

→ Name of Person Contacted: ____ or Left Message: ☐

RWQCB, Region 9 (if necessary): ____:____ AM PM (Category 1 Only) **(858) 637-5581** By: _____________

(858) 822-8344 (after-hours)

→ Name of Person Contacted: ____ or Left Message: ☐

OC Health Dept ____:____ AM PM (Category 1 Only) **(714) 433-6000** By: _____________

(714) 628-7008 (after-hours)

→ Name of Person Contacted: ____ or Left Message: ☐

Other ________________ ____:____ AM PM Phone: ______________________________ By: _____________

→ Name of Person Contacted: ____ or Left Message: ☐

Signs Posted: ☐ Yes ☐ No, If Yes, Location of Posting: ______________________________________

Notification Notes: ____

____

____

INTERNAL NOTIFICATIONS

CONTACT	TIME	DATE	METHOD	INITIALS
Public Affairs				
General Manager				
Executive Director of Operations				
Director of Wastewater Operations				
Director of Water Operations				
Collection Systems Manager				
Water Quality Manager				
Customer Service Manager				
Water Maintenance Manager				
Water Operations Manager				
Environmental Compliance Manager				
Env. Compliance Specialist				
FOG Program Manager				
Coast Keepers*				
Ranger at Crystal Cove*				

* Only if Newport Coast is affected – coastkeeper1@earthlink.net

Notes: ____

Response Crew: ______________, ______________, ______________, ______________

______________, ______________, ______________, ______________

APPENDIX H2

Methods for Estimating Spill Volume

Methods for Estimating Spill Volume

A variety of approaches exist for estimating the volume of a sanitary sewer spill. This appendix documents the three methods that are most often employed. The person preparing the estimate should use the method most appropriate to the sewer overflow in question and use the best information available.

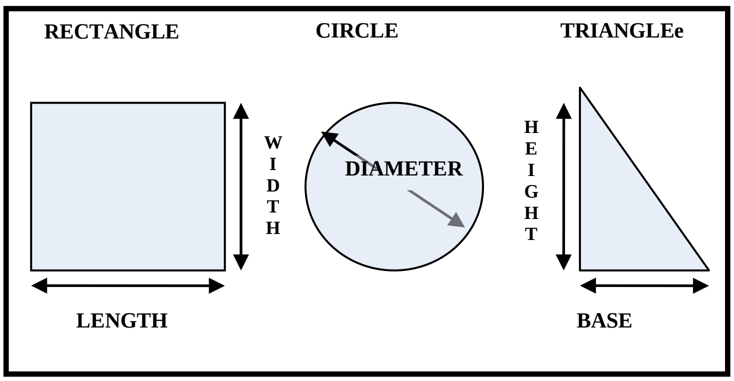
Method 1 Eyeball Estimate

The volume of small spills can be estimated using an "eyeball estimate". To use this method imagine the amount of water that would spill from a bucket or a barrel. A bucket contains 5 gallons and a barrel contains 50 gallons. If the spill is larger than 50 gallons, try to break the standing water into barrels and then multiply by 50 gallons. This method is useful for contained spills up to approximately 200 gallons.

Method 2 Measured Volume

The volume of most small spills that have been contained can be estimated using this method. The shape, dimensions, and the depth of the contained wastewater are needed. The shape and dimensions are used to calculate the area of the spills and the depth is used to calculate the volume.

Common Shapes and Dimensions



Step 1 Sketch the shape of the contained sewage (see figure above).

Step 2 Measure or pace off the dimensions.

Step 3 Measure the depth at several locations and select an average.

Step 4 Convert the dimensions, including depth, to feet.

Step 5 Calculate the area in square feet using the following formulas:

Rectangle: Area = length (feet) x width (feet)
Circle: Area = diameter (feet) x diameter (feet) x 0.79
Triangle: Area = base (feet) x height (feet) x 0.5

Step 6 Multiply the area (square feet) times the depth (in feet) to obtain the volume in cubic feet.

Step 7 Multiply the volume in cubic feet by 7.5 to convert it to gallons

Method 3 Duration and Flowrate

Calculating the volume of larger spills, where it is difficult or impossible to measure the area and depth, requires a different approach. In this method, separate estimates are made of the duration of the spill and the flowrate. The methods of estimating duration and flowrate are:

Duration: The duration is the elapsed time from the time the spill started to the time that the flow was restored.

Start Time: The start time is sometimes difficult to establish. Here are some approaches:

- Local residents can be used to establish start time. Inquire as to their observations. Spills that occur in rights-of-way are usually observed and reported promptly. Spills that occur out of the public view can go on longer. Sometimes observations like odors or sounds (e.g. water running in a normally dry creek bed) can be used to estimate the start time.
- Changes in flow on a downstream flowmeter can be used to establish the start time. Typically the daily flow peaks are "cut off" or flattened by the loss of flow. This can be identified by comparing hourly flow data during the spill event with flow data from prior days.
- Conditions at the spill site change over time. Initially there will be limited deposits of toilet paper and other sewage solids. After a few days to a week, the sewage solids form a light-colored residue. After a few weeks to a month, the sewage solids turn dark. The quantity of toilet paper and other materials of sewage origin increase over time. These observations can be used to estimate the start time in the absence of other information. Taking photographs to document the observations can be helpful if questions arise later in the process.
- It is important to remember that spills may not be continuous. Blockages are not usually complete (some flow continues). In this case the spill would occur during the peak flow periods (typically 10:00 to 12:00 and 13:00 to 16:00 each day). Spills that occur due to peak flows in excess of capacity will occur only during, and for a short period after, heavy rainfall.

End Time: The end time is usually much easier to establish. Field crews on-site observe the "blow down" that occurs when the blockage has been removed. The "blow down" can also be observed in downstream flowmeters.

Flow Rate: The flowrate is the average flow that left the wastewater collection system during the time of the spill.

There are three common ways to estimate the flowrate:

- The San Diego Manhole Flowrate Chart: This chart, included on the following page, shows sewage flowing from manhole covers at a variety of flowrates. The observations of the field crew can be used to select the appropriate flowrate from the chart. If possible, photographs are useful in documenting the basis for the flowrate estimate.
- Flowmeter: Changes in flows in downstream flowmeters can be used to estimate the flowrate during the spill.
- Counting Connections: Once the location of the spill is known, the number of upstream connections can be determined from the sewer maps. Multiply the number of connections by 200 to 250 gallons per day per connection or 8 to 10 gallons per hour per connection.

  For example:

  22 upstream connections x 9 gallons per hour per connection

  = 198 gallons per hour / 60 minutes per hour

  = 3.3 gallons per minute

Spill Volume: Once duration and flowrate have been estimated, the volume of the spill is the product of the duration in hours or days and the flowrate in gallons per hour or gallons per day.

For example:

Spill start time = 11:00

Spill end time = 14:00

Spill duration = 3 hours

3.3 gallons per minute x 3 hours x 60 minutes per hour

= 594 gallons

Manhole Overflow Flowrate Guide

City of San Diego
Metropolitan Wastewater Department

Reference Sheet for Estimating Sewer Spills from Overflowing Sewer Manholes

All estimates are calculated in gallons per minute (gpm)

Wastewater Collection Division
(619) 654-4160

5 gpm

25 gpm

50 gpm

100 gpm

150 gpm

200 gpm

225 gpm

250 gpm

275 gpm

All photos were taken during a demonstration using metered water from a hydrant in cooperation with the City of San Diego's Water Department.

rev. 4/99

Method 4 Single Home

This estimation method works only for spills where the blockage is in the lower lateral. It assumes 180 gallons per EDU, which is based on the District-wide average as of June 2010. Single-Family Residential homes = One EDU. For Commercial buildings, the EDUs can be found in WWMS, on the 'Service Line' screen.

When a spill affects landscaped areas, dirt, fields or any surface that tends to absorb the spill, it is often difficult to use the 'eyeball method' to make a valid estimation. This method will be useful in these cases.

Once the Spill Start Time and End Time are determined, this method can be applied. Example:

It is determined that the spill start time was 9:45 AM and the Spill End time was 1:30 (3 hours and 45 minutes)
From 9:45 to Noon (2 Hrs, 15 Minutes would be calculated using 0.20 GPM (135 minutes x 0.20 = **27.0 gallons**).
From Noon to 1:30 PM (1 Hr, 30 Minutes would be calculated using 0.15 GPM (90 minutes x 0.15 = **13.5 gallons**).
Total would be 27.0 gallons + 13.5 gallons = **40.5 gallons**.

This information alone likely does not tell the whole story. Typically, sewage does not run continuously from a home. If at all possible the resident should be interviewed. Be respectful and ask the resident if they would mind if you asked them a few questions to help determine the volume of the spill.
Example:
Since the time you noticed the spill:

How many people have been home?
Have you done any laundry (30 gallons/load) or ran the dish washer (9 gallons/load) or taken a shower (25 gallons)

Next, put all of the information you have gathered:

The size of the stain or water mark on the ground + any tissue, etc.
The answers to the questions about use.
The volume the Spill Estimation Method suggested

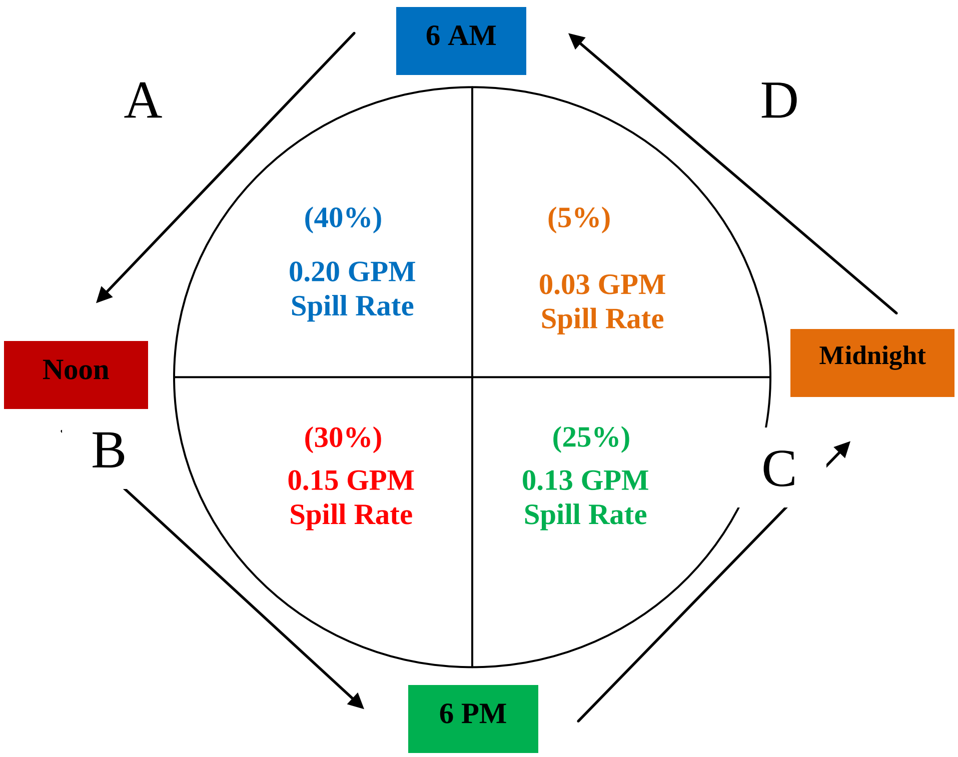
Does the information gathered suggest that the volume determined by the estimation tool be adjusted, up, down or the left as is?

Use the following and consider it to be Typical Use for each activity. The amounts listed below consider the water use difference of newer appliances and older appliances. It appears that around 1994 was watershed year. The amounts listed below assume that more appliances are newer than older.

Washing Machine	30 gallons/load
Dish Washer	9 gallons/load
Shower (10 Min.)	25 gallons/shower

180 GPD per Household

(District-wide diurnal flow patterns are applied to estimate usage during each period)



Time Period	Gals per Minute	Gals per Hour	Gals per Period
A - 6 AM to Noon	**0.20**	**12.0**	**72**
B - Noon to 6 PM	**0.15**	**9**	**54**
C - 6PM to 9 PM	**0.13**	**7.5**	**45**
D - 9 PM - Midnight	**0.03**	**1.5**	**9**

Spill Start Time ___________ - Spill End Time ___________ = Spill Duration ___________

Spill Duration ___________ x Spill Rate ___________ x EDUs ______ = Spill Volume ___________

This is to be used as a guide for spill estimation for lower lateral blockages. Each six-hour period flow rate assumes a constant flow, which would not be typical in a home or business. In the absence of any other information or in conjunction with other information, this is intended to assist with spill estimations.

APPENDIX H3

Sample Warning Sign

Sample Warning Sign

Questions concerning exposure, posting, and clean up should be directed to:

Irvine Ranch Water District

(949) 453-5300

APPENDIX I1

FOG Control Program Manual

ENVIRONMENTAL
ENGINEERING & CONTRACTING, INC.
501 Parkcenter Drive, Santa Ana, CA 92705
Phone (714) 667-2300 Fax (714) 667-2310

IRVINE RANCH WATER DISTRICT

FATS, OILS, AND GREASE (FOG) CONTROL PROGRAM MANUAL

Date Prepared:

December 15, 2004

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1.0 INTRODUCTION

Irvine Ranch Water District's (District) Fats, Oils, and Grease (FOG) Control Program has been developed to prevent FOG-related sanitary sewer overflows (SSOs) as required by the Santa Ana Regional Water Quality Control Board (SARWQCB) *General Waste Discharge Requirements* (WDR), Order No. R8-2002-0014, issued in April 2002. This order was issued in response to a regional SSO problem and was issued to 32 co-permittees, which included local agencies, such as cities and special districts, in the northern and central portions of Orange County.

The FOG Control Program's goal is to eliminate all FOG-related SSOs. These SSOs are usually attributable to cooking grease in wastewater discharged from Food Service Establishments (FSEs)[1], multi-family housing, and single family homes that create FOG (or grease) blockages in sanitary sewer collection systems. These grease blockages, located in either the property owner's sewer lateral or the sanitary sewerage system, lead to SSOs, which can cause untreated sewage to flow onto streets and travel to storm drains, creeks, and other surface waters. Untreated sewage on private property or in the street is a nuisance and poses an obvious human health risk. If this sewage reaches the ocean, it often results in coastal contamination, beach closures, and the associated potential human health risks.

To achieve this goal of eliminating FOG-related SSOs, the WDR has identified key requirements for a FOG Control Program, which are as follows:

- Limit grease discharges that may cause blockages;
- Prohibit FOG discharges that may cause sewer overflows;
- Adopt and enforce an ordinance;
- Require implementation of kitchen best management practices (BMPs);
- Require installation of grease removal equipment, as necessary;
- Inspect FSEs; and
- Implement source control measures for sewer line "hot spots[2]".

These requirements are the key issues that were addressed in the development of the District's FOG Control Program.

[1] Food Service Establishments (FSEs) are those establishments primarily engaged in preparing or serving food to the public such as restaurants, hotels, commercial kitchens, bakeries, caterers, schools, prisons, correctional facilities, and care institutions.
[2] Known problem areas in the sanitary sewer system that require more frequent cleaning and maintenance.

2.0 FOG CONTROL PROGRAM BACKGROUND AND OVERVIEW

2.1 Service Area

The District provides water and sewer service to a population of 316,000 through 89,067 connections. The District's service area includes approximately 85,019 acres (133 square miles (Refer to the map in Appendix A).

2.2 Sanitary Sewer Overflows

The District has adopted a Sewer System Overflow Response Plan (SSORP) to ensure that any reported spill is responded to immediately to protect the public health and safety, and to protect the beneficial uses of the waters of the United States. The SSORP identifies the response procedures, the notification and reporting requirements, and follow-up requirements for the District associated with SSOs. The partial list of historical SSOs is provided in Appendix B.

2.3 Historical FOG Control Activities

The District initiated a FOG Characterization Study (Study) in 2004 to provide key information and program recommendations for the development of the District's FOG Control Program. The Study consists of four tasks:

- Hot Spot Characterization - identifying and mapping the known problem areas in the sanitary sewer system that require more frequent cleaning and maintenance (referred to as "hot spots") due to FOG. Key information will be obtained from available staff to identify the factors that cause or may contribute to the 180 areas identified as hot spots.
- FOG Source Characterization - physically inspecting the hot spots through the use of closed circuit television (CCTV) equipment to further assess approximately 75 critical hot spots identified by the District's staff to confirm known or to identify unknown problems in the sanitary sewer system and to identify potential sources of FOG.
- FSE Characterization - physically inspecting and educating the FSEs. Approximately, 750 FSEs located within the district service area will be inspected to identify and classify each FSE's potential to generate and discharge FOG to the sanitary sewer system.
- Data Integration and Program Recommendations - mapping the hot spot and FSE locations, development of databases for the information collected from the FSE Characterization, and the Hot Spot Characterization and the FOG Source Characterization. Correlations and recommendations for the development of the District's FOG Control Program will then be developed utilizing these resources.

Although the District's Study has not yet been concluded, the results from FOG Characterization Studies from similar sewering agencies (that have been completed) are most likely very similar to the anticipated District's results. Thus, these Study results from similar sewering agencies will be utilized as a basis for the program. The Studies concluded that FOG Source Characterization (CCTV inspection of Hot Spots) is extremely beneficial at identifying the potential sources, determining the cleaning effectiveness, defining the contributing issues (e.g., structural issues, roots, other), and assisting in defining the approach for resolving and/or controlling the grease blockage issues for Hot Spots. Additionally, the Studies concluded that FSE Characterization activities are beneficial in identifying potential grease producing equipment, identifying the removal equipment and maintenance practices, and kitchen best management practices.

The Studies recommended inspections to ensure that the grease removal equipment (GRE) is maintained properly and that kitchen best management practices (BMPs) are followed to minimize the accumulation of grease and blockages in the sanitary sewer system. Additionally, the Studies recommended: cleaning of hot spots be continued and the cleaning effectiveness and frequency be evaluated (through the judicious use of CCTV) on an ongoing basis for District staff and cleaning contractors; and upgrades to sewer pipe segments be prioritized in hot spot areas focusing on structural repairs that may minimize grease accumulation and potentially resolve the hot spot.

2.4 Overview of FOG Control Program

The FOG Control Program is based on the FOG Characterization Studies from similar sewering agencies and the requirements of the WDR. This program integrates various elements into the program to accomplish the goal. These key elements of the program are: sewer line maintenance activities associated with the FOG-related hot spots; a FOG Control Ordinance, and inspection process to minimize the discharge of FOG from FSEs; an educational outreach program to minimize the discharge of FOG from multi-family housing, and single family homes; and the Orange County Sanitation District's (OCSD) Waste Discharge Pretreatment and Source Control Program for discharge of FOG from industry.

3.0 SEWER LINE – HOT SPOT PREVENTATIVE MAINTENANCE

3.1 Overview of Sewage Collection System and Mapping

The District's sewage collection system consists of a network of trunk sewers, manholes, and a lift station, which conveys approximately 14 million gallons per day at MWRP and 4.3 million gallons per day at (LAWRP) of sewage generated within the District's service area to trunk sewers for treatment at District Water Reclamation Plants. The system consists of approximately 791miles of collection system mainline piping ranging in size from 6 inches to 60 inches. The system includes 14 sewage lift stations, approximately 70,122 linear feet of forced main, 13,460 manholes and over 100,213 individual service connections. The District is responsible for repairs to the sewer laterals from the public sewer main to the property line in the public right of way.

This sewer collection system is mapped utilizing two methods: Atlas Maps and a Composite (Digital) Map. Historically, the core mapping for the District has been documented by the use of sectional Atlas Maps. These Atlas Maps have been incorporated into Atlas Books that include every sewer mainline and manhole

The District has also developed a Composite Map, which displays the entire system on a single map utilizing GIS. The Composite Map incorporates a grid system similar to the Atlas Maps and displays the information contained on the Atlas Maps. As modifications to the sewer system occur, the Composite Map is updated and the affected pages of the Atlas Map are printed to update the Atlas Maps, as appropriate. (Refer to the map in Appendix C).

3.2 Routine Sewer Line Cleaning and CCTV

The entire collection system is cleaned on approximately a one-year cycle. The line cleaning operation is accomplished utilizing a Vactor unit by two trained operators. The general process consists of hydrojetting the sewer line and vacuuming excessive debris generated from downstream manholes. The program is typically performed in a progressive manner meaning that the system is cleaned from manhole to manhole continuing on each successive day at the manhole following that at which work was ceased on the previous day. If significant FOG is identified during the line cleaning operation, the area is then evaluated for potential further analysis utilizing closed circuit television (CCTV) inspection.

Visual inspection, utilizing CCTV, of the entire collection system is conducted on a rotating basis every 6 years years. Any problems identified during the video inspection are scheduled for correction depending on their severity. Copies of the video recording are made by the contractor and supplied to the District.

3.3 Hot Spot Sewer Line Identification, Prioritization and Cleaning

Sewer line cleaning is conducted in FOG-related Hot Spots or specific reaches of sewer pipe that have a history of FOG-related problems or pose higher than normal risk of an SSO. These Hot Spots are identified during normal maintenance of the collection system by maintenance staff when they observe conditions that warrant more frequent cleaning. Additionally, if necessary, locations where an SSO occurs may be designated as a Hot Spot and cleaned on a more frequent basis. The frequency of cleaning for these Hot Spots ranges generally from monthly to semi annually depending on the severity of the problem and the cleaning effectiveness. These Hot Spots are evaluated (through the judicious use of CCTV) on an ongoing basis. Additionally, the list of Hot Spots is periodically reviewed to assess the necessity to maintain high frequency cleaning at each location. Refer to Appendix D for an example Hot Spot Report and Appendix C for an example of a Composite Sewer & Hot Spot Map.

3.4 FOG Sewer Line Characterization and Source Identification Activities

Many issues in the sanitary sewer system can contribute to a hot spot, each with varying degrees of severity. Management of this information for each hot spot location is necessary to identify effective solutions and to prioritize resources. Sewer line characterization is the process of classification and prioritization of these hot spots in the District's sanitary sewer system. It is important to note that while there are many reasons and causes for hot spots in the sanitary sewer system, the focus of the FOG Control Program is the FOG-related locations.

The characterization process consists of collecting all known (or perceived) factors associated with each hot spot from the sewer maintenance staff to identify the critical information. Factors related to pipe conditions and potential sources are identified, documented and mapped. Relationships between the various factors are then developed to define each hot spot. For critical hot spots, visual inspections utilizing CCTV of the hot spot and the sewer pipe upstream of the hot spot is conducted: to confirm known or to identify unknown problems in the sanitary sewer system; and to identify the potential sources of FOG. This information is critical to the FOG Control Program to enable identification and implementation of the appropriate mitigation solutions.

The potential solutions include the evaluation of structural issues that impact hot spots. The resolution of the structural issue is evaluated to determine if repair may minimize grease accumulation and potentially resolve the hot spot. Additionally, the laterals (and associated discharger[s]) identified as potential sources of FOG during these CCTV inspections will be documented and the information will be provided to the FOG Control Program Manager for appropriate source reduction and enforcement activities (refer to Sections 4.7 and 4.8).

Ultimately, this information will help to guide the focus of the FOG Control Program to those hot spot locations that present the greatest potential for SSOs.

3.5 Hot Spot Data Management

The sewer line hot spot cleaning is the responsibility of the Collection System Manager and data management is the responsibility of the Administrative Analyst who works directly with the FOG Control Program Manager.

The Hot Spot data management process consists of:

- Database that is utilized to document and manage the Hot Spot data. The database identifies: Hot Spot locations and the associated sewer piping; cleaning frequencies; and structural issues associated with each Hot Spot. (Refer to the Appendix D for a Hot Spot Report)
- Composite Map displaying the location of the Hot Spots (Appendix C)

4.0 FSE FOG CONTROL PROGRAM

4.1 Legal Authority

The District has adopted Grease Control Regulations (Section 7.11 of the District's Rules and Regulations) to specify appropriate FOG discharge requirements for food service establishments (FSEs) to prevent blockages of sewer lines resulting from discharges of FOG. The discharge requirement prohibits FSEs from "the discharge into the sewer system of FOG that may accumulate and/or cause or contribute to blockages in the sewer system or at the sewer system lateral."

The key elements of these regulations are the requirement of FSEs to:

- Obtain a FOG Wastewater Discharge Permit to discharge wastewater to the sanitary sewer system;
- Implement best management practices (BMPs); and
- Install, operate and maintain an approved type and adequately sized grease interceptor.

4.2 Food Service Establishments (FSEs)

These regulations are applicable to all Food Service Establishments designated as facilities defined in California Uniform Retail Food Service Establishments Law (CURFFL) Section 113785, and any commercial entity within the boundaries of the District, operating in a permanently constructed structure such as a room, building, or place, or portion thereof, maintained, used, or operated for the purpose of storing, preparing, serving, or manufacturing, packaging, or otherwise handling food for sale to other entities, or for consumption by the public, its members or employees, and which has any process or device that uses or produces FOG, or grease vapors, steam, fumes, smoke or odors that are required to be removed by a Type I or Type II hood, as defined in CURFFL Section 113785.

The FSEs identified within the District are establishments ranging from sandwich shops to full service restaurants, including major kitchens in retirement homes or hospital facilities. These FSEs are listed in Appendix E.

4.3 FOG Wastewater Discharge Requirements

The District has developed a FOG Wastewater Discharge Permit (Permit) for FSEs (Appendix F) and issues each FSE a Permit that identifies the facilities requirement. The Permit has General Permit Conditions (or requirements) that apply to all FSEs; and it may also have specific permit conditions that apply uniquely to individual FSEs.

4.3.1 GENERAL PERMIT REQUIREMENTS

General Permit Conditions have been developed to identify the core requirements of the FOG Regulation, which the FSEs are required to comply with. These conditions are segregated into sections and are summarized as follows:

4.3.1.1 Part I - Effluent Limitations and Discharge Requirements

- Waste discharge of FOG into the sewer system will not accumulate and/or cause or contribute to a blockage.
- General Prohibitions
    - No food grinders (garbage disposal units) for new or existing FSEs – 180 days to retrofit
    - No emulsifying additives, no use as a supplement to interceptor maintenance
    - No disposal of waste cooking oil into drains
    - No discharge of wastewater in excess of 140 degrees Fahrenheit into grease removal equipment
    - No discharge of wastewater from dishwashers into a grease trap or interceptor
    - No toilet discharge into grease interceptor
    - No waste removed from the interceptor shall be discharged into the sewer system

4.3.1.2 Part II - Requirements for FOG Control

- Best Management Practices (BMPs)
    - Installation of drain screens
    - Segregation and collection of waste cooking oils
    - Disposal of food waste into trash or garbage, and not into sinks
    - Employee Training
    - Kitchen signage
- FOG Pretreatment
    - Requirement for the installation of a grease interceptor
    - Requirement for grease interceptor maintenance (FOG and/or solids cannot exceed 25% of the capacity of the interceptor)
    - Frequency of grease interceptor maintenance (minimum quarterly [once every 3 months])

4.3.1.3 Part III - Record-Keeping and Notification and Reporting Requirements

- Record Keeping requirements
    - Logbook of employee training
    - Records of spills and/or cleaning of the lateral or sewer system
    - Logbook of grease control equipment cleaning activities
    - Copies of grease control equipment records or waste hauling manifests
    - Records of sampling data and height monitoring of FOG and solid accumulation in the interceptor
- Notification Requirements
    - Notification of a spill
    - Notification regarding planned changes

4.3.1.4 Part IV - Standard Conditions

- Non-transferability of Permit
- Access requirements
- Civil Penalties
- Criminal Penalties

- Severability
- Termination of service

4.3.2 SPECIFIC PERMIT CONDITIONS

Specific requirements can be required or authorized by the FOG Control Program Manager for individual FSEs. These specific permit conditions can be segregated into two categories: 1) grease interceptor installation requirements for FSEs; and 2) other requirements or permit modifications.

4.3.2.1 Grease Interceptor Installation Requirements

The requirement for the installation of a grease interceptor is a key requirement of the District's FOG Regulations. However, this requirement has many options for FSEs that may delay or potentially override this requirement. The attached flow chart generally describes the evaluation process that will be utilized for the grease interceptor installation requirement.

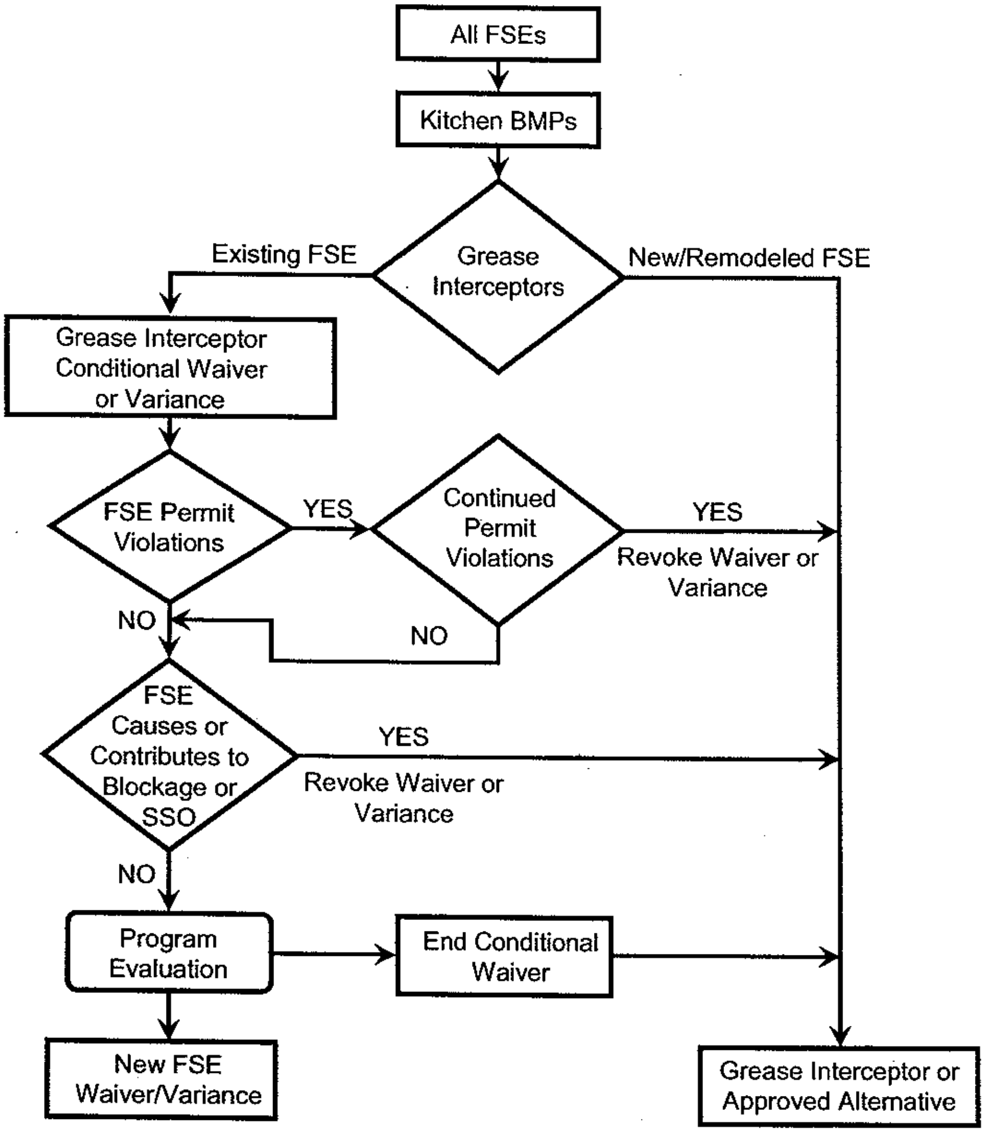


Figure 1: Grease Interceptor Installation Evaluation Process Flow Chart

Based on the process flow chart, the majority of existing FSEs that do not have grease interceptors installed have been issued a "Conditional Waiver" from the requirement to install a grease interceptor. However, if the FSE has continued program violations or if the FSE is identified as a significant contributor of FOG to the sewer system, the "Conditional Waiver" may be revoked requiring the installation of a grease interceptor.

4.3.2.2 Other Requirements or Modifications

There are other situations where specific permit conditions will be required or approved by the FOG Control Program Manager. A few of the common "other" specific conditions are as follows:

- Authorization for the utilization of an additive
- Requirement for increased maintenance frequency of the grease interceptor
- Authorization to extend the period between pumping services grease interceptor pumping services
- Requirement to submit records (grease interceptor maintenance log and waste hauling receipts and other logs) to the District on a scheduled semi-annual basis

4.4 Grease Interceptors

4.4.1 OPERATION

Grease interceptors are underground or in-ground grease collection devices that separate FOG (or grease), solids, and water based on the principle of Stoke's Law. Stoke's Law describes the rising or settling of a particle in a fluid (water in this case). Simply put, under non-turbulent conditions in an interceptor given enough time, particles that are lighter then water (grease) will rise to the surface and particles that are heavier than water (solids) will settle to the bottom. A typical conceptual interceptor design is illustrated in Figure 2.

The proper plumbing and placement of baffles will provide the non-turbulent conditions. The proper dimensions and volume of the interceptor will provide sufficient retention time to allow the particles to fully rise or settle before they pass-through to the outlet of the interceptor. Over time, the grease and solids layers thicken and will eventually fill the first chamber if they are not removed. If the grease and solids are not removed regularly, the interceptor no longer functions for its intended purpose, and grease will be carried into the sewer system. Emulsified or partially emulsified particles will rise or settle slower, which is why soaps and other emulsifiers may cause some grease or solids to pass-through an interceptor and collect downstream of the interceptor.

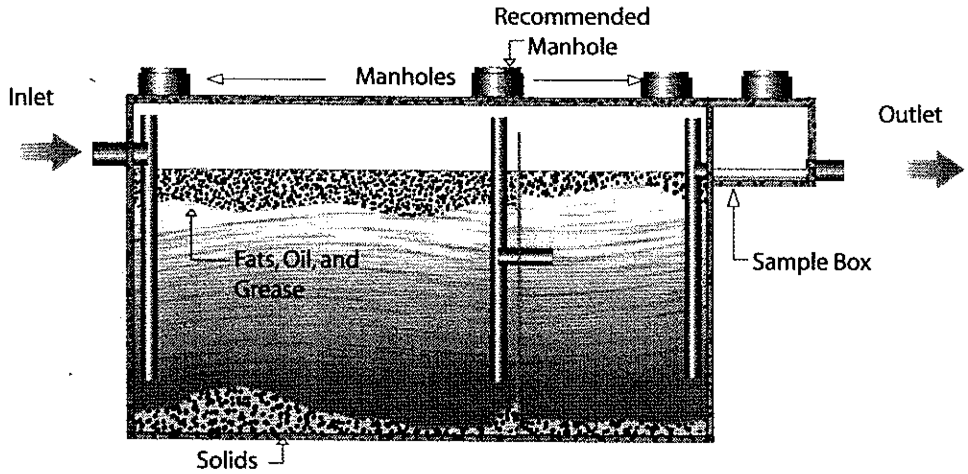


Figure 2: Typical Conceptual Grease Interceptor Design – Side View

Since an interceptor is not self-cleaning or free of maintenance, it is critical that an interceptor be suitably designed with manholes in the right locations to facilitate maintenance and that it be cleaned and pumped at a frequency that maintains its design removal efficiency.

4.4.2 SIZING

The District's FOG Control Program Manager will review and approve the sizing and installation of grease interceptors. This is accomplished by requirement of the permittee, by the appropriate Building Department, for the District's approval prior to issuance of the building permit. Refer to Appendix G for the form utilized by the Building Departments to refer the permittee to the District for grease interceptor installation and sizing approval.

The FOG Control Manager will base the design and sizing of the grease interceptors on the current version of the California Plumbing Code[3] (Code). Section §1014.8, "Grease Interceptors for Commercial Kitchens", refers to Appendix H of the Code for the provisions required for installation and sizing of grease interceptors. The FOG Control Program Manager will also consider the potential for large grease interceptors to become septic (which may create nuisance odors and corrosive conditions) due to excessively long retention times. Thus, the Code will be utilized with the following general considerations:

1) If the California Plumbing Code sizing calculation exceeds 1,500 gallons, the calculation should be compared against formulas such as the Honolulu Formula[4]

[3] The Code is based on the Uniform Plumbing Code of the International Association of Plumbing and Mechanical Officials with California amendments

[4] Many cities in the US have developed their own interceptor sizing criteria (e.g., Honolulu, Hawaii and Cary, North Carolina) based primarily on retention time and flow rate. Honolulu has developed a relatively simple interceptor sizing formula based on a retention time of 30 minutes, a storage factor of 1.25, and the maximum flow rate of the influent.

(refer to Appendix H) to ensure that the interceptor is not over-sized. If the results are dramatically different, the FOG Control Program Manager will use utilize his/her best judgment based on other factors at the FSE (e.g., cooking equipment, menu, frequency of use of the drainage fixture units) to determine the final size of the interceptor.

2) The floor of the interceptor should not be too deep to allow for proper cleaning and/or the individual interceptor should not be larger than 3,000 gallons for most installations. Multiple interceptors may be installed to satisfy very large flows.

3) An FSE calculation of 375 to 750 gallons should require an interceptor of 750 gallons.

4.5 Waste Hauling Requirements

Proper disposal of waste grease collected either from grease traps and interceptors or through kitchen practices is essential to a successful FOG control program. To ensure that FSEs properly dispose of their waste FOG and that haulers and disposal/recycling sites are properly operated, the District requires that all hauler documentation be completed and that the hauler provide the FSE a copy prior to departing the FSE. The FSE is required to maintain copies of the hauling documentation. The minimum information requirements to be documented on the hauler's record are (Refer to Appendix I for copy of the District's Waste Hauling Documentation requirements):

- Name of hauling company
- Name and signature of operator performing the pumpout
- Documentation of full pumpout with volume of water and FOG removed (e.g., 1500 gallons)
- Documentation of the level of floating FOG and Settable Solids (to determine if volume exceeds 25% capacity of the grease removal equipment)
- Documentation if repairs to the grease interceptor are required
- Identification of the facility where the hauler is planning to dispose of the waste

4.6 FSE Education

The District has developed FSE FOG Control educational material for the FSEs. The initial education to the FSEs was through FOG Characterization Study inspections conducted in 2004, through mailing, or ongoing inspections. In this process, the FSE was provided the General Requirements, a Kitchen BMP Poster, a Training CD, Record Keeping Logs and other Educational Material. This information is also available to FSEs by downloading it from the District's website www.irwd.com. Refer to Appendix J for examples of Kitchen BMP Signage, Record Keeping Logs, and other Educational Material.

4.7 FSE Inspections

To ensure compliance with the FOG Control Program requirements, the District has developed a few types of FSE Inspections. These inspections and their purpose are as follows:

Initial Inspections	These inspections are conducted to identify and classify each FSE's potential to generate FOG and its potential to discharge the FOG to the sanitary sewer system. If not adequately controlled, this FOG can lead to sewer blockages and, potentially, SSOs. The inspection identifies the type of food, equipment, and kitchen practices that contribute to FOG discharges and the equipment (e.g., grease interceptors, grease traps) that may reduce the discharge of FOG to the sewer. These initial inspections also provides the opportunity to educate the FSEs on the impact of their grease discharges, what they can do to minimize grease discharges, and how the District's Regulation could potentially impact them.
BMP Inspections	These inspections are conducted to evaluate compliance with the facility's best management practices requirements.
GRE Inspections	These inspections are conducted to evaluate compliance with the facility's grease removal equipment requirements.
Compliance Inspections	These inspections are conducted where it is determined by the FOG Control Program Manager that a follow-up inspection is required for a Non-Compliance issue that has been identified in previous BMP, GRE or FOG Source Sewer Line Inspections.
Enforcement Inspections	These inspections are conducted when elevated enforcement of the Permit requirements are required or when the revocation of the FSE's grease interceptor installation Conditional Waiver, Waiver or Variance is required.

The inspection strategy is to focus the District's resources on FSEs in the vicinity and upstream of Hot Spots and on FSEs that have been identified with a greater potential to generate FOG and discharge FOG to the sanitary sewer system. Generally, FSE inspections will be conducted on a biannual basis.

4.8 FSE Enforcement

The District has developed an enforcement response plan to respond to Non-Compliance issues identified during the inspection processes. The enforcement response will be based on the severity of the non-compliance and the history of non-compliance at the FSE. The general approach utilized is displayed below in Figure 3.

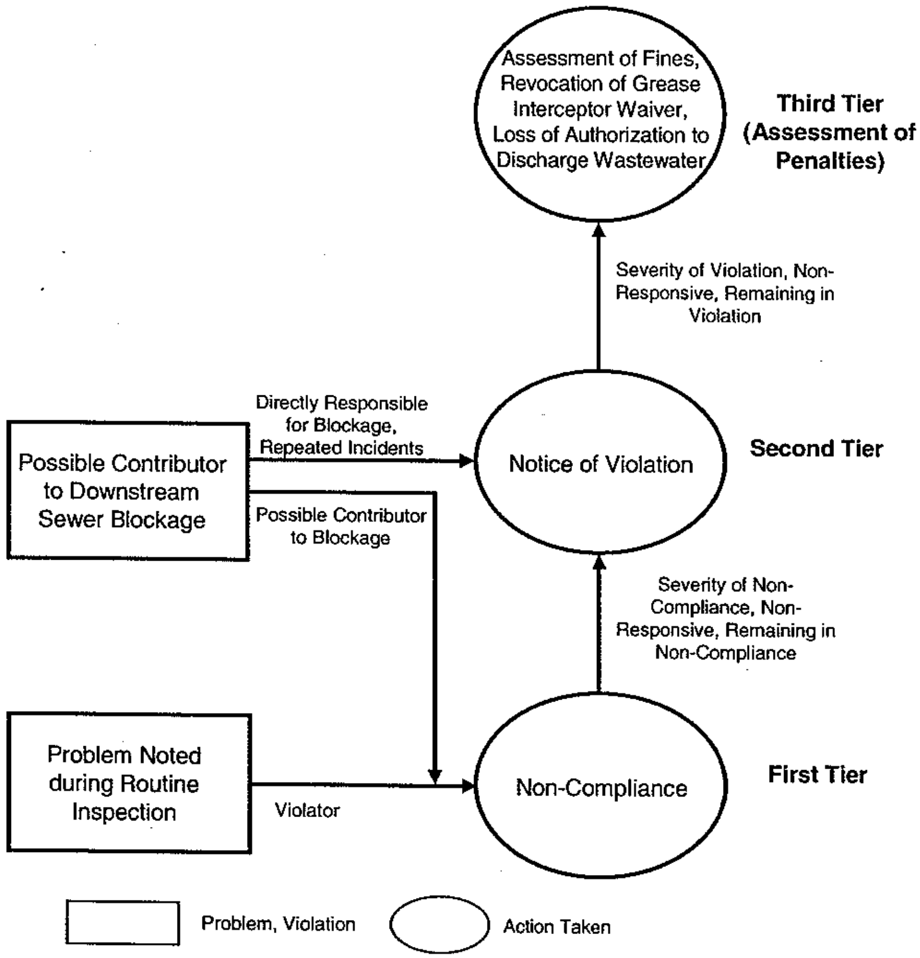


Figure 3: FOG Control Program General Enforcement Response Plan

4.8.1 BMP NON-COMPLIANCE

Issues identified as deficient during the BMP inspection process will be documented and the FSE will be issued a Notice of Non-Compliance. The Notice will identify the area of non-compliance and the required action. Issues identified as deficient during the inspection will compromise the effectiveness of the FOG BMP Program, which will increase the FSEs potential to discharge FOG into the sanitary sewer. Therefore, the overall impact of each of the deficient issues will need to be evaluated individually and in relationship to the other reported deficiencies to determine the projected impact and severity of the combined deficient issues. Generally, for a single deficient issue (not considered as a serious non-compliance individually), no further enforcement action will be taken after correction of the deficiency. For multiple deficient issues, a Notice of Violation may be issued with the potential for assessment of a non-compliance fee.

For repeated issues identified as non-compliant, the enforcement process may be elevated by: issuance of a Notice of Violation; assessment of non-compliance fees; increased assessment of fees; revocation of the FSE's Conditional Waiver requiring installation of a grease interceptor (if applicable); and the potential for the loss of the FSE's right to discharge wastewater into the District's sewer collection system.

4.8.2 GRE NON-COMPLIANCE

Issues identified as deficient during the GRE inspection process will be documented and the FSE will be issued a Notice of Non-Compliance. The Notice will identify the area of non-compliance and the required action. The majority of the issues on the GRE inspection form, if identified as deficient, will compromise the effectiveness of the GRE and would likely have resulted in a direct discharge of FOG into the sanitary sewer. Therefore, for these items it is considered a serious non-compliance issue and a Notice of Violation with the potential assessment of a non-compliance fee may be issued

For repeated issues identified as non-compliant, the enforcement process may be elevated by: assessment of non-compliance fees; increased assessment of fees; and the potential for the loss of the FSE's right to discharge wastewater into the District's sewer collection system.

4.8.3 FOG SOURCE SEWER LINE NON-COMPLIANCE

FSEs identified as sources of FOG to the District's sewer piping during FOG Source Sewer Line inspections will be issued Notices of Non-Compliance. This Notice will inform the FSE that FOG discharging from their lateral has impacted the District's sewer line. This is considered a serious non-compliance issue and a Notice of Violation may be issued and there may be an assessment of a non-compliance fee.

- If the FSE does not have a grease interceptor, the FSE will be informed that they have been identified as a significant FOG discharger, that their BMP practices do not appear to be effective and that stringent adherence to BMPs is required. Additionally, they will be informed that if their facility is identified as a source of FOG to the District's sewer during any future FOG Source Sewer Line inspections, the FSE's grease interceptor "Conditional Waiver" may be revoked requiring the installation of a grease interceptor.

- If the FSE has a grease interceptor, the FSE will be informed that they have been identified as a significant FOG discharger, and that the maintenance of their grease interceptor has not been effective. The FSE may be required to: 1) pump their grease interceptor on a more frequent basis; 2) conduct a functional integrity test of their grease interceptor; and/or 3) have their kitchen drain lines dye tested to ensure that the appropriate drains are connected to the interceptor.

For repeated non-compliance, the enforcement process may be elevated by increased assessment of fees including termination of the FSE's right to discharge wastewater into the District's sewer collection system.

4.8.4 COMPLIANCE SCHEDULE AGREEMENTS (CSA)

The General Manager may require the permittee to enter into a Compliance Schedule Agreement (CSA) when the permittee is in non-compliance with the terms of the Regulations, and/or is required to install grease control equipment or grease interceptor. The CSA may not be initiated until all amounts owed to the District by the FSE are paid in full and, if the compliance schedule is not achieved, the General Manager may initiate the enforcement process. This includes termination of the FSE's right to discharge wastewater into the District's sewer collection system.

4.8.5 APPEALS

Any FSE affected by the action or determination of the FOG Control Program Manager or Notice of Violation issued by an inspector may file a request for an appeal hearing with the General Manager. This request is required to be in writing and must be submitted within 15 days of the date of the notice of the decision or action. The General Manager will conduct a hearing to allow the appellant(s) to present information supporting the FSE's position. The General Manager will review the facts, make a determination concerning the appeal, and provide in writing the findings to the appellant.

Any FSE affected by the action or determination of the General Manager may file a request for appeal hearing with the Board of Directors. This request is required to be in writing and must be submitted before the date the General Manager's order becomes final. The Board of Directors will grant all hearing requests concerning appeals for permit suspension, revocation or denial. The Board of Directors will evaluate all other hearing requests and will determine whether they will grant or deny the request. The Board of Directors, during the hearing, will allow the appellant(s) to present information supporting the FSE's position. The Board of Directors will review the facts, make a determination concerning the appeal, and provide in writing the Board of Directors' findings to the appellant.

4.9 FSE FOG Program and Data Management

The FOG Control Program is managed by the FOG Control Program Manager and the inspection and enforcement activities are conducted by District staff or by outside contractors under his/her supervision. The program is well integrated with the collection system maintenance program, specifically the hot spot sewer cleaning and video inspection activities.

The FSE data management process consists of:

- Access database that is utilized to identify the FSEs in the FOG Control Program and the specific details and inspection history of each facility.
- Composite Map displaying the location of the FSEs (Appendix C)

Additionally, the District utilizes their internal Customer Service Records, business licenses, Orange County Health Care Agency's (OCHCA) website, building departments' new construction or tenant improvement reviews for commercial or industrial property, and input from District field personnel to identify new FSEs or modifications to existing FSEs.

5.0 MULTI-FAMILY HOUSING, AND SINGLE FAMILY HOME FOG CONTROL PROGRAM

The multi-family housing, and single family home FOG Control Program will utilize education as the primary method for controlling the discharge of the FOG to the sewer system. Educational information concerning FOG will be provided in the District's Quarterly Newsletter, and FOG education brochures will be mailed with utility bills on an annual basis to educate District customers.

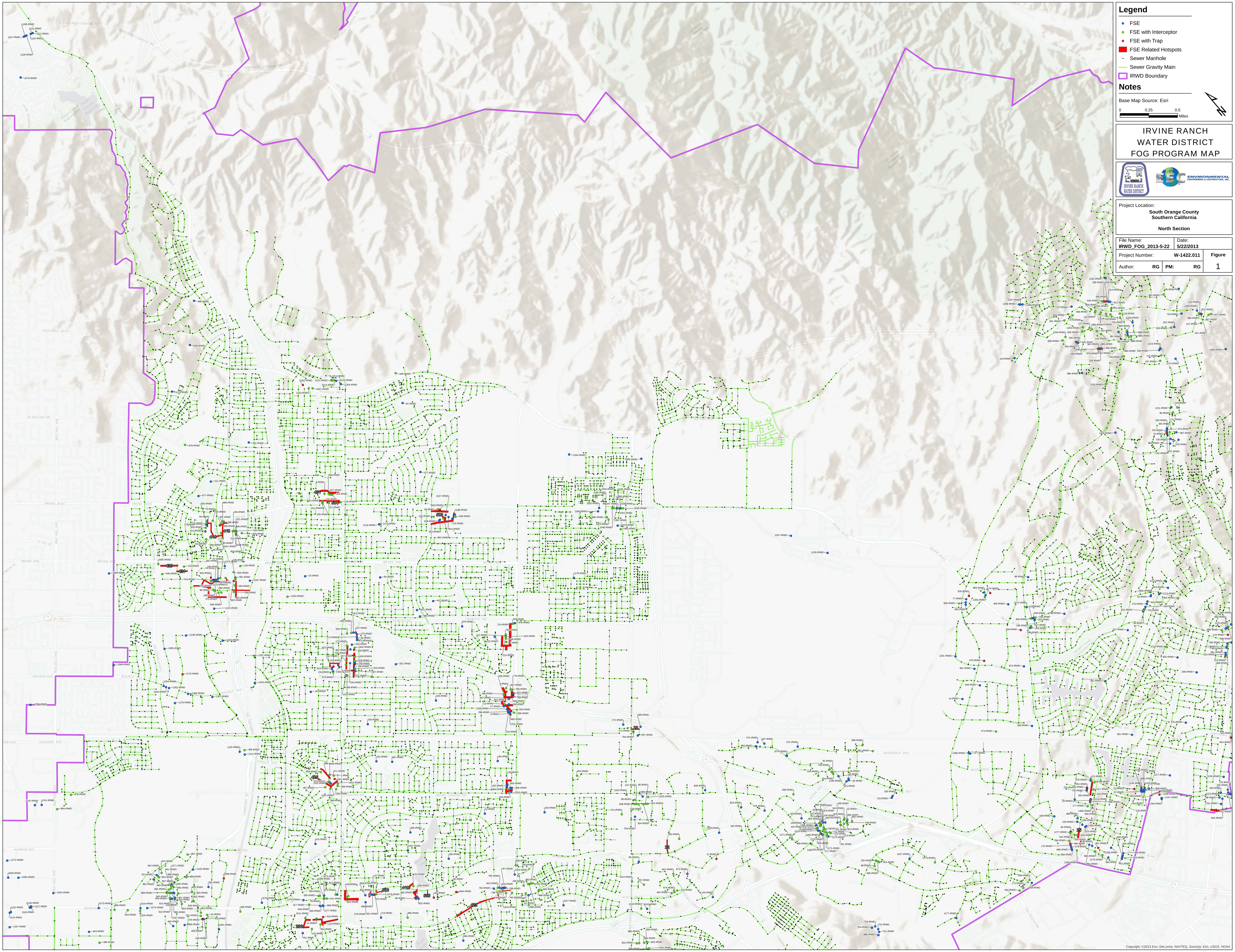
For areas identified as potential upstream sources of FOG in the sewer system, more frequent mailing of FOG brochures will be conducted. Additionally, FOG brochures and other educational material will be provided to multi-family housing for posting in common areas. Refer to Appendix K for FOG educational material.

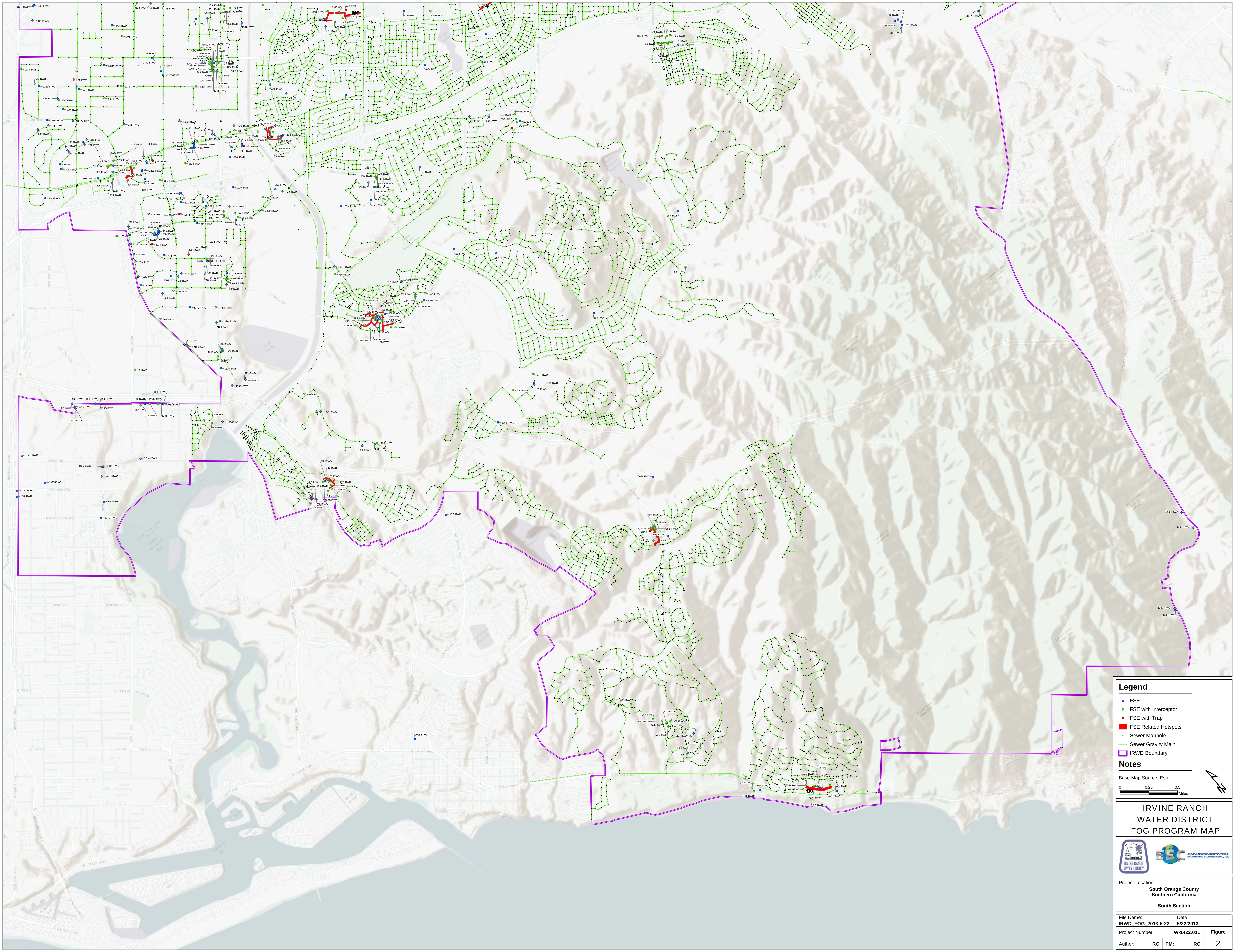
6.0 INDUSTRIAL FOG PROGRAM

Orange County Sanitation District's source control program is utilized to regulate the wastewater discharged from Industrial users into the District's sewer collection system. The District will coordinate with OCSD for regulation and enforcement for those industrial discharges that are identified as significant FOG discharges.

APPENDIX I2

FOG Food Service Establishments and Hotspots


Legend
FSE
FSE with Interceptor
FSE with Trap
FSE Related Hotspots
Sewer Manhole
Sewer Gravity Main
IRWD Boundary
Notes
Base Map Source: Esri
0 0.25 0.5 Miles
IRVINE RANCH WATER DISTRICT FOG PROGRAM MAP
IRVINE RANCH WATER DISTRICT
EEC ENVIRONMENTAL ENGINEERING & CONTRACTING, INC.
Project Location:
South Orange County
Southern California
North Section
File Name: IRWD_FOG_2013-5-22
Date: 5/22/2013
Project Number: W-1422.011
Figure 1
Author: RG
PM: RG
Copyright: ©2013 Esri, DeLorme, NAVTEQ, Sources: Esri, USGS, NOAA



IRVINE RANCH WATER DISTRICT FOG PROGRAM MAP

Project Location:
South Orange County
Southern California

South Section

File Name: **IRWD_FOG_2013-5-22**	Date: **5/22/2013**	
Project Number: **W-1422.011**		Figure
Author: **RG**	PM: **RG**	2

APPENDIX J1

2006 Sewer Master Plan

IRVINE RANCH WATER DISTRICT

SEWER COLLECTION SYSTEM MASTER PLAN

JUNE 2006

Prepared by:

DUDEK

For:

IRVINE RANCH WATER DISTRICT

TABLE OF CONTENTS

FIGURES

TABLES

PLATES

(LOCATED AT THE END OF EACH CHAPTER)

1.0 LAND USE PLANNING

1.1 PURPOSE

Information discussed in this chapter is derived from Chapter 2, Land Development, of the District's Water Resource Master Plan (WRMP). Land use information from the WRMP was updated and re-presented in this chapter. The following discussions outline the land use and land use planning by jurisdictional agencies, primarily the City of Irvine and the City of Lake Forest, with portions of the City of Orange, Tustin, and Newport Beach included in the analysis. As part of the preparation of the Sewer Collection System Master Plan (SCSMP), General Plan documents for each agency were reviewed, and the land use information derived from those documents was compared to existing land use categories in the WRMP (Table 2-1). Subsequently, those land use categories were updated as appropriate.

1.2 LAND USE PLANNING

Irvine ranch Water District (IRWD) is comprised of over 84,000 acres, approximately one-sixth of the area of Orange County. In addition to encompassing the City of Irvine, IRWD is bounded by and includes portions of the Cities of Tustin, Santa Ana, Costa Mesa, and Newport Beach to the west, the City of Lake Forest to the east, and by large portions of unincorporated Orange County land to the north. The incorporated cities and the County are responsible for land use planning within the IRWD service area. In addition, as the major landowner within the IRWD service area, The Irvine Company (TIC), has significant influence on land use decision making.

Since the formation of IRWD in 1961, land use has been changing steadily in parallel with continuing development of the area. Although agriculture has been maintained successfully in the region for many years, most agricultural land has been converted to residential, commercial, industrial, or other urban uses. As these changes occur, land use planning has been a dynamic process, with adopted General Plans within IRWD frequently updated.

Each land use jurisdictional agency (cities and the County) within the IRWD boundary is required by the state to prepare a General Plan document stating the long range vision for their respective agency. These General Plan documents provide a Land Use Element section that determines how land will be developed. The Land Use Element identifies land use categories and assigns them to geographic areas within the municipality. This element also identifies standards for the intensity of development and density of population for each of the designated land uses.

The General Plan having the greatest effect on IRWD is the City of Irvine General Plan. That General Plan was adopted in 1973 and has undergone several amendments since that time.

1.3 LAND USE CATEGORIES

To develop appropriate land use categories for use in developing appropriate sewer flow generation factors, the categories used in most Water Resources Master Plan (WRMP) were compared to current General Plans and zoning documents of the jurisdictional agencies within the IRWD service boundary. Table 1-1 organizes the specific land use categories used in the SCSMP into five major land use types: residential, commercial, industrial, open space and other and mixed land use. Four digit numerical designations have been added for use in the GIS database.

1.3.1 RESIDENTIAL LAND USE

The 2003 WRMP currently contains 26 residential land use categories, which are derived from the residential land use categories in each of the General Plans of the jurisdictional agencies within IRWD. Although some of the residential categories are similar in density ranges and/or people per dwelling unit factors, the detailed breakdown will allow a more precise matching to agency categories and projections. The review completed as part of the SCSMP added one new land use category, High Rise Residential Density. This new category is used primarily in the IBC area for redevelopment of existing commercial or industrial land uses to high density residential.

The density range values are derived from the agencies' planning documents, as do the people per dwelling unit values. However, in areas where the population density values were not available, these values were interpolated using other agency values for similar densities.

1.3.2 NONRESIDENTIAL LAND USE

Non-residential Land Use categories have remained relatively unchanged from the 2003 WRMP, with the exception of the addition of a land use category for Hotels. Only minor differences in categories from agency to agency were found to exist, and the projection of potable or nonpotable water demand or wastewater generation was not found to be appreciably affected by these differences.

A land use category of 'no service' is provided for areas within the IRWD service area that receive all water and sewer service from other agencies.

Table 1-1 Land Use Categories

Code	Land Use	Agency	Ave Density DU/AC	Population Density
1100 Residential				
1111	Res-Rural Density	Orange	0.30	3.68
1121	Res-Estate Density	Orange	1.20	3.68
1131	Res-Low Density	Orange	4.00	3.25
1141	Res-Low-Medium Density	Orange	10.50	3.68
1161	Res-Medium Density	Orange	19.50	3.45
1122	Res-Estate Density	Irvine	0.50	2.61
1132	Res-Low Density	Irvine	3.00	2.61
1162	Res-Medium Density	Irvine	7.50	3.50
1172	Res-Medium-High Density	Irvine	17.50	2.03
1182	Res-High Density	Irvine	32.50	2.60
1192	Res-High-Rise Density	Irvine	40.00	2.60
1133	Res-Low Density	Newport	1.00	3.20
1153	Res-Medium-Low Density	Newport	2.75	2.45
1163	Res-Medium Density	Newport	5.00	2.13
1183	Res-High Density	Newport	12.25	1.36
1134	Res-Low Density PC	Tustin	4.50	1.36
1164	Res-Medium Density PC	Tustin	11.80	2.60
1184	Res-High Density PC	Tustin	17.40	2.05
1115	Res-Rural Density	County	0.26	3.95
1135	Res-Suburban Density	County	9.25	3.75
1175	Res-Urban Density	County	29.00	3.15
1126	Res-Estate Density	Lake Forest	0.50	2.61
1136	Res-Low Density	Lake Forest	3.00	2.61
1166	Res-Medium Density	Lake Forest	7.50	3.50
1176	Res-Medium-High Density	Lake Forest	17.50	2.03
1186	Res-High Density	Lake Forest	32.50	2.60
1200 Commercial			KSF/AC	
1210	Comm-General Office		25.00	
1221	Comm-Community		9.09	
1222	Comm-Regional		10.53	
1230	Comm-Recreation		8.33	
1240	Comm-Institutional		8.89	
1244	Comm-Hospital		8.70	
1260	Comm-School		13.33	
1273	Comm-Military Air Field			
1290	Comm-Hotel			
1300 Industrial			KSF/AC	
1310	Industrial-Light		25.00	
1320	Industrial-Heavy		25.00	
Open Space & Other				
1820	Park-Community			
1830	Park-Regional			
1840	Fuel Modification Zone			
1850	Park-Wildlife Preserve			
1880	Park-Open Space (Rec)			
1900	Vacant			
2000 Agriculture				
2100	AG-Low-Irrigated			
2110	AG-Low-Irrigated (TIC)			
2200	AG-High-Irrigated			
2210	AG-High-Irrigated (TIC)			
4100	Water Body			
9100	Mixed Use			

1.4 PLANNING AREAS

A planning area concept is used with respect to future land use intensity standards and development phasing. These areas are typically based on a combination of the City of Irvine and TIC planning areas. As a result, IRWD will remain tied to "planning areas" as the basic unit of future development projections. Phasing information provided by the City of Irvine and TIC is based on these same planning areas. As shown on Figure 1-1, IRWD defines and uses a significant number of individual planning areas.

1.5 LAND USE PROJECTIONS AND PHASING

1.5.1 EXISTING LAND USE

Existing land use information was obtained from the County of Orange's Tax Assessor data. This information was augmented with aerial photos and site visits where necessary. Figure 1-2 shows the 2006 existing land use within the IRWD service area.

1.5.2 REDEVELOPMENT WITHIN IRWD

Currently, the Irvine Business Complex (IBC) is the only area in the District with an appreciable amount of ongoing or planned redevelopment. The IBC area has traditionally been comprised of predominately commercial and industrial businesses. In 2004, the City of Irvine began studying a strategy to address the issues associated with increasing residential development in the IBC. At the time this Master Plan was completed, the City was in the process of completing a Mixed Use Residential Overlay Zoning Code for the IBC. This master plan includes zoning changes approved by the City through May 2006.

1.5.3 SUB-AREA MASTER PLAN (SAMP)

A SAMP is a water, sewer, and reclaimed water facility planning study prepared by IRWD for a specific planning area. Where available, SAMPs were used to refine general plan land use and phasing information. SAMPs are generally completed on an area after the developer has generated a specific plan of development. This information is typically regarded to be of greater detail and accuracy than General Plan data. Figure 1-3 shows the SAMPs referenced in the preparation of the SCSMP.

Figure 1-1 IRWD Planning Areas

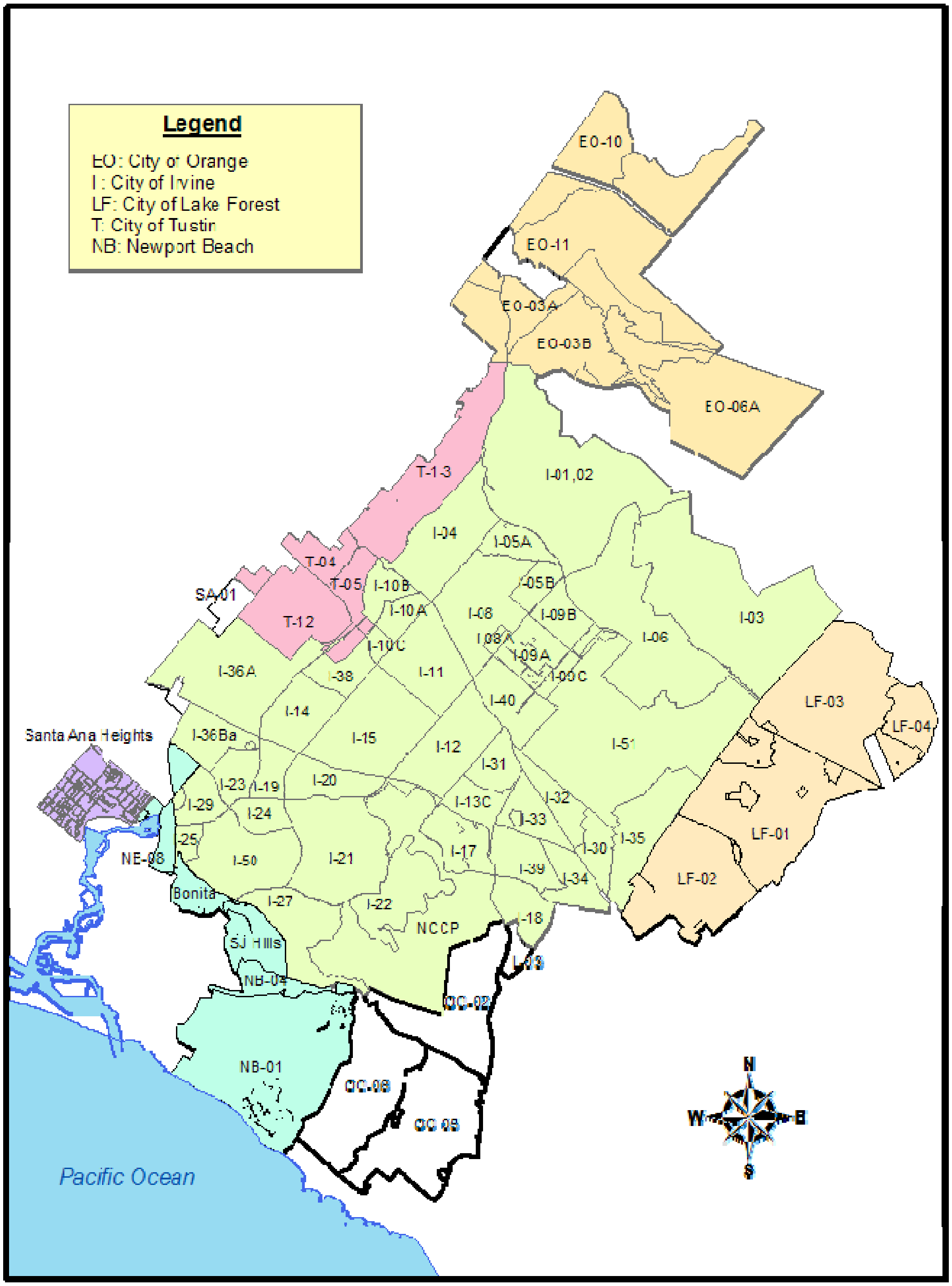
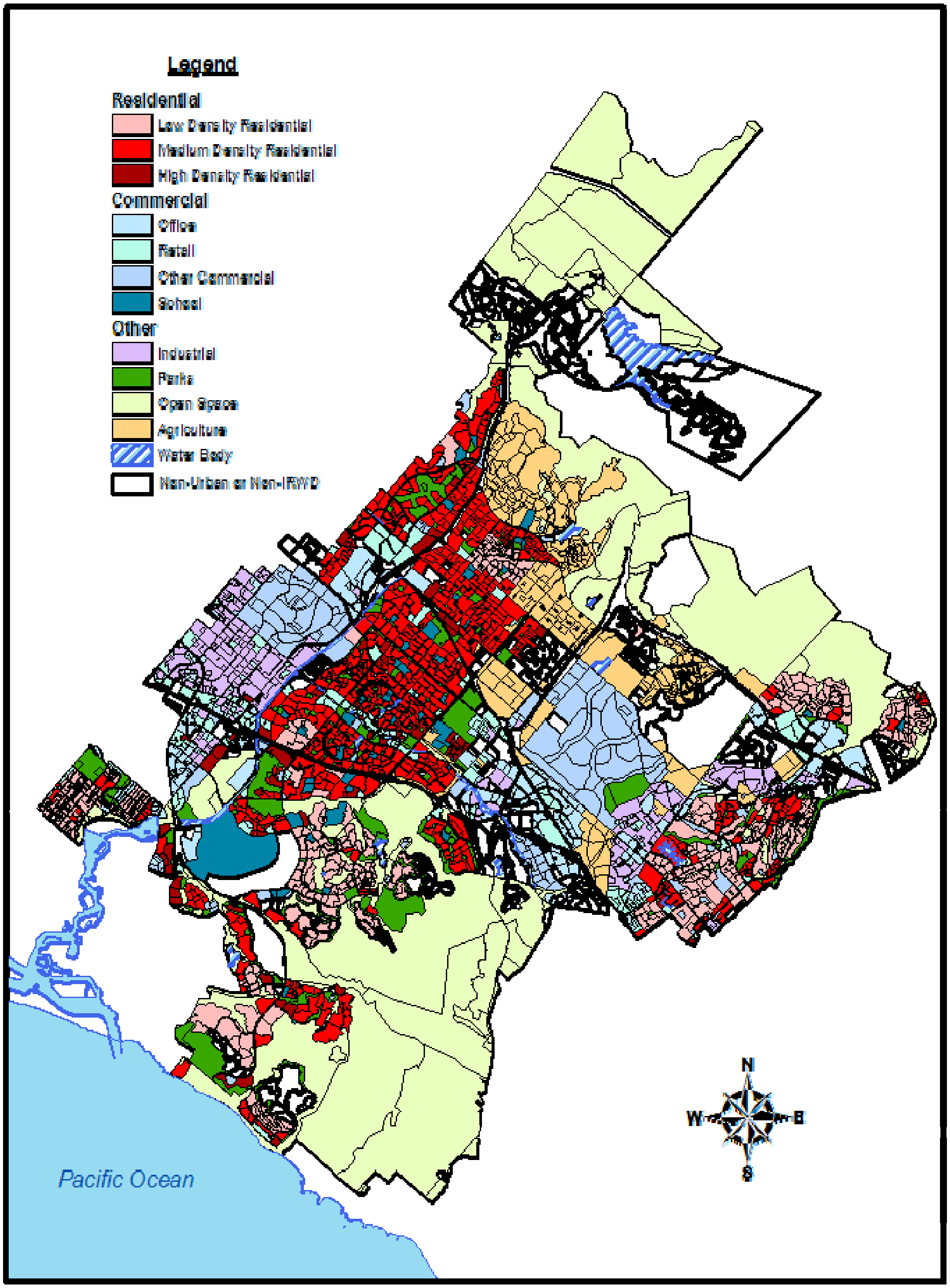
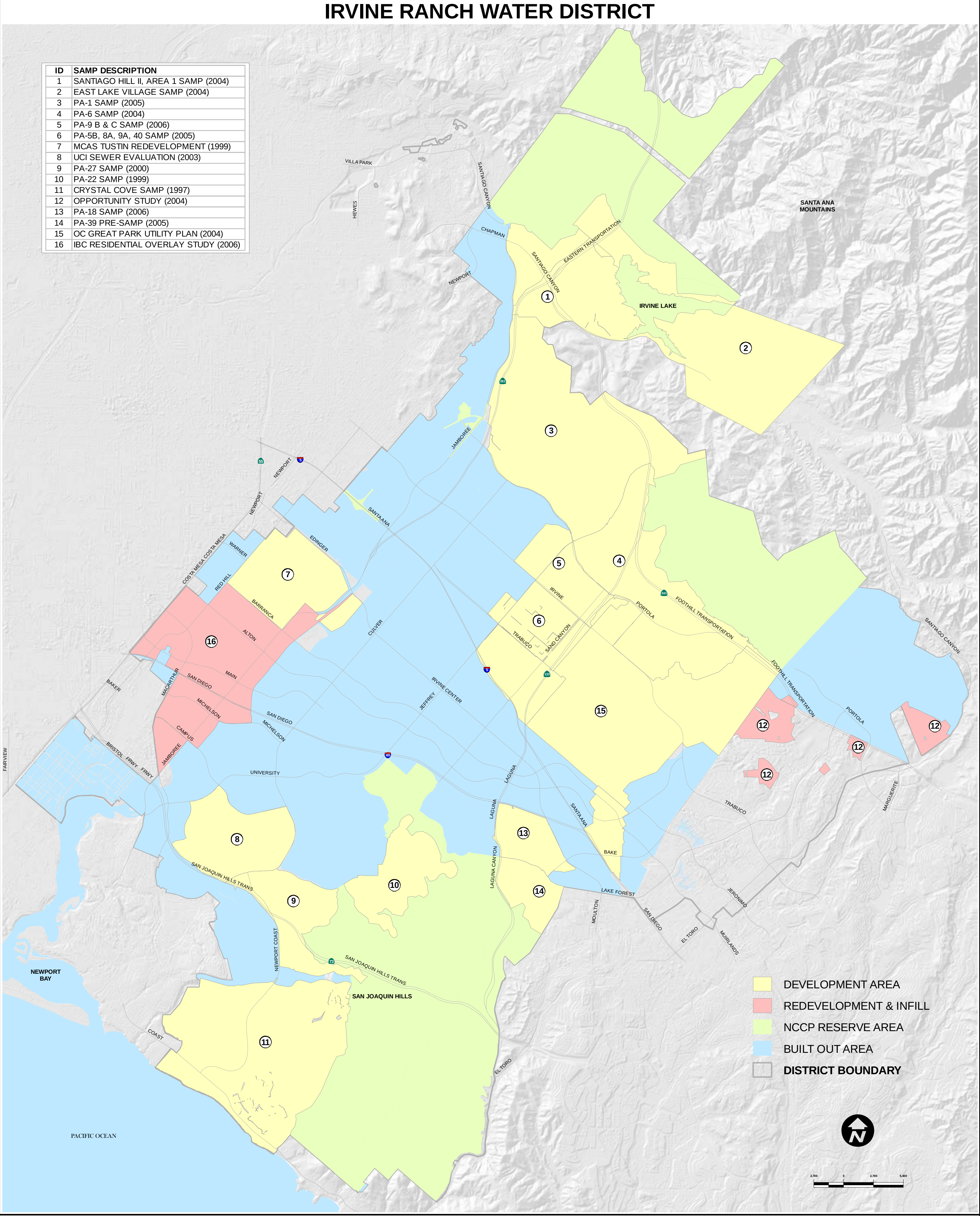


Figure 1-2 Existing Land Use



IRVINE RANCH WATER DISTRICT



ID	SAMP DESCRIPTION
1	SANTIAGO HILL II, AREA 1 SAMP (2004)
2	EAST LAKE VILLAGE SAMP (2004)
3	PA-1 SAMP (2005)
4	PA-6 SAMP (2004)
5	PA-9 B & C SAMP (2006)
6	PA-5B, 8A, 9A, 40 SAMP (2005)
7	MCAS TUSTIN REDEVELOPMENT (1999)
8	UCI SEWER EVALUATION (2003)
9	PA-27 SAMP (2000)
10	PA-22 SAMP (1999)
11	CRYSTAL COVE SAMP (1997)
12	OPPORTUNITY STUDY (2004)
13	PA-18 SAMP (2006)
14	PA-39 PRE-SAMP (2005)
15	OC GREAT PARK UTILITY PLAN (2004)
16	IBC RESIDENTIAL OVERLAY STUDY (2006)

FIGURE 1-3 PLANNING DOCUMENTS

DUDEK

1.5.4 NATURAL COMMUNITY CONSERVATION PLANNING (NCCP)

The NCCP program is a collaborative planning program involving landowners, local governments, and state and federal agencies designed to provide long term, large-scale protection of natural vegetation and multi-species habitat. The NCCP program provides for a portion of IRWD to be designated as permanent open space (NCCP Reserve Area) or restricted use open space (Special Linkage). Figure 1-3 shows the areas within IRWD that are designated as NCCP Reserve, Special Linkage, or Permanent Open Space.

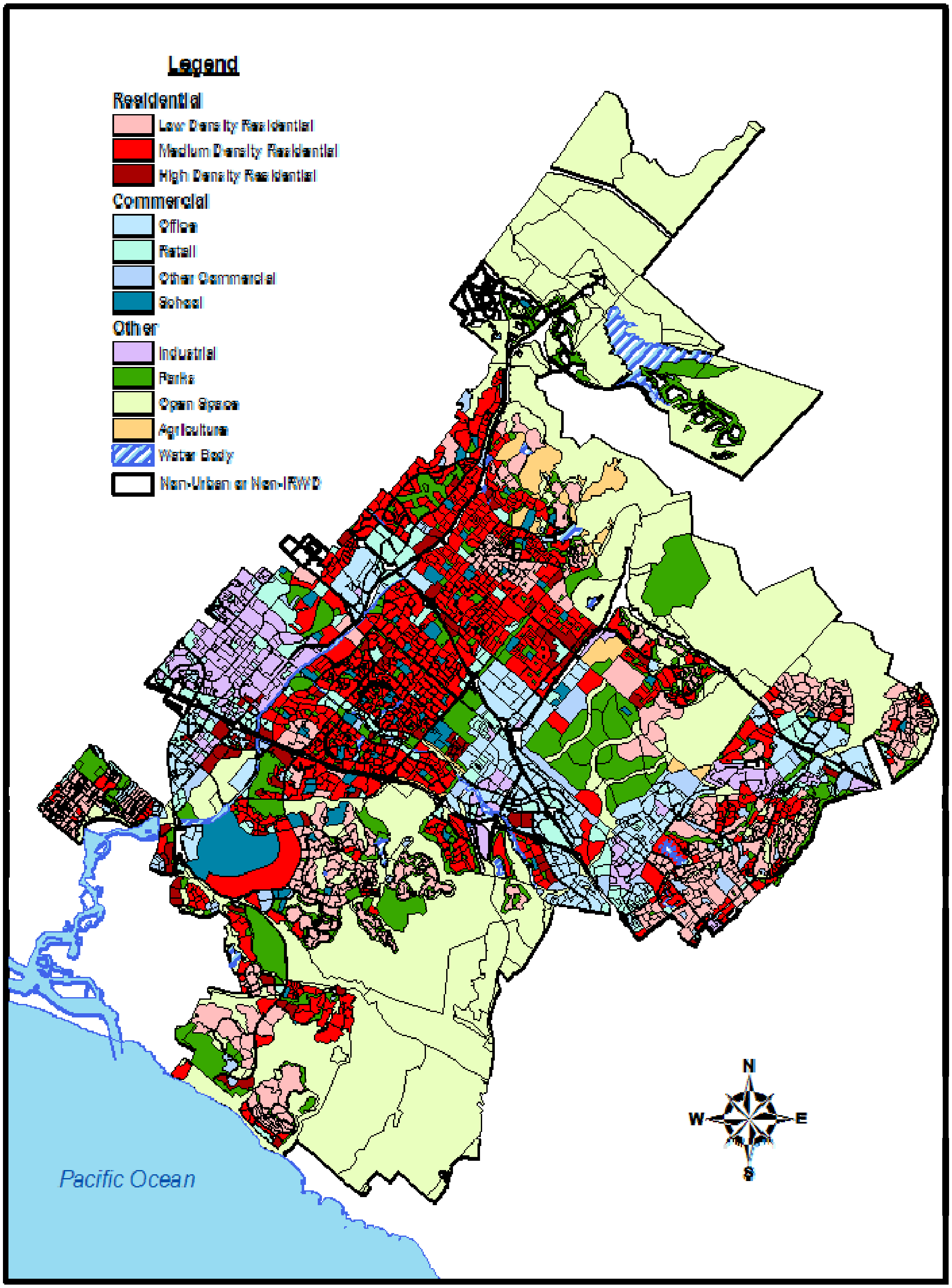
1.5.5 GREAT PARK AND HERITAGE FIELDS (FORMER MARINE CORPS AIR STATION, EL TORO)

At the time this master plan was being completed, Lennar Corporation and the City of Irvine had not yet released detailed land us planning information for their respective development areas at the Great Park. Therefore, the SCSMP used the most recent update of the City of Irvine Zoning Overlay for the Great Park area.

1.5.6 ULTIMATE LAND USE

The ultimate land use presented in this master plan is a combination of the data sources presented above. Figure 1-4 shows ultimate land use within the IRWD service area. A projection of land use categories by acreage is shown in Table 2-3 of the WRMP. This table shows that residential acreage will increase by 50% by 2025, agriculture land uses will decline by almost two-thirds, and most of the vacant land within the IRWD service area will have been developed.

Figure 1-4 Future Land Use



1.6 RECOMMENDATIONS

- Continue to use tools,, such as GIS-based Water Demand Forecasting software, to readily update land use projections from local agencies within the IRWD service area.

- Add three new land use categories to the District's land use planning process in this document and the WRMP: High Rise Density, Hotel, and Fuel Modification Zones.

- Require the land use element maps of future SAMPs to be completed in a digital format for timely integration into the GIS database.

2.0 SYSTEM CHARACTERISTICS

2.1 PURPOSE

This chapter describes the overall characteristics of the Irvine Ranch Water District (IRWD) sewer collection system. The development of planning criteria for flows and capacity are discussed in Chapter 3 and the evaluation of the District's existing sewer collection system is discussed in Chapter 4.

2.2 OBJECTIVES

The primary objective of this chapter is to characterize the existing conveyance system assets of the District.

2.3 PHYSICAL GEOGRAPHY

Drainage patterns within the District's wastewater collection system are defined by the physical geography of its service area. The District is bounded on the northeast by the Santa Ana Mountains and on the south by the San Joaquin Hills. Topography between these two major land features generally slopes gently to the west and northward.

The District's two primary drainage features include San Diego Creek and Peters Canyon Wash / Channel. The Peters Canyon drainage feature extends from approximately the eastern portion of the City of Orange in the north, following generally along the Jamboree, Myford and Harvard Avenue alignments, to its confluence with San Diego Creek near the intersection of Interstate 405 and Harvard Avenue.

San Diego Creek is divided into two major reaches. Reach 2 extends from an area near the intersection of Highway 133 and Interstate 405, and continues northerly and westerly, generally along the Interstate 405 alignment, to a point near the intersection of Harvard Avenue and Interstate 405. At that point, San Diego Creek combines with the Peters Canyon drainage forming San Diego Creek Reach 1. San Diego Creek Reach 1 extends from the intersection of Interstate 405 and Harvard Avenue to its discharge into Newport Bay, a point just west of McArthur Boulevard.

As a result of these dominant drainage features, the District's sewer system flows generally from the northeast to southwest. At points where the system intersects with the predominant drainage features, the system drainage patterns shift to a generally southeast to northwest direction. The primary southeast to northwest drainage feature is San Diego Creek Reach 2.

The area immediately west of the Peters Canyon drainage generally exhibits an easterly drainage pattern. The drainage pattern then follows a southerly drainage pattern toward the

Harvard Avenue Trunk Sewer (HATS), which flows south to its intersection with the OCSD Main Street Interceptor.

The Newport Coast area, located to the south of the San Joaquin Hills ridgeline, exhibits a southerly drainage pattern toward the OCSD pipeline located in the Coast Highway.

The overall topography, and associated drainage areas, of the District are shown on Figure 2-1.

2.4 SYSTEM METRICS & INVENTORY

The District owns and operates a large and complex sewer collection system to serve its current, as well as future, customers. Some key facts about the District are summarized in Table 2-1.

Table 2-1 Key Facts about IRWD

Total Length of Sewer Pipeline	4.4M Linear Feet (834 Miles)
Estimated Value @$10/IN/Ft	$450M
Customers	87,500 Residents 5,800 Non-Residents

Wastewater collected by the system is conveyed to Regional Treatment Facilities as shown in Figure 2-2.

IRVINE RANCH WATER DISTRICT

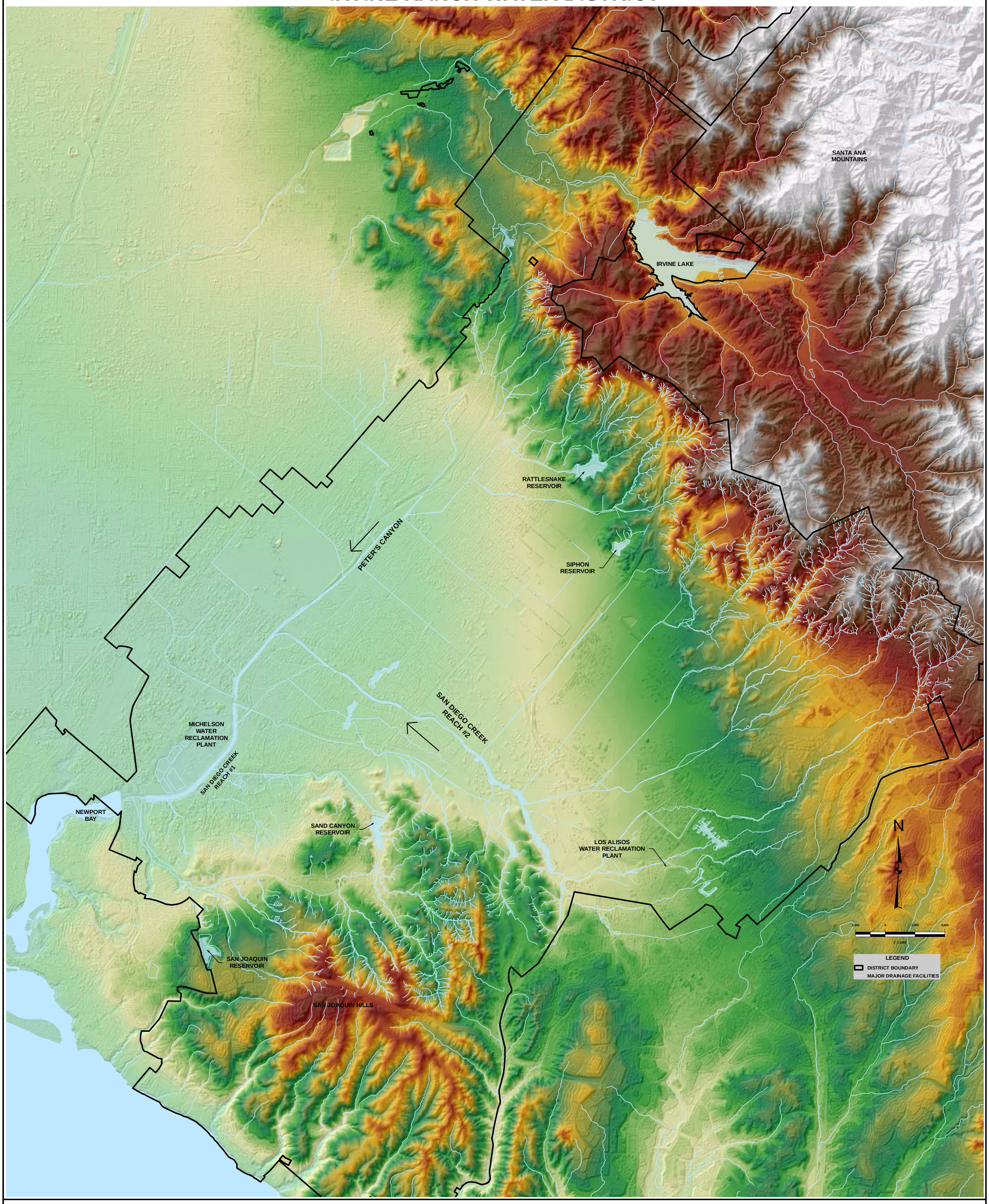


FIGURE 2-1 DOMINANT DRAINAGE FEATURES

DUDEK

FIGURE 2-2 DOMINANT DRAINAGE FEATURES

IRVINE RANCH WATER DISTRICT

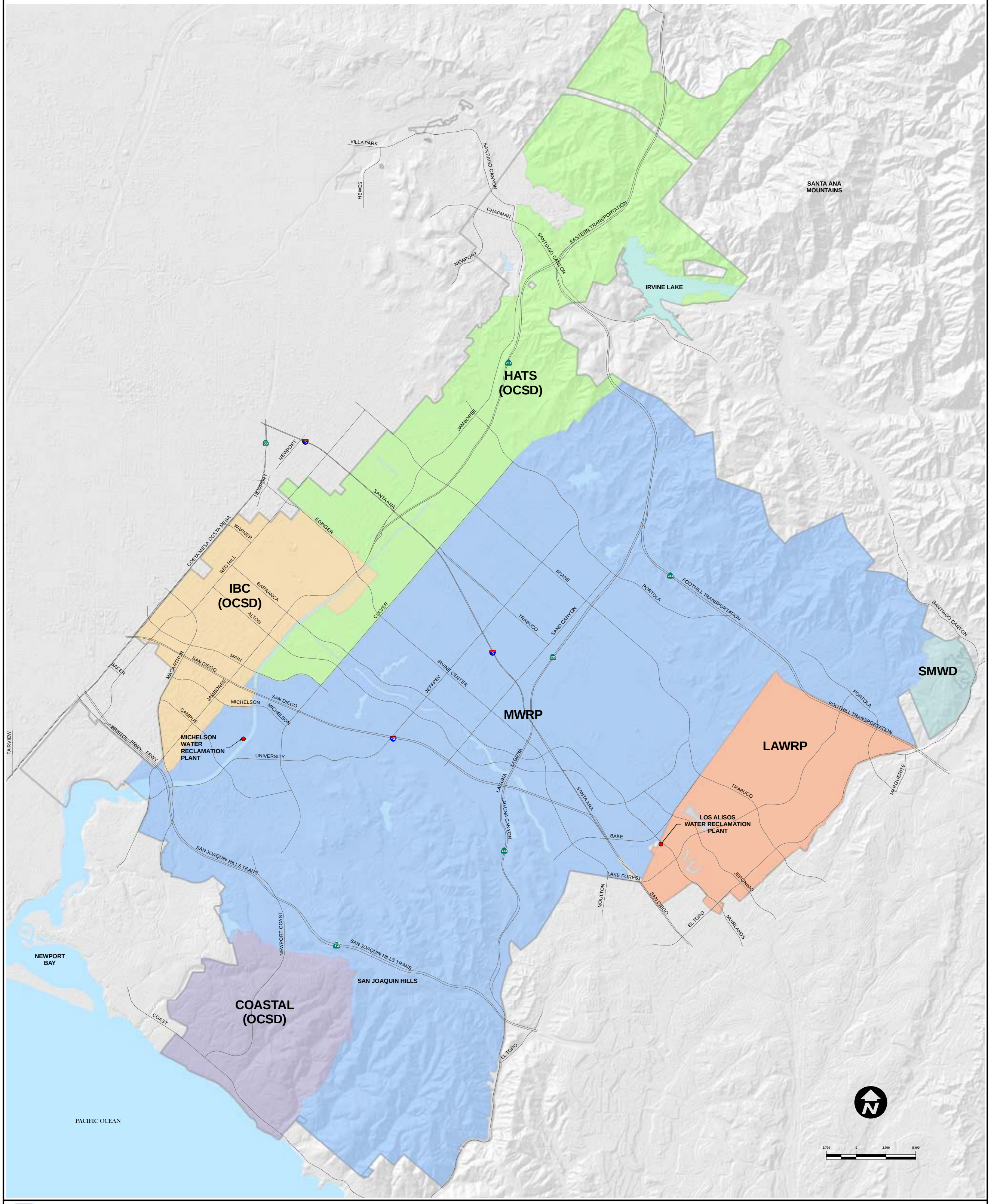


FIGURE 2-2 REGIONAL TREATMENT FACILITIES

DUDEK

2.4.1 LIFT STATIONS

The District owns and operates 24 lift stations throughout its collection system. Twelve of these are considered major facilities. Lift stations convey tributary flow from low areas constrained by topographic elevations to higher elevations where the flows can be conveyed to the treatment plant by gravity. Lift stations typically require significant maintenance and attention by District operations personnel, and represent a significant risk point in the system for overflows or spills. As such, it is the goal of the District to minimize the number and size of lift stations within the collection system.

Flows tributary to lift stations are conveyed through pumps into pipelines that operate under pressure. These are called force mains. The force main flows discharge into the gravity collection system. The potential for odor at these discharge points is significant. As a result, lift stations and force mains are operated in such a manner to minimize the travel time in the force main and the turbulence at the discharge point. Lift stations are also constructed with redundant facilities and standby power to minimize the potential for spills and potential impact to the environment. For the purposes of this master plan, lift stations require additional modeling efforts and are also discussed in Chapter 6 - Reliability and Redundancy.

Table 2-2 describes each of the District's lift stations and its operating characteristics.

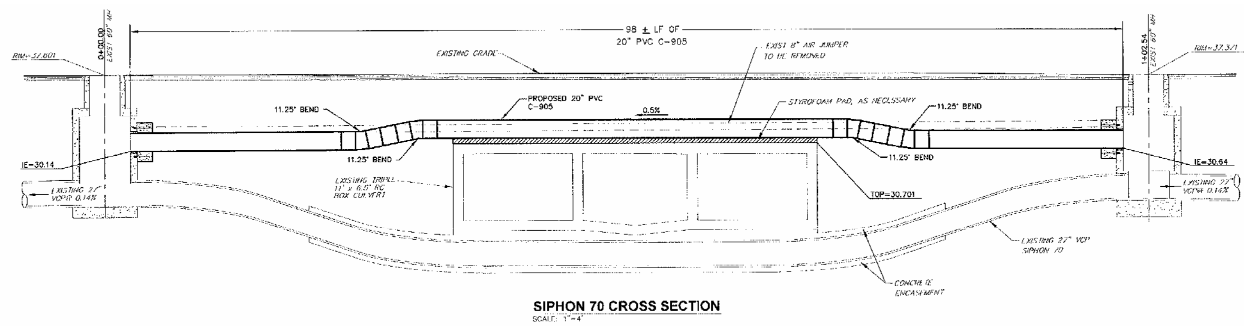
Table 2-2 Lift Stations

Lift Station Name	Location	System ID	Pumps	Discharge System		
			Total Capacity (MGD)	FM Length (ft)	FM Diameter (inch)	Velocity (ft/s)
Bayview	Bayview Way at Bayview Place	LS01	0.504	2,852	6	3.96
University	MacArthur at University	LS05	1.728	5,142	12	3.40
Newport Coast Dr.	21244 Newport Coast Drive	LS10	2.304	2,957	12	4.53
Portola Hills	Glenn Ranch and Saddleback Ranch	LS11	1.354	1,456	10	3.83
Borrego	Towne Center and Pasatiempo	LS12	0.444	4,464	8	1.96
Buck Gully	Buck Gully at White Pine	LS13	0.259	1,433	6	2.04
Montecito/ TR14070	Via Burrone	LS15	0.172	1,278	4	3.04
Michelson (IRWD)	Michelson Drive	LS30	N/A	2,221	12	N/A
Michelson (OCSD)	Michelson Drive	LS30	N/A	1,975	12	N/A
McGaw	McGaw Ave	LS31	1.440	78	12	2.83
Coastal Ridge	TBD	LS29	0.374	3,847	6	2.94
La Canada	Lake Forest Dr.	LS19	0.259	3,074	10	0.73
Coyote Canyon	Bonita Canyon Dr. west of Coyote Dr	LS16	0.720	2,455	12	1.41
Bonita Culver	Culver Rd	LS06	0.432	1,111	6	3.40
Muddy Canyon	Pacific Coast Hwy	LS18	0.288	N/A	N/A	N/A
Irvine Park	Irvine Park Rd	LS25	0.389	N/A	N/A	N/A
SJHR SLS	Ridgeline Dr	LS21	N/A	N/A	N/A	N/A
DATS	W. Segerstrom	LS24	N/A	N/A	N/A	N/A
Duck Club	Michelson Dr	LS27	N/A	N/A	N/A	N/A
Michelson - Caretaker Housing Lift Station	Michelson Dr	LS28	2.520	5,857	12	4.95
El Morro School Lift Station	Pacific Coast Hwy	LS22	N/A	N/A	N/A	N/A
Los Trancos Low Flow Lift Station	Pacific Coast Hwy	LS17	N/A	N/A	N/A	N/A
Main St.	Main St.		N/A	N/A	N/A	N/A
Operations Center - Auto Shop Lift Station	Michelson Dr	LS26	N/A	N/A	N/A	N/A

2.4.2 SIPHONS

The District's collection system also contains special structures known as siphons. Siphons are used to convey wastewater flows under man-made or natural obstructions. Making use of existing differences in elevations on either side of the obstruction, sufficient pressure is created to convey the flow beneath the obstacle. Siphons operate under pressure and create special hydraulic and maintenance challenges. Operational attention must also be given to the potential formation of hydrogen sulfide, a foul smelling gas, at these facilities. Odor complaints are typically experienced at improperly vented siphons.

Figure 2-3 Example Siphon



As presented in Figure 2-3, flow is from right to left. The slope of the siphon is steep at the upstream portion of the pipe. The middle of the siphon is level, followed by a steep slope upwards at the opposite end. As long as water is flowing into the upper end of the pipeline, water is conveyed by gravity through the structure, thus the siphon is considered a gravity portion of the collection system. While in operation the middle section is flowing in a full pipe. The lack of oxygen increases the likelihood of anaerobic bacteria which produce hydrogen sulfide. Additionally the operation of siphons is through a number of parallel pipes (barrels). In many instances one of the parallel pipes is held as a spare barrel, to allow for increased velocities through the remaining barrels. The spare barrel is then used only when maintenance is performed. Siphons should be regularly monitored to assure that proper cleansing velocities are maintained.

Table 2-3 lists the characteristics of each of the siphon structures contained in the District's trunk sewer system. The siphons are also included on the overall collection system map.

Table 2-3 Siphons

Siphon Location	Year Constructed	No. Of Barrels	Length (ft)	Diameter	Material	Model ID
El Toro Rd/Glen Ranch Rd	1990	2	312	8	VCP	20477
El Toro Rd/Portola Pkwy	1992	2	374	8	VCP	20540
Foothill Transportation/Lake Forest Dr	1996	2	148	8, 10	VCP	20491
Harvard Av/Barranca Pkwy	1986	3	160	24	VCP	20484
Harvard Av/University Dr	1976	3	437	15, 24, 30	VCP	20496
Jamboree Rd/ North of Main St	1972	2	79	8, 12	VCP, PVC	293
Jamboree Rd/North of Trevino Dr	1988	1	276	24	VCP	20506
Jamboree Rd/Octa Metrolink	1986	4	412	15, 18, 24	VCP	20480
Jeffrey Rd/Alton Pkwy	1988	2	275	20, 21	VCP	20488
Main St/Veneto	1986	3	455	18,24,42	VCP	20510
Michelson Dr/Riparian	1976	2	443	24	VCP	20487
Milano Dr/North of La Salud	1970	2	70	15, 27	VCP	20503
Peters Canyon Rd/Walnut Rd	1999	1	265	8	VCP	20513
Prism/Linear	1987	2	250	8	VCP	21488
Sand Canyon Av/Barranca Pkwy	1987	2	297	8, 12	VCP	20493
Shady Canyon Dr/Sage Creek	2001	1	243	8	PVC	20504
University Dr/Harvard Av	1966	3	204	10, 15, 18	ACP	20498
University Dr/SR-73	1998	2	317	16	PVC	20501
Vernal Spring/Canyon Creek	2003	1	232	8	PVC	20507

2.4.3 DIVERSION STRUCTURES

Diversion structures are located throughout the system. These structures divert or split the upstream flows into two separate downstream pipelines. The locations of these facilities are characterized by at least two flow outlets from a single manhole or junction box. Diversion structures are important because they provide the availability of alternative flow routing in time of need or emergency.

A good example of diversion structure operations is the Main Street Diversion Structure. Through this structure, the District can direct flow to the Michelson treatment facility through a pipeline located along the San Diego Creek Channel alignment or to an OCSD treatment facility through a pipeline located along the Main Street alignment. This type of facility provides enhanced operational flexibility.

Diversions are also important with respect to system modeling and/or flow measurement programs, as the structures create a direct impact on the flows measured and on model calibration. Table 2-4 provides a list of the significant diversion structures identified throughout the District's collection system. It is noted that this table should not be considered a complete list of District diversion structures, as there are numerous flow diversion facilities throughout District's system particularly within the collection pipelines of less than ten inches in diameter. In addition, it is noted that there are an especially high number of diversion structures in the Los Alisos WRP Service Area.

Table 2-4 Diversions in Main Trunk System

Upstream Pipe ID	Location	Treatment Plant
MH123N006MH123N038	Irvine Center Dr./Valley Oak Dr.	MAIN
MH060E004MH060E006	San Leandro/Culver Dr.	MAIN
MH099N018MH099N019	Bethany Dr./Blinn Ln.	MAIN
MH048W061MH048W056	Von Karman Ave./Main St.	IBC
MH048S045MH048S044	Main St./Jamboree Rd.	MAIN
MH057N003MH057N247	Milano Dr./La Salud	MAIN
MH048S023MH048W063	Main St. and Cartwright Rd.	IBC
MH047W043MH048N021	Von Karman Ave./Alton Pkwy	IBC
MH060E021MH060E097	Main St./San Mateo	MAIN
MH205E338MH205E289	Muirland/El Toro	LAWD

2.4.4 EXISTING SEWER TRUNK SYSTEM

For the purposes of this Master Plan, the gravity sewer collection system has been divided into two components. Pipelines with diameters less than ten inches are defined to be minor collectors. Pipelines with diameters greater than or equal to ten inches are defined to be major collectors. (Trunks) and define the most critical components of the sewer collection system. A total of thirty-two "trunk" lines were defined for evaluation.

On occasion, minor collectors are included in the trunk system. These pipelines typically connect larger diameter pipelines and force mains, or serve as a major collector pipeline within the existing system.

Trunk sewers are grouped in relation to their primary drainage basin, and are identified by the major roadway or geographical feature along which each facility is aligned. For each treatment facility or primary discharge point, trunk pipeline information is summarized in Table 2-5.

The trunk sewers and other major collection system facilities are shown on Plate 2–1 Major Collection System Facilities found at the back of this chapter.

Table 2-5 Major Trunk Sewers

Drainage Area	Trunk Line	Description
Los Alisos (LAWRP)	Aliso Park	Begins in Osterman Road North of Normandale and flows south along Osterman, Pittsford and Aliso Park Drive to its junction with the Cherry Trunk at El Toro Road.
	Aliso Park West	Begins near Vintage Woods Road and extends south in Lake Forest Drive until it crosses into an easement that ends near Bellcroft. It continues south in Bellcroft to Blueberry way where it turns west, then south in Elsberry Way then southwest in Windsong Drive until it connects to the Aliso Park Trunk in Aliso Park Drive.
	Bake	Beginning near Bake and Baffin Bay Drive the line drains to the south and west along Bake to it enters the LAWRP near Bake and Muirlands
	Bake/Dimension	Begins near Rancho Parkway and Bake Parkway follows the western right of way in Bake to its junction with Dimension. At Dimension the flow turns south and winds through the industrial park and winds through easements until it joins the Orchard Rim Trunk near Orchard Rim and Sharmilla.
	Muirlands	Beginning at the intersection of El Toro Road and Muirlands Boulevard, the flow continues northwesterly along Muirlands to the LAWRP located at the intersection of Muirlands and Bake.
	Orchard Rim	Begins near the intersection of Orchard Rim and Sharmilla, the line flows to the southwest along Orchard Rim to its connection with the Serrano Creek Trunk Sewer at Orchard Rim and Trabuco.
	Serrano Creek	Begins near the intersection of Trabuco Road and Serrano Road. The trunk follows Serrano Road to Toledo way where it turns northwest and connects to the Bake Trunk at Bake and Toledo.
	The Woods	Beginning bear Rimhurst Drive and Montcliff Drive the trunk follows Rimhurst to Trabuco Road. At Trabuco the line turns northwest to Ridgeroute Drive. It turns southwest and follows Ridgeroute Drive to Shoshone Drive. It follows Shoshone and then enters an easement that follows the major drainage way to the southwest crossing Jeronimo near Woodbluff Road. It then intersects Lake Forest Drive and continues south in Lake Forest to its intersection with the Muirlands Trunk.
Los Alisos (LAWRP/ETWD)	Cherry	Beginning at Rocky Road and Portola Pkwy the line travels south to El Toro Road. It then parallels El Toro Road to Aliso Park Road where it turn south and follows the alignment of Cherry southwesterly to Metrolink/Front St where it turns Northwest to the El Toro Frontage Road. Here it travels south to a diversion which splits flow to ETWD and LAWRP.
Michelson (MWRP)	405/Michelson	Begins near University and 405 and drains to the west along Jordan to Cinnamon then along 405 to Michelson and along Michelson to Hopkins where it turns North along Culver to 405 and along 405 to Harvard Avenue where it joins the Culver North Trunk
	Alton-Bake	Begins near Portola Parkway and Bake Parkway continues south in east side of Bake to it crosses to the west near South Pointe Drive. It then continues through an easement to Alton Parkway where it turns south in Alton to its connection with the 405 Trunk. Note that the lower portion has been realigned to minimize the likelihood of storm damage.

Table 2-5 Major Trunk Sewers (continued)

Drainage Area	Trunk Line	Description
Michelson (MWRP)	**Bonita Canyon/ University**	Beginning at Turtle Ridge and Federation Way, the trunk flows north to Bonita Canyon Drive. It then turns to the west and follows Bonita Canyon Drive west passing beneath the SJH Tollway (83). At Regents Road it turns north and parallels SJH Tollway passing Macarthur Boulevard and turning North along the creek. Near the park located at the intersection of University and La Vida, it turns east, passes through a siphon beneath SJH and MacArthur Boulevard and empties into the University Lift Station (LS-5). From this pump station it flows along University to the North to the Harvard Avenue Siphon crossing to the MWRP.
	Culver North	Begins near Portola Parkway and Culver, follows Culver to San Leandro. Along the north side of San Leandro until it turns south along the east side of the Harvard drainage channel, it then joins the flows from the south and travels across the siphon to the MWRP.
	Culver South	Beginning on Shady Canyon Drive near Shade Tree this trunk travels west along Shady Canyon and then turns North on Culver Drive. It follows Culver Drive and joins the University South Trunk at University and Culver.
	Irvine Center	Begins at Irvine Center Drive at Scientific and continues to the West along Irvine Center Drive where it crosses I-405 to connect with the 405 Trunk near Pacifica.
	Jeffery	Begins near Irvine Boulevard and Jeffrey. Travels southwest along Jeffery to its connection with the 405 Trunk Line (San Diego Creek Trunk)
	MWRP North	Begins at the intersection of San Leandro and Culver Drive. Follows San Leandro to the west to Harvard Avenue, it then turns south and follows Harvard to Michelson where it turns west and then South on Riparian. It ends at the MWRP.
	MWRP South	Begins northwest of the intersection of Harvard and University at the entrance to the siphon and crosses westerly to Riparian Way and then North to the MWRP.
	Quail Hill	Begins in Quail Hill Parkway near Knoll Crest and continues northwesterly in QHP to Sand Canyon where it turns back to the east and then crosses I-405 and joins the 405 Trunk.
	San Diego Creek (405)	Beginning near the intersection of I-5 and I-405 the general alignment follows the San Diego Creek drainage way in the east side of I-5. Near I-5 Exit 94B the Trunk turns to the west and passes along Spectrum Drive and then along the San Diego Freeway to Culver Drive. In Culver Drive the line flows to the north to San Leandro where it connects to the MWRP North Trunk.
	University East	Beginning on Turtle Rock Drive near Sierra Bravo Road, this trunk winds easterly along Morningside Drive to the upper end of the Shady Canyon, it then winds north along the Sand Canyon Reservoir and Strawberry Farms Road to University Drive. The trunk then follows University Drive to the west to Harvard Avenue where it turns Northwest and is siphoned across the San Diego Creek to the MWRP.

Table 2-5 Major Trunk Sewers (continued)

Drainage Area	Trunk Line	Description
OCSD - HATS	Harvard Ave Trunk Sewer	Begins in the north near Spring Valley and Modesto, along the East side of the Eastern Transportation Corridor to Harvard Avenue at Peters Canyon. Continues south in Harvard Avenue to Main Street (OCSD)
	Jamboree North	Extends from Santiago Canyon Road in North along Perters Canyon then Jamboree Road, jogs west along Bryan Avenue, then continues south in Myford to Edinger where it jogs to east to join the Harvard Avenue Trunk Sewer.
OCSD - IBC	Jamboree (IBC)	Begins at the southern end of Construction Circle in IBC and flows south to Barranca and then northwest long Barranca to its intersection with Jamboree. It then flows south west along Jamboree until it joins the McGaw Trunk at Jamboree and McGaw.
	Main Street	Begins at the Main Street Diversion Structure and flows west in main street to it joins the OCSD trunk system west of IBC or is pumped through the Main Street Pump Station.
	Main Street South	Begins at Von Karman and Main Street, it is a parallel line that flows to the west along Main Street to Red Hill and Main Street. Several diversions and interconnects are found on this line.
	McGaw	Begins at McGaw and Jamboree and flows west to the intersection with Red Hill.
	Red Hill	Beginning at the intersection of Red Hill and McGaw, the flow follows the Red Hill Avenue to its intersection with Main Street.
	Von Karman - South	Begins at Birch Street and Von Karman in the IBC. Flows North along Von Karman to its junction with Main Street.
OCSD - NC	Newport Coast	Beginning near Newport Ridge and Terrace Ridge, this line follows Newport Ridge to its intersection with Newport Coast Drive. It then follows Newport Coast Drive to its connection with the OCSD line in Coast Highway.
	Pelican Hills	Begins at Pelican Hills Circle and Pelican Hills Road and flows south along Pelican Hill Road into an easement that then connects to the OCSD sewer in Coast Highway.
Santa Margarita WD	SMWD South	Beginning at Saddleback Ranch Road and traveling south to LS11. Pumped down force main in Glenn Ranch Road where it crosses through a siphon to the SMWD.

Table 2-6 Major Trunks Physical Characteristics

Drainage Area	Trunk Line	Start Year	End Year	Length	Min. Dia.	Max. Dia.	Count MHs
Los Alisos (LAWRP)	Aliso Park	1981	1992	8,923	10	24	33
	Aliso Park West	1981	1986	7,181	10	15	23
	Bake Pkwy	1971	2000	15,986	10	24	50
	Bake/Dimension	1987	2004	6,648	8	15	38
	Muirlands Blvd	1972	1978	7,800	15	21	29
	Orchard Rim	1977	1986	5,487	15	15	30
	Serrano Creek	1971	1998	7,005	15	21	19
	The Woods	1968	1981	12,672	8	15	56
Los Alisos (LAWRP/ETWD)	Cherry Ave	1989	2000	24,057	8	24	87
Michelson (MWRP)	405/Michelson	1965	1973	13,940	10	15	56
	Alton-Bake	1979	1990	31,000	10	21	97
	Bonita Canyon/ University	1964	2001	27,776	12	30	85
	Culver North	1965	1998	37,895	10	39	112
	Culver South	1966	1968	4,015	10	15	10
	Irvine Center Drive	1989	1995	10,339	15	24	36
	Jeffery Rd	1988	2003	17,994	18	36	51
	MWRP North	1976	1976	10,007	24	51	21
	MWRP South	1966	1976	2,433	15	39	6
	Quail Hill	2001	2003	5,585	10	15	21
	San Diego Creek (405)	1975	1998	38,644	18	48	116
	University East	1965	2000	12,858	12	18	38
OCSD - HATS	Harvard Ave. Trunk Sewer (HATS)	1986	2000	30,322	10	54	96
	Jamboree North	1970	2003	47,423	6	42	135
OCSD - IBC	Jamboree (IBC)	1972	1984	4,123	10	18	18
	Main Street	1971	1987	15,477	15	66	29
	Main Street South	1971	1986	6,004	12	27	16
	McGaw Ave	1990	1992	6,084	12	24	19
	Red Hill Ave	1971	1971	5,170	27	63	11
	Von Karman - South	1997	1998	7,124	10	48	20
OCSD – NC	Newport Coast	1990	1992	18,920	10	18	60
	Pelican Hill Rd	1990	1990	6,023	10	12	25
Santa Margarita WD	SMWD South	1972	1990	7,267	8	48	20

2.5 SUMMARY OF WASTEWATER FLOWS

Wastewater flows generated from homes and businesses are conveyed to collectors which in turn flow to trunks. The trunks convey the flows to Water Reclamation Plants (WRP) for treatment and disposal.

2.5.1 FLOWS BY TREATMENT PLANT TRIBUTARY AREA

The ultimate destination for wastewater collected in the District's system is a treatment plant or Water Reclamation Plant. Existing flows in the District's system are conveyed to the Michelson WRP, the Los Alisos WRP, or to treatment plants operated by El Toro Water District, Santa Margarita Water District or Orange County Sanitation District. Table 2-7 shows the average daily flow and percentages for each treatment plant tributary areas.

Table 2-7 Average Daily Flow by Current Treatment Plant Area

Treatment Plant	2006 Average Flow (mgd)	2010 Average Flow (mgd)	2015 Average Flow (mgd)	2020 Average Flow (mgd)	2025 Average Flow (mgd)
Coastal (OCSD)	0.79	0.91	0.92	0.93	0.93
IBC (OCSD)	2.43	3.20	3.75	4.06	4.32
HATS	6.94	7.99	8.62	8.94	9.29
LAWRP	6.18	6.69	7.17	7.17	7.17
MWRP	15.64	20.82	23.66	25.41	26.95
Total	**31.99**	**39.60**	**44.12**	**46.52**	**48.66**

2.5.2 FLOWS BY TRUNK SEWER SYSTEM

The flows at each of the treatment plants arrives through major trunk systems. Table 2-8 describes the current and future flows in each Major Trunk system.

Table 2-8 Average Daily Flow by Major Trunk Tributary Area

Trunk System Tributary Area	2006	2010	2015	2020	2025
MWRP Tributary Area					
Alton-Bake Trunk	1.69	2.10	2.43	2.62	2.70
San Diego Creek Trunk	4.35	5.78	6.32	6.86	7.58
Jeffrey Trunk	1.13	3.07	3.78	4.48	4.99
Culver Trunk	4.51	5.42	5.79	6.10	6.34
Lower San Diego 51 Trunk	0.06	0.06	0.06	0.06	0.06
Culver South 24 Trunk (Michelson South)	0.73	0.77	0.77	0.77	0.77
Irvine South (Newport)	0.91	1.26	2.14	2.14	2.14
Jamboree (E.of SAH)[1]	0.46	0.46	0.46	0.46	0.46
Jamboree/Bison[1]	0.20	0.20	0.20	0.20	0.20
University Trunk	1.61	1.71	1.71	1.72	1.72
Subtotal MWRP	**15.64**	**20.82**	**23.66**	**25.41**	**26.95**
LAWRP Tributary Area					
Bake LAWRP Trunk	1.87	2.16	2.40	2.40	2.40
Lake Forest Trunk	0.61	0.62	0.62	0.62	0.62
Muirlands Cherry	2.07	2.09	2.11	2.11	2.11
TCWD In-flows[2]	0.15	0.20	0.27	0.27	0.27
SMWD In-flows[2]	1.10	1.10	1.10	1.10	1.10
Glenn Ranch (to SMWD)	0.38	0.52	0.67	0.67	0.67
Subtotal LAWRP	**6.18**	**6.69**	**7.17**	**7.17**	**7.17**
OCSD Tributary Area					
Newport Coast	0.79	0.91	0.92	0.93	0.93
HATS	4.74	5.79	6.42	6.74	7.09
OCSD In-flows[1]	1.40	1.40	1.40	1.40	1.40
Silverado (Caltrans)[1]	0.80	0.80	0.80	0.80	0.80
IBC	2.43	3.20	3.75	4.06	4.32
Subtotal OCSD	**10.17**	**12.09**	**13.30**	**13.94**	**14.54**
Grand Total	**31.99**	**39.60**	**44.12**	**46.52**	**48.66**

1. From OCSD Gallonage Flow Summary Sheets
2. From El Toro Road Sewer Lift Station Abandonment Study (TRC, 2006)

2.6 CONCLUSIONS

This section has discussed and cataloged the primary physical assets of the District's trunk sewer system. The Sewer Collection System is extensive and complex. The following chapters discuss the planning criteria and the results of the capacity analysis.

3.0 SEWER PLANNING CRITERIA

3.1 PURPOSE

One of the primary objectives of the Sewer Collection System Master Plan is to determine the available capacity of the collection system and identify any deficiencies resulting from those system capacities. To accomplish this objective, a hydraulic model of the District's collection system was prepared. The hydraulic model is composed of both the physical characteristics of the system and the computed flows that are to be conveyed by that system. The previous chapter discussed the primary physical characteristics of the District's system. This section focuses on the flow definitions that are used by the model and the planning criteria used to evaluate the results.

3.2 FLOW GENERATION FACTORS

In the development of this Master Plan, analyses were performed to determine the water demand and sewage flow generation factors for representative land uses throughout the District's service area. This information was used to recommend updates to Tables 2-1 and 3-1 of the District's Water Resources Master Plan (2003), and to provide sewer flow loading information for use in the Sewer Collection System Master Plan. A "Water Demand and Flow Generation Factor Study" was completed to accomplish this task and is included in the Appendix A. Appendix A discusses the processes used to update the land use categories, the procedures used to calculate water demands and sewer flow generation factors, and the results of those analyses.

The primary results of the Flow Generation Study included updated of the District's table for Flow Generation Factors, formerly Table 2-1 in the Water Resources Master Plan 2003. These factors were based on water billing information, land use GIS layers and flow monitoring accomplished in 2005/2006. This information provides detailed guidance on the application of local and irrigation water demands and wastewater flow generation factors for each land use category in the District. This information is to be used for planning purposes unless more specific information is available and applicable. Table 3-1, is a summary of the wastewater flow generation factors used for this study. A full accounting of the processes and data used in development of this information is included in the appendix to this report.

Table 3-1 Water Demand and Flow Generation Factors

Revised 03/04/2006 Code	Land Use	Agency	Ave Density DU/AC	Wastewater Flow Generation Factor Gallons/DU/Day
1100 Residential				
1111	Res-Rural Density	Orange	0.30	350
1121	Res-Estate Density	Orange	1.20	350
1131	Res-Low Density	Orange	4.00	350
1141	Res-Low-Medium Density	Orange	10.50	250
1161	Res-Medium Density	Orange	19.50	350
1122	Res-Estate Density	Irvine	0.50	350
1132	Res-Low Density	Irvine	3.00	350
1162	Res-Medium Density	Irvine	7.50	250
1172	Res-Medium-High Density	Irvine	17.50	150
1182	Res-High Density	Irvine	32.50	125
1192	Res-High-Rise Density	Irvine	40.00	180
1133	Res-Low Density	Newport	1.00	350
1153	Res-Medium-Low Density	Newport	2.75	250
1163	Res-Medium Density	Newport	5.00	210
1183	Res-High Density	Newport	12.25	155
1134	Res-Low Density PC	Tustin	4.50	350
1164	Res-Medium Density PC	Tustin	11.80	175
1184	Res-High Density PC	Tustin	17.40	135
1115	Res-Rural Density	County	0.26	350
1135	Res-Suburban Density	County	9.25	310
1175	Res-Urban Density	County	29.00	110
1126	Res-Estate Density	Lake Forest	0.50	350
1136	Res-Low Density	Lake Forest	3.00	350
1166	Res-Medium Density	Lake Forest	7.50	250
1176	Res-Medium-High Density	Lake Forest	17.50	165
1186	Res-High Density	Lake Forest	32.50	180
1200 Commercial			**KSF/AC**	
1210	Comm-General Office		25.00	56
1221	Comm-Community		9.09	210
1222	Comm-Regional		10.53	190
1230	Comm-Recreation		8.33	54
1240	Comm-Institutional		8.89	40
1244	Comm-Hospital		8.70	220
1260	Comm-School		13.33	15
1273	Not Used		Rooms/Ac	
1290	Comm-Hotel		50.00	180
1300 Industrial			**KSF/AC**	
1310	Industrial-Light		25.00	50
1320	Industrial-Heavy		25.00	4500

3.3 HOURLY FLOW VARIATIONS

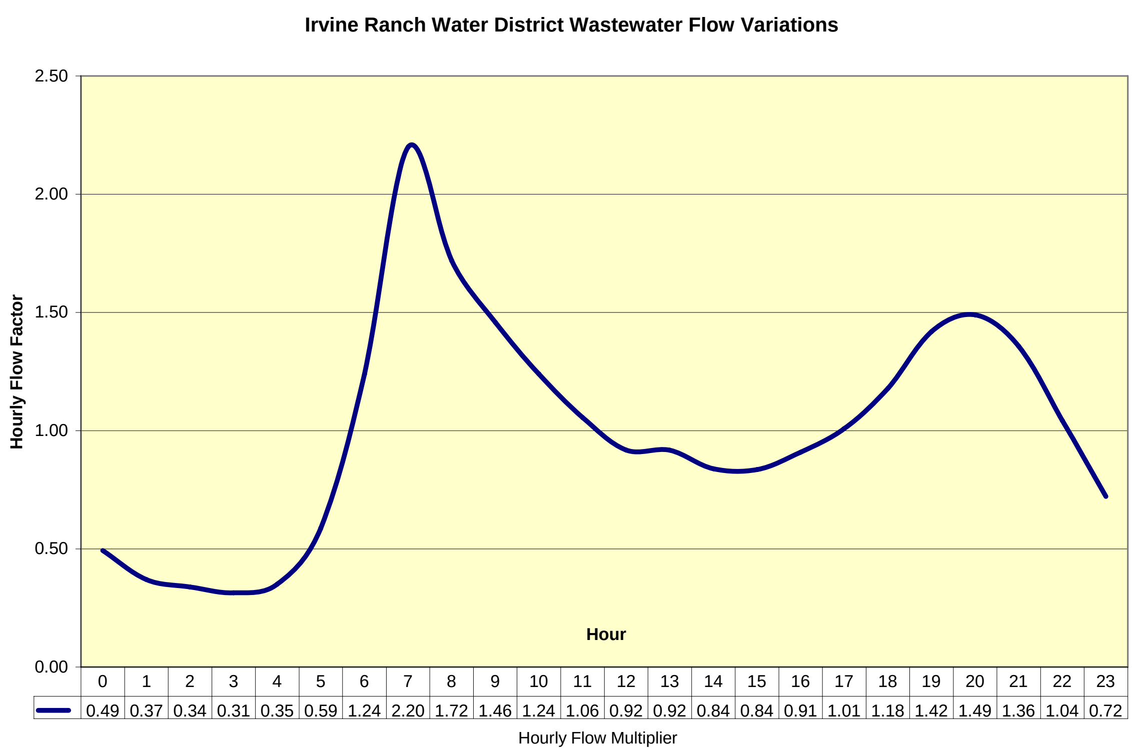
Wastewater flows vary throughout the day based on the demographics and individual characteristics of each wastewater generator. These hourly flow variations are an important part of determining the hydraulic capacity of the sewer collection system. The District's Flow Measurement Program characterized the flow volumes per land use as discussed in the above section. The flow measurement information was also used to define the hourly flow variations for residential and non-residential land use types.

Under the first phase of the flow measurement program, a number of flow measurement devices (monitors) were installed throughout the collection system. These devices were positioned to measure flow from generally homogenous land use areas. Each device sampled the flow rate within the sewer system on a five minutes interval. For each measurement site, hourly average flow rates were used to define the diurnal pattern of the actual flow in the system. Hourly peak flow factors were calculated to allow comparison of the flow measurement results between drainage basins with different flow volumes. Hourly peak flow factors are calculated by dividing the average hourly flow rate by the average daily flow rate.

3.3.1 RESIDENTIAL FLOW VARIATIONS

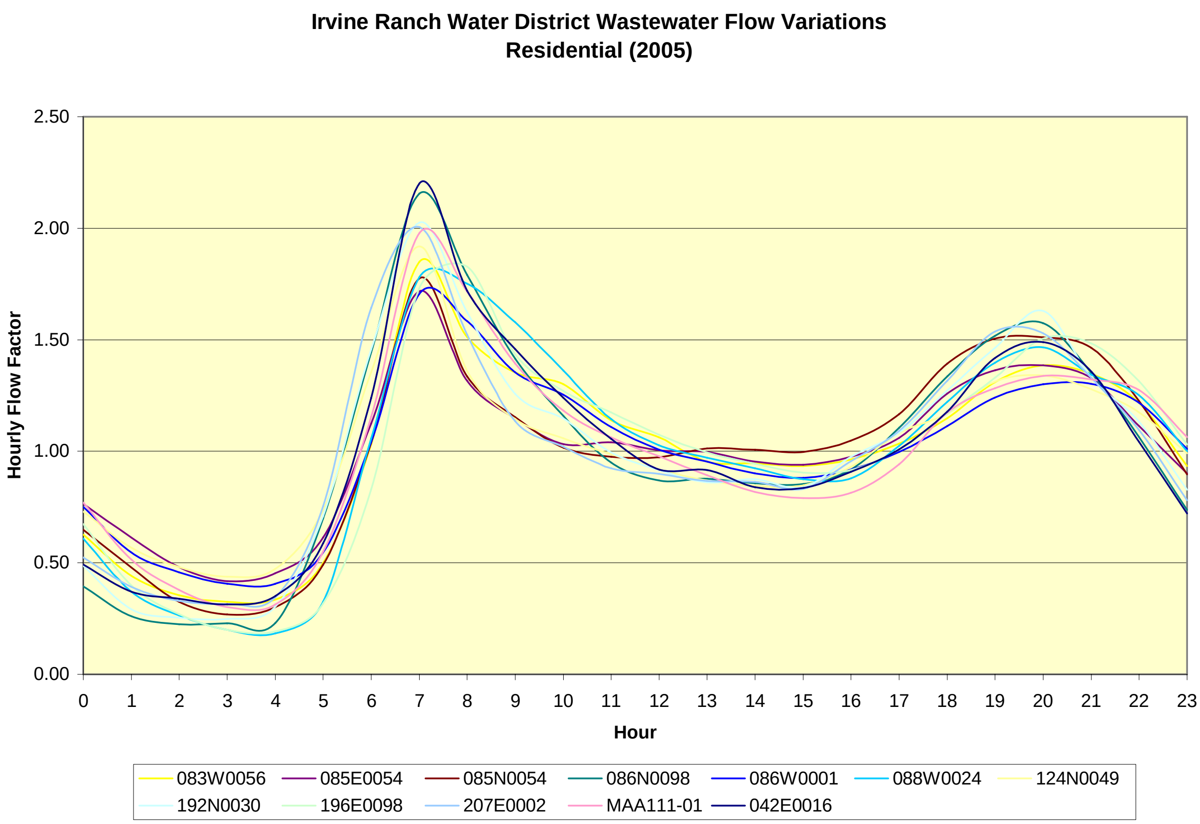
Figure 3-1 illustrates the Residential Hourly Flow Pattern used for master planning purposes.

Figure 3-1 Residential Hourly Flow Pattern



The previous figure illustrates a peak flow rate for residential flow that occurs approximately at 7:00 AM, with a secondary peak occurring approximately at 9:00 PM. This residential flow pattern was found to be very consistent across the District, suggesting that the demographics and sewer flow generation patterns are very similar throughout the District's service area. To illustrate the relative consistency of the residential diurnal patterns in the District, Figure 3-2 is presented to show the similarity of observed variations in hourly flow patterns across the District's sewer collection system. Each line represents the average flow measured from an area that was predominately residential.

Figure 3-2 Observed Residential Flow Patterns

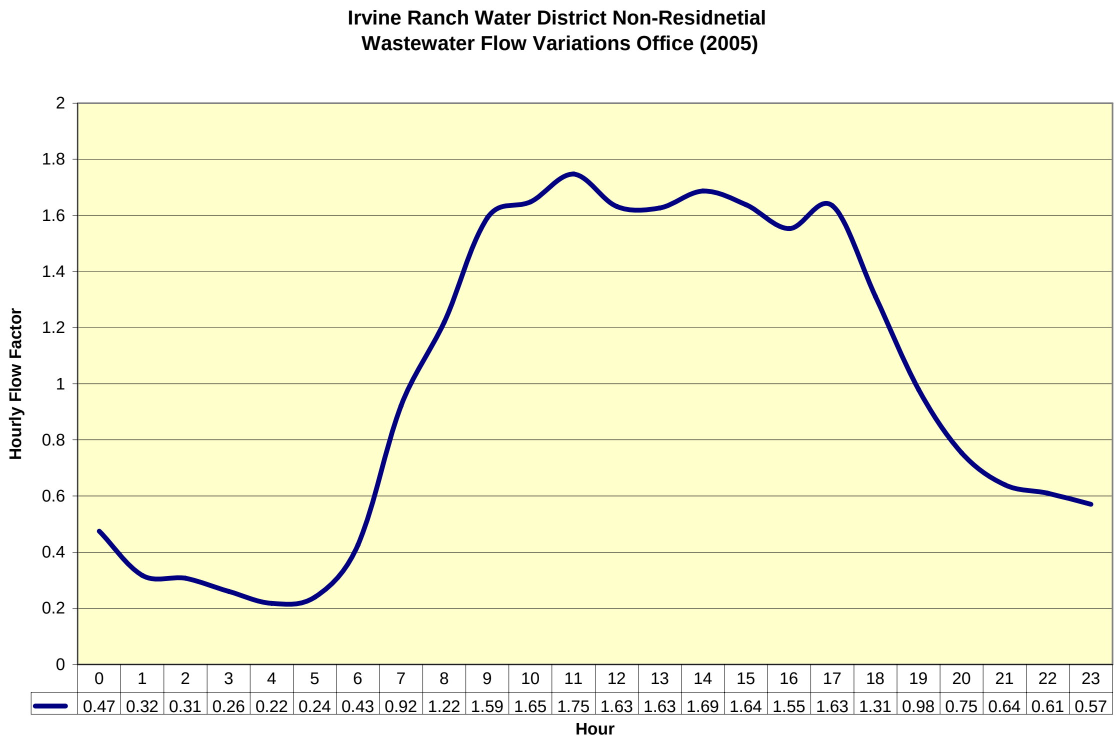


The peak flow factors shown in this section are only applicable to existing developments. Newly designed facilities will use the higher peak factors discussed in Section 3.4.4. As developments mature, observed peaking rates decline due to additional upstream flow volume.

3.3.2 NON-RESIDENTIAL

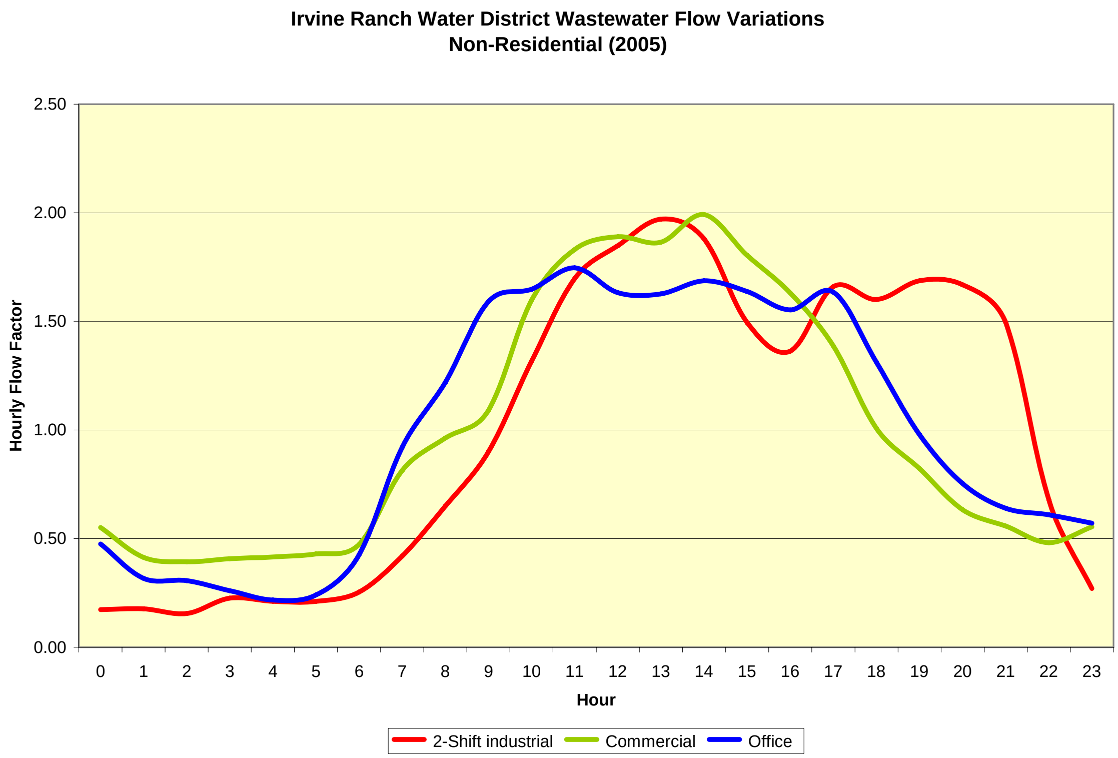
Non-residential wastewater flow is generated from a variety of commercial and industrial developments and users. As a result, there is less conformity between observed patterns. Figure 3-3 illustrates the observed non-residential hourly flow variation resulting from the 2005 Flow Measurement Program. In the master plan model, point loads were created for large flow generators with observed flow patterns. These flows varied depending on the type of hourly flow generation such as commercial, school and two-shift industrial. Figure 3-3 shows the type of non-residential flow variations used for office flows.

Figure 3-3 Typical Non-Residential Flow Variation



Flow varies significantly depending on the type of non-residential flow source. Figure 3-4, illustrates the three primary variations measured at non-residential sites throughout the District. These represent Office, Commercial and Industrial uses.

Figure 3-4 Observed Non-Residential Flow Patterns



Flows from known areas of high use were also loaded into the model. These flows were derived from observed flow metering results or from special planning studies done by others. Table 3-2, lists the major flow loads that were added to the model.

Table 3-2 Point Loads from Major Users

Description	Model Manhole Id	Average Daily Flow (MGD)	Source
English Canyon (SMWD)	100022	0.80	Flow Measurement
Royal Carpet	952	0.50	Flow Measurement
Industrial Metals	935	0.35	Flow Measurement
Maruchan	13728	0.35	Flow Measurement
Braun	471	0.33	Flow Measurement
El Toro Water District	20721	0.70	Flow Measurement
University California Irvine	16186	1.29	Campus Master Plan
OCSD	Varies	2.88	OCSD Gallonage Report
Total		**7.21**	

As part of the Sewer Master Plan Update, planning criteria in the Procedural Guidelines, Construction Manual, and the 1992 Sewer Master Plan were reviewed and updated to reflect current planning, design and construction directives of the District. The following discussions summarize planning criteria pertinent to the evaluation of existing and future infrastructure needs of the District. The review included:

- Sewer Main Sizing, Capacity & Performance Criteria
- Maximum depth/Diameter (d/D)
- Minimum Allowable Slope Criteria
- Sewer Flow Peaking Factor Criteria
- Sewer Pump Station & Force main Criteria
- Inverted Siphon Criteria

It is noted that this section only addresses the specific criteria appropriate and necessary for the completion of the Sewer Master Plan Update. The complete criteria for new sewer design and construction, the Guidelines and the Construction Manual, are available from the District.

3.4 GRAVITY PIPELINE CRITERIA

The District does not accept sewer mains smaller than 8-inches in diameter for operation and maintenance purposes. Sewer mains are not allowed to be constructed within a common trench condition with any other utility within the District's boundaries. Adequate horizontal and vertical spacing are required to be maintained at all times in accordance with District Standard Drawing W-14.

The District currently defines sewer mains by two primary categories, including Developer and Capital facilities. "Developer Facilities" are defined to include sewer mains ten (10) inches in diameter and smaller. "Capital Facilities" are defined to include sewer mains twelve (12) inches in diameter and larger.

It is noted that this master plan evaluates the adequacy of the primary trunk sewer throughout the District. Therefore, these facilities are by definition Capital Facilities. This does not preclude the District from requiring the construction of a specific improvement by a developer as part of overall development approval.

3.4.1 DESIGN CRITERIA

Design flows for residential sewer mains are required to be calculated based on the flow generation factors presented in Table 3-1 according to the most appropriate land use category. The District encompasses a variety of land use types, with different density and population per EDU values. Commercial/Industrial flow design criteria is required to be calculated by the design engineer based on projected generation rates for the specific commercial or industrial development. If overriding flow information is known for a specific commercial or industrial user, those flows should be substituted for the flows calculated from Table 3-1.

Peak dry weather design flows for sewer mains are to be design to maintain a specific depth (d) to diameter (D) ratio, based on the selected diameter of the pipeline. The design flow depth for sewer mains is required to be consistent with Table 3-3:

Table 3-3 Allowable Flow Depth at Peak Design Flow

Diameter Range	d/D
Diameter < 15”	0.50
Diameter = 15”	0.67
Diameter > 15”	0.75

Maintenance of specific d/D ratios under peak dry weather flow conditions provides sufficient pipeline capacity to accommodate wet weather flow, including infiltration, inflow and other storm related water, over and above the actual wastewater. This additional headspace also provides a margin of safety for variations in flow estimation. In the case of 12-inch and smaller pipelines, 50 percent of the pipeline is set aside for wet weather conditions. As the pipeline increases in diameter, the percentage of reserved pipeline capacity reduces, thereby maintaining a consistent capacity reserve. In addition to wet weather flows, future changes in land use (potentially increasing wastewater production) can be accommodated within pipeline replacement. The overall intent is to provide a factor of safety within the pipeline for wet weather and other unexpected flows.

Design criteria establish a means of selecting a pipeline size and vertical slope that provides the required capacity and flushing velocity for projected flows and the available head space above the water surface for potential unexpected peak flows above normal projected conditions. Such instances of peak flows exceeding design conditions may occur during rain events where any number of potential avenues of water conveyance may allow rain water into the sewer collection system. Groundwater is another potential source of defect flow that may contribute to overall Inflow and Infiltration (I&I) that can occur during the life span of a pipeline segment. Excessive I&I within a collection system will increase the risk of sanitary sewer overflows.

The design criteria for gravity pipelines provides for an industry standard margin of safety from sanitary sewer overflows by dedicating the remaining head space (air space above the water level) for unexpected I&I situations. Once in operation for a long period of time, if a pipeline operates with a peak flow higher than the design criteria, it is not necessarily a trigger for upsizing the pipeline segment capacity. This is particularly relevant for areas that have already reached their ultimate build-out condition and do not expect any further increase in flows.

3.4.2 Performance Criteria

Gravity pipeline performance criteria provide a means of prioritizing pipeline segments that are experiencing flows above design standards. The prioritization system ranges from low to medium to high priority. It is based upon the pipeline depth to diameter (d/D) ratio at peak flow, and is dependent on the diameter of the pipe. Table 3-4 lists performance priorities for all diameter ranges. Any gravity pipe that is expected to experience pressure flow, or surcharging, is of the highest priority.

Table 3-4 Pipeline Performance Criteria

Priority	d/D at Peak Flow		
	Diameter < 15"	Diameter = 15"	Diameter > 15"
Low	0.5 – 0.75	0.67 – 0.80	0.75 – 0.85
Medium	0.75 – 0.93	0.80 – 0.93	0.85 – 0.93
High	> 0.93	> 0.93	> 0.93

The District requires that pipelines not be designed to flow at critical depth on a nominal basis. Near critical depth, relatively small changes in energy can cause significant depth changes in the depth of flow. This condition can result in excessive turbulence and increased hydrogen sulfide generation, leading to corrosive conditions and accelerated deterioration of the pipeline.

In general, the above criteria are used by District Operations for observing pipelines that pose a potential risk of surcharging. As part of the system evaluation for this master plan, the above ranking system is used to evaluate the performance of pipelines and focus on segments that present the highest risk of surcharging and potential failure.

3.4.3 Allowable Sewer Main Slope

Hydraulic modeling is the preferred method for planning and design but following guidelines can be used for making rough estimates when modeling is not practical. Sewer mains are required to be designed and constructed to provide mean velocities of not less than two and two-tenths (2.2) feet per second (fps) when flowing at the design depth defined above. Peak flow (Q_P) is defined by Manning's formula as outlined below:

$$Q_P = (K'/n)\ d8/3\ S\ 1/2$$

Where; Q_P = peak design flow (cfs), K' = coefficient based on required ratio of depth to diameter (unitless), n = Manning's Roughness Coefficient (unitless), d = diameter of pipe (ft), and S = Slope (ft/ft).

The District requires new sewer mains to be computed using the values in Table 3-5 for Manning's Coefficient (n) in calculating flow capacity and velocity:

Table 3-5 Manning's Coefficient (n) for New Pipes

Allowable Pipe Material*	Manning's n
Gravity Sewers:	
SDR-35 PVC	0.010
Extra Strength VCP	0.013
GRP (Glass Reinforced Plastic)	0.010
Force mains:	
AWWA C-900, Class 150 PVC (12 inch or less in diameter)	0.010
AWWA C-905 PVC (greater than 12 inches in diameter)	0.010
HDPE	0.010
Sewer Laterals:	
Extra Strength VCP	0.013
SDR-35 PVC	0.010

**Refer to Section 4.7 for definition of District approved pipeline materials.*

Flow computations in aging or deteriorated sewer mains require additional considerations to determine the appropriate value of Manning's Coefficient (n). Table 3-6 provides the range of allowable values based on the identified age of the sewer main. Under no circumstances will the District allow the use of a Manning's Coefficient (n) of less than 0.010 or greater than 0.015 for computing sewer main capacity. Variation from the table above will require the review and approval of the District Engineer.

Table 3-6 Variation in Manning Coefficient (n) with Sewer Main Age

Sewer Main Age	Manning's n* (PVC)	Manning's n* (VCP)
0 to 10 years	0.010	0.013
11 to 30 years	0.011	0.014
31 to 50 years	0.012	0.015

** It is noted that actual condition of the sewer main is to be based on inspection of the interior surface of the pipeline, and the consultation/approval of the District Engineer is required.*

The values of K' needed for computation of flow in sewer mains is based on the circular pipe section. As shown in Section 4.2, only three specific d/D ratios are needed for the calculation based on the size of the sewer main. Table 3-7 provides the K' value for each d/D ratio required.

Table 3-7 Values of K' for Circular Pipe Sections

d/D = 0.50	0.232
d/D = 0.67	0.366
d/D = 0.75	0.422

To derive the velocity in the sewer main, the flow (Q) is divided by the area of flow (A) at a given d/D ratios. The equation is:

$$A = C_a\, d^2$$

Where A = Areas (sf), C_a = Area Constant based on d/D ratio in circular pipe, and d = diameter of the pipe. The values of C_a for the various required d/D ratios are as shown in Table 3-8.

Table 3-8 Values of C_a for Circular Pipe Sections

d/D = 0.50	0.393
d/D = 0.67	0.559
d/D = 0.75	0.632

The maximum allowable slope for a sewer main is that slope which generates a maximum flow velocity of less than or equal to eight (8) fps at the peak flow (Q_P), at a d/D as calculated using Manning's equation and an "n" value based on the type and condition of the sewer main. The maximum velocity is limited to prevent excessive wear and deterioration of the internal pipe walls.

Similarly, the minimum slope is that slope which maintains the minimum allowable flow velocity of 2.2 fps in the sewer main. It is noted that as the sewer main diameter increases, physical limitations on the ability to maintain an extremely shallow slope result in the minimum slope remaining constant for increasing diameters. It is unreasonable to expect sewer mains to be accurately constructed to excessively shallow slopes. Table 3-9 provides the maximum d/D and minimum allowable slopes for sewer mains constructed within the District.

Table 3-9 Allowable Slopes for Sewer Mains

Diameter (in)	Maximum d/D Ratio	VCP Pipe Min. Slope (%) @ n=0.013	PVC/GRP Pipe Min. Slope (%) @ n=0.010	Comments
4	-	2.00	2.00	Residential laterals only
6	-	1.00	1.00	Multi-Use & Commercial laterals only*
8	0.5	0.40	0.24	Minimum collection system pipeline size
10	0.5	0.30	0.18	
12	0.5	0.25	0.08	Minimum Constructible Slope = 0.08%
15	0.67	0.15	0.08	Minimum Constructible Slope = 0.08%
18	0.75	0.12	0.08	Minimum Constructible Slope = 0.08%
21	0.75	0.10	0.08	Minimum Constructible Slope = 0.08%
24	0.75	0.09	0.08	Minimum Constructible Slope = 0.08%
30	0.75	0.08	0.08	Minimum Constructible Slope = 0.08%
36	0.75	0.08	0.08	Minimum Constructible Slope = 0.08%
42	0.75	0.08	0.08	Minimum Constructible Slope = 0.08%
48	0.75	0.08	0.08	Minimum Constructible Slope = 0.08%

**The minimum slope on 6-inch sewer shall be 1% or s=0.010 where the tributary area consists of less than 20 dwelling units.*

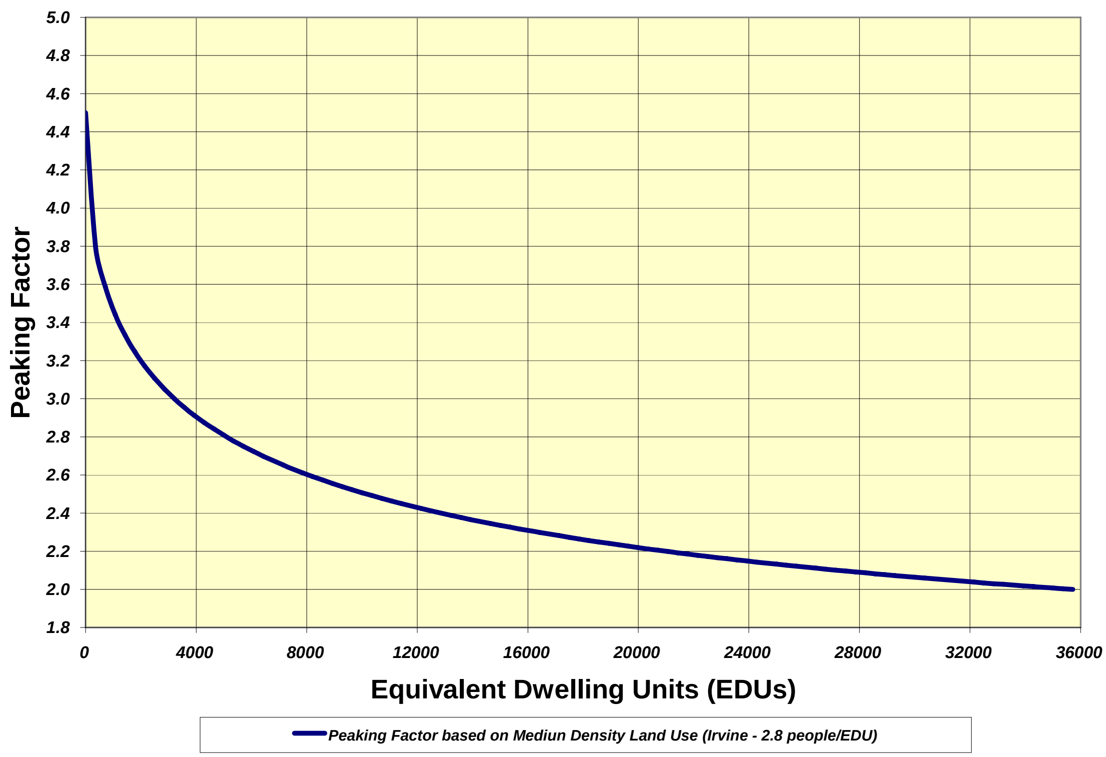
The above minimum slopes are the minimum allowable. Wherever possible, sewers are required to be designed at slopes greater than the minimum slope by the criteria. Under special conditions, the design engineer may request the District Engineer to allow slopes of less than the minimum stated above. The design engineer must submit that request, along with back-up data and calculations, to prove that the depth of flow at design average flow will be sufficient to maintain acceptable velocities in the sewer main.

The design engineer's request is required to detail the reason why the normal minimum slope cannot be achieved. The request and supporting data will be reviewed by the District Engineer.

3.4.4 PEAKING FACTORS

District sewer mains are required to be designed and sized using peak flow (Q_P) conditions, determined by multiplying average flow (Q_A) conditions by a peaking factor. As stated in Section 4.2, design flows for residential sewer mains are required to be calculated based on the number of EDUs served. Similarly, the design peaking factor is selected based on the number of EDUs served. Like the design flow discussed in Section 4.2, the peaking factor selection is based on the base generation rate of a low density residential land use, defined to be 288 gallons per EDU per day (gpd/EDU) and a density of 1.6 EDUs per acre. Based on this land use definition, Figure 3-5 outlines applicable peaking factors based on dwelling units served.

Figure 3-5 Peaking Factors



It is noted that for development of this Sewer Master Plan, flow metering was conducted to define the flow characteristics of a variety of land use types. The detailed discussion of the flow metering performed and the resulting allowable flow factors for each specific land use type are presented in Section 3.2.

Generally, developments containing more than 400 dwelling units are required to provide the District with a comprehensive sewer system analysis for the development (IRWD Guidelines). That report (a Sub-Area Master Plan or Utility Study) includes an analysis of the proposed sewer system using a computerized hydraulic model, a complete description of the facilities to be constructed, maps, and computations providing the design criteria meeting the requirements of the Sewer System Guidelines. This master plan incorporates the information provided by these reports where appropriate and available.

3.4.5 Minimum Depth for Sewer Mains

The minimum depth of cover, measured from finish street grade to the top of sewer main, is required to be seven (7) feet, unless otherwise approved by the District Engineer. New manholes included in the master plan development conform to this standard.

3.4.6 MANHOLES

The development of information in the master plan includes the alignment of manholes. New facilities identified in the master plan conform to the District standards. Sewer mains are required to have manholes located where the sewer main or pipeline alignment meet the following conditions:

A. Manholes are to be installed at the end of sewer mains, at changes in vertical grade, changes in pipe diameter, changes in horizontal alignment, or intersection of two (2) or more sewer mains that are eight (8) inches or greater in diameter.

B. Manholes are to be installed along the sewer main alignment at a maximum distance of 300 feet for 6-inch sewers (not allowed for sewer main construction), 400 feet for 8- to 15-inch sewer mains, and 500 feet for 18- to 30-inch sewers. The District Engineer is to be consulted to determine the required spacing of manholes on sewer mains greater than 30 inches in diameter.

C. Manholes are to be installed at the termination point of sewer force mains. The invert of the force main discharge is to be constructed to the same elevation of the manhole base and downstream sewer main, and direct the discharge of the force main in the direction of downstream flow to minimize turbulence and odor production. In the event that the force main discharge and the downstream flow are at an angle of less than 180 degrees, the design is to include a manhole of sufficient diameter to allow for the force main discharge to enter the manhole at an angle of no more than 45 degrees, with the manhole base channelized to direct the discharge into the downstream pipe with the least turbulence possible. The District Engineer reviews and approvals all force main discharge designs prior to construction.

D. Drop manholes are not normally allowed. Installation of drop manholes will be allowed only with the review and approval of the District Engineer. The design engineer must submit evidence of the need for the construction of a drop manhole and why other options to avoid the drop manhole are not viable.

E. Each manhole will be designed to provide 0.2 feet of drop across manhole base

3.5 FORCE MAIN CRITERIA

Force main facilities are only included in the master plan where insufficient topography is available for gravity flow conditions. Sizing of the needed force main facilities conforms to the District standards as discussed below.

The sizing of sewer force mains is determined during the design phase of the project and only after a comparative study of the construction cost and pumping costs for several alternative sizes has been completed and provided to the District Engineer for review and approval. This requirement allows the District Engineer to consider the needs and cost-effectiveness of the proposed pump station and corresponding force main sizing. In no circumstance will a force main be constructed with a diameter of less than six (6) inches.

The capacity of the force main is equivalent to the design peak flow of the corresponding pump station. The capacity analysis is to be conducted for the new force main installation (C=140) and the future force main condition (C=100). The required nominal design velocity for the force main is three (3.0) fps, with minimum velocity of two (2.0) fps, and maximum allowed velocity of eight (8.0) fps. The maximum headloss in the designed force main cannot exceed five (5) feet per 1,000 feet of force main.

Parallel force mains are to be provided for the purpose of facilitating operation and maintenance, as well as the prevention of sewer spills. Parallel force mains are to be of equal size, each equivalent in capacity to that required for a single force main installation. The design of force mains is to include appropriately located air release valves and blow-offs. Every attempt must be made to design a constantly rising force main installation to avoid future odor concerns. The design must include the installation of tracing wires for non-metallic force main materials.

3.6 SEWER PUMP STATIONS

The master plan includes evaluation of existing and identification of new sewer pump stations within the District. The District has established standard design guidelines for interim sewage pump stations, which are required to serve a development until a master planned sewer facility is constructed and operational. Design criteria for permanent master planned pump stations have been established by the District Engineer. New pump station included in the master plan conform to the standards of the District. For the purposes of the master plan, the capacity of the station is the primary information provided. Subsequent design of the station will be reviewed by the District Engineer.

3.7 INVERTED SIPHONS

Inverted siphons will only be used when specifically approval by the District Engineer, and after all other design options have been investigated. The inverted siphon is designed with a minimum of two barrels and a gated system at the inlet that directs the flow towards either the primary or secondary barrel. The minimum peak flushing velocity of wastewater through the any barrel of the inverted siphon is required to be three and one-half (3.5) fps. Higher flushing velocities are preferred in all cases, up to a maximum of six (6) fps. Vertical curves must be used for all changes in slope (minimum of 100 feet). Vertical slopes shall be limited to a maximum of 15 percent. The design engineer uses Manning's equation, modified to reflect head losses for full pipe flow, when calculating friction loss and capacity of each inverted siphon barrel. Velocities are to be calculated as peak volume divided by barrel area (V = Q/A).

Inverted siphon barrels are to be constructed of either PVC or HDPE. Inverted siphon installation are required to be submitted to the District Engineer for review and approval prior to construction.

3.8 CONCLUSION

As stated previously, the design criteria contained in this chapter are those needed for the analyses of this master plan evaluation. Other design criteria are contained in the District Guidelines and Construction Manual, and those tasked with design of such facilities are directed to those documents for additional information. These design criteria were used in the evaluation of existing and future improvement for the sewer system identified in this Master Plan. In addition, the design criteria are used in the determination of and assignment of reliability and redundancy factors to each District sewer facility, thereby facilitating the development of sewer system reliability and redundancy recommendations.

3.9 RECOMMENDATIONS

The following recommendations are made relative to the portions of the District's Procedural Guidelines that were reviewed as a part of this project.

- Update the Guidelines with respect the allowable d/D ratio for 15-inch pipelines. Most Southern California utilities use a d/D ration of 0.5 for pipelines less than 18 inches and a d/D ratio of 0.75 for pipelines 18 inches or greater.
- Update the Guidelines to include consideration of alternative pipe material such as HDPE or GRP.
- Update the Guidelines to include a requirement for air jumpers on inverted siphons.
- Revisions to the Guidelines for lift station and forcemain facilities are recommended to be added to this report upon the completion of the ongoing Lift Station review.
- Currently, the District's guidelines define peaking factors based on population. It is recommended that the Guidelines be changed to defined peaking factors for design purposes based on equivalent dwelling unit (EDU) counts, as used in the development of this study.
- It is recommended that the Guidelines be updated to reflect the defined performance criteria (based on depth to diameter ratios), as defined and used in this study. In addition, the Guidelines are recommended to be updated with the various computational parameters (i.e. Manning Coefficient and Minimum Slope) used in the development of this study.

4.0 EXISTING SEWER SYSTEM ANALYSIS

4.1 PURPOSE

The primary purpose of the existing sewer system analysis is to define the current hydraulic "state of the system" based on existing flows and to calibrate the model for use with future flows. The performance of the wastewater collection system and its components were evaluated based on comparisons with established and verified design and performance criteria.

This chapter is written to:

- describe modeling data,
- determine wet weather flow response (Inflow and Infiltration),
- review the model calibration process,
- discuss capacity evaluation criteria,
- provide model results and recommendations based on existing flow.

The evaluation method employs the use of the InfoSewer hydraulic modeling software, which performs hydraulic calculations based on Manning's equation, standard open channel flow routing algorithms and Hazen-Williams equation for pressure flow in force mains. *InfoSewer* performs extended period simulations (EPS) to route wastewater flows through the conveyance system using observed hourly variations of flow rates. This provides for the application of time-varying flow in a manner that accurately simulates IRWD's wastewater generation rates.

4.2 HYDRAULIC MODEL DEVELOPMENT

A hydraulic model of the IRWD trunk system was developed from the recently updated 2005 GIS. The model is comprised of the conveyance system (manholes, gravity pipelines, siphons, lift stations, force mains, etc…) and the flows to be conveyed through the system. This section discusses the definition of the physical network used for modeling.

Facility data from the updated GIS system was used to define the model network and populate the model database. Manhole locations, invert elevations, pipeline diameters, pipeline lengths, and other pertinent information were obtained directly from the GIS system. In cases of missing data, basic assumptions were made and the model database was updated to maintain a record of modifications made.

4.2.1 MODEL NETWORK DEFINITION

The hydraulic model network is generally defined as all pipes with diameter greater than 10 inches in diameter, although a significant number of 6 and 8-inch pipes were also included to maintain network connectivity. The model consists of 3,605 manholes (nodes) and 3,637 pipe segments totaling over one million feet (or approximately 200 miles) in length. Gravity pipe diameters range from 6 to 66 inches. Approximately 33,231 feet (or 6.3 miles) of force mains are also included, which range in size from 6 to 12 inches in diameter. Additionally, the IRWD model contains 10 lift stations and 18 siphons. The following tables list the characteristics of the gravity pipelines, force mains, lift stations, siphons and diversions that were included in the model.

Table 4-1 Modeled Gravity Pipelines and Force Mains

Diameter (inch)	Existing System Length (ft)
6	8,793
8	49,165
10	241,123
12	164,706
15	226,056
16	3,375
18	85,006
20	1,546
21	42,869
24	69,674
27	9,443
28	5,079
30	19,709
33	17,222
36	30,505
37	448
39	5,690
42	25,001
45	10,223
48	3,582
51	4,975
54	5,893
60	5,233
63	4,157
66	6,624
Total	**1,046,097**

Table 4-2 Modeled Lift Stations

Lift Station Name	Location	System ID	Pumps	Discharge System		
			Total Capacity (MGD)	FM Length (ft)	FM Diameter (inch)	Max. Velocity (fps)
Bayview	Bayview Way at Bayview Place	LS01	0.504	2,852	6	3.96
University	MacArthur at University	LS05	1.728	5,142	12	3.40
Newport Coast Dr	21244 Newport Coast Drive	LS10	2.304	2,957	12	4.53
Portola Hills	Glenn Ranch and Saddleback Ranch	LS11	1.354	1,456	10	3.83
Borrego	Towne Center and Pasatiempo	LS12	0.444	4,464	8	1.96
Buck Gully	Buck Gully at White Pine	LS13	0.259	1,433	6	2.04
Montecito/ TR14070	Via Burrone	LS15	0.172	1,278	4	3.04
Coastal Ridge	TBD	LS29	0.374	3,847	6	2.94
La Canada	Lake Forest Dr.	LS19	0.259	3,074	10	0.73
Coyote Canyon	Bonita Canyon Dr. west of Coyote Dr	LS16	0.720	2,455	12	1.41

Except for the University Lift Station (LS-5), all other lift stations are represented as fixed speed pumps. This allows the model to identify stations where incoming flows exceed the firm pumping capacity of the lift station and cause a deficiency in the system. Data was provided by the District to approximate the pumps' operational settings.

Table 4-3 Modeled Siphons

#	Siphon Location	Year Built	No. Of Barrels	Length (ft)	Diameter	Material	Crosses	Model ID
1	El Toro Rd/Glen Ranch Rd	1990	2	312	8	VCP		20477
2	El Toro Rd/Portola Pkwy	1992	2	374	8	VCP	Creek	20540
3	Foothill Transportation/Lake Forest Dr	1996	2	148	8, 10	VCP	Creek	20491
4	Harvard Av/Barranca Pkwy	1986	3	160	24	VCP	Barranca Drainage	20484
5	Harvard Av/University Dr	1976	3	437	15, 24, 30	VCP	Barranca Drainage	20496
6	Jamboree Rd/ North of Main St	1972	2	79	8, 12	VCP, PVC	Barranca Drainage	293
7	Jamboree Rd/North of Trevino Dr	1988	1	276	24	VCP	Cycle Path	20506
8	Jamboree Rd/Octa Metrolink	1986	4	412	15, 18, 24	VCP	Peter's Canyon	20480
9	Jeffrey Rd/Alton Pkwy	1988	2	275	20, 21	VCP	Barranca Drainage	20488
10	Main St/Veneto	1986	3	455	18,24,42	VCP	Barranca Drainage	20510
11	Michelson Dr/Riparian	1976	2	443	24	VCP	San Diego Creek	20487
12	Milano Dr/North of La Salud	1970	2	70	15, 27	VCP	Creek	20503
13	Peters Canyon Rd/Walnut Rd	1999	1	265	8	VCP	Road	20513
14	Prism/Linear	1987	2	250	8	VCP	Creek	21488
15	Sand Canyon Av/Barranca Pkwy	1987	2	297	8, 12	VCP	Barranca Drainage	20493
16	Shady Canyon Dr/Sage Creek	2001	1	243	8	PVC		20504
17	University Dr/Harvard Av	1966	3	204	10, 15, 18	ACP	Creek	20498
18	University Dr/SR-73	1998	2	317	16	PVC		20501

Table 4-4 Modeled Diversions

Location	Modeled Pipe ID	Treatment Plant	Diameter In	Diameter Out 1	Diameter Out 2	How Modeled?
Irvine Center Dr. / Valley Oak Dr.	8752	MAIN	12"	12"	12"	Based on Diameters
San Leandro / Culver Dr.	11297	MAIN	36"	36"	36"	75% to SW, 25% to NW
Bethany Dr. / Blinn Ln.	15044	MAIN	10"	10"	10"	Based on Diameters
Von Karman Ave. / Main St.	833	IBC	21"	21"	21"	Based on Diameters
Main St. / Jamboree Rd.	858	MAIN	15"	15"	15"	Based on Diameters
Milano Dr. / La Salud	14727	MAIN	24"	24"	30"	Based on Diameters
Main St. / Cartwright Rd.	301	IBC	18"	10"	18"	Based on Diameters
Von Karman Ave. / Alton Pkwy	886	IBC	15"	10"	15"	Based on Diameters
Main St. / San Mateo	10555	MAIN	45"	48"	45"	100% to MWRP, 0% to OCSD
Muirland / El Toro	23128	LAWD	21"	15"	21"	0.7MGD to SMWD, rest to LAWD

The model of the physical system is complex and is considered to accurately represent the majority of critical system assets. As additional information is located or surveyed the model updates will increase the accuracy of the results. Plate 4-1 at the back of the chapter shows the extent of the collection system and the trunk model.

4.2.2 MANHOLE AND PIPELINE NOMENCLATURE

The updated GIS provides a common nomenclature for the entire IRWD system. A sewer atlas is maintained and each manhole is named by its Atlas Map Page and a unique identifier. For example, manhole MH059W001 is on Atlas Map page 059W and has the unique identifier of 001. Similarly, a pipe name incorporates the upstream and downstream manhole names for the pipes unique ID. For example, MH045W079MH045W078 flows between manholes 78 and 79 on Atlas Map page 045W. Infosewer uses this nomenclature as well as its own unique integer values in situations where dummy nodes or pipes were required for modeling purposes. When referred to in tables or text, this is known as the Model ID.

4.2.3 PIPELINE FRICTION FACTOR

Friction factors for pipelines vary with the material and the age of the pipe. For analysis purposes, the pipeline friction factor assumes that the pipeline has been in service for some period of time, and that some fouling, deposits, and deterioration may have occurred. A roughness factor as indicated by a Mannings' coefficient ("η") of 0.013 is typically used to evaluate existing interceptors and for projection of future sizing needs. Studies have shown that this value typically accounts for most pipe roughness, joints, and fouling that occurs after several years of collection system operation.

4.3 FLOW LOADING AND ALLOCATION

4.3.1 APPLICATION OF SEWER FLOW GENERATION FACTORS

As an adjunct project, a Water Demand and Sewage Flow Generation Factor Study was prepared. A summary of the flow generation factors developed in the study is presented in Chapter 3. The District uses these values to generate the flow per loading unit for use in the sewer collection system model.

4.3.2 SEWER TRIBUTARY AREAS (STAS)

The GIS system was used to define sewer tributary areas (STAs). Sewer tributary areas were defined by tracing the unmodeled network upstream of a modeled manhole, or injection node. Any property draining to the traced network was then assigned to that injection node, and finally the property boundaries were dissolved to create an STA. These were then used by the District to intersect with the Water Demand Forecast tool to define the amount of wastewater flow that is generated in each STA. The STA's flows were then used in the model to perform the capacity analysis. Figure 4-1 shows the STAs that were developed for existing and future flow loading.

IRVINE RANCH WATER DISTRICT

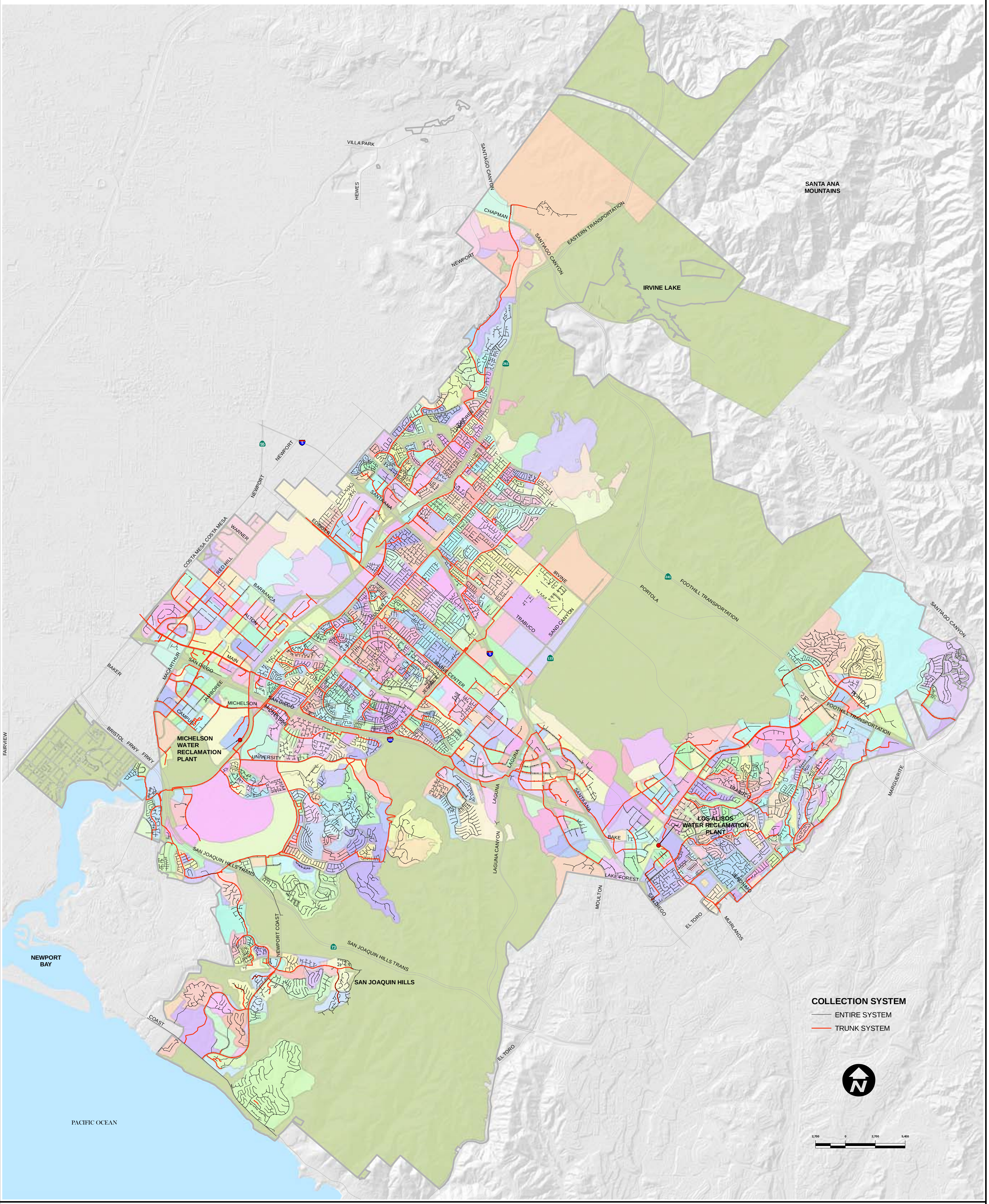


FIGURE 4-1 SEWER TRIBUTARY AREAS

DUDEK

4.3.3 Special Flows

Large point loads, such as those coming from an industrial facility or participating water agency, were not captured using the STAs and Flow Generation Factor method. Average daily flow from these sources was estimated and assigned an appropriate diurnal profile. Each flow was then applied to the model at a single injection node. Table 4-5 lists the special case flows that were included in the model.

Table 4-5 Special Case Flows

Description	Model Injection Node	Average Daily Flow (MGD)	Source
Royal Carpet	952	0.50	Flow Measurement
Industrial Metals	935	0.35	Flow Measurement
Maruchan	13728	0.35	Flow Measurement
Braun	471	0.33	Flow Measurement
English Canyon (SMWD)	100022	0.80	Flow Measurement
El Toro Water District	20721	0.70	Flow Measurement
University California Irvine	16186	1.29	Campus Master Plan
OCSD	Varies	2.88	OCSD Gallonage Report
Total		**7.21**	

4.4 INFILTRATION AND INFLOW ANALYSIS

In addition to the flows observed during the average dry weather condition (ADWF), a wet weather analysis was used to determine the impacts of defect flows. The following section analyzes three events that were observed during the flow measurement period.

Flows originating from defects are generally known as defect flows or Inflow and Infiltration (I&I). Defect flows that occur consistently regardless of precipitation are known as Base Inflow and Infiltration (BII). Defect flows that only occur as a result of a rainfall event are known as Rainfall Derived Inflow and Infiltration (RDII). This section discusses an analysis of the RDII observations in the District's Sewer Collection System during the spring of 2006.

Inflow and infiltration flows originate from defects in the collection system. Each is distinguished by the method that it enters the collection system. Inflow comes from direct connections to the surface waters. Examples of inflow sources would include, missing clean out covers, missing manhole covers, roof, patio, refuse bin, storm and other drains that are connected to the sanitary sewer system. Inflow is characterized by a rapid response and diminishment closely following the pattern of the rainfall event. Inflow is most frequently located through the use of smoke testing during dry weather.

Infiltration flows enter the system from indirect connections through the soil. Examples of infiltration sources include cracked pipe, offset joints, manhole/pipe connections, and manhole chimney seals. Infiltration has a slow initial response to rainfall and the infiltration defect flows may last for months after the rainfall event. Infiltration defects are best located through the use of closed circuit television (CCTV) inspections performed during periods of high groundwater.

Base infiltration and inflow is accounted for in the calculation of Average Dry Weather Flow (ADWF). RDII flows into the sewer and temporarily elevates wastewater flows in the collection system. The volume and rate of RDII that enters the sewage system during an event is affected significantly by previous soil conditions, the intensity and volume of the rainfall and by the conditions of the pipe system. RDII can vary greatly in different parts of the collection system depending on each of these variables.

This section presents the findings of the I&I analysis performed as part of this study, which included rainfall monitoring and temporary flow monitoring at several key locations in the District. Conclusions on the magnitude and location of I&I throughout the sewer system are presented, as well as recommendations for follow-up work.

4.4.1 TEMPORARY FLOW AND RAINFALL MONITORING

To evaluate the severity of RDII, 8 flow measurement sites were selected. These sites were selected at locations near the lower reaches of the major trunks. Figure 4-2 shows the locations and Table 4-6 presents summary information of the 8 meters that were used to measure the collection system's response to wet weather events.

IRVINE RANCH WATER DISTRICT

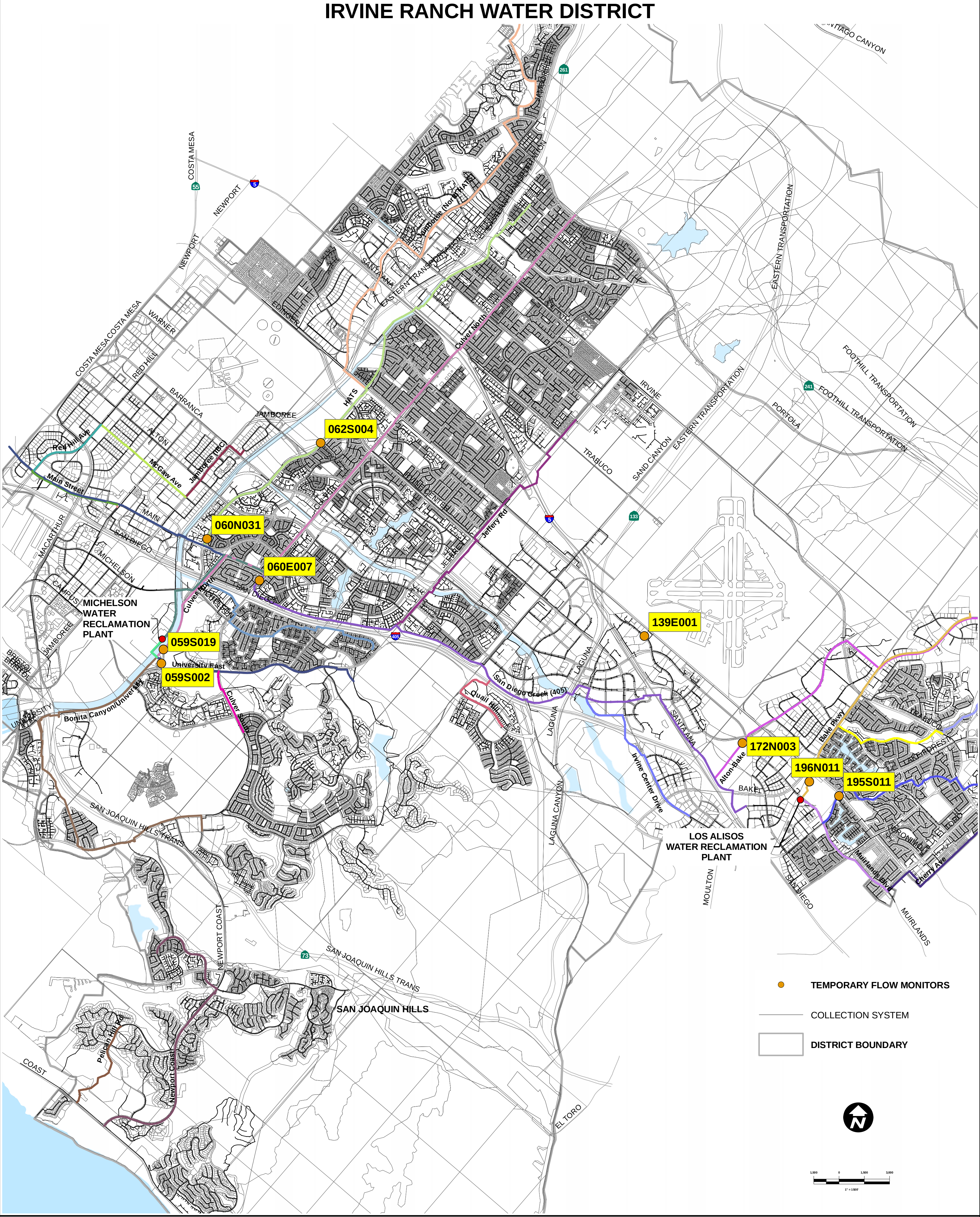


FIGURE 4-2 TEMPORARY FLOW MONITORS FOR I&I ANALYSIS

DUDEK

FIGURE 4-2 TEMPORARY FLOW MONITORS FOR I&I ANALYSIS

Table 4-6 Temporary Flow Meters used for I&I Analysis

Geotivity ID	IRWD GIS ID	Trunk Line	Pipe Diameter (in.)
196N011	MH196N132	LOS ALISOS	18
060E007	MH060E007	CULVER	42
195S011	MH196N111	LAKE FOREST	15
060N031	MH060N031	HARVARD	54
059S002	MH059S002	SD CREEK	18
172N003	MH172N003	SD CREEK	18
059S019	MH059S019	UNIVERSITY	24
062S004	MH062S004	HARVARD	45

Rainfall data was purchased from NOAA for the permanent rain gauge located at The John Wayne Airport. Several rainfall events occurred during the flow monitoring period. Table 4-7 lists the three most significant events defined for the purposes of this analysis.

Table 4-7 Rainfall Events

Event	Date of Event	Total Rainfall (in.)
1	February 27-28	0.94
2	March 27-29	0.97
3	April 5	1.00

4.4.2 RDII Analysis Method

The volume of RDII is calculated as the difference between the measured flow during the storm and a typical base flow that would be expected to occur if there had been no rainfall. In other words, the average dry weather flow (ADWF) is subtracted from the observed wet weather flow (WWF) to find Defect Flow. ADWF hydrographs were calculated by averaging data for at least 14 days during periods of no rainfall or lingering rainfall effects.

4.4.3 RDII Analysis Results

Table 4-8, Table 4-9, and Table 4-10 provide a numerical summary of the RDII response for each flow meter for each rainfall event. Appendix B shows plots of WWF vs. DWF, Defect Flow, and Rainfall for each of the selected flow meters for each rainfall event.

All of the sites responded with increases of flow normally associated with infiltration defects. Very small percentage increases in flow are seen in the data during the April storm, which occurred late in the season when soil has reached its maximum saturation. This is the time when infiltration would be at its peak.

The overall conclusion is that IRWD has very “tight” collection system exhibiting very small increases in flow to rainfall events observed during the flow measurement program.

The Operations staff has observed that there are many refuse area drains that being connected to the sanitary system during new construction. These connections are apparently being constructed with the understanding that drainage from these areas is contaminated and therefore not clean enough to be tied to the storm drainage system. If this construction continues to be allowed, it is expected that RDII related to direct inflows will increase in the future.

Table 4-8 RDII Response to February Storm

Meter	Average Dry Weather Flow (MGD)	Increase In Volume Due To Wet Weather (MGD)	Increase In Flow Volume (%)	Area-weighted Increase in Flow Volume (GPAD)
Los Alisos (196N001)	2.182	0.368	16.9	242.673
Culver (060E007)	4.606	0.690	15.0	119.940
Lake Forest (195S011)	0.527	0.048	9.1	72.960
HATS (060N031)	6.368	0.538	8.4	108.005
SD Creek (059S002)	1.640	0.131	8.0	57.002
SD Creek (172N003)	1.961	0.144	7.3	71.248
University (059S019)	1.874	0.024	1.3	6.441
HATS (062S004)	6.915	0.0	0.0	-10.353

Table 4-9 RDII Response to March Storm

Meter	Average Dry Weather Flow (MGD)	Increase in Volume due to Wet Weather (MGD)	Increase in Flow Volume (%)	Area-weighted Increase in Flow Volume (GPAD)
Los Alisos (196N001)	2.182	0.128	5.9	84.582
Culver (060E007)	4.606	0.136	3.0	23.673
Lake Forest (195S011)	0.527	0.022	4.2	33.677
HATS (060N031)	6.368	0.329	5.2	66.123
SD Creek (059S002)	1.640	0.0	0.0	-53.192
SD Creek (172N003)	1.961	0.627	32.0	310.036
University (059S019)	1.874	0.327	17.4	86.478
HATS (062S004)	6.915	0.407	5.9	93.385

Table 4-10 RDII Response to April Storm

Meter	Average Dry Weather Flow (MGD)	Increase in Volume due to Wet Weather (MGD)	Increase in Flow Volume (%)	Area-weighted Increase in Flow Volume (GPAD)
Los Alisos (196N001)	2.182	0.018	0.8	11.853
Culver (060E007)	4.606	0.0	0.0	-53.847
Lake Forest (195S011)	NO DATA	NO DATA	NO DATA	NO DATA
HATS (060N031)	6.368	0.493	7.7	99.140
SD Creek (059S002)	1.640	0.131	8.0	56.831
SD Creek (172N003)	1.961	0.651	33.2	322.104
University (059S019)	1.874	0.388	20.7	102.681
HATS (062S004)	6.915	0.421	6.1	96.418

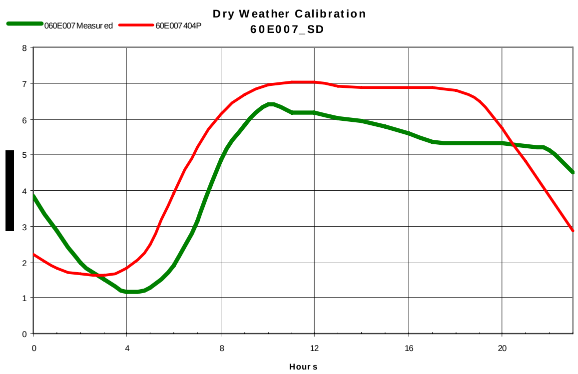
4.5 CALIBRATION

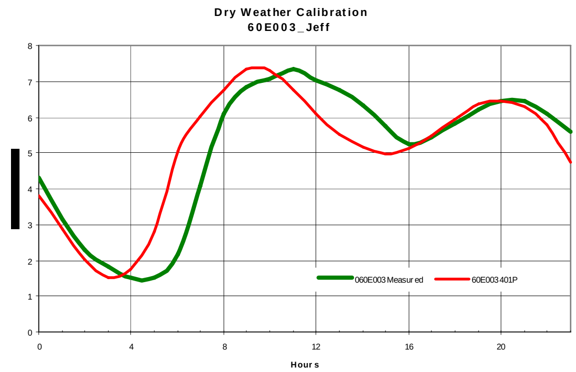
Once the flows were input into the hydraulic model from the revised Flow Generation Factors, the calibration process began. Calibration is a process where observed flows and predicted model flows are compared. Iterative adjustments are made to the sewage flow generation volumes, the diurnal patterns or the physical model until the model's predicted hydrographs closely approximate the observed flows. The primary purpose of a calibrated model is to provide an accurate representation of the hydraulic characteristics of the collection system.

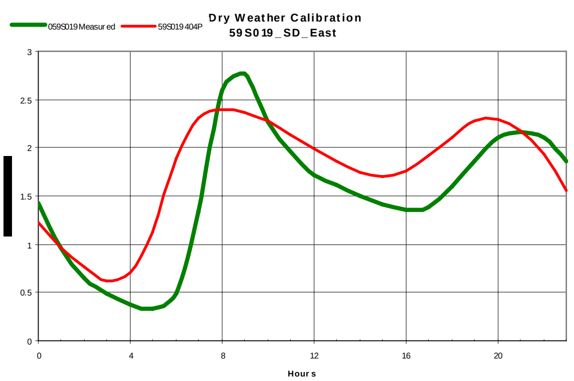
The basis of model calibration is accurate measurements of flow within the collection system. During the preparation of the Master Plan, flow measurements were made continuously for a period of at least 14 days at 60 locations throughout the Irvine Ranch Water District's sewer collection system. Data analysis was performed on these sites to define the Average Dry Weather hydrograph for each site. The Average Dry Weather hydrograph at key locations is the observed basis of comparison for the predicted model flows.

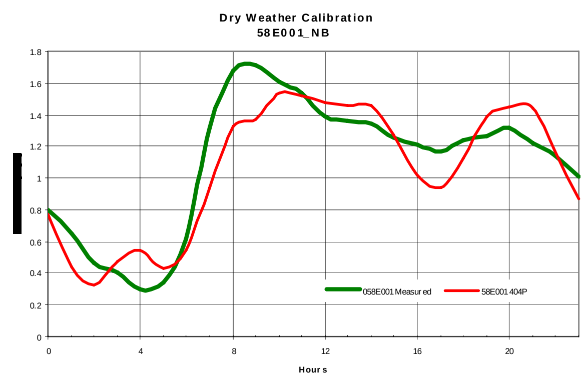
Figure 4-3 and Table 4-11 indicate the comparisons of Measured and Modeled flow that were observed at Key locations that are on the downstream ends of major drainage areas.

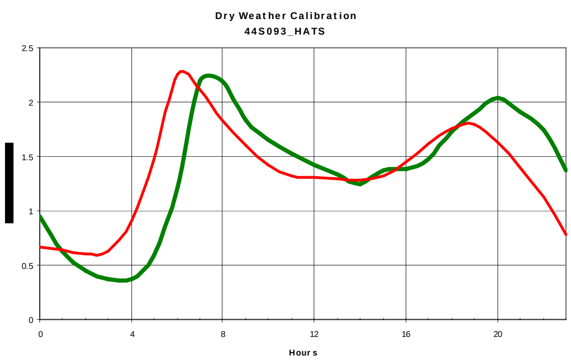
Figure 4-3 Typical Calibration Results 04/04/06











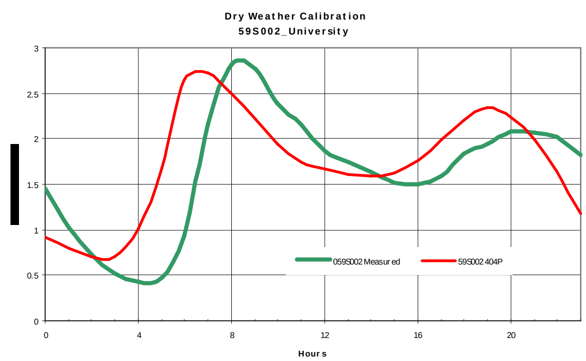


Table 4-11 Final Calibration Results

Calibration Results		Measured		Model		Difference	
Meter Location	**Trunk / Area**	**Average**	**Max**	**Average**	**Max**	**Average**	**Max**
48E079	IBC	0.634	1.091	0.571	1.029	-9.9%	-5.7%
48N015	IBC	1.143	1.472	0.841	1.548	-26.4%	5.2%
43S003	HATS_Top	0.688	1.433	0.690	1.202	0.2%	-16.1%
44S093	HATS	1.371	2.195	1.342	2.251	-2.1%	2.5%
84W079	JF	0.773	1.793	0.846	1.598	9.4%	-10.9%
63E005	JF	1.713	3.301	1.711	3.214	-0.1%	-2.6%
60N031	HATS_Bottom	6.368	10.131	5.813	7.658	-8.7%	-24.4%
60E006	SD_007	4.448	6.405	4.984	7.027	12.0%	9.7%
60E003	SD_003	5.052	7.344	4.298	6.128	-14.9%	-16.6%
59N001	SD_Rip	7.595	10.559	8.258	11.432	8.7%	8.3%
58E001	NB	1.098	1.709	1.053	1.539	-4.0%	-10.0%
59S019	SD_Church	1.513	2.776	1.755	2.399	16.0%	-13.6%
59S002	Univ	1.645	2.820	1.725	2.725	4.9%	-3.4%
57N010	NB	0.962	1.641	0.897	1.586	-6.7%	-3.3%
172N003	SD	1.957	3.085	1.783	2.563	-8.9%	-16.9%
Updated 4/04/2006					Average	-2.0%	-6.5%

The model calibration insures that there is an accurate representation of both the existing conveyance system and the flows that are injected into the model. Changes made to the physical model included the review and inclusion of information that was not a part of the provided GIS database (San Leandro Diversion Structure) and the elimination of portions of the system that did not belong to the District (Main Street Pump Station and Force Mains). Changes that were made to the flow representations included the overall reduction of the Design Flow Generation factors and the addition of base inflow and infiltration quantities derived from the flow measurement program.

4.6 CAPACITY ANALYSIS RESULTS

This section discusses the results of the hydraulic analyses conducted with respect to the existing system. An understanding of the hydraulic condition of the existing system is necessary to identify existing system deficiencies, and to help prioritize recommended system improvements resulting from the ultimate system analysis. The capacity of the trunk system was evaluated during peak hour of dry weather conditions Wet weather impacts on the system were minor during the flow metering period. (See Chapter 7 for details of Wet Weather I&I analysis).

4.6.1 GRAVITY PIPELINES

Capacity analysis of open channel systems is generally based on the consideration of the depth of flow as compared to the diameter of the pipe (d/D). Exceptions to these guidelines are allowed when considering siphons or other known areas of pressure flow. The following table indicates the numbers of pipes exceeding the Design and Performance Criterion. As shown, the system is predicted to be in excellent operating condition. No predicted points of overflow exist and few areas of high flow are noted. In the locations where the Operations Staff has noted high flows, it is likely that unmodeled conditions exist. For instance, in the model all pipes are modeled as having the full diameter available for the conveyance of flows. Field conditions for a pipe may include roots, fat accumulation or settling that would reduce the capacity of the pipe. This would result in pipes flowing at a deeper depth than predicted in the model.

The capacity analysis under dry weather flow conditions indicates that of all pipes in the trunk system model, 104 of the pipes (totaling 31,610 feet in length) exceeded the performance criteria. Plate 4-2 at the back of the chapter shows a map of the system color coded by depth to diameter ratios for the Existing Average Dry Weather flow conditions.

Table 4-12 lists the pipe line segments that were identified as capacity deficient according to the design criteria. This table is used as the beginning point for the formation of projects for inclusion into the CIP. This list does not include miscellaneous pipes that are instances of single pipes with deficiencies.

Table 4-12 Capacity-Deficient Pipeline Segments (Grouped)

Project Name	Model Pipe ID	From Manhole ID	To Manhole ID	Dia (in)	Length (ft)	Max d/D	Priority	Map ID
Walnut Ave\Franklin Ave	425	213	684	6	350	1	High	1
	412	684	429	6	308	1		
Turtle Rock Dr/Sunnyhill	15339	654	16144	10	147	0.507	High	2
	75	16144	16756	10	62	1		
Sand Canyon Ave/Barranca Ave/Laguna Canyon Rd	13751	9020	14264	10	280	0.892	High	3
	13478	13728	782	10	360	1		
	9802	782	10298	10	390	1		
	19499	10298	13903	12	206	1		
	13535	13903	12917	16	357	1		
	12568	12917	10291	16	110	1		
	9786	10291	10292	15	86	1		
	13415	10292	10065	15	272	1		
	19686	10065	12058	15	400	1		
	11851	12058	10810	15	398	1		
	10310	10810	10599	18	178	1		
	19719	10599	14186	12	309	1		
	13446	14186	13589	18	153	1		
	13399	13589	13171	18	254	1		
	12599	13171	13172	21	595	1		
	13749	13172	12544	21	572	1		
	12310	12544	12543	24	515	1		
	12309	12543	12796	24	168	1		
	13823	12796	14289	24	62	1		

Project Name	Model Pipe ID	From Manhole ID	To Manhole ID	Dia (in)	Length (ft)	Max d/D	Priority	Map ID
	13830	14289	14292	24	37	1		
Riparian VW	13203	13437	13735	42	840	1	High	4
	13427	13735	13592	42	77	1		
Muirlands Blvd/El Toro Rd	23483	23185	23315	8	35	1	High	5
	21133	21220	20959	15	272	0.718		
	21132	20959	20957	15	229	0.719		
	21131	20957	20958	15	286	0.718		
	23136	20958	22922	15	282	1		
	23139	21224	22923	15	365	0.737		
	23140	22924	21224	15	270	0.736		
	23141	20974	22924	15	269	0.736		
	23482	23314	22215	15	249	0.675		
	23617	23290	23316	15	405	0.807		
	23484	23316	23185	18	344	1		
	23127	21158	22920	21	546	1		
	22012	22206	22207	21	329	1		
	23703	22207	23531	21	364	1		
Morningside/Morning Star	17070	17712	17366	12	82	1	High	6
	17071	17366	17718	12	197	0.715		
	17882	17718	14709	12	172	0.664		
Kelvin Ave	841	952	951	10	400	1	High	7
	840	951	949	10	408	1		
	839	949	950	12	483	0.705		
Jamboree Rd	293	313	618	10	17	1	High	8
	487	618	698	10	27	1		
Deere Ave	902	989	990	12	486	1	High	9
	909	990	31	12	486	1		
Glenoaks	13275	13526	13527	36	437	0.878	Medium	10
	19495	13527	13857	36	428	0.816		
Dakota/Harvard Ave	1623	1595	1594	8	227	0.787	Medium	11
	5565	1594	5830	8	245	0.775		
	5794	5830	6061	8	314	0.769		
	5810	6061	6075	8	279	0.761		
	5825	6075	6088	8	227	0.758		
	5836	6088	6102	8	234	0.75		
	4630	5219	4854	12	436	0.509		
	4681	4854	5231	12	449	0.509		
	6260	6214	6529	12	298	0.516		
	6313	6479	6766	12	218	0.706		
W Yale Loop	11696	12205	12158	10	296	0.521	Low	---
	11598	12158	12132	10	400	0.517		
	11512	12132	11731	10	401	0.52		
	11248	11731	8239	10	208	0.563		
University Dr #2	15759	16650	16651	8	351	0.581	Low	---
	15795	16651	15162	8	290	0.542		

Project Name	Model Pipe ID	From Manhole ID	To Manhole ID	Dia (in)	Length (ft)	Max d/D	Priority	Map ID
	14445	15162	11807	8	290	0.582		
University Dr #1	19885	10256	14319	10	87	0.667	Low	---
	13957	14350	10131	12	396	0.517		
	13205	13737	13738	12	397	1		
	13857	14300	14299	12	139	0.595		
	13853	14299	13769	12	287	1		
	13887	13769	10261	12	414	0.625		
	9823	10262	10313	12	415	0.525		
	19518	10313	10130	12	373	0.632		
	9818	10130	10311	12	502	0.707		
	13903	10311	14322	12	471	0.727		
	19511	14322	12551	12	274	0.59		
	12317	12551	12798	12	366	0.66		
Springbrook N	12009	12394	12351	10	269	0.657	Low	---
	11932	12351	12189	10	398	0.586		
	19459	12240	12394	10	361	0.642		
Lake Forest Dr	22697	22528	21294	8	20	0.62	Low	---
	21519	21710	20755	10	278	0.548		
	23310	20755	20794	10	302	0.6		
	23271	23299	23295	12	402	0.614		
	23729	23301	23404	12	310	0.551		
	23744	23404	23552	12	168	0.521		
Harvard Ave	12651	13208	13149	12	71	0.53	Low	---
	16912	13149	14605	12	552	0.601		
E Yale Loop	9134	9699	7654	12	264	0.503	Low	---
	9470	9858	9780	12	415	0.632		
	9308	9780	9698	12	320	0.555		
Culver Dr	1210	1155	1156	10	285	0.511	Low	---
	1211	1156	1157	10	102	0.511		
	1212	1157	1264	10	396	0.507		
	1213	1264	1265	10	394	0.502		
Campus Dr	15509	16186	15970	12	92	0.621	Low	---
	15480	15970	15325	12	259	0.565		
	14778	15325	15115	12	308	0.542		
Alton Pkwy	477	471	469	12	509	0.563	Low	---
	476	469	470	12	499	0.736		

4.6.2 LIFT STATION MODEL RESULTS

Table 4-13 indicates that all of the lift stations are operating within capacity under existing flow conditions. Peak flow may exceed pumping capacity for short periods of time as additional flows are stored in the wet well.

Table 4-13 Lift Station Model Results

Lift Station Name	System ID	Total Capacity (MGD)	Average Flow (MGD)	Peak Flow (MGD)
Bayview	LS01	0.504	0.041	0.074
University	LS05	1.728	0.526	0.854
Newport Coast Dr	LS10	2.304	0.300	0.760
Portola Hills	LS11	1.354	0.209	0.525
Borrego	LS12	0.444	0.103	0.174
Buck Gully	LS13	0.259	0.027	0.069
Montecito/ TR14070	LS15	0.172	0.009	0.023
Coastal Ridge	LS29	0.374	0.070	0.175
La Canada	LS19	0.259	0.172	0.287
Coyote Canyon	LS16	0.720	0.270	0.596

4.6.3 SIPHONS MODEL RESULTS

Although none of the siphons exceed their capacities, Table 4-14 indicates there are potential problems in a number of siphons due to low velocities. As modeled the siphons were all in operation. Actual operation needs to be field verified especially in instances of low siphon velocities. It is possible that in these siphons that one or more of the barrels may be maintained as a spare which would increase the flow rate in the remaining barrels. Physical inspection and verification of siphon operations is recommended.

Table 4-14 Siphon Model Results

Description	Model Pipe ID	From Manhole ID	To Manhole ID	Diameter (inch)	Maximum Flow (mgd)	Maximum Velocity (ft/s)
El Toro Rd/Glen Ranch Rd	20652	583	575	8	0.676	3.00
	20653	583	575	8	0.678	3.01
El Toro Rd/Portola Pkwy	20719	20751	20750	8	0.056	0.25
	20715	20747	20400	8	0.056	0.25
Foothill Transportation/Lake Forest Dr	19718	12251	12375	10	0.175	0.50
Harvard Av/Barranca Pkwy	20659	8152	8673	24	2.397	1.18
	20658	8152	8673	24	2.451	1.21
	19712	8152	8673	24	2.397	1.18
Harvard Av/University Dr	19721	12794	12773	24	3.689	1.82
	19723	12794	12773	30	4.716	1.49
	19722	12794	12773	15	1.427	1.80
Jamboree Rd/North of Main St	466	694	693	8	0.802	3.56
	468	696	695	8	0.228	1.01
Jamboree Rd/North of Trevino Dr	20684	3626	20728	24	1.151	0.57
Jamboree Rd/OCTA Metrolink	20657	5300	6311	15	0.936	1.18
	20656	5300	6311	24	1.333	0.66
	20655	5300	6311	24	1.212	0.60
	20654	5300	6311	18	1.064	0.93
Jeffrey Rd/Alton Pkwy	19716	12202	12617	21	0.344	0.22
	19715	12202	12617	20	0.349	0.25
Main St/Veneto	19737	8530	8339	18	1.973	1.73
	19736	8530	8339	24	2.498	1.23
	19735	8530	8339	42	3.644	0.59
Michelson Dr/Riparian	19713	11968	8594	24	7.908	3.90
	19714	11968	8594	24	7.876	3.88
Prism/Linear	21853	21838	21830	8	0.084	0.37
	21854	21653	21837	8	0.084	0.37
Sand Canyon Av/Barranca Pkwy	19719	10599	14186	12	5.479	10.80
Shady Canyon Dr/Sage Creek	19731	19771	656	8	0.645	2.86
University Dr/Harvard Av	19724	19526	12538	15	2.011	2.54
	19725	19526	12538	18	2.464	2.16
	19726	19526	12538	10	0.78	2.21
University Dr/SR-73	19727	15801	16227	16	0.826	0.92
	19728	15801	16227	16	0.826	0.92

4.7 OPERATIONAL OBSERVATIONS AND CORRELATION TO MODEL RESULTS

As a part of the development of existing systems analysis, the following areas were noted in discussions with Operations and Maintenance crews to have hydraulic deficiencies. Correlations with the modeling results are shown (in italics) below.

4.7.1 OCSD/IBC OPERATIONS

- 15" line between Alton and Barranca accumulates debris.
  The model shows low velocities (<2fps) in this area.
- Royal Carpets, a new line was constructed. Flow is hot lint filled pipes. There are observed capacity issues at this site. Flow measurement program indicates that there is approximately 530,000 gpd being discharged at this location.
  The new line was included in the model and has adequate capacity.
- At second Barranca crossing siphon 3-month cleaning cycle.
  The model shows low velocities (<2fps) through this siphon.
- Flume @ Barranca siphon requires frequent cleaning.
  The model shows low velocities (<2fps) through this siphon.
- High grease locations are found along many areas throughout the IBC. These are primarily along Douglas and Von Karman south of I-5 and along Main Street between the Barranca Channel and Von Karman.
  The model shows low velocities (<2fps) in these areas and many other parts of IBC.
- Single 10" siphon crossing Barranca Channel requires frequent maintenance.
  The model shows this siphon to have adequate velocities. This siphon is included as part of the proposed Sand Canyon Ave/Barranca Pkwy CIP project.

4.7.2 IRWD OPERATIONS AND ENGINEERING

- Lake Forest area. This area was recently consolidated (Los Alisos WD) into District. Capacity in parallel pipelines is questionable.
  Flow monitoring conducted as part of this project showed that the parallel lines have surplus capacity.
- In the Los Alisos Area, surcharging has been observed in the El Toro Trunkline. See Tetra Tech report. Outside flows are picked up at Cherry and 2nd. 0.9 MGD from English Canyon Flow. There is a shared trunkline in El Toro "Pan Handle".
  This line is included as part of the proposed Muirlands Blvd/El Toro Rd CIP project.
- Coastal area is not seen as having any capacity problems.
  The model results agree with this statement.
- I&I is a problem. Low lying manholes should be noted and addressed to minimize I&I.
  According to the wet weather analysis conducted as part of this project, I&I does not pose a risk to system capacity.

4.7.3 Los Alisos Operations

- Parallel lines in Bake. Capacity Concerns.
  Flow monitoring conducted as part of this project showed that the parallel lines have surplus capacity.
- 21" line from Orchard Rim Elderwood crossing Trabuco always half full. Horse property in Serrano Creek Community Park.
  The model shows that a flat pipe section results in higher d/D ratios, but not high enough to require a CIP project.
- Siphon in Bake Crossing Serrano Creek U/S of Toledo collects grease/debris. Requires regular flushing.
  The model shows low velocities (<2fps) through this siphon.
- "Woods" area Fallen Leaf, Dove Tree, etc. Eucalyptus groves, lots of roots, clean 6 month cycle. Foam for roots unknown efficacy. Continue in "Woods" area. 10" line in Creek at end of Glenwood Drive. Always full.
  The model does not indicate that there is a capacity problem here.
- Cherry Avenue at RR turns 90^{o}, connection from golf course in RR Street (front) surcharge Geotivity Meter #7 (Pre MP).
  This line is included as part of the proposed Muirlands Blvd/El Toro Rd CIP project.

4.8 CONCLUSIONS AND RECOMMENDATIONS

4.8.1 Capacity Deficiencies

Based on the capacity analysis using the calibrated hydraulic model, the collection system generally has adequate capacity during average dry weather conditions. However, there are 21 areas which exceed the performance criteria, 11 of which are of medium or high priority. The following recommendations address these areas.

The following areas show capacity deficiencies of medium or high priority:

- Walnut Ave./ Franklin Ave. – 6"
- Turtle Rock Dr./ Sunnyhill – 10"
- Sand Canyon Ave/Barranca Ave/Laguna Canyon Rd. – 10" to 24"
- Riparian VW – 42"
- Muirlands Blvd./El Toro Rd. – 8" to 21"
- Morningside/Morning Star – 12"
- Kelvin Ave. – 10" to 12"
- Jamboree Rd. – 10"
- Deere Ave. – 12"
- Glenoaks – 36"
- Dakota/Harvard Ave. – 8" to 12"

A number of the above listed capacity deficient areas consist of isolated or very few segments of pipe, as can be observed in Table 4-12. Specific problem areas recommended as Capital Improvement Projects are shown in Table 4-14. Determining the appropriate size for the projects is evaluated during the future system modeling process, discussed in Chapter 5.

Table 4-15 Recommended Pipeline Capacity Improvement Projects

Proj. #	Project Name	Length (ft)	Alignment Description
1	San Canyon Ave/Barranca Ave/Laguna Canyon Rd	6,024	Upsize sewer line along Laguna Canyon Rd and Barranca Pkwy and along Sand Canyon Ave to San Diego Fwy
2	University Dr.	7,322	Upsize sewer line along University Dr between Culver Dr and Ridgeline Dr
3	Dakota/Harvard Ave.	4,142	Upsize sewer line along Dakota and Harvard Ave between Colorado and Octa Metrolink RR
4	West Yale Loop	1,305	Upsize sewer line along Main St and W Yale Lp between Culver Dr and Blue Lake S
5	Muirlands Blvd/El Toro Road	8,476	Upsize sewer line along Muirlands Blvd and El Toro Rd between Ferngreen Ln and El Toro Rd
		27,269	

4.8.2 INFLOW AND INFILTRATION

Based on the significant rainfall events and the observed increase in wet weather flows, the District has very few defects that were activated. Wet weather flows were not observed to have increased significantly throughout the season. In order to continue to track the wet weather performance of the system, we make the following recommendations:

- Install and maintain permanent flow measurement sites near the lower end of each of the major trunks
- Install and maintain constant recording permanent rain gauge installations throughout the District
- Install alarming devices to indicate surcharge conditions to the SCADA system
- Perform dry and wet weather flow data analyses to determine trends and severity of defect related flows
- Update hydraulic model to reflect additional wet weather events when observed
- Target defect location programs (smoke and CCTV) into areas displaying a significant wet weather response
- Revise construction specifications to eliminate connection of refuse area drains to the sanitary sewer collection system. As an alternative require sand/grease/trash interceptors prior to connection to storm drain system.

4.8.3 PERMANENT FLOW METERING

To insure that flows are properly accounted for in the systems expansion, permanent flow measurement sites are recommended at the locations listed below. These sites provide logical accounting for major trunk line flows and allow trend analysis to be performed. The results of the analysis will show how Wastewater Production (WWP), Base Inflow and Infiltration (BII) and Rainfall Dependent Inflow and Infiltration (RDII) change as the system ages or additional rehabilitation is performed. It is further recommended that the measurement system be equipped with surcharge alarming and that all data is communicated to the SCADA system. In this way, potential overflows in the lower reaches may be identified and prevented by requiring operator acknowledgement of alarm conditions.

Table 4-16 Recommended Permanent Flow Metering Locations

ID	Manhole ID	Location
1	059N001	Riparian/Access Rd. leading to MWRP
2	060E003	Culver Dr. North of San Leandro
3	060E007	Culver Dr. South of San Leandro
4	059S002	University & Harvard / Church Parking Lot
5	059S019	Harvard North of University in Bike Trail
6	058E001	University Dr. North of Campus Dr. in Bike Lane
7	060N031	Harvard Ave. South of San Carlos
8	172N003	Serrano Creek SE corner of Alton & Muirlands Blvd.
9	124W003	Trunk Line West of Sand Canyon Ave.
10	196N011	Bake and Muirlands Blvd.
11	OCSD	Outfall to OCSD on Main St. & San Diego Creek
12	OCSD	Outfall to OCSD on Main St. & Costa Mesa Fwy

5.0 FUTURE SYSTEM ANALYSIS

5.1 PURPOSE

To assure continuous high levels of customer service, the hydraulic model prepared for the Sewer Collection System Master Plan was used to evaluate the hydraulic capacity required for the predicted 2010 – 2025 customer base. The primary purposes of this chapter are to:

- Describe future extension of the collection system
- Describe Future flow loading techniques
- Describe the Results of the Capacity Analyses
- Describe capacity related project development
- Describe projects developed to address capacity restrictions

5.2 COLLECTION SYSTEM

The District plans for future customers through the Sub Area Master Plan (SAMP) process. In this process, the developer submits conceptual plans for the development of properties. These plans describe the roadway layout, future pipelines, connection points to the existing system and calculations of flow loading driven by planned land uses. The following paragraphs describe how these SAMPs and other studies were used to extend the Existing System Model, described in Chapter 4 – Existing System Analysis.

5.2.1 SYSTEM MODIFICATIONS

The SAMPs were provided as individual collection system models. These models were merged with the Existing System Model to represent the extensions of the future system. While the Existing System Model was skeletonized to include only 10 inch and larger lines, the SAMP models were not reduced. This was done primarily to allow for consistent flow loading throughout the SAMP areas. In this way there were no additional needs for the creation of future sewer tributary areas. The results from this integration of the SAMPS and other studies increased the overall modeled future system to the extents shown in Plate 5-1 at the end of this chapter. Table 5-1 describes the Future System Model elements.

Table 5-1 Future System Model Metrics

Diameter (inch)	Existing System Length (ft)	Additional System Length (ft)	Future System Length (ft)
6	8,793	0	8,793
8	49,165	449,641	498,806
10	241,123	55,223	296,346
12	164,706	42,880	207,587
15	226,056	45,018	271,074
16	3,375	0	3,375
18	85,006	12,076	97,081
20	1,546	0	1,546
21	42,869	0	42,869
24	69,674	116	69,790
27	9,443	1,464	10,907
28	5,079	0	5,079
30	19,709	0	19,709
33	17,222	0	17,222
36	30,505	0	30,505
37	448	0	448
39	5,690	0	5,690
42	25,001	0	25,001
45	10,223	0	10,223
48	3,582	0	3,582
51	4,975	0	4,975
54	5,893	0	5,893
60	5,233	0	5,233
63	4,157	0	4,157
66	6,624	0	6,624
Total	**1,046,097**	**606,418**	**1,652,515**

5.3 FLOW LOADING

As the system expands in the future, additional flow loads will be conveyed through the collection system to the treatment plants. These additional flows occur not only in the SAMP areas but also as the current service area is redeveloped. The following paragraphs describe the additional flow loading that was used to evaluate the hydraulic capacity of the future collection system.

Future flow loads in existing systems are provided by the District through the use of the Water Demand Forecast Tool for each of the modeled scenarios. Future flows from SAMP in addition to the existing system flows (2006) flow scenarios were created in the model for the 2010, 2015, 2020 and 2025 years.

As the existing system was calibrated flow factors were adjusted accordingly. The factor served as the basis for future average dry weather flows for each meter/area. The flows were augmented with base flows and infiltration as necessary. These Base Inflow and Infiltration (BII) flows are different for each major trunk and reflect the overall condition and location of defect flows along the trunk. While defect flows generally increase in time these are often offset by an expanded system rehabilitation program. As a result of this balance, defect flows were held constant throughout the planning horizon.

In addition to the Water Demand Forecast flows and Base Inflow and Infiltration, major non-residential point flows identified in the Existing System Model were retained. Individual SAMP flows were also incorporated into the model based on flows predicted in the SAMP studies.

The total future flow is the sum of the SAMP flows, BII flows, point flows and the predictions of the Water Demand Forecast Tool. The following Table 5-2 lists to total wastewater flow projections for sizing and phasing sewer improvements.

Table 5-2 Future Wastewater Flows

Treatment Plant	2006 Average Flow (mgd)	2010 Average Flow (mgd)	2015 Average Flow (mgd)	2020 Average Flow (mgd)	2025 Average Flow (mgd)
Coastal (OCSD)	0.79	0.91	0.92	0.93	0.93
IBC (OCSD)	2.43	3.20	3.75	4.06	4.32
HATS	6.94	7.99	8.62	8.94	9.29
LAWRP	6.18	6.69	7.17	7.17	7.17
MWRP	15.64	20.82	23.66	25.41	26.95
Total	**31.99**	**39.60**	**44.12**	**46.52**	**48.66**

5.4 CAPACITY CRITERION

For the development of new projects and evaluation of the future system, the same design and performance criteria was used as described in Chapter 3. See Table 3-3 for Gravity Pipe Design Criteria and Table 3-4 for Gravity Pipe Performance Criteria.

5.5 RESULTS

Gravity pipeline performance criteria was used to identify the quantity of pipelines within each of the performance ranks, for each of the flow scenarios. The following Table 5-3 lists the total length of pipe for each performance criteria rank.

Table 5-3 Summary of Total Length of Pipe (in feet) for Future Model by Performance Criteria

Year	2006	2010	2015	2020	2025
d/D	Pipe Diameter < 15"				
0.0-0.5	413,005	937,560	936,690	936,178	936,178
>0.5-0.75	17,085	27,112	27,966	28,007	28,007
>0.75-0.93	1,806	3,914	3,930	4,401	4,401
>0.93	6,774	9,750	9,750	9,750	9,750

Year	2006	2010	2015	2020	2025
d/D	Pipe Diameter = 15"				
0.0-0.67	213,204	247,540	247,540	247,540	247,540
>0.67-0.80	4,129	12,099	12,099	12,099	12,099
>0.80-0.93	405	787	787	405	405
>0.93	3,498	5,827	5,827	6,209	6,209

Year	2006	2010	2015	2020	2025
d/D	Pipe Diameter > 15"				
0.0-0.75	346,572	356,062	356,062	356,062	355,395
>0.75-0.85	939	2,457	2,457	2,457	2,932
>0.85-0.93	437	-	-	-	-
>0.93	8,317	11,401	11,401	11,401	11,594

The following figures indicate graphically those pipelines that are identified as capacity restricted based on Design Criteria for each of the flow scenarios.

IRVINE RANCH WATER DISTRICT

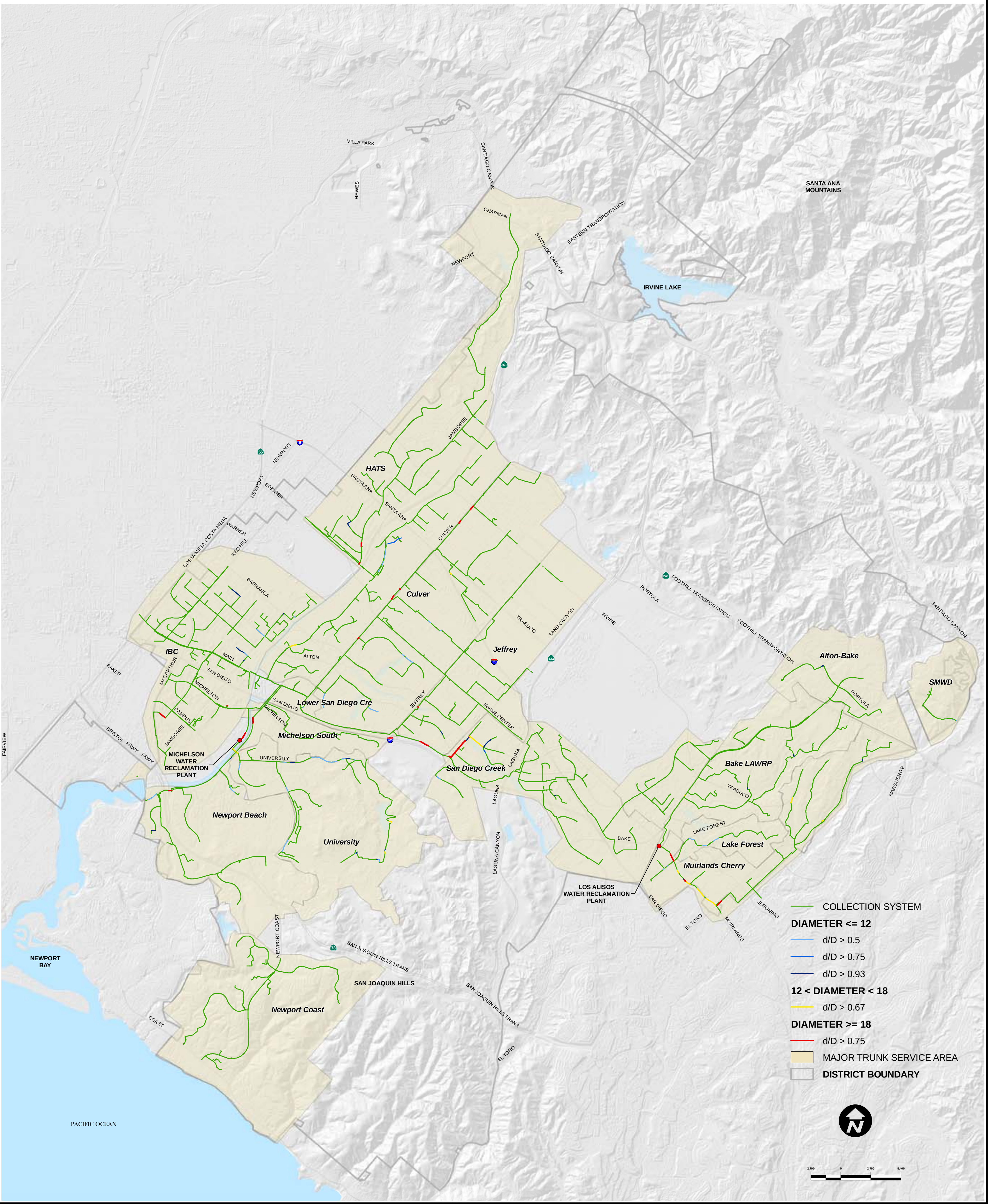


FIGURE 5-1 DEPTH TO DIAMETER RATIO (BY DIAMETER) - DESIGN, YEAR 2006 DUDEK

IRVINE RANCH WATER DISTRICT

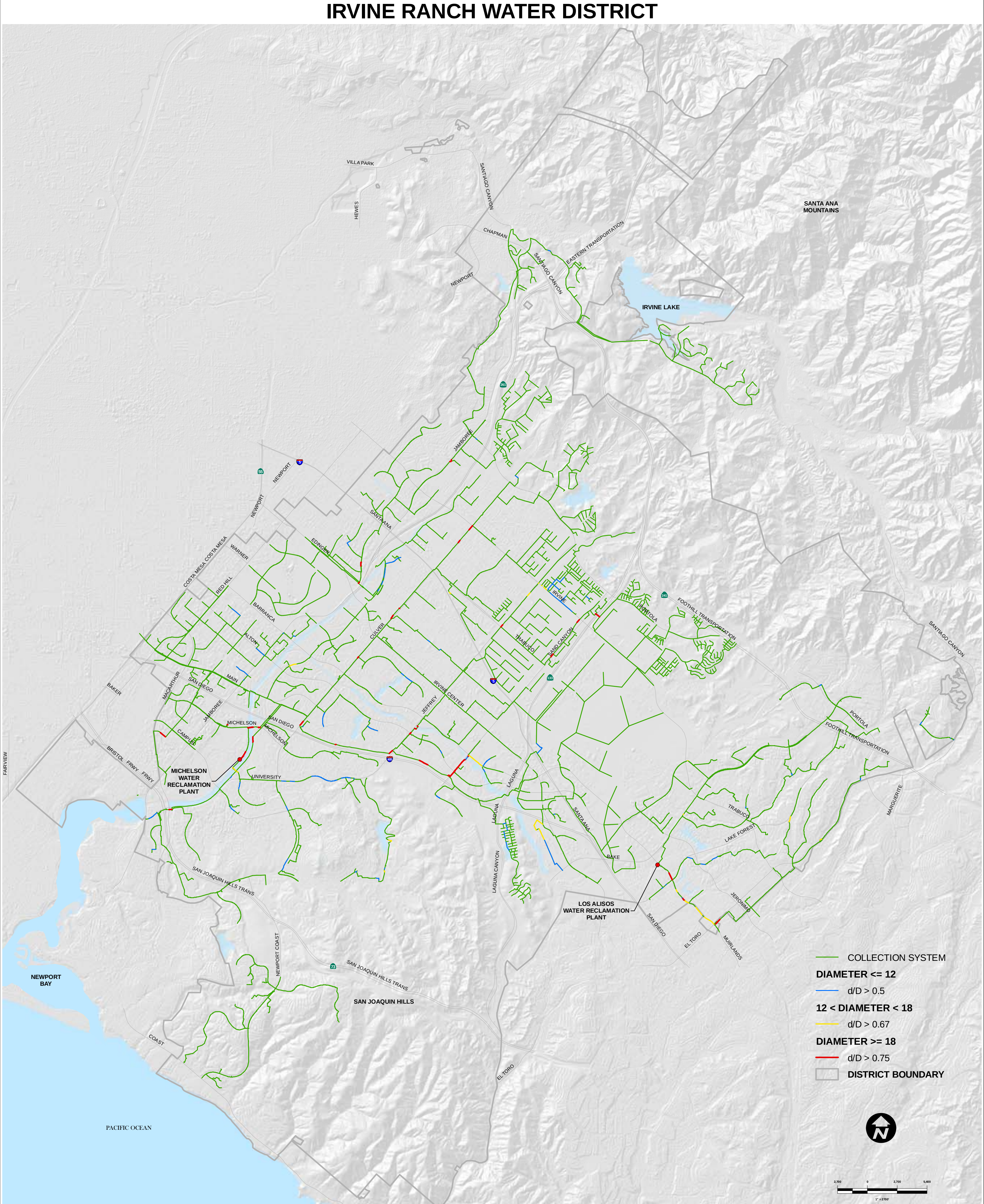


FIGURE 5-2 DEPTH TO DIAMETER RATIO (BY DIAMETER) - DESIGN, YEAR 2010

DUDEK

IRVINE RANCH WATER DISTRICT

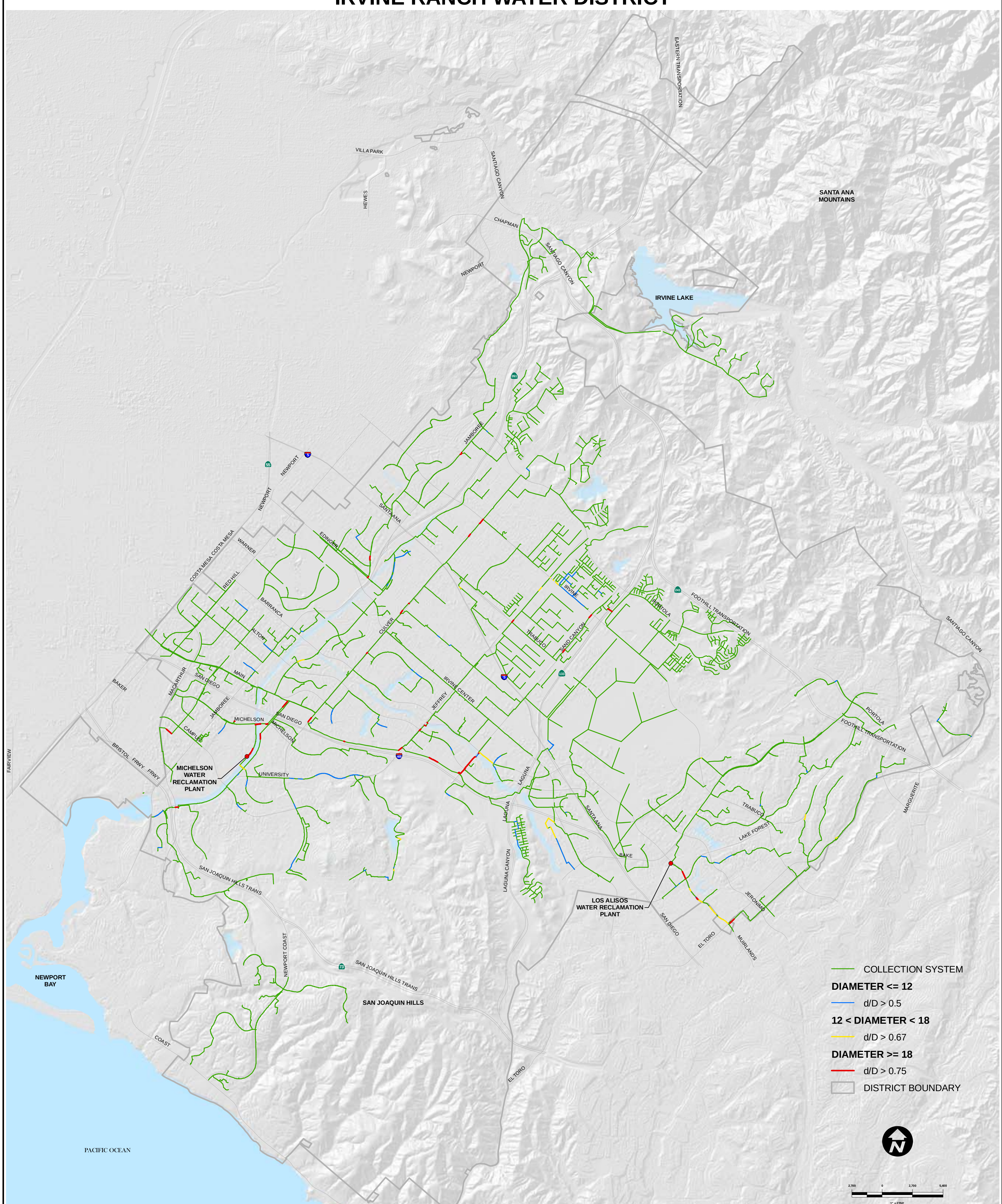


FIGURE 5-3 DEPTH TO DIAMETER RATIO (BY DIAMETER) - DESIGN, YEAR 2025

As shown, the majority of the system is properly sized for existing and future flows. As the system flows increase, so does the number of pipelines in the existing system or in two of the SAMP areas that do not meet the design criteria. In order to eliminate these limitations, projects were developed. The following section discusses the development of these capacity based projects.

5.6 PROJECTS

5.6.1 DEVELOPMENT

Pipeline replacement projects were developed for the pipeline segments and reaches that were determined to have hydraulic restrictions. Potential projects were identified by locating pipe deficient segments that were contiguous or within close proximity of one another. The deficient pipeline segments were grouped into projects and often included single pipe segments that were not capacity deficient. This is done to create logically constructible projects. In this way a single reach is designed and constructed as a single project. This removes the hydraulically deficient segment and provides a reach that is easier to maintain and to account for. The materials and age are consistent throughout an entire reach and there are fewer field coordination issues regarding protecting pipe in place.

As a result of the capacity related project development nine potential projects were identified for the ultimate planning period. These projects are required to establish capacity requirements in the existing and planned system to meet future demands. The following Table 5-4 describes the projects that were identified as a part of the modeling process. All projects identified were selected due to capacity deficiency in the existing pipeline.

Table 5-4 Capacity Related Pipeline Projects

Proj. #	Project Name	Length (ft)	Min/Max. Dia. (inch)	Min/Max Upsize Diameter (inch)	Alignment Description
1	Sand Canyon Ave/Barranca Ave/Laguna Canyon Rd	6,024	10/24	18/30	Upsize sewer line to 18" along Laguna Canyon Rd and Barranca Pkwy and to 24" along Sand Canyon Ave till San Diego Fwy
2	University Dr.	7,322	10/12	18/18	Upsize sewer line along University Dr between Culver Dr and Ridgeline Dr
3	Dakota/Harvard Ave.	4,142	8/12	12/18	Upsize sewer line along Dakota and Harvard Ave between Colorado and Octa Metrolink RR
4	West Yale Loop	1,305	10/10	12/12	Upsize sewer line along Main St and W Yale Lp between Culver Dr and Blue Lake S
5	Muirlands Blvd/El Toro Road	8,476	15/21	21/24	Upsize sewer line along Muirlands Blvd and El Toro Rd between Ferngreen Ln and El Toro Rd
		27,269			

Plate 5-2, at the end of this chapter, shows the extents of the projects that were identified through the modeling of the Future System.

As shown on Table 5-4 and in Figure 5-7, there are nine (9) projects necessary to meet the long term growth that is predicted to occur within the District using the design criteria. Once defined, the timing and the fiscal requirements must also be established. Priorities for the projects have been established based on (1) when the capacity deficiency is noted, (2) the severity as indicated by the Performance Criteria and (3) the total volume of flow that occurs at the location. Using this multi-parameter approach, projects are planned that address the largest, most severe and earliest occurring deficiencies first. Table 5-5 summarizes the recommended projects.

Table 5-5 Recommended CIP Projects

Project Name	Length (ft)	Existing Diameter (inch)	2025 Maximum d/D	2025 Average Flow Rate (mgd)	Upsize Diameter (inch)
Sand Canyon Ave/Barranca Ave/Laguna Canyon Rd	6,024	10, 12, 15, 16, 18, 21, 24	1.0	3.189	18, 24, 30
University Dr	7,322	12	0.72	0.684	18
Dakota/Harvard Ave	4,142	8, 12	0.787	0.399	12, 18
W Yale Loop	1,305	10	0.563	0.780	12
Muirlands Blvd/El Toro Rd	8,476	15, 18, 21	1.0	3.873	21, 24

5.7 CONCLUSIONS AND RECOMMENDATIONS

The Future System Hydraulic Model Analyses included applying additional flows anticipated through both the development of remaining Sub-Area Master Plans, as well as re-development of the IBC residential development overlay and 2004 opportunity study area. No additional deficiencies were identified within the collection system other than those projects already experiencing peak flows above the design capacity in the existing system, listed at the end of Chapter 4. Ultimate flows have increased through the system and therefore ultimate sizing of the deficient pipelines should be based on ultimate flows, as listed in the above Table 5-5. The increase in flows are primarily attributed to future redevelopment. See Chapter 8 for a summary of all recommended projects.

6.0 RELIABILITY AND REDUNDANCY

6.1 PURPOSE

In addition to identifying existing and future system deficiencies through the development of this master plan, the District is taking a proactive stance to enhance reliability and increase redundancy of the wastewater collection system. The objectives of this chapter are to:

- Present a risk management program which includes tools to assess system risks;
- Make operational and system improvement recommendations to increase reliability and redundancy within the collection system; and
- Define potential Capital Improvement Projects to improve operational flexibility and system redundancy in the collection system.

6.2 RISK ANALYSIS

A risk management program aims to systematically focus limited resources on areas which have the greatest risk of failure (spill). In addition, the program strives to identify areas with the highest consequence to failure in the collection system. Intuitively, a person knowledgeable in the operation of a sewer system could identify many high risk areas with little analysis. The approach in this chapter was used to confirm identified areas of concern, find potential areas which might not be obvious, and give the District a tool for prioritizing recommendations.

Operation and maintenance of a large collection system can be exhausting on valuable resources such as time, manpower, and equipment. The goal of this chapter is to perform the analysis which allows the District to develop an effective and streamlined maintenance schedule, and recommend system improvements which support preventive maintenance and reduced risk within the system.

This section identifies many characteristics or circumstances that may increase the potential risk of pipe or manhole failure. There are numerous situations that can lead to system failure. While this section focuses on those that are the most predictable and consequential, it is important to realize that risk can never be eliminated. When appropriately implemented, a risk management program focuses, on average, expenditures that will reduce risk and mitigate consequences.

6.2.1 APPROACH

Risk assessment is the process of identifying the probability and consequence of a predefined event. Risk can be defined by answering the following questions:

- What can go wrong?
- How likely is it to go wrong?
- What are the consequences?

To accomplish this assessment, a “risk factor” was assigned to every asset in the collection system. The risk factor is calculated using the following equation:

$$Risk\ Factor = Probability\ of\ Failure * Consequence\ of\ Failure$$

The first step in calculating the risk factor was to develop two sets of characteristics that determined the *Probability of Failure* (condition) and *Consequence of Failure* (criticality) for a facility. Physical characteristics that have an effect on the overall condition of a pipeline, such as material, age, and location, were used in the “condition” set. Characteristics which assess the adverse impacts of pipeline failure, such as proximity to waterways and potential spill volume, were used in the “criticality” set. Each characteristic was given a “weighted value” based on the District staff’s perception of its significance.

The second step in calculating risk was to assign a “ranking value” to each asset for each characteristic. For example, the flooding characteristic was assessed using the GIS layer obtained from the Federal Emergency Management Administration (FEMA). The flood layer was spatially intersected with the developed pipeline layer to assign a flood potential to each facility. If the potential was high (10-year flood zone) for a particular pipe, then it was inferred that flooding would likely occur near the pipe in the future. For these pipes, a higher ranking value was assigned for potential for flood damage.

In the final step, the risk factor was calculated by multiplying each condition ranking value by its corresponding criticality ranking value, and summing the products for each condition characteristic, as illustrated in Table 6-1. Pipes were divided into categories based on their calculated risk. Those pipelines identified as being “high risk” are assumed to require careful consideration for maintenance scheduling, specification modification, and CIP project prioritization. Plate 6-1 at the back of the chapter shows the District collection system color-coded by risk level, with “high risk” pipes highlighted in red.

Table 6-1 Example Risk Factor Matrix

		Criticality						
		Repair Duration	Repair Disruption	Waterways	Railroads	Sensitive Habitat	Spill Volume	
Condition	Material	0	0	0	0	0	0	**0**
	Age	0	150	750	0	600	0	**1500**
	Slope Blockage	0	50	250	0	200	0	**500**
	FOG Blockage	0	50	250	0	200	0	**500**
	H2S	0	50	250	0	200	0	**500**
	Capacity	0	0	0	0	0	0	**0**
	Corrosivity	0	0	0	0	0	0	**0**
	Liquefaction	0	50	250	0	200	0	**500**
	Flooding	0	150	750	0	600	0	**1500**
							Total Risk Factor =	**5000**

6.2.2 Definition of Evaluation Criteria

As mentioned before, there are countless variables which can affect pipe failure. This analysis considers those pipe characteristics which have a reasonable predictability of causing pipe failure. Special weighting was placed on those consequences which are of high priority to IRWD, such as proximity to natural waterways and sensitive habitat. Table 6-2 lists the characteristics, along with weighting values, ranking values, and data sources.

Based on meetings with IRWD operational and engineering staff, as well as the Board of Directors, certain criteria were of particular concern. The following plates are provided in the appendices to help District staff understand the impact of each evaluated criteria:

- Plate 6-2 Risk Assessment (Capacity Analysis)
- Plate 6-3 Risk Assessment (Age Analysis)
- Plate 6-4 Risk Assessment (Material Analysis)
- Plate 6-5 Risk Assessment (Waterways Analysis)
- Plate 6-6 Risk Assessment (Sensitive Habitat Analysis)
- Plate 6-7 Risk Assessment (Sulfide Generation and Corrosion Potential)

Table 6-2 Risk Analysis Evaluation Criteria (Failures)

FAILURE CONDITION	RANKING DEFINITION	RANKING VALUE	WEIGHT %	DATA SOURCE
Construction Damage	Level 1: Asset in area with no planned development activity	0	5	Land Use Layer (GIS)
	Level 2: Asset in area with planned development activity	1		- Existing and GP Land Use Codes
Pipeline Age	Level 1: Mild deterioration (less than 20 years old)	0	15	Pipes Layer (GIS)
	Level 2: Moderate deterioration (between 20 and 50 years old)	1		- Year Installed
	Level 3: Major deterioration (greater than 50 years old)	2		
Hydrogen Sulfide Production	Level 1: Hydrogen Sulfide Z-factor calculation less than 5,000	0	5	Modeling Results (GIS)
	Level 2: Hydrogen Sulfide Z-factor calculation between 5,000 and 10,000	1		Pipes Layer (GIS)
	Level 3: Hydrogen Sulfide Z-factor calculation greater than 10,000	2		- Flow, diameter, D/d, slope
Capacity Limitation	Level 1: Asset flowing at below critical performance depth (d/D < 0.75)	0	15	Modeling Results (GIS)
	Level 2: Asset flowing above critical performance depth (d/D > 0.75)	2		- D/d
	Level 3: Asset surcharging (d/D > 1)	3		
Soil Characteristics	Level 1: Asset can corrode and is located in area with non-corrosive soil types	0	5	Soils Mapping (GIS)
	Level 2: Asset can corrode and is located in area with moderately corrosive soil types	1		Pipe Material
	Level 3: Asset can corrode and is located in area with highly corrosive soil types	2		
Blockage (Pipeline Slope)	Level 1: Asset has a maximum daily velocity greater than 2 fps (slope > 0.01 for pipes < 10")	0	5	Modeling Results (GIS)
	Level 2: Asset has a maximum daily velocity less than 2 fps (slope < 0.01 for pipes ≥ 10")	1		- Velocity
Blockage (FOG Related)	Level 1: Asset not located in FOG hotspot	0	5	FOG Sites (GIS)
	Level 2: Asset located in FOG hotspot	1		- Location of hotspots
Liquefaction	Level 1: Asset located in area with non-liquefiable soil types	0	5	Liquefaction Mapping (GIS)
	Level 2: Asset located in area with historically liquefiable soil types	1		
Slope Failure	Level 1: Asset located in area with slope less than 15 percent	0	5	Soils Mapping (GIS)
	Level 2: Asset located in area with slope between 15 and 30 percent	1		- Soil type contains ground slope
	Level 3: Asset located in area with slope greater than 30 percent	2		
Flooding	Level 1: Asset not located within the 100-year flood plain	0	15	FEMA 100-year Flood Plain (GIS)

FAILURE CONDITION	RANKING DEFINITION	RANKING VALUE	WEIGHT %	DATA SOURCE
	Level 2: Asset located within the 100-year flood plain	2		
Soil Erosion	Level 1: Asset located in soil with k factor less than or equal to 0.17	0	5	Soils Mapping (GIS)
	Level 2: Asset located in soil with k factor between 0.17 and 0.32	1		- Kf factor
	Level 3: Asset located in soil with k factor of 0.43 or greater	2		
Pipe Material	Level 1: Asset constructed of VCP, PVC or plastic materials	0	15	Pipes Layer (GIS)
	Level 2: Asset constructed of ACP material	1		- Pipe Material
	Level 3: Asset constructed of RCP or metal material	2		

Table 6-3 Risk Analysis Evaluation Criteria (Consequences)

CONSEQUENCE FACTOR	RANKING DEFINITION	RANKINGVALUE	WEIGHT %	DATA SOURCE
Repair Duration	Level A: Asset repair requires less than one working day	0	15	Pipes Layer (GIS)
	Level B: Asset repair requires between one week and two work weeks	1		- Pipe diameter
	Level C: Asset repair requires up to six weeks	2		
Repair Disruption	Level A: Asset repair is under a surface road	0	15	Roads layer (GIS)
	Level B: Asset repair is under an arterial road	1		- Road Type
	Level C: Asset repair is under a major freeway	2		
Proximity to Waterways	Level A: Asset failure/repair is more than 500 feet from a natural waterway	0	25	Sensitive Waterways Mapping (GIS)
	Level B: Asset failure/repair is between 250 and 500 feet from a natural waterway	1		
	Level C: Asset failure/repair is between 0 and 250 feet from a natural waterway	2		
Proximity to Railroads	Level A: Asset failure/repair is more than 500 feet from a railroad right-of-way	0	5	Railroad Mapping (GIS)
	Level B: Asset failure/repair is between 250 and 500 feet from a railroad right-of-way	1		
	Level C: Asset failure/repair is less than 250 feet from a railroad right-of-way	2		
Proximity to Sensitive Habitat	Level A: Asset failure/repair is within a developed or disturbed area	0	20	Vegetation Layer (GIS)
	Level B: Asset failure/repair is within an agricultural area	1		
	Level C: Asset failure/repair is within a wetlands or other sensitive habitat	2		
Potential Spill Volume	Level A: Asset failure/repair on pipeline potential spill volume of less than 100gpm	0	20	Modeling Results (GIS)

CONSEQUENCE FACTOR	RANKING DEFINITION	RANKINGVALUE	WEIGHT %	DATA SOURCE
	Level B: Asset failure/repair on pipeline potential spill volume between 100gpm and 400gpm	1		- Flow
	Level C: Asset failure/repair on pipeline potential spill volume of more than 400gpm	2		

6.2.3 Risk Factor Results

The goal of the risk analysis is to identify pipelines that exhibit a potentially "catastrophic" combination of risk characteristics. These pipelines would, by definition, have a high risk of failure and major consequences related with that failure.

Applying the weightings defined in Table 6-2, a list of the top one percent of pipelines with the highest risk factors was developed. The analysis shows that a majority of the highest risk pipelines are located in the western portion of the District, near the Michelson Water Reclamation Plant (WRP). They are concentrated in the following areas:

- Culver North Trunk Line
- Main Street Trunk Line
- MWRP North Trunk Line
- University Trunk Line
- Along OCTA Metrolink Railroad

Several analysis factors combine and compound themselves in the above areas to increase the overall facility risk, including:

- Proximity to natural waterways (particularly San Diego Creek)
- Potential spill volume (located at downstream end of system)
- Pipe material (trunks constructed of RCP and ACP)
- Repair duration (no stockpile of larger diameter pipe)
- Flooding
- Capacity limitation

With regard to risk, it is observed that the District's largest trunks are aligned along San Diego Creek, a highly sensitive waterway for its drainage into the Back Bay. Some of these trunks are constructed of RCP, a highly corrodible material. Due to the high volume of flow, the District is unable to inspect these lines or supply bypass pumping in the event of a failure.

The results reflect the factors that are most critical to the District, including proximity to sensitive habitat, volume of flow, and proximity to natural waterways. However, weightings are subjective and can be re-defined based on appropriate considerations. The tool, supplied as part of the SCSMP, will allow District staff to analyze data based on any specific criteria or set of criteria by adjusting weight factors.

6.3 SYSTEM REDUNDANCY

System redundancy is an integral part of any effective risk management program. Redundancy can be equivocated with buying insurance. Though sometimes expensive, having a permanent backup strategy can minimize the consequences of a major failure event.

For most gravity mains, an aggressive Preventive Maintenance Program and an effective Spill Response Plan can minimize both the chance and the consequences of a sewer spill event. However, similar precautions are typically not as effective on the major trunks in a given collection system. Large diameter pipelines with substantial flows present both maintenance and repair problems. These pipelines tend to be inspected less due to accessibility and consistent flow. Repair materials for these pipelines are not typically kept in stock, and can have long lead times to acquire. Many trunks also follow natural water courses, which increase the consequences of their failure.

On trunks, the operational flexibility of redundant conveyance alignments is the most reliable approach to minimizing risk and consequences of failures. An effective approach to operational flexibility is to construct parallel pipelines, along with automated diversion structures. In the event of an emergency or when maintenance is required, flow can be diverted to a parallel system until the problem or maintenance event is completed.

The over-riding consideration is how much insurance is prudent and necessary. On one extreme, each trunk sewer could be paralleled with automated diversion structures at strategic locations. The main advantage of this alternative would be complete operational flexibility for diversion of flows around a potential system failure or when maintenance is required. However, implementation of such a solution would require significant expenditures and public disruption. Failure of these primary conveyance systems would require a major event, such as an earthquake or major flooding. Construction of parallel facilities in close proximity to existing facilities would likely be negatively impacted by these same events. Paralleling each trunk, while providing significant flexibility to District operations staff, would not significantly reduce the "risk" to the District's sewer system.

Because of the potential cost and public impact of achieving complete redundancy for the District's sewer trunk system, the analyses performed focus on the high risk areas identified in Section 6.1 above. As stated previously, Plate 6-1 illustrates the combined results of the system risk analysis. The areas of highest risk are located along the major trunks in close proximity to the San Diego Creek. Further redundancy analyses are focused on the following specific areas:

- The Michelson WRP,
- The three major trunks along San Diego Creek as they enter the Michelson WRP,
- The San Diego Creek Interceptor,

- The lower portions of the Culver Trunk System,
- The lower portions of the Jeffery Trunk System, and
- The Los Alisos WRP.

Five Projects (and one alternative) were identified to mitigate the above referenced high risk concern areas. Figure 6-1 illustrates the projects identified. The following discussions provide an explanation of each project. In some cases, the alternatives can be combined to provide increasing levels of reliability and redundancy. The projects identified in the following sections concentrate on increasing system redundancy and operational flexibility in the areas discussed above.

6.3.1 SOUTH SAN DIEGO CREEK INTERCEPTOR PARALLEL (ALTERNATIVE A)

This redundancy project constructs a sewer interceptor along the south side of the Interstate 405 alignment, from Irvine Center Drive to the 51-inch influent pipeline to the Michelson WRP. Trunk sewer crossings are required at Irvine Center Drive, Sand Canyon and Jeffery to provide points along the alignment to divert flows between the two facilities.

The anticipated redundancy benefits of this project would include:

- The project allows flow to be diverted out of the San Diego Creek Interceptor in the event of an emergency or for routine maintenance.
- Flows from PA-18, PA-39, Quail Hill and Spectrum 5 (PA-34) can be conveyed in this new pipeline as the primary conveyance to the Michelson WRP, making capacity in the San Diego Creek Interceptor available for future densification in the northern and eastern portions of the District.
- The project also accommodates diversion of the Los Alisos WRP influent to the Michelson WRP, or to OCSD, in an event of an emergency or plant upset condition.
- The project provides an alternate conveyance for the El Toro Water District in the event of an upset at their treatment plant. Flows from the El Toro plant can be conveyed through the SOCWA outfall to the Los Alisos WRP, and then diverted to the Michelson WRP or to OCSD.

This redundancy project requires construction of approximately 30,000 linear feet of between 24- and 42-inch gravity main, three freeway crossings (approximately 600 feet each at a cost of approximately $1,200 per foot), and three diversion structures (approximately $600,000 each.). The total project cost is projected to be approximately $45 million.

IRVINE RANCH WATER DISTRICT

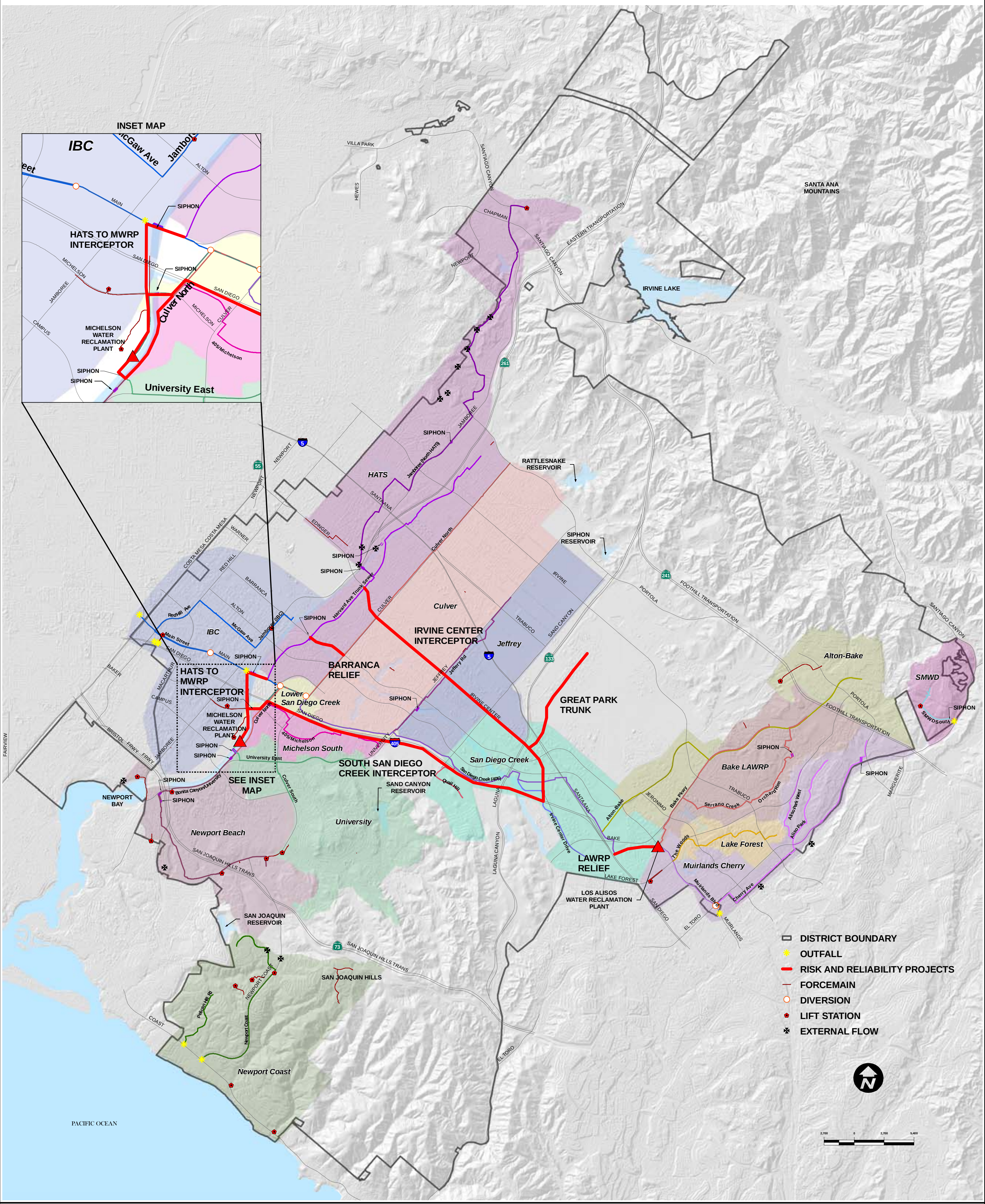


FIGURE 6 - 1 RISK AND RELIABILITY PROJECTS

DUDEK

FIGURE 6-1 RISK AND RELIABILITY PROJECTS. 06/21/2006

6.3.2 IRVINE CENTER DRIVE TRUNK (ALTERNATIVE B)

This redundancy project constructs a new sewer interceptor along the Irvine Center Drive alignment, from the San Diego Creek Interceptor at the Spectrum to the HATS trunk. Diversion structures are anticipated to be constructed at the new interceptor's intersection with the San Diego Creek Interceptor and with the Sand Canyon, Jeffery, and Culver Trunks, thereby allowing facilitating diversion of flow to and from these trunk facilities.

The anticipated redundancy benefits of this project include:

- The project facilitates the diversion of flow from the San Diego Creek Interceptor to reduce its flow levels in the event of an emergency or for routine maintenance.
- Collected flows north of Irvine Center Drive from the Sand Canyon, Jeffery, and Culver Trunks can be diverted into eh new Irvine Center Drive interceptor to relieve load on the lower portions of those facilities and/or the San Diego Creek Interceptor in the event of an emergency or for routine maintenance.
- The new interceptor is located above the identified "high risk" corridor along the San Diego Creek alignment, thereby effectively reducing flows prior to entering the high risk zone and minimizing risk of impact to the creek or other downstream sensitive habitats.
- The project also accommodates the diversion of Los Alisos WRP influent flows to the Michelson WRP or to OCSD in an event of plant shutdown.
- The project relieves capacity limitations in the San Diego Creek Interceptor for future densification in the northern and eastern portions of the District.

Construction of this project requires approximately 25,000 linear feet of between 24- and 36-inch gravity main and four major diversion structures. The total project cost is projected to be approximately $40 million.

6.3.3 LAWRP PLANT DISRUPTION

Diversion of flows from the Los Alisos WRP via the San Diego Creek Interceptor has been studied by the District previously. This redundancy alternative was considered as a part of the 2002 Los Alisos AWRP Reclaimed Water Production Potential Study, and again in the IRWD Los Alisos WRP Residuals Pumping Study in 2006. The earlier study identified significant capacity increases needed with in the San Diego Creek Interceptor system to allow diversion of Los Alisos WRP influent to the Michelson WRP. Changes in the overall development scenario within the District have modified the validity of these previous studies, particularly in light of the Great Park Development and anticipated residential redevelopment of the Irvine Industrial Complex (IIC East). Revised planning now allows for construction of a gravity and/or lift station force main system to convey flows to the South San Diego Creek Interceptor.

The approximate cost of this gravity alternative is anticipated to require an additional 2,100 linear feet of 36-inch main, pump station modifications at LAWRP and a forcemain at LAWRP, constructed at a cost of approximately $6.5 million. This project also requires construction of the SSDCI or Irvine Center Interceptor.

The following table summarizes costs for each of the identified Reliability and Redundancy Projects. Note that the South San Diego Creek Interceptor Project, the Irvine Center Interceptor, and the Barranca Relief projects are considered to be mutually exclusive project alternatives.

6.3.4 Barranca Relief Sewer

This redundancy project constructs a relief sewer along the Barranca alignment, from the Culver Trunk to the HATS. A diversion structure is required to be constructed at the intersection with the Culver Trunks, thereby allowing relief of flows from these trunks to the HATS .

The anticipated redundancy benefits of this project include:

- Flows north of Barranca in the Culver Trunks can be diverted to relieve the southern portions of these facilities in the event of an emergency or for routine maintenance.
- The project also accommodates diversion of the Los Alisos WRP to the Michelson WRP or to OCSD in an event of plant shutdown.

This project requires construction of approximately 3,500 linear feet of 36-inch gravity main and one diversion structures. The total project cost is estimated to be approximately $4.40 million.

6.3.5 Great Park Trunk

This redundancy project constructs a new sewer interceptor along the western edge of the Great Park property. Currently, a project specific sewer interceptor is anticipated along this alignment, serving the Heritage Fields development. The proposed project increases the diameter of this proposed facility within the Great Park and Irvine Spectrum areas, extending as necessary into PA-6. A diversion structures is required north of Irvine Boulevard to allow PA-6 flows to be diverted to this new facility.

The anticipated redundancy benefits of this project include:

- The project facilitates conveyance of flows from PA-6, diverted from the PA-9, and from the Jeffery Trunk system. The project reduces the flows from PA-9 into the siphon crossing the 133 Freeway in the event of an emergency or for routine maintenance. The siphon and many of the main trunks in PA-9 area were constructed with minimal slope and will likely require relief and significant maintenance attention.

- The project relieves the Jeffery Trunk for future densification in the PA-9 area.

The project requires increasing the diameter of approximately 12,500 linear feet of future pipeline from approximately 24- to 36-inch gravity main through the Great Park, upsizing of approximately 3,000 linear feet of existing gravity main through the Spectrum area to the San Diego Creek Interceptor, and extending the sewer main with approximately 1,000 linear feet of 24-inch gravity main to PA-6. The total project cost is project to be approximately $12.4 million.

6.3.6 MWRP Area (HATS Diversion Structure and Gravity Main)

The project includes construction of a large gravity main parallel to San Diego Creek, from approximately Main Street to the Michelson WRP. The alignment uses an existing sludge pipeline easement in the same location. The sludge pipeline is scheduled to be relocated, thereby allowing Michelson WRP sludge to be pumped to OCSD via the existing lift station at Park Place. In addition, it is anticipated that that the MPS-3 lift station and the new sludge pipeline would be sized with sufficient capacity (if necessary) to convey the total flow from the South Trunk (University force main) and Michelson Trunk as well.

This project provides the District with the following redundancy benefits:

- This project provides parallel capacity for both the 51-inch San Diego Creek interceptor and the 24-inch Culver Trunk, from the San Leandro Diversion Structure to the Michelson WRP. These pipelines convey flows from the northern part of the District to the Michelson WRP.
- The same project is currently being analyzed as an alternative to conveying flow from the HATS area to the Michelson WRP, as part of the HATS Diversion Project, and would eliminate the need for a permanent lift station.
- In the emergency event that influent to the Michelson WRP had to be diverted to OCSD, the new sludge pipeline and MPS-3 could be upsized to have sufficient capacity to convey flows from the southern parts of the District to OCSD.
- The alternative allows additional flows, diverted to the HATS area, to be conveyed to the Michelson WRP, but only in the event that the Irvine Center Drive Trunk is also constructed as described in Section 6.3.3 below.

This redundancy project would require the construction of approximately 8,300 linear feet of 60-inch gravity main, at an estimated cost of approximately $18 million. The predicted 2025 peak flow from the South San Diego Creek Siphon will approach 10 mgd. The pump station has a peak rated capacity of over 10 mgd, the 18” force main can effectively operate at slightly over 8 feet per second. The 27-inch gravity main would have a predicted d/D ratio of approximately 0.67.

Table 6-4 Reliability and Redundancy Projects

No.	Name	Project Cost	Comments
1a	South San Diego Creek Interceptor	$45,000,000	
1b	Irvine Center Drive Interceptor	$40,000,000	
2	LAWRP By Pass	$6,500,000	Requires either 1a or 1b
3	Barranca Relief	$4,400,000	Recommended with either 1a or 1b
4	Great Park Trunk	$12,400,000	Upsizing future line
5	HATS MWRP	$18,000,000	Can be HATS Diversion Alternative
Total Cost		**$81,300,000 – $86,300,000**	

6.4 RECOMMENDATIONS

The previous sections outline potential operational changes or capital projects that could be constructed to minimize the risk associated with the existing and future District collection system. Recommendations associated with each are outlined below.

6.4.1 OPERATIONAL RECOMMENDATIONS

The following recommendations are provided based on individual risk management characteristics for minimization of pipeline failure events and/or sewer system overflows (SSOs) and the associated consequences. It is not practical to anticipate that any recommendation can prevent any or all SSOs in the future. However, it is anticipated that risk can be reduced through effective management and maintenance of the District system. The District is recommended to implement the following operational items:

- Develop a GIS-based database of the storm sewer system of each agency, including specific plans developed for each potential spill location. Correlate that data base to the District collection system for spill containment definition purposes.

- Enter into an on-call contractor with a reputable hauling company for the purposes of disposal of spills larger than those that can be handled by District equipment.

- The District currently owns over 8,000 feet of flexible piping that can be used for by-pass pumping during emergencies. Each lift station is recommended to be equipped with proper piping to allow quick connection and disconnect between the station and appropriate receiving manhole.

Other specific operational recommendations include the following:

Pipes with High Risk Factors. These pipes, in the event of failure, would threaten the integrity of the overall system. The pipelines pose a significant health impact on the local population and, therefore, promote strong media interest and potentially widespread public concern.

One initiative could be to purchase equipment that would enable operational staff to inspect and clean trunk pipelines. If inspections lead staff to believe that the pipelines are in poor condition, they are recommended to be rehabilitated or replaced without delay. As a backup safety measure, high-flow equipment is recommended to be stored near high risk pipelines, perhaps at Michelson WRP, for use in the case of an emergency event.

Construction Damage. Construction debris in the sewer system was the most common reason for construction-related SSOs in the past 5 years at IRWD. Often, after the spill has occurred, it is difficult to identify the offending development because multiple contractors tend to work in the same area. It is recommended that the District institute a more formal process with developers in regards to containment methods and bulkhead removal. The District is recommended to monitor developer activity and establish a penalty fee schedule for contractors who do not follow set standards.

Pipeline Age. It is recommended that the District inspect pipelines greater than 40 years in age on an annual basis and replace corroded or damaged pipelines as identified. Furthermore, it is recommended that pipelines with more than five recorded failures be replaced.

Hydrogen Sulfide Release. It is recommended that the District inspect the crown of its pipes when and where ever possible. Consideration of sandblasting and coating concrete manholes where hydrogen sulfide is a potential problem is advised. In addition, Chapter 7 discusses corrosion and hydrogen sulfide in more detail and makes additional specific recommendations.

Capacity Limitation. It is recommended that the District establish a permanent flow monitoring program, and construct additional storage at lift stations for emergency use. (Specific recommendations for lift stations improvements will be made as part of the Lift Station Review Study which will be incorporated into the SCSMP when completed).

Soil Corrosion. It is recommended that the District minimize the use of corrosive pipe materials (i.e. DIP, CIP, and others), particularly in areas with corrosive soil properties. If corrosive pipe is necessary, it is recommended that the pipes be encased with non-corrosive materials or that parallel redundant pipes are constructed to allow for frequent inspection.

Blockage due to Low Velocity or Fat, Oil, and Grease. It is recommended that the District maintain its quarterly cleaning schedule on previously identifies trouble spots. Also, inspect potential trouble spots using the low velocity map from the existing system model to proactively identify new hotspots. Special attention is recommended for low velocity pipes with known or anticipated grease inceptors in their tributary areas. The database with locations of grease interceptors is recommended to be updated annually.

Pipe Material. It is suggested that the District prohibit or severely restrict future construction of ACP, RCP, or metal pipes that are more susceptible to corrosion from hydrogen sulfide in sewer systems.

Potential Spill Volume. It is recommended that the District provide more detailed operational procedures in its Spill Response Plan, correlated to various spill sizes, and the purchase equipment that is capable of mitigating larger spills. It would be suggested that the District maintain 2-hour response contracts with major pump providers to bolster spill response, and consider setting up staged storage and spill booms near high risk sites.

6.4.2 Reliability and Redundancy Recommendations

The previous discussions provide a series of redundancy projects that target methods of increasing the District's flexibility in the event of an emergency situation. The projects focus on providing alternative flow paths for the major trunk system, whereby the District can divert flow around potential system failures in higher risk areas of the service area. In general, it is recommended that the District review the redundancy alternative, select the appropriate alternatives that complement their current operational procedures, and program the selected alternative for design and construction in the near future.

It is understood that these projects, while beneficial to protection of the environment and provision of increase operational flexibility, do not preclude the continued safe and reliable operation of the District's collection system. In fact, the District has experienced very few sanitary sewer overflow situations in the last five to ten years. Considering the extreme cost of providing redundant interceptor facilities in comparison to the relatively low cost that the District has experienced in sewer overflow situations, it is questionable whether the monetary justification exists for the expenditures to provide redundant facilities. That being said, like insurance of any sort, the cost benefit relationship is typically not realized until a catastrophic event occurs. In these situations, the District's expenditures on redundant facilities could be significantly less than fines and other clean up costs. Furthermore, it is difficult to place a cost on the public impact of significant sewer overflows.

The following recommendations are provided with regard to the identified reliability and redundancy project alternatives:

- Paralleling of the entire trunk sewer system is not recommended in that catastrophic failures will likely impact both the existing and parallel systems. A more prudent approach would be to combine the various identified alternatives in a manner that provides for alternative routing of collected flows in pipelines that are geographically separated by more than two miles.

- Begin feasibility studies on the various identified project to more fully determine the engineering and environmental constraints each project would face. The planning level reviews prepared to date are not sufficient for complete evaluation of the alternative.

- Conduct review discussions with operations staff to identify any fatal flaws in the redundancy alternative, or to clarify additional constraints that may exist. The operations staff was involved in the development of the identified alternative, but further review from their department will be vital to the overall success of the redundancy projects.

- Select alternative that allow the District the ability to divert flow not only away from a potential failed pipeline, but also to divert flows away from identified high risk areas of the service area. The selected alternative, like the Irvine Center Drive Interceptor project, that intercept and divert flow prior to high risk areas of the District can significantly increase the operational staff's ability to minimize environmental impact in the event of a system failure. Also, having the ability to divert flow into multiple trunk system, as opposed to only one system, is recommended.

References

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7.0 OPERATIONAL CRITERIA

7.1 PURPOSE

The objectives of the operational criteria chapter include:

- Review of the District's Fats Oils and Grease (FOG) program,
- Documentation of odor-related complaints and discussion of correlations with the Hydrogen Sulfide (H2S) generation modeling performed, and
- Summarization of operational issues and identification of operational recommendations to improve the reliability of the overall collection system.

7.2 FATS, OILS, AND GREASE (FOG) PROGRAM

7.2.1 BACKGROUND

Between the years 2000 to 2001, the Orange County Grand Jury conducted a sewer spill survey of the County's wastewater agencies and found that, from 1987 to 2000, there were 252 beach closure orders resulting in more than 2,000 beach closure days. Almost all of these closures were attributed to sanitary sewer overflows (SSOs). Of the 35 surveyed agencies, 29, or 83 percent, reported that grease was a major contributor to their SSOs.

Based upon these findings, the Grand Jury, in its report, "Sewage Spills Beach Closures – Trouble in Paradise," recommended that a countywide grease control ordinance be adopted. Although an ordinance was never adopted, on April 26, 2002, the California Regional Water Quality Control Board, Santa Ana Region (Region 8), adopted Order Number R8-2002-0014 which established General Waste Discharge Requirements (WDRs) for sewage collection agencies in Orange County within the Santa Ana Region. Thirty-two publicly-owned sewage collection agencies, including Irvine Ranch Water District, were named in that Order.

As part of the Order, each agency is required to develop and implement a Sewer System Management Plan (SSMP). An SSMP consists of written practices and procedures to properly manage, operate, and maintain the sewer collection system, and remain compliant with the WDR. One aspect of the SSMP is the development and implementation of an effective Fats, Oils, and Grease (FOG) Program, designed to control the amount of FOG that is discharged into the District's sewer collection system. The state-imposed deadline for the development and implementation of these FOG programs was December 30, 2004. The goal of a FOG program is to reduce or eliminate FOG-related SSOs.

7.2.2 CHARACTERIZATION STUDY

To properly assess the Irvine Ranch Water District (District's) FOG potential and thus develop an effective program to control the discharge of FOG, a FOG Characterization Study was performed in 2004. That FOG Characterization Study is comprised of various components designed to determine what effect FOG has upon the sewer collection system, where FOG generation originates, and what steps need to be incorporated to control the discharge of FOG. Grease problem areas or "hot spots" were identified and mapped, while closed circuit television (CCTV) was used to inspect hot spots and identify possible sources of FOG discharge.

Food service establishments (FSEs) were also characterized for their ability to generate and discharge FOG. The California Uniform Retail Food Service Establishments Law (CURFFL), California Health and Safety Code Section 113785, defines what constitutes an FSE. Although the potential for generating FOG is present anytime food is being prepared, studies have shown the greatest amounts and concentrations of FOG discharges come from FSEs.

There are approximately 750 FSEs within the District's jurisdiction. The District's FSE characterization involved physical inspections to identify and classify each FSEs potential to generate and discharge FOG, along with an educational outreach program on practices to reduce FOG generation. Data gathered during the FOG Characterization Study was used to develop the District's FOG Control Program.

7.2.3 FOG CONTROL PROGRAM

To be effective, the District's FOG Control Program relies on:

- Routine maintenance practices,
- Source control measures, and
- Educational outreach.

The District's sanitary collection system is cleaned approximately once each year by District crews. Should significant levels of FOG be encountered during the normal cleaning operations, the affected areas are analyzed using CCTV inspection to determine the source and cause of the FOG buildup. Should conditions warrant, the affected areas are added to the District's "hot spot" list. The District routinely uses CCTV, on an approximate six-year rotation, to visually inspect the condition of its sewer collection system and to ensure the effectiveness of its cleaning operations.

"Hot spots" (or problem areas that pose a higher than normal risk of SSOs) are cleaned and inspected on a more frequent basis. Depending upon the severity and cleaning effectiveness of a hot spot, the cleaning frequency may range from monthly to semi-annually. The Collection System Manager is responsible for hot spot cleaning, while the Administrative Analyst, who reports directly to the FOG Control Program Manager, analyzes hot spot field data to determine the most effective remediation process.

As it is clear how a portion of the collection system is added to the District's hot spot list, there are no defined procedures for removal of a portion of the collection system from the list. It is reasonable to expect that the causes of FOG-related blockages (i.e. FSEs) will occasionally move or cease operations within a given portion of the District. If a particular FSE or other offending establishment eliminates its discharges to a particular portion of the collection system, the District should be able to eliminate the Hot spot from the list to avoid unnecessarily cleaning a "hot spot" that is no longer a problem.

7.2.4 AUTHORITY

The District has established its legal authority for its FOG Control Program through its Fats, Oils and Grease Control Regulations, Section 7.11 of the District's Rules and Regulations for Water, Sewer, Recycled Water and Natural Treatment System Service. This is a comprehensive set of regulations that govern every aspect of the District's FOG Control Program. These regulations are very similar to the regulations adopted by the other wastewater agencies (cities and districts) that are under Region 8 Order Number R8-2002-0014.

Like its FOG Control Regulations, the District's FOG Control Program is very similar to the FOG Control Programs adopted by other Orange County wastewater agencies under Order Number R8-2002-0014. This approach ensures an effective program that does not create an economic disadvantage to FSEs within the District's jurisdiction when compared to FSEs located in other jurisdictions under the same Order.

7.2.5 FOG CONTROL PROGRAM COMPARISON WITH NEW WDR REGULATIONS

The new Statewide WDR promulgates specific action for wastewater agencies to implement. The following is a review of those requirements and a comparison of how the district has complied with those requirements.

The new WDR requires each Enrollee to evaluate its service area to determine whether a FOG control program is needed. If an Enrollee determines that a FOG program is not needed, the Enrollee must provide justification for why it is not needed. If FOG is found to be a problem, the Enrollee must prepare and implement a FOG source control program to reduce the amount of these substances discharged to the sanitary sewer system. This plan shall include the following as appropriate:

- An implementation plan and schedule for a public education outreach program that promotes proper disposal of FOG;

  This requirement is satisfied by Section 4.6 of the district's FOG Control Program and required BMPs listed in the individual permits.

- A plan and schedule for the disposal of FOG generated within the sanitary sewer system service area. This may include a list of acceptable disposal facilities and/or additional facilities needed to adequately dispose of FOG generated within a sanitary sewer system service area;

This requirement is satisfied by Section 4.5 of the District's FOG Control Program and in the BMPs. BMPs are required by Section 7.11.3.4 of the District's Rules and Regulations.

- The legal authority to prohibit discharges to the system and identify measures to prevent SSOs and blockages caused by FOG;

  The legal authority for the District's FOG Control Program is found in Section 7.11 of the District's Rules and Regulations for Water, Sewer, Recycled Water, and Natural Treatment System Service.

- Requirements to install grease removal devices (such as traps or interceptors), design standards for the removal devices, maintenance requirements, BMP requirements, record keeping and reporting requirements;

  This requirement is satisfied by Sections 4.3, 4.4, 4.7, 4.8, 4.9, of the District's FOG Control Program and Sections 7.11.3, 7.11.4, 7.11.6, 7.11.7 of the District's Rules and Regulations.

- Authority to inspect grease producing facilities, enforcement authorities, and whether the Enrollee has sufficient staff to inspect and enforce the FOG ordinance;

  This requirement is satisfied by Section 7.11.7.4 of the District's Rules and Regulations and included in Part IV, B of the Wastewater Discharge Permit.

- An identification of sanitary sewer system sections subject to FOG blockages and establishment of a cleaning maintenance schedule for each section; and

  The District conducted a FOG Characterization Study to determine where and to what extent FOG impacted the District.

- Development and implementation of source control measures for all sources of FOG discharged to the sanitary sewer system for each section identified above.

  This requirement is satisfied by Section 3 of the District's FOG Control Program.

7.3 ODOR CONTROL AND CORROSION PREVENTION PROGRAM

H2S in the sewer collection system has the potential for odor complaints and corrosion control issues. Odor complaints were reviewed and H2S computer modeling was completed to identify problem areas. The following discussions summarize the results of the analysis and the recommendations for program enhancement.

7.3.1 EXISTING ODOR CONTROL PROGRAM

In response to repeated odor complaints at or around several of its facilities, the District has been implementing an odor control program for approximately the last five years. Biomagic, an odor control oxidant, is added to wet wells at the following locations:

- Buck Gully Lift Station,

- Newport Coast Lift Station,
- Coyote Canyon Lift Station,
- University Lift Station, and
- Michelson Water Reclamation Plant.

Current efforts have proven to reduce sulfide levels to less than 5 ppm in most control areas.

7.3.2 Review of Odor-Related Complaints

The District maintains a database of received odor complaints throughout its service area. Received complaints are classified within the database as being either “District problems” or “customer problems.” Plate 7-1 at the back of the chapter illustrates the location of odor complaints and areas where operational staff commonly detects odor within the District. In addition, this Plate shows the results of the hydrogen sulfide generation and corrosion potential study, which is discussed in Section 7.3.3.

As stated previously, the majority of odor complaints for the District occur in the vicinity of the following features:

- Retail centers and parking lots,
- Restaurants,
- Inverted siphons, and
- San Diego creek Interceptor.

The majority of odor complaints are reported near inverted siphons. This odor complaint scenario is a common occurrence. Figure 7-1, below, shows a typical sewer siphon. This Figure shows a 27-inch diameter open channel flow gravity sewer approaching the sewer siphon inlet box on the right-hand side of the figure. The space between the water surface in the approach or exit sewer and the top of the pipe (crown) is defined herein as “headspace” or “headspace air.”

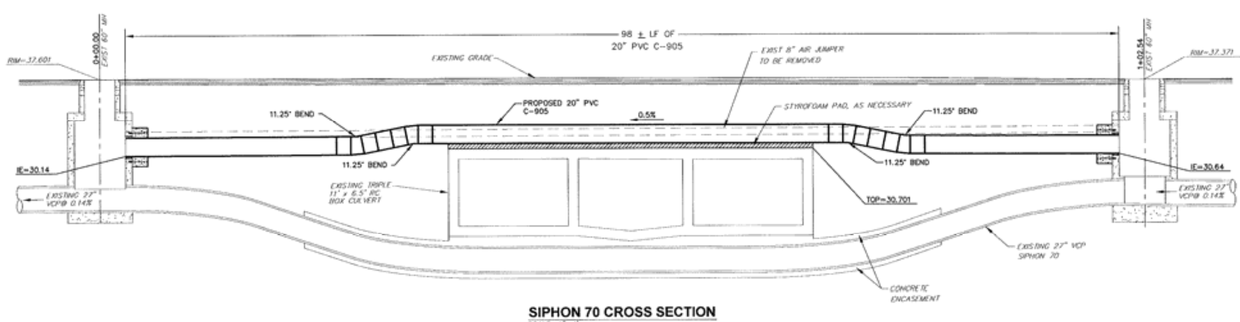

Figure 7-1
Typical Sewer Siphon

As is typical for sewer siphons, a “depressed sewer”, “inverted siphon”, or “siphon”, equal in diameter, or slightly smaller, to the inlet sewer, is then routed down and under the intervening obstacle, which is a triple box culvert storm drain in this case. The siphon then rises to the siphon outlet box at the left-hand side of the figure. The siphon runs full between the siphon inlet and outlet boxes and returns to open channel flow as it continues downstream from the siphon outlet structure.

The headspace air at the siphon has hydrogen sulfide concentrations that can be quite odorous. The headspace air typically flows downstream in the same direction as the wastewater, until it reaches a headspace obstruction, such as siphon. Headspace air cannot pass through a siphon because the hydraulic grade line is higher than the siphon pipe causing the siphon to flow full and thereby not allowing the passage of the headspace air.

As a result of the headspace blockage, the upstream sewer headspace air will pressurize sufficiently to cause an upstream release of odorous headspace air through the path of least resistance. Odorous air outlets may include pick holes in manhole covers, plumbing vents in houses and businesses, and compromised sewer joints. It is this discharge of odorous air to which the public objects. Provision of air jumpers at inverted siphon locations is recommended to prevent unwanted release of odorous air to the environment.

7.3.3 Assessment of Sulfide Conditions in the IRWD System

Within the District’s collection system, a pipeline’s potential for sulfide generation and sulfide release to the air stream was estimated based on hydraulic analysis methods. Although an actual corrosion rate was not calculated, areas within the IRWD collection system subject to potential corrosion problems were identified based on upstream sulfide generation characteristics and local turbulence conditions.

7.3.3.1 Z-Factor Analysis

Using the Pomeroy Z-Factor equation, sulfide generation was calculated for the pipes as follows:

$$Z = \frac{BOD * 1.07^{(T-20)}}{Q^{0.67} * S^{0.5}} * P/b$$

Where;	Z	=	Dimensionless quantity, representing sulfide build-up potential
	BOD	=	Biochemical oxygen demand
	T	=	Sewage temperature, degrees centigrade (C)
	S	=	Slope of pipeline, feet per feet (ft/ft)
	Q	=	Sewage flow, cubic feet per second (cfs)
	P/b	=	Ratio of wetted perimeter to surface width of the stream, ft/ft

For pipelines greater than or equal to ten inches in diameter, the existing dry weather flow from the hydraulic model was used in the Z-factor calculation. For 8-inch and smaller pipelines, the Z-factor was calculated based on the assumption that pipes were flowing half-full. Plate 7-2 shows pipelines in red which have a Z-factor greater than 10,000. According to Pomeroy's theory, these are the pipelines with the greatest potential for sulfide generation. Red coded pipelines, located at the upstream ends of the system, were disregarded because the wastewater is very "fresh" at this point, which reduces its likelihood of sulfide generation. Force mains, inverted siphons and surcharged sewers were also indicated in the figure, as these components of the system have a high probability of sulfide generation.

In the event that the sulfide concentration increases in the wastewater stream, areas of high turbulence can cause release of the hydrogen sulfide into the air space. Therefore, analysis of the system focused on areas of high turbulence as critical spots for hydrogen sulfide release. The following hydraulic characteristics were considered to be indicators of increased turbulence:

- Manholes with drops between upstream and downstream invert elevation of 3 feet or more,
- Manholes with differences in upstream and downstream modeled velocity of 5 fps or more, and
- Pipes with computed daily hydraulic jump conditions (i.e. modeled flow changes from subcritical to supercritical throughout the day).

7.3.3.2 Results of Z-Factor Analysis

As indicated in Plate 7-2 at the back of the chapter, there are several areas within the District's collection system which exhibit sulfide-releasing characteristics and are located downstream of major sulfide-generating facilities. Table 7-1 provides detail relative to the numbered areas shown on the figure.

Table 7-1 Potential High Risk Sulfide Generation and Release Areas

Map ID	Trunk Line	Street	City	Pipe Material	Sulfide-Generating Condition	Sulfide-Releasing Condition
1	University/Bonita Canyon and MWRP South	Between MWRP and intersection of University Dr and Campus Dr	Irvine	ACP and VCP	University LS force main, Siphons	Change in velocity, Siphons, 90 Degree bends
2	MWRP North	Michelson Dr and Riparian VW	Irvine	RCP	Siphon, Wastewater age	90 Degree bend
3	Main Street	West of Main St and Veneto	Irvine	RCP	Siphon, Wastewater age	Manhole drop
4a	Main Street	Main St and Jamboree Rd	IBC	RCP	High Z factors, siphon	Change in velocity
4b	Main Street	Main St and Cartwright Rd	IBC	RCP	High Z factors	Change in velocity
4c	Main Street	Main St and Von Karman Ave	IBC	RCP	High Z factors	Change in velocity

Map ID	Trunk Line	Street	City	Pipe Material	Sulfide-Generating Condition	Sulfide-Releasing Condition
4d	Main Street	Main St and MacArthur Blvd	IBC	RCP	High Z factors	Manhole drop
4e	Main Street	Main St and Sky Pk S	IBC	RCP	High Z factors	Change in velocity
5	Red Hill	Redhill Ave between McGaw Ave and Main St	IBC	RCP	High Z factors	Manhole drop
6	University/Bonita Canyon	University Dr between Jamboree Rd and SR-73 exit 14C	Newport Beach	VCP and PVC	Bayview LS force main	Change in velocity
7	University/Bonita Canyon	Mesa VW and Bonita Canyon Dr	Newport Beach	VCP	Coyote Canyon LS force main	Change in velocity
8	Newport Coast	Newport Coast Dr, about 1300' north of Pelican Hill Rd	Newport Beach	VCP	Newport Coast Dr LS force main	Change in velocity
9	Newport Coast	Newport Coast Dr, about 600' northeast of East Coast Hwy	Newport Beach	VCP	High Z factors	Change in velocity
10	Irvine Center Drive	West of Irvine Center Dr and Pacifica	Irvine	VCP	High Z factors	Manhole drop
11	San Diego Creek (405)	I-405 and Sand Canyon Ave	Irvine	VCP	High Z factors	Manhole drop
12	Jeffrey and San Diego Creek (405)	I-405 and Jeffrey Rd	Irvine	RCP	Siphon, High Z factors	90 Degree bend
13	San Diego Creek (405), Culver North, MWRP North	San Leandro and Culver Dr	Irvine	ACP and RCP	High Z factors, Wastewater age	San Leandro Diversion Structure, 90 Degree bends
14	MWRP North, Main Street	500' south of intersection of Main St and San Mateo	Irvine	RCP	High Z factors, Wastewater age	Main Street Diversion Structure, 90 Degree bends
15	HATS	Harvard Ave between Alton Pkwy and Barranca Pkwy	Irvine	RCP	Siphon, Wastewater age	Change in velocity, Manhole drop
16	Jamboree and HATS	OCTA Metrolink RR and Harvard Ave	Irvine	RCP and VCP	Siphon, High Z factors	Major junction (change in velocity)

For these areas, concrete manholes are at risk of corrosion if their lining is not totally intact. If the sulfide-releasing areas are constructed of a corrodible material, such as RCP or ACP, the pipe and joints could also be at risk. System maintenance personnel are recommended to approach these areas with caution because of their risk for having high sulfide concentrations.

The most critical area in the District relative to corrosion is the IBC area. Approximately half of the pipelines in the IBC area have Z-factors greater than 10,000. In addition, the main trunk in the IBC area, the Main Street Trunk, is constructed of RCP material. Another trunk in the IBC area, the Red Hill Trunk, is also constructed of RCP material. Both trunks look to exhibit reaches of increased turbulence.

Another area with potential corrosion problems is located upstream of the MWRP, along the MWRP North, MWRP South, and Culver Trunks. At this point in the system, wastewater must pass through two diversion structures, at least two inverted siphons and a number of 90 degree bends to get to the MWRP. In addition, the wastewater is very mature, and thus very likely to be releasing sulfides into the air space. A majority of the pipes in this area are made of RCP, ACP, or other metal material.

Other areas of concern include pipelines downstream of lift stations (force mains), namely the University Lift Station, Bayview Lift Station, Coyote Canyon Lift Station, Newport Coast Lift Station, and Portola Hills Lift Station.

7.3.3.3 Correlation with Field Observations

Although the District does not have a permanent corrosion control program, it does have an aggressive odor control program, as described above. Typically, odor is directly attributed to the release of sulfides into the air, which is also the cause of sewer corrosion. It then follows that areas which have a high number of odor complaints may also be areas of elevated corrosion potential. Whether or not corrosion occurs in the system is dependent upon the pipe material, flow depth, manhole lining condition, and other factors.

Two sources of information were used to correlate the Z-factor analysis with field observations:

- Odor complaint database from the Customer Service Department
- Field experience of operational staff

Plate 7-1 documents the information from these sources as provided. The figure supports the conclusion that there is a high corrosion potential along the:

- San Diego Creek Interceptor,
- Newport Coast Trunk,
- lower portion of the HATS Trunk, and
- in the vicinity of the Michelson WRP.

In addition, it was confirmed that the Main Street Trunk requires treatment under OCSD's corrosion control program. Based on these correlations, these areas are recommended to be the first sites to receive odor and corrosion control measures.

Many odor complaints are near inverted siphons. However, this finding does not necessarily indicate that hydrogen sulfide is being generated at siphons. As discussed previously, odor problems occur at siphons because air is unable to follow the wastewater and is forced out of manholes. Therefore, siphon-related complaints were not considered in the corrosion potential analysis.

7.4 OPERATIONAL OBSERVATIONS

Interviews were conducted with the District Collections System staff to identify areas of known operational deficiencies. Capacity related issues are summarized and have been evaluated in Chapter 4, Existing System Analysis. The following discussions provide a summary of the interviews organized by area. A complete set of meeting minutes are included in the appendix to this Master Plan.

7.4.1 IBC Operations Notes from OCSD/IBC Interviews

- At the Loop north of Barranca, gravel is often found in the pipeline.
- Both siphons crossing Barranca Channel require frequent maintenance.
- The 15-inch pipeline between Alton and Barranca regularly accumulates debris.
- The flume at the Barranca siphon requires frequent cleaning.
- High grease locations are found along many areas throughout the IBC. These are primarily along Douglas and Von Karman south of I-5 and along Main Street between the Barranca Channel and Von Karman.

7.4.2 Notes from IRWD Operations and Engineering Interview

- In the Los Alisos Area, surcharging has been observed in the El Toro Trunk (see previous report). External flows are picked up at Cherry and 2nd, along with 0.9 MGD from English Canyon Flow. There is a shared trunk in El Toro "Pan Handle."
- Odors have been reported at Loft Station 9.
- There has been corrosion of the concrete-lined forcemains in these same areas.
- Irvine Industrial area (central zone) has had problems due to poultry businesses and correctional facility. Sediment problems, although not in District facilities.
- I&I is a problem. Low lying manholes should be noted and addressed to minimize I&I.

7.4.3 Los Alisos Operational Notes

- The parallel pipelines in Bake have known capacity concerns.
- The siphons located in the easement southeast of Prism Place near Linear Lane are occasional problems.
- The siphon in Bake Crossing Serrano Creek U/S of Toledo collects grease and debris. Requires regular flushing.
- The "Woods" area, easement south of Apache Drive/Shoshone, has access problems. Manhole cover is also a problem near the elementary school site. District found a 12-inch rock in pipeline near Valley Rim Road.
- The "Woods" area along Fallen Leaf, Dove Tree, etc., contains eucalyptus groves, lots of roots, and must be cleaned on a 6-month cycle. Foam for roots unknown efficacy. Continue in "Woods" area.

- The pipeline in easement located east of Yellowstone Lane in Toledo Way, turns southeast and joins another pipeline, is very flat and creates occasional problems.
- The 90-degree bend at Jutewood Place to El Gato Way regularly exhibits grease build-up.
- There is a potential sag in the pipeline from Overlake Drive east to Ridge Route Drive.
- The pipeline in Starbuck Road to Easement to Canada L.S is very deep and has possible sags.

The primary purpose of providing this information is to document the known operational challenges of District staff, and provide a single source list of known issues. Ongoing operations relative to these areas have proven to be successful in controlling problems. Future operational procedural reviews are recommended to include continued review and maintenance of these areas. Future design projects are recommended to evaluate potential resolution to these operational challenges. As recommendations of this report are implemented and development growth increases overall system flows, changes may occur in the severity of these maintenance concerns. Therefore, it is recommended that operations staff regularly monitor these known points of concern in the system, and add or subtract other information from the list as the conditions within the collection system change.

7.5 RECOMMENDATIONS

7.5.1 FOG PROGRAM

The District's FOG program is a relatively new program. The following recommendations are made to augment the success implementation of the program for the District:

- It is recommended that the District revise its FOG program components to reflect the latest requirements of the State's WDR. Although review of the District's FOG program shows that the overall program is actually somewhat more stringent in many areas than the recently promulgated statewide WDR. The measurement for the State will be an observed overall reduction is FOG-related SSOs. There is one component of the WDR that might be of concern to the District. That component regards an impending change to the UPC that deals with a revised terminology used to describe grease traps and grease interceptors. The following discussion is taken from recent WDR Steering Committee minutes:

  "Adoption of New Terms: Automatic grease traps will start to be called "hydro-mechanical grease interceptors" and conventional grease interceptors will be known as "gravity grease interceptors." Since both types of grease removal equipment will be called "grease interceptors," FOG Control Programs will need to work more closely with their building, plumbing, and/or planning departments to ensure that the appropriate device is installed. Agencies should review their Ordinances and program requirements relative to this issue."

The District is recommended to have its appropriate department managers, and possibly its legal counsel, review Section 7.11 of the District Rules and Regulations, once the above changes are added to the CPC to eliminate any possible conflict in terms related to grease control devices.

- It is recommended that the District consistently record and map FSEs and FOG violations. It is further recommended that when FSEs are known to close that are tributary to the hot spot, the hot spot be tested to determine if it can be removed from the hot spot list.

- Review of the FOG rules and regulations shows that the District's program has all the necessary legal authority needed for all contemplated actions. It is recommended that the District review the program authority on an annual basis to make certain that these legal authorities are maintained.

- The District's FOG program provides for cost recovery from FSE-caused SSOs, including not only remediation costs but fines, legal fee and other regulatory costs. It is recommended that the District review the program language on an annual basis to asure that the District's cost recovery rights are maintained as future regulatory and legal landscapes might change.

- It is not clear whether the District's FOG rules extend only to FSEs, whether include food storage locations, where loss of utilities may result in FOG flows to the sewer collection system, as well. It is recommended that the District's add specific language to the FOG program to include these facilities, subject to the review and approval of the District's legal counsel.

7.5.2 Hot Spots

The following recommendations are made in terms of hot spots:

- It is recommended that the District test the "hot spot" list by suspending its accelerated cleaning schedule in controlled areas and document the build up of FOG related materials. If the pipeline begins to experience FOG related problems, return it to the hot spot list. However, if the pipeline does not, it could then be removed from the list. Testing should be done on a minimum five-year cycle.

- Evaluate potential Odor Complaints and correlation to FOG FSE locations. Development of a map correlating FSE locations with known odor complaints would allow the District to track FSE existence and target those FSEs that are contributing to the overall odor control problems. Also, as the FSEs move or go out of business, the hot spot list can be updated to eliminate points that are no longer a problem. The District could promulgate a requirement for FSEs to register their location with the District and to notify the District in the event that they move or cease business. This requirement would reduce District cost in maintaining the map and data.

7.5.3 Odor Control and Corrosion Prevention

7.5.3.1 Expansion of Existing Odor Control Program

It is recommended that the District develop and implement a more comprehensive odor and corrosion control program. Though the District has an ongoing odor control program, review has indicated that expansion of the program could significantly reduce odor complaints and corrosion potential throughout the sewer system. For example, although the goal of adding Biomagic is to eliminate odor, the program may have corrosion-reducing benefits as well because the oxidant diminishes the rate of sulfide generation. It is recommended that the condition of pipelines downstream of treated lift stations be compared to pipelines downstream of untreated lift stations to determine if there is less corrosion downstream of lift stations dosed with Biomagic. If there is a correlation, the existing odor control program could be broadened to fight corrosion as well.

7.5.3.2 Air Jumpers

Air jumpers should be installed at all siphon locations. Air jumpers are recommended to be provided at inverted siphons to convey airflow within the head space of the upstream pipe across the span of the siphon to the downstream manhole. By providing an air jumper, air pressure is not built up in the upstream pipeline, potentially resulting in the release of hydrogen sulfide into the atmosphere and causing odor complaints and unsafe health risks. Air jumpers are recommended to be constructed or PVC or HDPE, sized at a minimum of one half the total area of the upstream pipeline, and sloped at a minimum of two (2) percent to convey condensation to either the upstream or downstream manhole. The air jumper is located at an elevation high enough in the manhole to prevent surcharged wastewater from entering the air jumper.

7.5.3.3 Pipeline and Manhole Inspections

It is recommended that ALL of the major trunk lines at the downstream end of the system be inspected for corrosion potential. Due to the unavailability of high-flow bypass pumping equipment, IRWD's operational staff is unable to inspect many of the pipelines suspected of being susceptible to corrosion. Inspection of high risk pipelines is paramount to verifying whether a corrosion problem exists and assessing the severity of that problem.

Manhole inspections are recommended to check for cracking or degradation of the manhole lining. If degradation exists, the integrity of the exposed concrete is recommended to be assessed. Repair of corroded sections is recommended and the lining system re-sealed to prevent further damage. This work would be conducted according to the District's current procedure for recoating manholes on smaller pipelines.

CCTV inspections of the pipelines are recommended to be conducted and reviewed, focusing on the integrity of pipe crowns and waterlines in RCP, ACP or metal pipes. Particular attention is required where highly corrodible joints of ACP pipelines exist. Where pipeline corrosion is a high potential because of pipe material, pipe lining may be a potentially cost effective method of reducing risk of failure.

7.5.3.4 New Sewer Construction

Because of the damaging effect of continued sulfide generation, especially in downstream reaches, and the difficult and costly measures required to reduce sulfide once generated, it is recommended that future sewers be constructed to design standards that minimize or eliminate potential sulfide generation. The parameters of concern include minimum slope and flow rate, pipe diameter, and pipe material.

Sewer slope, size, and flow rate are interrelated; absolute standards for these factors would be impractical and too restrictive for economical design. Therefore, it is recommended that a sulfide analysis be included with any sewer design submitted to the District for approval. The analysis could be based on the Pomeroy-Parkhurst formula, using conservative empirical coefficients to promote a degree of safety in the overall design. The coefficients of concern include M' (the effective specific sulfide flux coefficient), with minimum value of 2.5 x 10-4 meters per hours, and m (the empirical coefficient for sulfide losses, or outgassing), with a value of 0.6. Results of the sulfide analysis indicate the correct combinations of pipeline gradient, minimum flow assumed, and pipeline diameter. Correct application of the formula and use of the recommended coefficients may be checked by District staff during submission of plans and specifications for construction.

Pipelines are recommneded to be manufactured of an inert material capable of providing a life of over 50 years when exposed to sulfide concentrations. If vitrified clay pipe is not used, then alternative materials are recommended that protected with a plastic or epoxy liner with a life expectancy equivalent to that of the VCP pipe material.

Manholes, particurlarly on trunk sewers, are recommended to be lined with an integral inert material or painted after construction with a material capable of resisting low pH corrosion. In some areas, locking manholes may be necessary to discourage illegal septage dumping and consequent negation of assumptions used in the sulfide analysis. Further, drop manholes are recommended to be equipped with an aspirator to entrain air and assist with oxygenation of downstream reaches.

Lift stations are recommended to be equipped with Biomagic or other oxidant injection systems to minimize odor production in wet wells and restrict the formation of sulfide, not only in the pump stations themselves but in downstream reaches, especially where high turbulence caused by pumping could result in outgassing.

If the parameters established during the sulfide analysis cannot be met, some method of sulfide treatment, such as Biomagic or chloring injection, is recommeded to be provided along reaches of new sewer construction. The cost of operation of dosing stations are recommended to be borne by parties responsible for pipeline construction. Total cost of these stations must include the present worth of annual O&M costs over the life the sewer.

References

Sulfide Task Group of the Water Pollution Management Committee of the Environmental Engineering Division of the ASCE, Sulfide in Wastewater Collection and Treatment Systems, ASCE, 1989.

Brown and Caldwell Consulting Engineers, City of Mesa Sewer System Sulfide Study, October 1983.

Pomeroy, R.D. Prospective Flow Conditions in the Proposed Mesa-Tempe Trunk Sewer, prepared for the Cities of Mesa and Tempe Arizona, October 1963.

Greeley and Hansen, Sulfide Control Station Location Study, City of Mesa, March 1989.

8.0 CAPITAL IMPROVEMENT PROGRAM PROJECTS

8.1 PURPOSE

- Review the basis of the capital cost estimation.
- Document the recommended improvements and associated costs for projects identified with the previous chapters of the Master Plan

8.2 BASIS OF COSTS

To plan for the financial resources required for the projects identified in this Master Plan, cost estimates were made. The Engineering News Record Construction Cost Index (ENR CCI) for Los Angeles at the time of this report, April 2006, was 8555. In the future all construction costs should be adjusted using the most current ENR CCI.

8.2.1 PIPELINE REPLACEMENT COSTS

Pipeline costs are estimated from previous planning documents and from recent bid tabulations. These conceptual costs are considered adequate for fiscal planning. The actual costs at design and construction may vary due to site specific requirements. The following table indicates the unit costs that were used as the basis of project cost estimates.

Table 8-1 – Pipeline Unit Cost Estimates

Diameter (Inches)	Construction Costs ($/LF)	Capital Costs* ($/LF)
8	120	180
12	180	270
18	270	405
24	360	540
30	450	675
36	540	810
42	630	945
48	720	1,080
54	810	1,215
60	900	1,350

Technical services, field engineering and contingencies are estimated to equal 50% of the construction costs and are segregated as follows:

Technical Services – 25%

- Preparation of environmental documentation
- Processing of approvals and permits
- Preliminary planning and design documents

- Final Design/Preparation of Plans, Specifications and Project Manuals
- Preparation of As-Builts
- Surveying

Field Engineering – 15%

- Contract Administration
- Coordination with other agencies
- Administration of geotechnical, archaeological, ROW and other outside services
- Construction Inspection

Contingencies – 10%

8.3 RECOMMENDED IMPROVEMENT PROJECTS

The recommended capital improvement program projects are divided into the following groups:

- Pipeline Capacity Projects
- Reliability and Redundancy Projects

Replacement projects typically identified by Operations Staff due to the age and condition of facilities are not included within this report as CIP projects. The projects comprising the CIP are shown in Table 8-2.

8.3.1 PIPELINE CAPACITY PROJECTS

The following projects were identified as exceeding design capacity and/or surcharging with both existing and ultimate system flows. Details of pipeline capacity projects are located in Chapter 4.

MWRP 42-inch North Influent :
The MWRP 42-inch northern influent line is currently operating at 100% capacity. It is recommended that approximately 900 feet of this pipeline be upsized to 54-inch. Also, this project is recommended to be built with the MWRP Upgrades.

Muirlands Blvd/El Toro Road:
Near the westerly boundary of the District, pipelines along Muirlands Blvd and El Toro Road are currently showing a significant number of pipelines surcharging. The majority of pipeline segments along Muirlands Blvd. are 15 inches in diameter with a current peak flow of approximately 73%. The downstream segments of 18 and 21-inch pipelines along Muirlands Blvd and continuing onto El Toro Road indicate surcharging occurring during peak flows.

Ultimate flows through this segment are expected to increase by only one-percent. Therefore existing surcharged pipelines should be upsized as required to accommodate existing flows.

Sand Canyon Ave/Barranca Ave/Laguna Canyon Road:

Existing pipelines just west of the Spectrum Corporate Park along Sand Canyon Ave and Barranca are indicating a surcharged condition within the hydraulic model under peak flows. Pipeline sizes in this region range from 10-inchs to 24-inches. Recommended pipeline upsizing includes a range of 12 to 30 inches depending on the location and flows.

University Drive:

Existing pipelines along University Drive west of Culver are 12-inchs in diameter. Based on existing system flows, the pipelines along University Drive are operating between 60% and 73% of capacity. Modeling results identified one segment surcharging, although the geometry within the model appears unusual and flows are likely consistent with adjacent pipelines. Given the current capacity limitations, this section is operating under the Low Priority for replacement. Operations stall should monitor this region and note any indications of surcharging. Given the location and operational status, funds should be reserved for replacement in the future. . Future redevelopment and increases in flow projected for the Concordia University will likely result in a surcharging condition along this stretch of University Drive. Operations staff should monitor flows along this stretch of University Drive to determine when upsizing will be required.

Dakota/Harvard Ave.

From the Colorado Park south west along Dakota Road existing pipelines are 8-inches in diameter. From Dakota south on Harvard next to the Harvard Community Athletic Park and to Edinger Avenue, the pipeline is 12-inches in diameter. Pipelines along Dakota are observing a peak flow at approximately 77% of capacity, well above the design capacity of 50%. Flows along Harvard are just above the design capacity. Flows upstream of Dakota are minimal and little to no increase in flow is expected over time. Therefore the primary project is to upsize pipelines along Dakota Avenue. Since flows within Harvard are also above design capacity, these were included as well in the recommendation, although there remains a significant volume of additional capacity in the event the District chooses to defer replacement until a later date.

W Yale Loop:

Similar to the Dakota/Harvard Project, the West Yale Loop is a smaller diameter (10-inch) pipeline experiencing existing peak flows of just over 50% of capacity. Development within the drainage basin will be minimal. Therefore although current flows exceed design capacity, the District can defer replacement and monitor this reach in the future for any significant flow changes or upstream development that may increase the priority.

8.3.2 RELIABILITY AND REDUNDANCY PROJECTS

The following are projects identified in Chapter 6 measures the District should consider adding to the Collection System Capital Improvement Program to provide both reliability and redundancy for protection from sanitary sewer overflows. See Chapter 6 for further discussion as to the benefits of each project. The projects have been divided into two categories, San Diego Creek related projects and general system redundancy projects.

SAN DIEGO CREEK REDUNDANCY

1A – SOUTH SAN DIEGO CREEK INTERCEPTOR PARALLEL

This project would build a sewer interceptor on the south side of the 405 freeway from Irvine Center Drive to the 51" influent line to MWRP. Trunk crossings would be made at Irvine Center Drive, Sand Canyon and Jeffery to allow flow from the San Diego Creek to be diverted to the new parallel.

1B – IRVINE CENTER DRIVE TRUNK

This project would build a sewer interceptor in Irvine Center Drive from the San Diego Creek Interceptor in the Spectrum to HATS. Diversion structures would be built at the San Diego Creek Interceptor, Sand Canyon, Jeffery, and Culver Trunks to allow flows from these trunks to be diverted.

2 – LAWRP RELIEF

This project requires the construction of either project 1A or 1B. Previously the diversion of flows from the Los Alisos Water Reclamation Plant into the San Diego Creek Interceptor have been studied. This option was considered as a part of the 2002 TetraTech LAWRP Reclaimed Water Production Potential Study and again in the IRWD LAWRP Residuals Pumping Study 2006 by HDR. The earlier study identified significant capacity increases needed in the San Diego Creek Interceptor due to diverting all of the flow from LAWRP to MWRP. Changes in the total development picture have changed. Especially with the Great Park Development for the ET MCAS area and anticipated residential redevelopment of the Irvine Industrial Complex (IIC East). Proper planning would allow for the construction of a gravity and/or lift station force main system to convey flows to the South San Diego Creek Interceptor.

3 – BARRANCA RELIEF SEWER

This project is recommended to be built with either project 1A or 1B and would build a relief sewer in Barranca from the Culver Trunk to the HATS. A diversion structure would be built at the Culver Trunks to allow flows from these trunks to be diverted to HATS .

GENERAL SYSTEM REDUNDANCY PROJECTS

4 – MWRP AREA (HATS DIVERSION STRUCTURE AND GRAVITY MAIN)

This project would include building a large gravity main along side of the San Diego Creek from Main Street to MWRP. This alignment would utilize the existing sludge line easement in the same location. The sludge line would be removed and relocated to allow the MWRP sludge to be pumped to the OCSD via the existing lift station in Park Place. In addition, it is recommended that the MPS-3 lift station and the new sludge line be sized with sufficient capacity (if necessary) to pump all of the flows from the South Trunk (University force main) and Michelson Trunk.

5 – GREAT PARK TRUNK

This project would build a sewer interceptor in on the west side of the Great Park. Currently a sewer interceptor is anticipated in this location to serve the Heritage Fields development. This interceptor would be upsized through the Great Park and through the Irvine Spectrum and extended as necessary into PA-6. A diversion structures would be built north of Irvine boulevard to allow PA-6 flows to be diverted to this trunk.

8.3.3 LIFT STATION IMPROVEMENTS

A separate Lift Station Reliability and Redundancy report will be prepared and included as an attachment to the Master Plan that identifies related projects.

8.4 CAPITAL IMPROVEMENT PROGRAM COSTS

Table 8-2 summarizes the opinion of probable project costs for the recommended sewer pipeline improvements and redundancy projects. All costs are stated in current dollars.

Table 8-2 – Recommended Capital Improvement Program Projects

Project No.	Name	Description	Size	Quantity	Total Project Cost
PIPELINE CAPACITY PROJECTS					
	Muirlands Blvd/El Toro Rd	Upsize existing sewer line along Muirlands Blvd and El Toro Rd between Ferngreen Ln and El Toro Rd due to capacity limitations.	21-in 24-in	8,500 ft	$8,500,000
	MWRP North Influent	Upsize existing sewer line to 54" Riparian View.	54-in	900 ft	1,500,000
	Sand Canyon Ave/Barranca Ave/Laguna Canyon Rd	Upsize existing sewer line to 18" along Laguna Canyon Rd and Barranca Pkwy and to 24" along Sand Canyon Ave till San Diego Frwy due to capacity limitations.	18-in 24-in 30-in	6,000 ft	4,100,000
	University Dr	Upsize existing sewer line along University Dr between Culver Dr and Ridgeline Dr due to capacity limitations.	18-in	7,300 ft	7,000,000
	Dakota/Harvard Ave	Upsize existing sewer line along Dokota and Harvard Ave between Colorado and Octa Metrolink RR due to capacity limitations.	12-in 18-in	4,100 ft	3,100,000
	West Yale Loop	Upsize existing sewer line along Main St and W Yale Lp between Culver Dr and Blue Lake S due to capacity limitations.	10-in	1,300 ft	850,000
			Subtotal		**$25,050,000**
SAN DIEGO CREEK REDUNDANCY PROJECTS					
1a	South San Diego Creek Interceptor	Build a sewer interceptor on the south side of the 405 freeway from Irvine Center Drive to the 51" influent line to MWRP. Trunk crossings would be made at Irvine Center Drive, Sand Canyon and Jeffery to allow flow from the San Diego Creek to be diverted to the new parallel.	24-in - 42-in	30,000 ft	$45,000,000
1b	Irvine Center Int.	Build a sewer interceptor in Irvine Center Drive from the San Diego Creek Interceptor in the Spectrum to HATS. It would allow flow in the San Diego Creek Interceptor to be reduced to a manageable level in the event of an emergency or for routine maintenance. It would also accommodate the diverting of LAWRP to MWRP or OCSD in an event of plant shutdown.	24-in - 36-in	25,000 ft	40,000,000

SAN DIEGO CREEK REDUNDANCY PROJECTS (cont.)					
2	LAWRP By Pass	Diversion of flows from the Los Alisos Water Reclamation Plant into the San Diego Creek Interceptor.	36-in	2,100 ft	$6,500,000
3	Barranca Relief	Build a relief sewer in Barranca from the Culver Trunk to the HATS. Flows north of Barranca from the Culver Trunk could be diverted to reduce flows in the southern portions of these Culver in the of an emergency or for routine maintenance. It would also accommodate the diverting of LAWRP to MWRP or OCSD in an event of plant shutdown.	36-in	3,500 ft	4,400,000
			Subtotal	**$50.9 to $55.9 million**	
GENERAL REDUNDANCY PROJECTS					
4	Great Park Trunk	Build a sewer interceptor on the west side of the Great Park. It would allow most of the flows from PA-6 diverted from the PA-9 and Jeffery Trunk. This would reduce the flows in PA-9 and the siphon crossing the 133 Freeway in PA-9C in the event of an emergency or for routine maintenance.	24-in - 36-in	12,500 ft	$12,400,000
5	HATS MWRP	This project would give parallel capacity for both the 51" San Diego Creek interceptor and 24" Culver Trunk from the San Leandro Diversion Structure to MWRP.	60-in	8,300 ft	18,000,000
			Subtotal		**$30.4 million**
			Total	**$106.4 to $111.4 million**	

APPENDIX J2

Example Sub Area Master Plan

SUB AREA MASTER PLAN
PLANNING AREA 40 Project Numbers 11399 and 21399

SUB AREA MASTER PLAN

PLANNING AREA 40

Project Numbers 11399 and 21399

January 2011

PREPARED BY

STANTEC CONSULTING SERVICES INC.

PREPARED FOR

IRVINE RANCH WATER DISTRICT

PLANNING AREA 40
SUB AREA MASTER PLAN

Project Numbers 11399 & 21399

Prepared for:
Irvine Ranch Water District
15600 Sand Canyon Avenue
Irvine, CA 92618

Prepared by:
Stantec Consulting, Inc.
19 Technology Drive
Irvine, CA 92618

January 2011

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1.0 EXECUTIVE SUMMARY

This Sub Area Master Plan (SAMP) is for the Planning Area 40 (PA 40) Study Area which includes the PA 40 new community development and a portion of PA 12 (existing Travel Land) in the City of Irvine. Planning Area 40 is generally located at the southeast comer of Jeffrey Road and Trabuco and is bounded by Jeffrey Road, Trabuco, the Santa Ana Freeway (1-5) and the former MCAS El Toro. The Study Area is shown in Figure 1-1.

PA 40 was originally master planned to serve as an extension of the Irvine Spectrum, a business district which incorporated the industrial uses in existence today, and allowed for a full range of office/high technology uses. New land use entitlement approved by the City of Irvine in 2008 changed the planning area to be predominantly residential and mixed use areas.

1.2 Land Use

Currently, the interim land use within PA 40 consists of irrigated agriculture. The area of PA 40 between Sand Canyon Avenue and SR 133 also contains existing maintenance and storage yard facilities for the Irvine Unified School District, OC Transit Authority (OCTA), and Caltrans. The northern portion of the PA 12 area to be studied currently consists of the existing Travel Land RV facility off of Burt Road from Sand Canyon Road.

The land uses for the PA 40 planning area consist of 559 medium density residential units, 2,481 medium-high density residential units (1,309 units east of the SR 133), 1,769 high density residential apartment and affordable housing units, a middle school and elementary school, retail commercial, commercial industrial uses, and mixed use areas. The planning information utilized in this SAMP is based on the approved VTTM 17277 information and current zoning information. Land uses are illustrated in Figure 2-1.

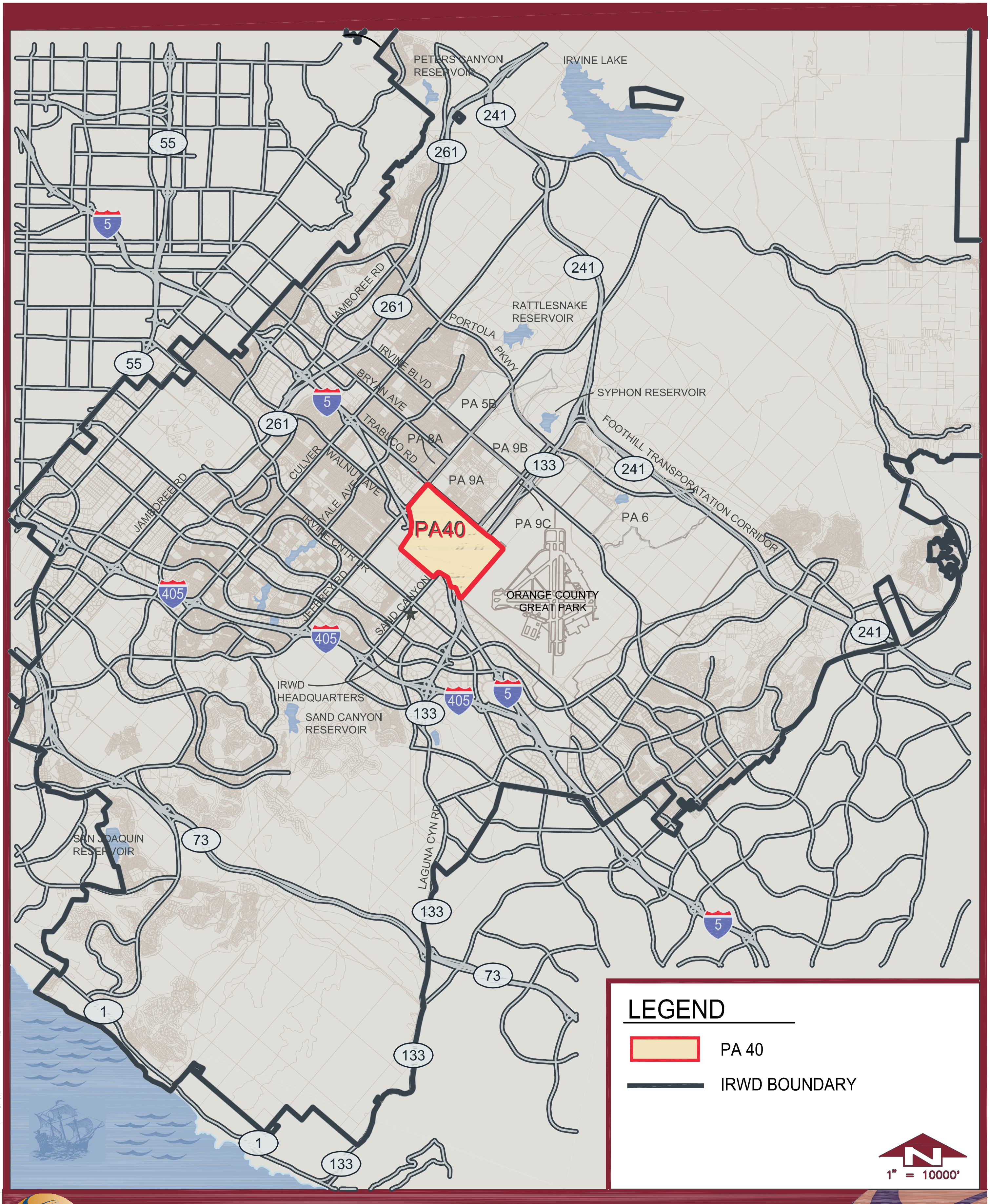
1.3 Domestic Water System Plan

The proposed land use development for the Study Area will add approximately 1,434 ac-ft per year of domestic water demand (1,364 ac-ft/yr to PA 40 and 70 ac-ft/yr to PA 12 area). PA 40 flow rates are estimated to be 846 gpm, 1,860 gpm, and 3,552 gpm for average day, maximum day, and peak hour demand conditions respectively. The PA 12 portion flow rates are estimated to be 44 gpm, 96 gpm, and 184 gpm for average day, maximum day, and peak hour demand conditions respectively.

The Study Area will be served by three (3) pressure zones; two gravity feed and one pressure reduced zone. Zones 2 (355 HGL) and 3 (470 HGL) each will be gravity fed from the Northwood Zone 2 and Zone 3 reservoirs. Zone 3R is a sub-zone that is pressure reduced from Zone 3 and will have an HGL of approximately 380 feet. Table 3-1 summarizes the various proposed pressure zones and the pad elevations to be served from these zones and sub-zones. Figure 3-2 shows the service areas within the various pressure zones.

For purposes of this SAMP, the primary source of supply for Zone 3 is assumed to be from the existing OC-72 turnout off the Allen-McCulloch Pipeline (AMP), which contains a hydraulic grade of approximately 470 feet. The secondary supply source is the Zone 1 to 3 Booster Pump Station at the Central Zone 1 reservoir. The Zone 1 to 3 BPS provides groundwater supply from the Dyer Road Well Field.

Zone 2's sources of supply will be the Northwood Zone 2 reservoir and the Irvine Blvd/Jeffrey Road (P5) pressure reducing station from the Zone 3 distribution system. A new Zone 3 to 2 PRV station is proposed to



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PLANNING AREA 40 SAMP

PREPARED FOR THE:

IRVINE RANCH WATER DISTRICT

LOCATION MAP

FIGURE 1-1

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19 Technology Drive, Irvine, CA 92618 Phone 949.923.6249 Fax 949.923.6188 www.stantec.com

be constructed along Sand Canyon Road, a few hundred feet north of Marine Way. This new PRV is to be constructed with the Sand Canyon Grade Separation project soon to begin construction.

Regional system facilities supplying the PA 40 Study Area are shown in Figure 3-3 and the onsite facilities are illustrated in Figure 3-4.

Improvements in Sand Canyon Avenue and improvements in Trabuco Road between Jeffrey Road to the SR 133 have been completed with stub-outs provided for the onsite pipelines to the PA 40 area. A Zone 3 to 2 PRV station along Sand Canyon Avenue is being constructed with the Sand Canyon Avenue Grade Separation project and assumed to be existing for purposes of this SAMP.

No additional pumping stations or storage facilities will be needed on-site within or for the SAMP Study Area boundary. One (1) on-site pressure reducing station will be required to reduce pressure from the Zone 3 to 3R system is proposed at the east end of Nightmist Road, east of Sand Canyon Avenue.

1.4 Sanitary Sewer Collection System Plan

The total Study Area wastewater flows generated are estimated to be 0.974 MGD (0.919 MGD from PA 40, and 0.055 MGD from the PA 12 portion) based on average daily dry weather flows.

As shown in Figure 4-1, the proposed wastewater flows will be collected and conveyed offsite from three main drainage areas. The first area, Area 1, includes the area between Jeffrey Road and Sand Canyon Avenue and is the largest of the areas. Area 1 wastewater flows are collected and flow into the existing 30-inch Jeffrey Road Trunk Sewer at a manhole north of the 5 freeway. Area 2 is the area between Sand Canyon Avenue and the SR 133, and includes the PA 12 portion. This area flows into the existing 12-inch sewer along Sand Canyon Avenue and along the rail road tracks to the existing 30-inch Jeffrey Road Trunk Sewer. Area 3 consists of the drainage area is east of the SR 133. The wastewater flows from this area will be conveyed by the proposed 12-inch sewer “O” Street, and proposed upsizing of existing trunk sewers, as proposed by the OC Great Park SAMP.

Peak dry weather flows from each of the three drainage areas are estimated to be 1.98 cfs for Area 1, 0.56 cfs for Area 2, and 0.89 cfs for Area 3.

1.5 Nonpotable Water System Plan

Nonpotable water uses for the area within the Study Area will require approximately 656 ac-ft per year of nonpotable water (PA 40 demands are estimated to 590 ac-ft/yr, and PA 12 portion is estimated to be 66 ac-ft/yr). Flow rates for PA 40 are estimated to be 365 gpm, 1,060 gpm, and 2,193 gpm for average day, maximum day, and peak hour demand conditions respectively. The PA 12 portion flow rates are estimated to be 41 gpm, 120 gpm, and 248 gpm for average day, maximum day, and peak hour demand conditions respectively.

The Study Area nonpotable water demands will be served by a single pressure zone, Zone B (HGL 460). Zone B is currently and will continue to be directly served by gravity flow (HGL of 460) from the Northwood Zone B Storage Tank, the Zone B Rattlesnake and 75-1 Booster Pump Station. (See Figure 5-3 of Chapter 5)

The existing Zone C to B PRV Station in Sand Canyon Avenue just north of Irvine Boulevard opens to support peak flow conditions and pressures in the Zone B area south of Irvine Boulevard. However, flows through this PRV ultimately will stress a heavily taxed Zone C system. Additionally, pumping up to from Zone A to C and then pressure reducing down to Zone B is an inefficient model of operation not desired by IRWD. Therefore, a new Zone A to B BPS, along with pipeline improvements in Sand Canyon Avenue with upgrades to the East IIC A to B BPS, is proposed along Jeffrey Road to support peak flows and alleviate peak flows through the Zone C to B PRV.

PA 40 will be developed in phases, with the first phase of development consisting of the high density residential areas west of “A” Street to Jeffrey Road. This first phase of grading operations will begin late 2010. During the interim period between the first phase and the subsequent phases, TIC Agricultural will continue operations within the remaining eastern portion of PA 40 that straddles Sand Canyon Avenue.

To accommodate the flow requirement for the interim agriculture operations including frost conditions, two proposed connections for supply from Trabuco Road will need to be 8-inch with 8-inch meters. The lateral west of Sand Canyon Avenue is already an 8-inch pipe, but the existing 6-inch meter will need to be replaced with an 8-inch meter. The other lateral east of Sand Canyon Avenue is a 4-inch diameter pipe. This lateral connection will need to be upsized to an 8-inch diameter lateral with an 8-inch meter.

A temporary A to B BPS is also proposed at the northwest corner of the intersection of Jeffrey Road and Irvine Boulevard. The pump station should have a capacity of 4,500 gpm with TDH of about 170-ft to meet the full frost demand required by TIC. This temporary A to B BPS should be converted to a permanent BPS once the PA 40 development is built out west of the SR 133 and the interim agricultural needs are no longer required.

In addition to an altitude valve at the Northwood Zone B Tank, the existing 20-inch Zone A pipeline in Jeffrey Road between Irvine Boulevard to Trabuco Road should be converted and connected to the Zone B system. The 30-inch pipeline that is now used for ILP supply to PA 40 should be connected to the Zone A system.

1.6 Natural Treatment System

To treat the dry and wet weather runoff from the proposed PA 40 development, The Irvine Company (TIC) is preparing designs for water quality basins (WQ Basins). After construction of the WQ Basins, they will be transferred to IRWD. IRWD will maintain the WQ Basins through the Natural Treatments Systems (NTS) Plan.

Currently, Geosyntec Consultants is finalizing an update to the IRWD NTS Plan called the “Evaluation of Water Quality BMPs in Portions of the City of Irvine Planning Area 40 for Consistency with Regional Treatment Program Criteria”. Basin locations and criteria are based on the information provided in this report.

PA 40 is divided into four (4) major drainage regions as illustrated in Figure 6-1of Chapter 6. There are four (4) NTS WQ Basins designed to serve the drainage regions and all are offline stormwater basins that include Type I wetlands.

1.7 Easements

IRWD will require unlimited access to their facilities for routine maintenance, operation, repair, replacements, monitoring, and other critical functions. The majority of the existing and proposed improvements in the PA 40 Study Area are within public right of way. However, there are several areas where IRWD facilities may be within parking areas, private access roads, drive ways, or even perhaps lettered lots.

This SAMP proposes easements that cover both the new water and sewer improvements as described in Chapters 3 and 4.

The proposed easements are as shown in Figure 7-1 of Chapter 7. Although not all required pipelines or easements within the individual tracts or parcels may be shown, it is understood that easements for all IRWD maintained facilities will be required in accordance with IRWD guidelines and requirements. Where a proposed easement is required over private roads or driveways for more than one property, a separate permanent easement will be necessary from each property owner. Some temporary construction easements might be required for construction of the proposed sewer improvements.

1.8 Telemetry

Telemetry is required for proper monitoring and maintenance of pumping, storage, and pressure reducing facilities. The active, or primary source, IRWD maintained facilities will be fully telemetered with permanent, metered electrical service to communications to the IRWD Operations Center and where possible be programmable logic controller (PLC) via wireless radio signals. The Design Engineer will be required to apply to the City of Irvine for electrical utility service addresses for the telemetry panels. The latest updates to the IRWD Construction Manual Standard Drawing E-Series will be the source for telemetry standards and requirements for all facilities.

The existing telemetry facilities for the study area that are currently monitored are identified in Figure 8-1. The Zone 3 to 3R PRV station (P-7) in Trabuco Road is the primary source for the proposed PA 40 service area zone and is equipped with existing telemetry. New telemetry equipment will only be required for the proposed Zone A to B BPS along Jeffrey Road north of Irvine Boulevard. There are no other pumping, pressure reducing, or storage facilities proposed by this SAMP other than the Zone 3 to 3R PRV (P-3) at the east end of Nightmist Road.

It is proposed that the A to B BPS will send telemetry signals to a data collection site via a licensed microwave band radio system. If a direct line of site is not available to the MRWP Operations Center, data collection could possibly be at Rattlesnake Complex facility, which will then relay the signals to the MWRP Operations Center via existing radio communications. If radio communications or a direct line of sight is not feasible, a secondary option would be to utilize a telemetry cable to the existing RTU 46 site at the existing PRV P005 near the intersection of Jeffrey Road and Irvine Boulevard

1.9 Phasing and Construction Schedule

The Study Area is proposed to be developed in five (5) phases. The first phase will include the development area consisting of the school site and high density apartment sites west of “A” Street. Phase 2 will be the residential, school, and parks between “A Street and Sand Canyon Avenue. Phase 3 will be the commercial area, mixed use area, and day care center located between Sand Canyon Avenue and the SR 133. The eastern portion of PA 40, east of the SR 133, will constitute Phase 4. Phase 4 would complete the build out of PA 40. The future development of the existing Travel Land site, or northern portion of PA 12, is assumed to be the last phase, Phase 5.

The proposed facilities required for each phase are illustrated in Chapter 9 in Figures 9-1, 9-2, and 9-3.

1.10 Project Costs

The engineering cost opinions in this Chapter 10 are provided for both IRWD funded Capital and developer funded projects. Table 1-1 below is provided as a summary of costs estimated for each of the domestic water, sewer collection, and nonpotable water systems. Costs subtotalled for each phase in provided in Chapter 10.

Table 1-1 Study Area Summary of Estimated Project Costs

Planning Area/Phase/System	Total Estimated Project Costs	IRWD Portion	Developer Portion
PA 40			
Domestic Water System	$ 4,968,500	$ 785,200	$ 4,183,300
Wastewater Collection System	$ 4,485,200	$ 1,909,600	$ 2,575,600
Nonpotable Water System	$ 8,467,200	$ 7,687,700	$ 779,500
Subtotal PA 40	**$ 17,920,900**	**$ 10,382,500**	**$ 7,538,400**
PA 12			
Domestic Water System	$ 819,300	$ 177,900	$ 641,400
Wastewater Collection System	359,900	-	$ 359,900
Nonpotable Water System	$ 334,400	$ 48,600	$ 285,800
Subtotal PA 12	**$ 1,513,600**	**$ 226,500**	**$ 1,287,100**
Total	**$ 19,434,500**	**$ 10,609,000**	**$ 8,825,500**

1. Total costs are rounded to the nearest hundred dollars.

2.0 LAND USE

2.1 Land Use and Current Planning

The Irvine Planning Area 40 (PA 40) Study Area includes the PA 40 new community development and a portion of PA 12 (existing Travel Land) in the City of Irvine. Planning Area 40 is generally located at the southeast comer of Jeffrey Road and Trabuco and is bounded by Jeffrey Road, Trabuco, the Santa Ana Freeway (1-5) and the former MCAS El Toro. The proposed land uses for the Study Area are illustrated in Figure 2-1.

PA 40 was originally master planned to serve as an extension of the Irvine Spectrum, a business district which incorporated the industrial uses in existence today, and allowed for a full range of office/high technology uses. New land use entitlement approved by the City of Irvine in 2008 changed the planning area to be predominantly residential and mixed use areas.

Currently, the interim land use within PA 40 consists of irrigated agriculture operated by farmers leasing land from TIC. The area of PA 40 between Sand Canyon Avenue and SR 133 also contains existing maintenance and storage yard facilities for the Irvine Unified School District, OC Transit Authority (OCTA), and Caltrans. The northern portion of the PA 12 area to be studied currently consists of the existing Travel Land RV facility off of Burt Road from Sand Canyon Road.

PA 40 is at different stages of planning and development. A middle school site is under construction at the northwest corner of the planning area at Jeffrey Road and Trabuco Road, with offsite street improvements completed for Visions Street and Roosevelt. Also, final engineering is underway for the first phase of development which encompasses the high density residential areas on the west side near the middle school site. This area is within the VTTM 17277. The area east of the SR 133 includes zoning for two scenarios of development which is discussed in detail in the section below. The PA 12 portion of the existing Travel Land site has had some level of commercial and industrial planning performed in the past, but does not have any current usable detailed planning information other than the zoning information.

2.2 Land Use Data

The land uses for the PA 40 planning area consist of residential areas varying from medium to high density apartment housing, a middle school and elementary school, retail commercial, commercial industrial uses, and mixed use areas. The planning information utilized in this SAMP is based on the approved VTTM 17277 information and current zoning information. A copy of the current zoning information used is included in the Appendix.

There are currently two scenarios for land use based on the zoning information for the area east of the SR 133 adjacent to the Great Park boundary. The first scenario, Scenario 1 assumes the current VTTM 17277 which plans for a maximum of 3500 units, leaving 418 units not used. The area east of the SR 133 is entirely mixed use with a total maximum building square footage of 1.5 million square feet. For Scenario 2, based on traffic generation equivalence, 1309 residential units maximum could be built on the easterly side of SR-133. This residential area would have a maximum density of 25 units/acre with maximum 3-story allowed. Also, the difference between Scenario 1 and 2 for total non-residential square footage is the 769,230 square feet which is converted to 1309 units. Scenario 2 is the worst case scenario as is shown in Table 2-1.

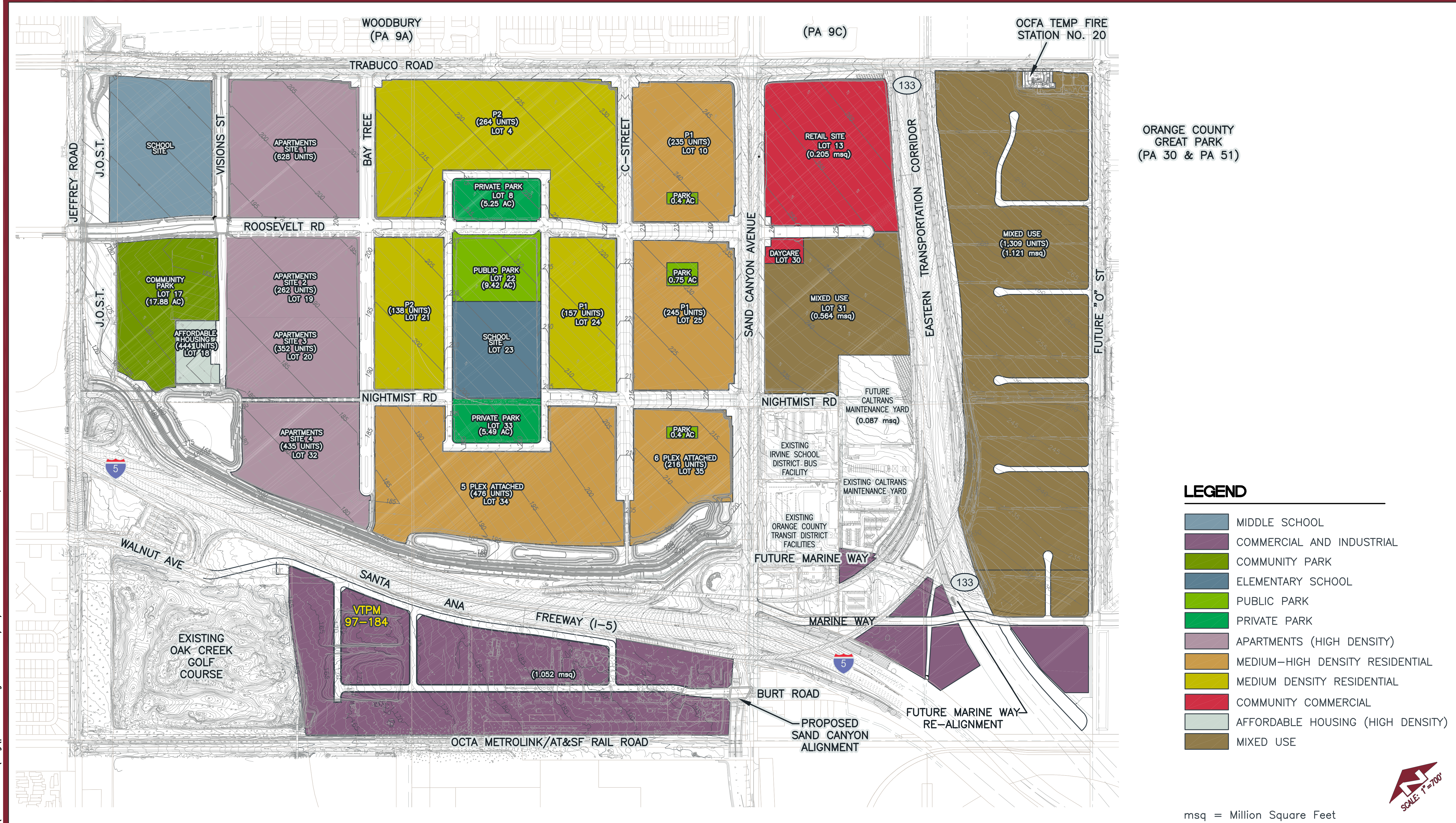
A detailed breakdown of the proposed land uses are provided in Table 2-1. The table subtotals the land uses by three main areas: PA 40 areas that are west of the SR-133; PA 40 areas east of the SR-133; and the area to be studied within the northern portion of PA 12.

Table 2-1 PA 40 Study Area Land Use Summary

Land Use	Area, acres	Dwelling Units	Square Feet
Planning Area PA 40			
West of SR 133			
Existing Maintenance Facilities (OCTD, IUSD, Caltrans)	32.0	-	372,839
Proposed Caltrans Maintenance Yard	8.0	-	87,120
Commercial/Industrial	11.0	-	215,622
Commercial Retail	26.1	-	205,000
Day Care Facility	1.3	-	133,000
Mixed Use Area	25.7	-	503,771
Community Park	37.4	-	-
School (Middle and Elementary)	30.5	-	100,000
Residential - Medium Density	68.7	559	-
Residential - Medium High Density	93.5	1,172	-
Residential - High Density	75.0	1,769	-
West of SR 133 Subtotal	**409.2**	**3,500**	**1,617,352**
East of SR 133			
Existing Fire Station	1.5	-	-
Residential - High Density	54.4	1,309	-
Commercial / Industrial	54.6	-	1,120,770
East of SR 133 Subtotal	**110.5**	**1,309**	**1,120,770**
Planning Area PA 40 Subtotal	**519.7**	**4,809**	**2,738,122**
PA 12 Portion (Travel Land and VTPM 97-184)	59.5	-	1,051,974
PA 40 Study Area Total	**579.2**	**4,809**	**3,790,096**

2.3 Proposed Development Access

Access to the PA 40 area development will be from Jeffrey Road, Trabuco Road, and Sand Canyon Avenue as shown in Figure 2-1. The area east of the SR 133 will be accessed by Trabuco Road, Marine Way, and the future “O” Street as identified in the previous Great Park SAMP. The PA 12 portion included in this SAMP will be accessed from Sand Canyon Avenue and Burt Road from the east, and a future extension of Walnut Road from the West.



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Stantec
19 Technology Drive, Irvine, CA 92618 Phone 949.923.6249 Fax 949.923.6188 www.stantec.com

PREPARED FOR THE:
IRVINE RANCH WATER DISTRICT

PLANNING AREA 40 SAMP

PROPOSED LAND USE

FIGURE 2-1

3.0 DOMESTIC WATER SYSTEM

3.1 Domestic Water System Pressure Zone Service Areas

IRWD has established criteria in their Water Resources Master Plan (WRMP) for determining domestic water pressure zone service boundaries. The WRMP guidelines require, when feasible, to adhere to the criteria as shown in Figure 3-1 and described below:

- Minimum static pressure is equal to 58 pounds per square inch (psi) based on a full reservoir.
- Maximum static pressure is equal to 100 psi, based on a full reservoir.

Therefore, in a standard pressure zone, the highest allowable service elevation is determined by subtracting 134 feet (58 psi) from the full reservoir level. The lowest allowable service level is determined by subtracting 231 feet (100 psi) from the reservoir high water level (HWL).

Pressures falling between 80 and 100 psi, based on the IRWD's established reservoir elevations, will be regulated by individual pressure regulators. Where system pressures exceed 100 psi, system pressure reducing stations (PRV) will be installed to create pressure reduced sub-zones, limiting maximum line pressures to 100 psi, where practical.

Based on these guidelines, the planning area within the Study Area will be served by three (3) pressure zones; two gravity feed and one pressure reduced zone. Zones 2 (355 HGL) and 3 (470 HGL) each will be gravity fed from the Northwood Zone 2 and Zone 3 reservoirs. Zone 3R is a sub-zone that is pressure reduced from Zone 3 and will have an HGL of approximately 380 feet. Table 3-1 summarizes the various proposed pressure zones and the pad elevations to be served from these zones and sub-zones. Figure 3-2 shows the service areas within the various pressure zones.

For purposes of this SAMP, the primary source of supply for Zone 3 is assumed to be from the existing OC-72 turnout off the Allen-McCulloch Pipeline (AMP), which contains a hydraulic grade of approximately 470 feet. The secondary supply source is the Zone 1 to 3 Booster Pump Station at the Central Zone 1 reservoir. The Zone 1 to 3 BPS provides groundwater supply from the Dyer Road Well Field.

Zone 2's sources of supply will be the Northwood Zone 2 reservoir and the Irvine Blvd/Jeffrey Road (P5) pressure reducing station from the Zone 3 distribution system. A new Zone 3 to 2 PRV station is proposed to be constructed along Sand Canyon Road, a few hundred feet north of Marine Way. This new PRV is to be constructed with the Sand Canyon Grade Separation project soon to begin construction.

Regional system facilities supplying the PA 40 Study Area are shown in Figure 3-3 and the onsite facilities are illustrated in Figure 3-4.

Table 3-1 Domestic Water System Pressure Zone Summary						
Pressure Zone/Source	PRV No.	HGL, ft	Pad Elevations Served [a], ft		Minimum Static Pressure, psi	Maximum Static Pressure[b], psi
			Upper	Lower		
Zone 2 New PRV Station (DPR 196) Existing Northwood Zone 2 Reservoir Existing PRV - P5[c] (DPR005)	1[d]	335 355 340	215	161	52 61 54	75 84 77
Zone 3 Existing AMP OC-72 Existing Zone 1 to 3 BPS Existing Northwood Zone 3 Reservoir		470	285	215	80	110
Zone 3R Existing PRV Station (DPR171) Proposed PRV Station (P-3, DPR198)	2[c] 3[d]	380 370	234	195	63 59	80 76

a) Pad elevations noted are tentative, and are within the Study Area only. Grading plans are under progress. Pads elevations will need to be updated according to the updated grading plans.
b) Lots with static pressure greater than 80 psi require individual pressure regulating valves.
c) Primary source feed PRV
d) Secondary source feed PRV

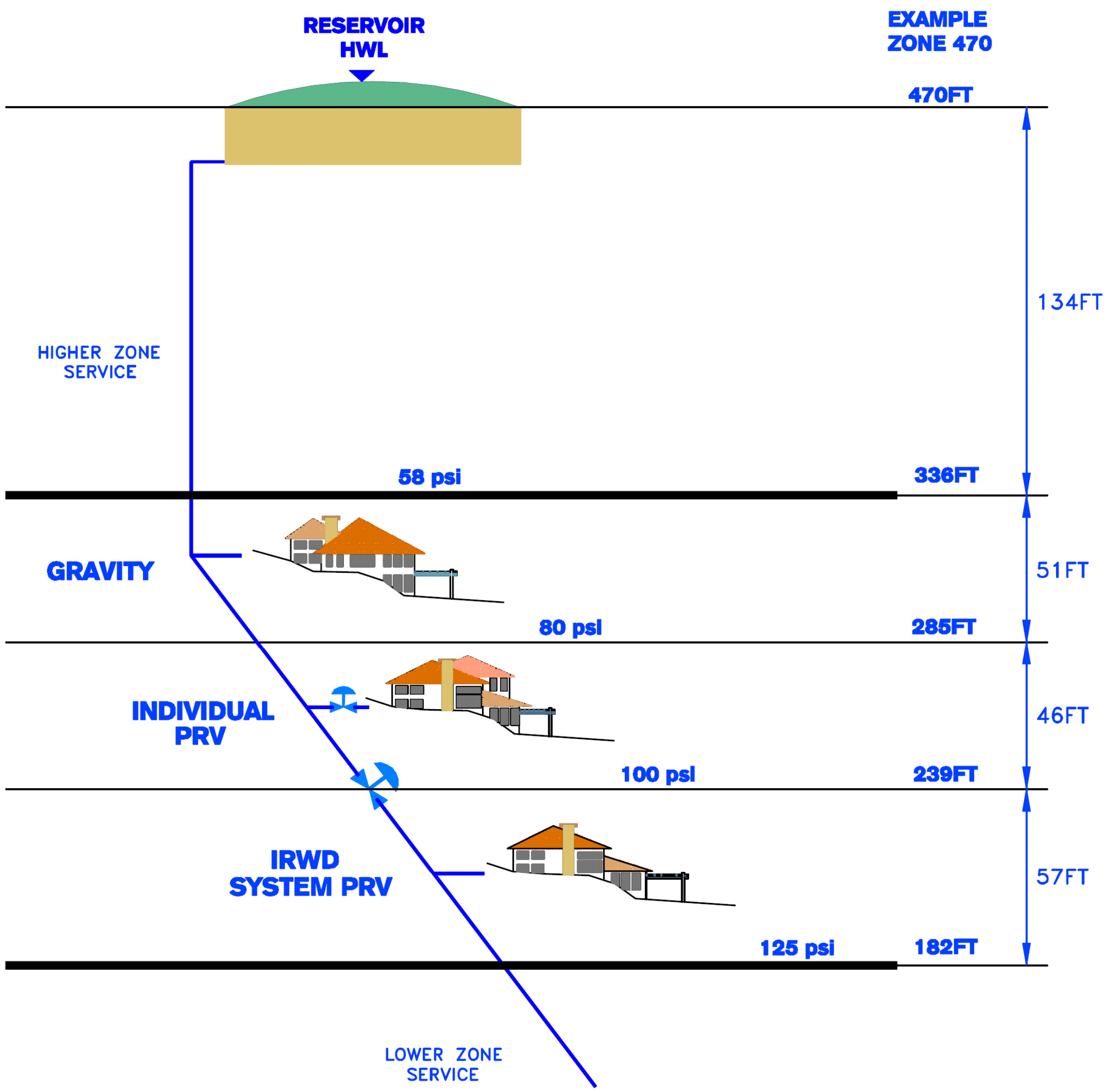
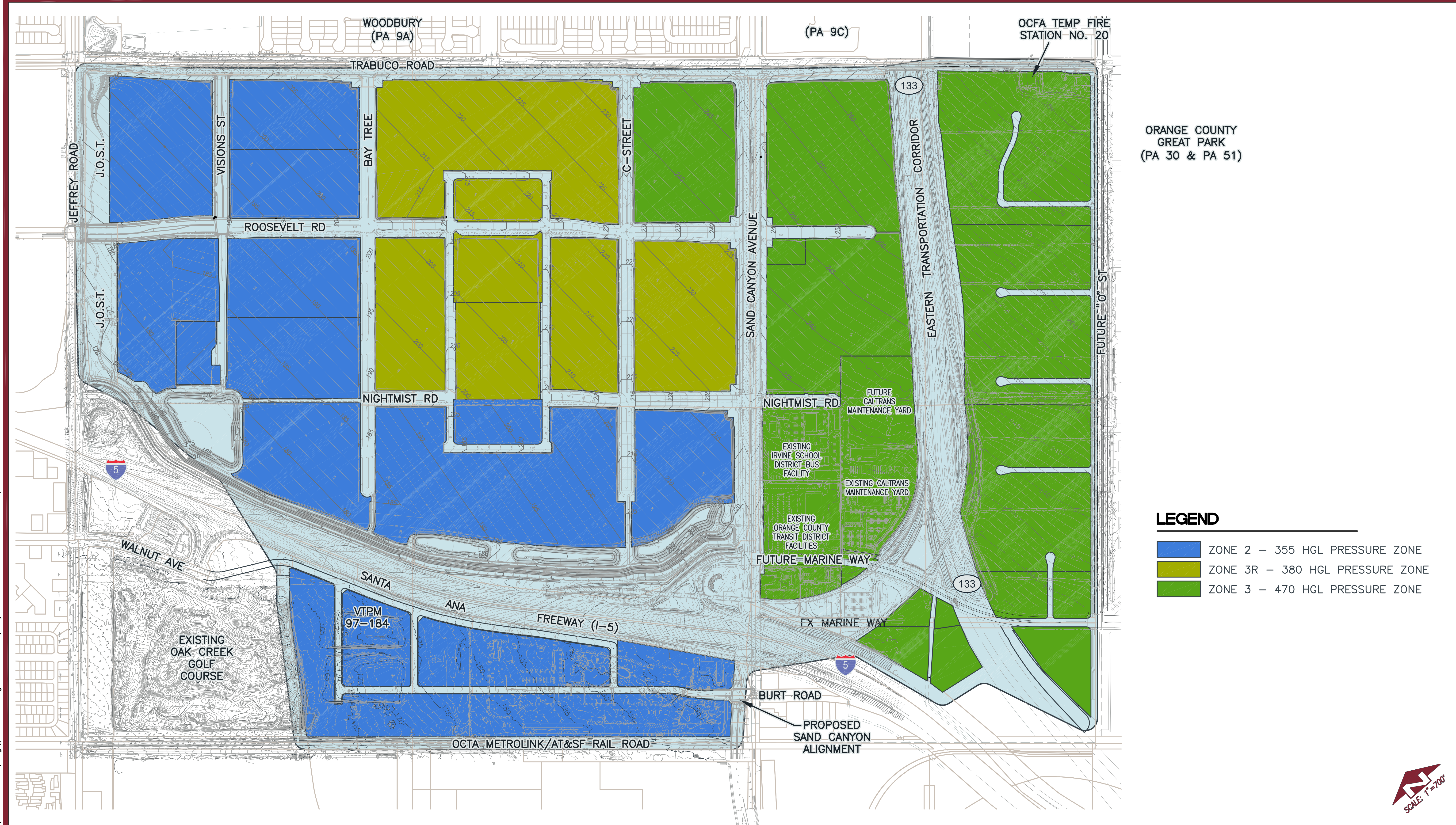


Figure 3-1 Typical Static Potable Water System Service Range



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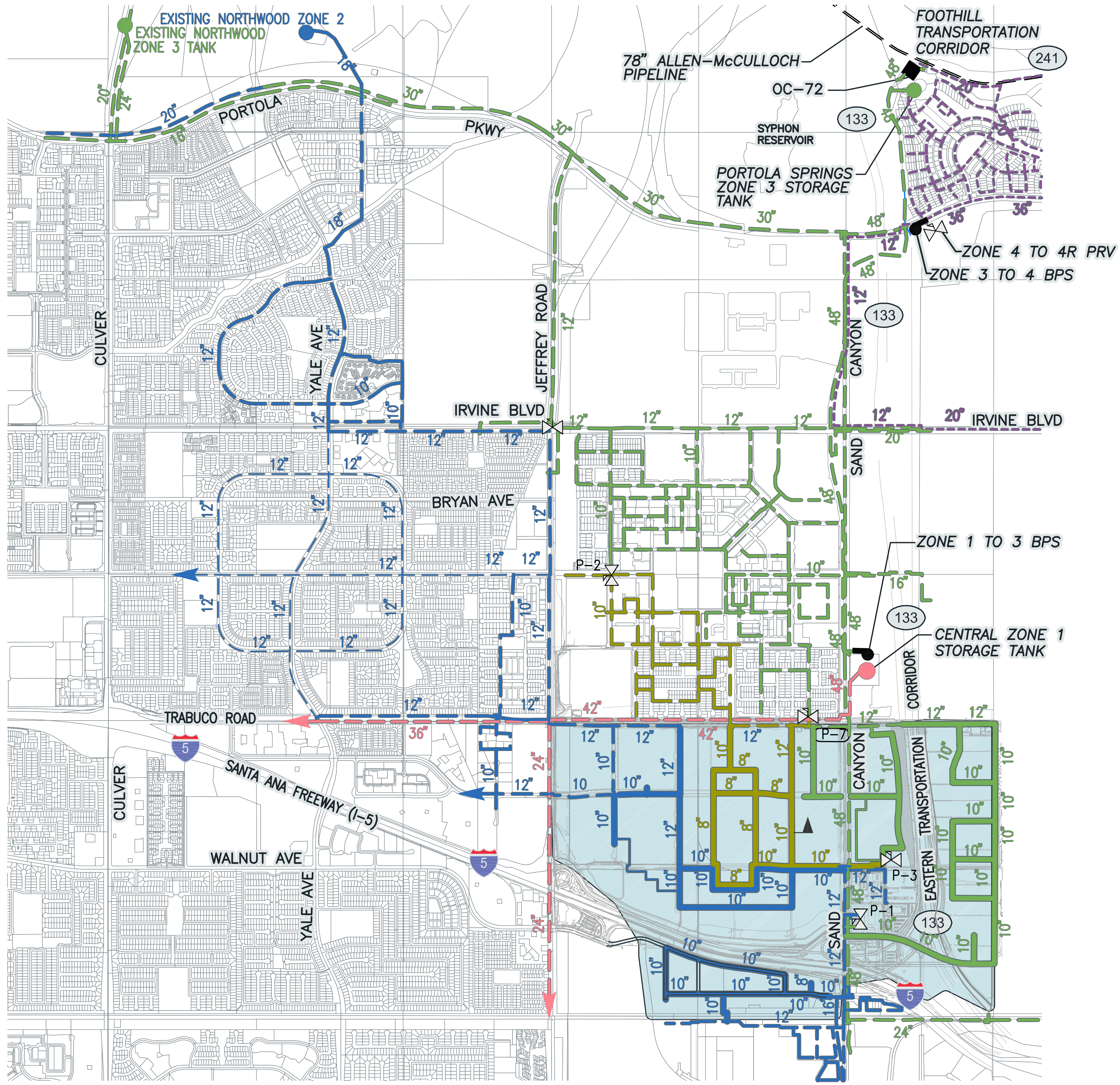
PLANNING AREA 40 SAMP

DOMESTIC WATER PRESSURE ZONES

FIGURE 3-2



LEGEND

- PROPOSED ZONE 2 (355 HGL) PIPELINES
- PROPOSED ZONE 3 (470 HGL) PIPELINES
- PROPOSED ZONE 3R (380 HGL) PIPELINES
- EXISTING ZONE 4 (640 HGL) PIPELINES
- EXISTING ZONE 1 PIPELINES
- EXISTING ZONE 2 PIPELINES
- EXISTING ZONE 3 PIPELINES
- EXISTING ZONE 3 PIPELINES
- PRESSURE REDUCING STATION
- STORAGE TANK
- BOOSTER PUMP STATION
- SAMPLING LOCATION

NOTE: ALL PIPES 8" DIAMETER, UNLESS OTHERWISE NOTED

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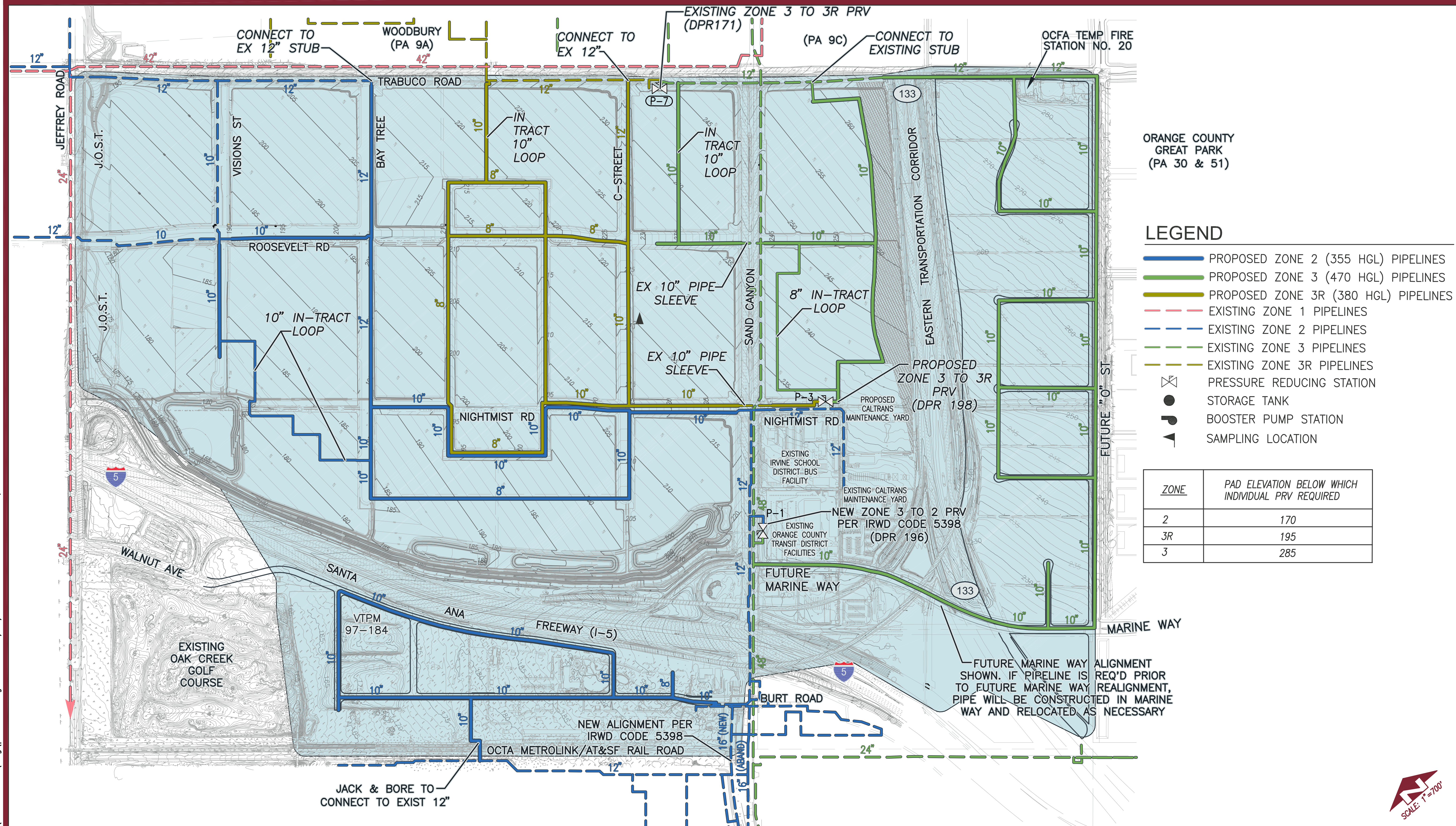
REGIONAL DOMESTIC WATER SYSTEM FACILITIES

FIGURE 3-3



ZONE	PAD ELEVATION BELOW WHICH INDIVIDUAL PRV REQUIRED
2	170
3R	195
3	285

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DOMESTIC WATER SYSTEM FACILITIES

FIGURE 3-4

3.2 Domestic Water Duty Factors

Table 3-2 reflects current and previously adopted duty factors from the WRMP. Duty factors from the WRMP were used in this SAMP for calculation of the average day demands.

Table 3-2 Domestic Duty Factors

Land Use	Average Day Demand Factor [a]
Res. Medium, gpd/du	310
Res. Medium-High, gpd/du	180
Res. High, gpd/du	200
Commercial/Industrial, gal/ksf/day	60
Commercial Retail, gal/ksf/day	220
Mixed Use, gal/ksf/day	60
School, gal/ksf/day	15
Park/Recreational[c], gal/day	2,000

a) Based on IRWD WRMP assumption of domestic supply for interior and exterior.
b) Duty factors are rounded to nearest 10.
c) Assumed local demand for parks. Nonpotable water used for irrigation purposes.

3.3 Domestic Water Peaking Factors

Table 3-3 provides a list of domestic water peaking factors for maximum day and peak hour demands as presented in the WRMP. Peaking factors developed from Figure 3-6 in the WRMP were used in this SAMP to more closely reflect the peak demands for the Study Area.

Table 3-3 Domestic Water Peaking Factor Comparison

Source	Maximum Day
WRMP Figure 3-6	2.2
District Wide	1.8
	Peak Hour
WRMP Figure 3-6	4.2
District Wide	2.5

3.4 Projected Domestic Water Demands

Domestic water demands are estimated based on the assumption that the nonpotable system is implemented to the fullest extent practical to irrigate parks, recreational areas, and common landscape areas. Domestic water will be used to serve all interior and exterior uses, including fire flows, to residential lots and structures. The average domestic demand for the PA 40 Study Area is estimated to be approximately 1.28 MGD or 889 gpm. Maximum day demands are 2.82 MGD. Table 3-4 summarizes the domestic water demands by land use within each development within PA 40. Table 3-5 provides a listing of the water demands according to pressure zone.

Table 3-4 Estimated Domestic Water Demands

Land Use	Demand (gpm) Average Day	Max Day	Peak Hour
PA 40-West of SR 133			
Existing Maintenance Facilities	16	34	65
Proposed Caltrans Maintenance Yard	4	8	15
Commercial/Industrial	9	20	38
Commercial Retail	31	69	132
Day Care Facility	20	45	85
Mixed Use Area	21	46	88
Community Park	1	3	6
School (Middle and Elementary)	1	2	4
Residential - Medium Density	120	265	505
Residential - Medium High Density	147	322	615
Residential - High Density	246	541	1,032
PA 40-West of SR 133 Subtotal	616	1,355	2,586
PA 40-East of SR 133			
Existing Fire Station	1	3	6
Residential - High Density	182	400	764
Commercial / Industrial	47	103	196
PA 40-East of Sand Canyon Subtotal	230	506	966
PA 40 Subtotal	**846**	**1,860**	**3,552**
PA 12 Portion (Travel Land and VTPM 97-184)	44	96	184
PA 40 Study Area Total	**889**	**1,957**	**3,736**

Table 3-5 Domestic Water Demands by Pressure Zone

Land Use	Demand, gpm		
	Average Day	Maximum Day	Peak Hour
Zone 2			
Existing Maintenance Facilities	16	34	65
Proposed Caltrans Maint. Yard	4	8	15
Commercial/Industrial	9	20	38
School	1	2	4
Residential – Medium High Density	92	203	387
Residential – High Density	246	541	1,032
PA 12 Portion	44	96	184
Zone 2 Subtotal	**411**	**904**	**1,726**
Zone 3R			
Community Park	1	3	6
School	1	2	3
Residential – Medium Density	120	265	505
Residential – Medium-High Density	54	118	226
Zone 3R Subtotal	**176**	**388**	**740**
Zone 3			
Commercial Retail	31	69	132
Commercial/Industrial	47	103	196
Day Care Facility	20	45	85
Existing Fire Station	1	3	6
Mixed Use Area	21	46	88
Residential – High Density	182	400	764
Zone 3 Subtotal	**303**	**666**	**1,271**
PA 40 Study Area Total	**889**	**1,957**	**3,736**

3.5 Domestic Water System Evaluation Criteria and Assumptions

Pipelines were initially sized to maintain velocities below eight (8) feet per second (fps) during peak hour demands. Pipe diameters were increased as necessary to maintain a minimum 20 psi residual pressure during fire flow conditions.

Fire flow criteria are based on the IRWD's WRMP and other recent information for the proposed fire flow requirements. The community facilities and multi-family housing areas are assumed to incorporate fire sprinkler systems, and would thus require a fire flow no greater than 3,000 gpm as required for multi-family uses. The required minimum residual pressure pursuant to IRWD design criteria is 20 psi. Larger homes may also require sprinkler systems to meet City of Irvine Standards. This could impact the meter and service size required. The Orange County Fire Authority and the City of Irvine should be contacted prior to making any adjustments to the criteria in Table 3-6. Actual fire flow requirements are determined upon final tract approval. Detailed information regarding building areas and types of construction is required to provide a more exact estimate of the required fire flows.

Table 3-6 Fire Flow Criteria

Land Use	Fire Flow Criteria	Duration, hours
Low Density Residential	1,500 gpm	2
Medium Density Residential	2,500 gpm	2
Medium-High/High Density Residential	3,000 gpm	4
School	3,000 gpm	4
Commercial/Industrial	4,000 gpm	4

3.6 Proposed Domestic Water Facilities

3.6.1 Offsite Facilities

The offsite domestic water facilities are presented in Figure 3-3. As shown, the majority of the necessary offsite facilities are already constructed for the developments in Woodbury and Stonegate north of PA 40. Improvements in Sand Canyon Avenue and improvements in Trabuco Road between Jeffrey Road to the SR 133 have been completed with stub-outs provided for the onsite pipelines to the PA 40 area. The Zone 3 to 2 PRV station along Sand Canyon Avenue is being constructed with the Sand Canyon Avenue Grade Separation project and assumed to be existing for purposes of this SAMP.

Offsite facilities are required to serve the PA 40 service area east of the SR-133. The 12-inch pipeline along Trabuco Road and the future "O" Street alignment will be needed as proposed in the OC Great Park SAMP for PA's 31 and 50.

The pipeline facilities necessary for the PA 12 Portion will be completed for the Sand Canyon Avenue Grade Separation project currently underway. The only other offsite facility will be a 10-inch pipeline constructed by jack and bore methods across the railroad to connect to the existing Zone 2 facilities from Oak Canyon Road.

3.6.2 Onsite Facilities

The proposed onsite domestic water facilities are presented in Figure 3-4. As illustrated on Figure 3-3, the primary source of supply for Zone 3 will be from the existing OC-72 turnout off the Allen-McCulloch Pipeline (AMP), which contains a hydraulic grade of approximately 470 feet. The secondary supply source is the existing Zone 1 to 3 Booster Pump Station at the Central Zone 1 reservoir, which is supplied by the Dyer Road Well Field.

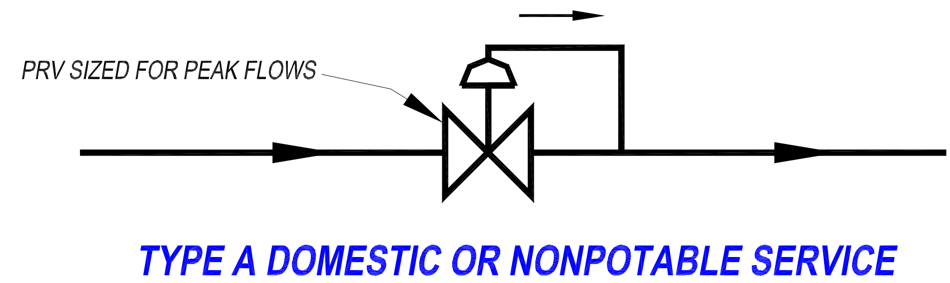
Zone 2's secondary source of supply will be from the Northwood Zone 2 Reservoir and pipelines in Jeffrey Road and Trabuco Road. Zone 2's secondary source of supply will be from the existing pressure reducing stations from the Zone 3 distribution system at Jeffrey Road/Irvine Boulevard and at Sand Canyon Avenue/Marine Way.

No additional pumping stations or storage facilities will be needed on-site within or for the SAMP Study Area boundary. One (1) on-site pressure reducing station will be required to reduce pressure from the Zone 3 to 3R system. Table 3-7 provides a listing of the proposed pressure reducing stations that will be required. This table includes proposed operation the new Zone 3 to 2 PRV (P-1) constructed with Sand Canyon Grade Separation project. It should be noted that P-1 under normal daily demand conditions will flow up to 800 gpm to 1,600 gpm during maximum day and peak demand periods respectively, but with no flow under normal average day demands. Zone 2 is set up to operate with pressure reduction in conjunction with the existing PRV station (P005) at Irvine Boulevard and Jeffrey Road. Also, the proposed P-3 is to be backup supply to the Zone 3R service area and should not open during normal flow conditions. All of the flow is provided by the existing PRV (P-7) in Trabuco Road.

Table 3-7 Proposed PRV Operating Conditions

D/S Pressure			HGL, feet		Maximum	Average
PRV	Zone	Type [a]	U/S [b]	D/S [c]	Flow[d], gpm	Flow, gpm
Existing P-1 (DPR196)	2	B	470	335	4,904	411
Proposed P-3 (DPR198)	3R	B	470	370	3,388	176

a) See Figure 3-5.
b) U/S – Upstream setting.
c) D/S – Downstream setting.
d) Maximum flow is based on the fire flow requirement plus maximum day demand to the zone.



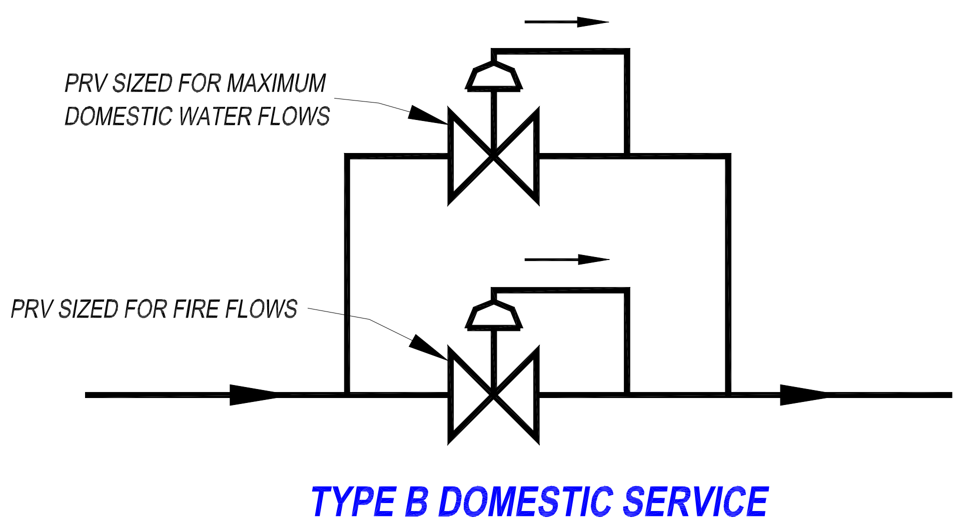


Figure 3-5 Typical Pressure Reducing Station Layouts

3.7 Domestic Water System Computer Analysis

The domestic water system analysis was conducted using the MWH Soft's InfoWater software including the modeled system facilities from the Great Park SAMP service area. To determine and verify pipeline sizes, steady-state analyses were run for maximum day plus fire flow demands and peak hour demands conditions.

The maximum day plus fire flow analysis was conducted using the software's fire flow analysis feature. The fire flow requirements were applied to the junction nodes per Table 3-6 for the various land use areas. The following is a brief description of the modeling results.

Table 3-8 Maximum Day plus Fire Flow Modeling Results

Zone	Max Day Demands Only Resulting Pressure Range	Required Fire Flow	Minimum (MDD plus FF) Residual Pressure
2	46-75 psi	4,000 gpm	30 psi (located at the south end of "C" Street)
3R	64-79 psi	3,000 gpm	36 psi (northern portion of medium density area between "A" St and "C" St)
3 – West of 133	88-98 psi	4,000 gpm	41 psi (east end of Nightmist east of Sand Canyon Ave)
3 – East of 133	81-98 psi	4,000 gpm	30 psi (middle area between Trabuco Rd and Marine Way)

The Table 3-9 shows the modeling results for the peak hour analysis for each zone. All residential demand nodes exceed 50 psi. It should be noted that the minimum pressure of 46 psi is located at the existing IUSD facility yard which is currently serviced by 12-inch Zone 2 pipeline in Sand Canyon Avenue. No change to this configuration is proposed.

Table 3-9 Peak Hour Analysis Modeling Results

Zone	Peak Hour Resulting Pressure Range	Maximum Pipe Velocity
2	46-75 psi	3.5 fps
3R	60-77 psi	3.0 fps
3 – West of 133	78-92 psi	2.3 fps
3 – East of 133	73-92 psi	1.7 fps

3.8 Water Quality Analysis

A limited water quality analysis was able to be conducted based on pipeline velocities since the pipelines analyzed are proposed facilities. The predicted velocity can be used as a general indicator for potential water quality problems if velocities are too low and not allowing for adequate flushing or circulation of the pipelines. The District's established minimum velocity criteria is as stated in the WRMP is 1 fps. This velocity is established as necessary to properly flush the water through the pipelines and prevent the water from becoming stagnant.

The model predicted velocities in the proposed pipelines during average day demands and peak hour demands conditions. The majority of the pipelines result in velocities less than 1 fps for the average day demands, and about half of the pipelines flow less than 1 fps during peak hour demand conditions. The pipelines are sized for maximum day plus fire flow demand conditions and therefore oversized for normal average and peak operating conditions. Water quality could potentially be a concern, in particular for the internal tract facilities.

To aid in monitoring water quality, sampling stations per IRWD Standard Drawing W-26 should be provided throughout the systems. Sampling stations should be located in strategic areas to represent water quality for the general area. These stations will provide a means for collecting water samples on a regular basis. Additionally, it is recommended that fire hydrants be placed at the end of cul-de-sacs or pipeline dead end mains to assist IRWD in maintaining water quality in these areas through periodic flushing, or a 4-inch diameter main be utilized after the last hydrant with blow-offs installed at the end of each street. Routine flushing can alleviate potential problems before they occur.

4.0 WASTEWATER COLLECTION SYSTEM

4.1 Wastewater Generation Factors

Duty factors for wastewater generation, listed in Table 4-1 are based on IRWD's interior potable water demand factors represented in the WRMP.

Table 4-1 Wastewater Generation Flow Factors

Land Use	Wastewater Average Daily Generation Factor, [a]
Medium Density Residential	220 gpd/du
Medium-High Density Residential	150 gpd/du
High Density Residential	145 gpd/du
Commercial Retail	150 gpd/ksf
Commercial/Industrial	52 gpd/ksf
School	12 gpd/ksf
Recreation	41 gpd/ksf

a) Based on IRWD's WRMP potable water interior demand factors. Duty factor estimates the average dry weather flow.

4.2 Proposed Onsite Wastewater Flows

The wastewater generation factors listed in Table 4-1 and the land uses presented in Chapter 2 were used to develop the projected onsite wastewater flows for the PA 40 SAMP Study Area. Table 4-2 presents the projected average and peak wastewater flows. The total projected average day dry weather flows are estimated to be 0.974 MGD, or 1.507 cfs. Peak dry weather flows are estimated to 3.466 cfs for the SAMP study area.

The Sewer Collection System Master Plan (SCSMP) dated June 2006 was utilized to determine the peaking factors that should be used for the PA 40 area. Based on the product mix and the combined diurnal curves for the residential and non-residential peaking factors, the peaking factor used for the PA 40 SAMP study area is 2.3 times average day flows. Maximum day to average day dry weather flows factor is assumed to be 1.3.

Table 4-1 Onsite Wastewater Flow Projections					
Land Use	Unit Quantity	Flow Factor (gpd/unit)	Average Dry Weather Flows gpd	Average Dry Weather Flows cfs	Peak Dry Weather Flows (cfs)
PA 40-West of SR 133					
Existing Maintenance Facilities	373	52	19,388	0.030	
Proposed Caltrans Maintenance Yard	87	52	4,530	0.007	
Commercial/Industrial	216	52	11,212	0.017	
Commercial Retail	205	150	30,750	0.048	
Day Care Facility	133	150	19,950	0.031	
Mixed Use Area	504	52	26,196	0.041	
Community Park			-	-	
School (Middle and Elementary)	100	12	1,200	0.002	
Residential - Medium Density	559	220	122,980	0.190	
Residential - Medium High Density	1,172	150	175,800	0.272	
Residential - High Density	1,769	145	256,505	0.397	
PA 40-West of SR 133 Subtotal			**668,511**	**1.034**	**2.378**
PA 40-East of SR 133					
Existing Fire Station	50	52	2,600	0.004	
Residential - High Density	1,309	145	189,805	0.294	
Commercial / Industrial	1,121	52	58,280	0.090	
PA 40-East of SR 133 Subtotal			**250,685**	**0.388**	**0.892**
PA 40 Subtotal			**919,196**	**1.422**	**3.271**
PA 12 Portion (Travel Land and VTPM 97-184)			54,703	0.085	0.195
PA 40 Study Area Total			**973,899**	**1.507**	**3.466**

4.3 Offsite Tributary Wastewater Flows

There are no anticipated offsite wastewater flows that will be routed through the onsite PA 40 SAMP Study Area collection system. The PA 40 onsite flows will be conveyed by the onsite collection and discharge into the offsite trunk sewer system in Jeffrey Road, and via the existing 12-inch trunk between Sand Canyon Avenue to Jeffrey Road which runs along the railroad just south of the PA 12 portion included in this SAMP. (See Figure 4-1)

The onsite flows from the area of PA 40 east of the SR 133 will be collected to the 12-inch trunk sewer along the future "O" Street to the existing trunk sewer system that crosses the I-5 Fwy as shown in Figure 4-1. The offsite trunk sewer system was proposed as part of the Great Park SAMP, which included the flows from this portion of PA 40.

4.4 Wastewater System Evaluation Criteria and Assumptions

Proposed layouts for the onsite wastewater system were performed using IRWD criteria presented in the Sewer Collection System Master Plan. Manning's "n" was assumed to be 0.013 in all cases. Table 4-4 lists criteria for pipe sizes, minimum slopes, and maximum depth of flow to diameter ratios.

Table 4-2 Sewer Design Criteria [a]

Pipe Size, inches	Min. Slope, ft/ft	Max. Depth/Dia. Ratio
8	0.0040	50 percent
10	0.0028	50 percent
12	0.0022	50 percent
15	0.0015	67 percent
18	0.0012	75 percent
21	0.0010	b
24	0.0008	b
27	0.00067	b
30	0.00058	b

a) Based on IRWD's 1992 Sewer Collection System Master Plan.
b) For pipes 18" and larger d/D = 0.75, where "d/D" is the ratio of calculated flow depth to pipe diameter

4.5 Proposed Wastewater Collection System

The proposed wastewater flows will be collected by via three main drainage areas. The first area, Area 1, includes the area between Jeffrey Road and Sand Canyon Avenue and is the largest of the areas. Area 2 is the area between Sand Canyon Avenue and the SR 133. Area 3 consists of the drainage area is east of the SR 133.

Table 4-3 is provided to summarize the estimated flow to be generated from each of these three drainage areas.

Table 4-3 Onsite Wastewater Flow Projections by Drainage Area

Land Use	Unit Quantity	Flow Factor (gpd/unit)	Average Dry Weather Flows gpd	Average Dry Weather Flows cfs	Peak Dry Weather Flows (cfs)
Area 1 – Between Jeffrey Road and Sand Canyon Avenue					
Commercial/Industrial	216	52	11,212	0.017	
Community Park			-	-	
School (Middle and Elementary)	100	12	1,200	0.002	
Residential - Medium Density	559	220	122,980	0.190	
Residential - Medium High Density	1,172	150	175,800	0.272	
Residential - High Density	1,769	145	256,505	0.397	
Area 1 Subtotal			**567,697**	**0.878**	**2.020**
Area 2 – Between Sand Canyon Avenue and SR 133					
Existing Maintenance Facilities	373	52	19,388	0.030	
Proposed Caltrans Maintenance Yard	87	52	4,530	0.007	
Commercial Retail	205	150	30,750	0.048	
Day Care Facility	133	150	19,950	0.031	
Mixed Use Area	504	52	26,196	0.041	
PA 12 Portion (Travel Land)			54,703	0.085	
Area 2 Subtotal			**155,517**	**0.242**	**0.554**
Area 3 – East of SR 133					
Existing Fire Station	50	52	2,600	0.004	
Residential - High Density	1,309	145	189,805	0.294	
Commercial / Industrial	1,121	52	58,280	0.090	
Area 3 Subtotal			**250,685**	**0.388**	**0.892**
PA 40 Study Area Total			**973,899**	**1.507**	**3.466**

Drainage Area 1

Drainage area 1 is largest area with an average daily flow anticipated to be 0.567 MGD. This drainage area will consist of primarily residential flows and convey wastewater flows west of Sand Canyon Avenue. The proposed collection system will be entirely gravity flow consisting of sewer pipes ranging in size from 8-inch to 12-inch diameter. (See Figure 4-1)

All of the flows will be collected by an existing 16-inch PVC C905 gravity sewer that will discharge into the existing 30-inch Jeffrey Road trunk sewer. Due to the location of this existing 16-inch sewer and the NTS basin, the existing and proposed grades require the proposed 12-inch sewer and other onsite sewer mains in this area to be deep, approximately 20-feet or more.

Evaluation of the existing 30-inch trunk sewer is beyond the scope of this SAMP. According to IRWD, the regional sewer study and SCSMP assumed the maximum 3,918 dwelling units from PA 40 and concluded that the Jeffrey Road trunk sewer has capacity to accommodate flows from PA 40. Analysis of the onsite sewer system shows that all proposed pipelines meet the d/D and velocity criteria for IRWD.

Drainage Area 2

The area between Sand Canyon Avenue and SR 133 is estimated to generate about 0.155 MGD on average. This area contains existing development which currently flows to the existing sewer mains in Sand Canyon Avenue to the 12-inch sewer that runs westerly along the railroad tracks from the existing Travel Land site. This existing 12-inch sewer discharges flows into the existing 30-inch trunk sewer in Jeffrey Road.

The proposed flows will be conveyed by an 8-inch sewer that will connect to the existing sewer near Nightmist and Sand Canyon Avenue. Based on the hydraulic modeling, the existing 12-inch sewer will have capacity to collect the additional proposed flows from PA 40. The maximum d/D was analyzed at peak flows to be 0.40 and the maximum velocity was found to be 4.8 fps.

Drainage Area 3

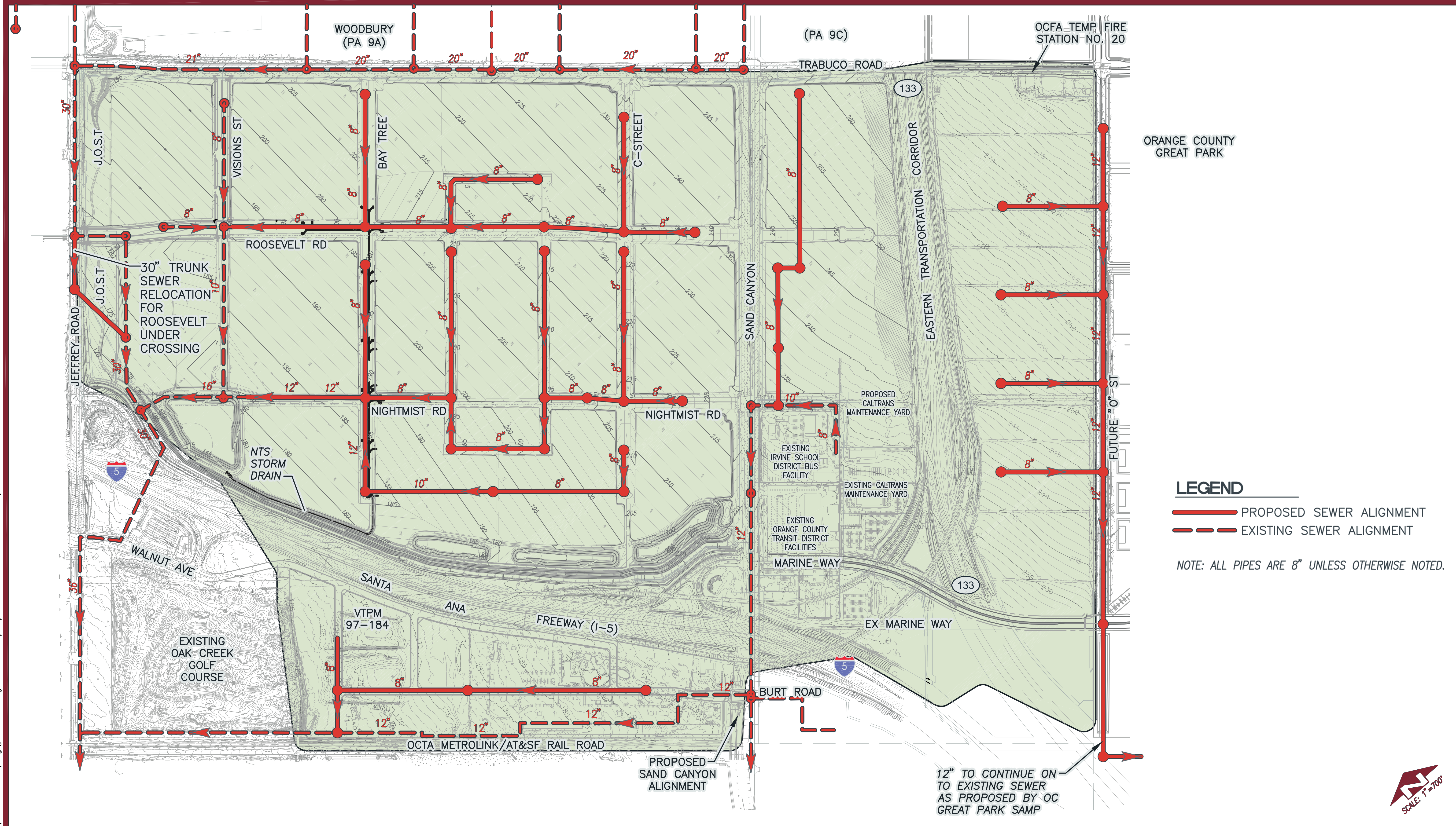
The area east of the SR 133 has been included with previous planning and regional sewer analyses for the Great Park SAMP. This area will collect the flows to a new 12-inch sewer southerly along the future “O” Street alignment. This new 12-inch sewer will be routed southerly to the existing trunk sewer system crossing the 5 Fwy. (See OC Great Park SAMP’s Figure 4-1) Coordination will be required with the 5-Points Community development and the construction of “O” Street.

The 12-inch sewer in “O” Street will be deep due to the 8-inch sewers from the PA 40 area needing to “buck” grade to connect into the 12-inch “O” Street sewer. Depths in the northerly portion of “O” Street could be 21 ft to 22 ft deep depending on the final grading for the PA 40 east area. Depths could reduce to about 15-ft as the sewer approaches Marine Way.

A regional sewer study to evaluate the offsite sewer impacts of the PA 40 flows from Area 3 is beyond the scope of this SAMP. It should be noted that the previously assumed flows for this area were 0.110

MGD average daily flows. Flows from this area per this SAMP are estimated to be 0.250 MGD, more than double the previously estimated average flows. This is due to the additional residential units assumed for the PA 40 mixed used area east of SR 133 which are 1,309 units as compared with 500 units in the Great Park SAMP Regional Study.

Due to the uncertainty of the PA 40 east development and development schedules of both PA 40 and the Great Park, a separate study should be performed to evaluate flows and capacity of the proposed 12-inch sewer in "O" Street and the proposed upsizing of the existing trunk sewer system.



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Stantec
19 Technology Drive, Irvine, CA 92618 Phone 949.923.6249 Fax 949.923.6188 www.stantec.com

PREPARED FOR THE:
IRVINE RANCH WATER DISTRICT

PLANNING AREA 40 SAMP

SEWER COLLECTION SYSTEM FACILITIES

FIGURE 4-1

5.0 NONPOTABLE WATER SUPPLY

5.1 Nonpotable Water Supply and Pressure Zone Service Areas

IRWD established criteria in their WRMP for determining nonpotable water pressure zone service boundaries. These guidelines call for service zones to meet the criteria as shown on Figure 5-1 and as follows:

- Minimum Static Pressure: 60 psi, based on a full reservoir.
- Maximum Static Pressure: 150 psi, based on a full reservoir.

Therefore, in a standard pressure zone, the highest allowable nonpotable service elevation is determined by subtracting 139 feet (60 psi) from the full reservoir level, or in the case of a subzone, from the pressure reducing station HGL setting. The lowest allowable service level is determined by subtracting 346 feet (150 psi) from the reservoir HWL, or in the case of a subzone, the pressure reducing station HGL setting. Table 5-1 summarizes the proposed nonpotable water pressure zone service ranges for the Study Area.

The Study Area nonpotable water demands will be served by a single pressure zone, Zone B (HGL 460), as shown in Figure 5-2. Zone B is currently and will continue to be directly served by gravity flow (HGL of 460) from the Northwood Zone B Storage Tank, the Zone B Rattlesnake and 75-1 Booster Pump Station. (See Figure 5-3) The existing Zone C to B PRV Station in Sand Canyon Avenue just north of Irvine Boulevard opens to support peak flow conditions and pressures in the Zone B area south of Irvine Boulevard. However, flows through this PRV ultimately will stress a heavily taxed Zone C system. Therefore, a new Zone A to B BPS, along with pipeline improvements in Sand Canyon Avenue with upgrades to the East IIC A to B BPS, is proposed along Jeffrey Road to support peak flows and alleviate peak flows through the Zone C to B PRV.

Table 5-1 Nonpotable Water System Pressure Zone Summary

Source of Supply	HGL, ft	Elevations Served, [a] ft		Static Pressure, psi	
		Upper	Lower	Minimum	Maximum
Zone B: Northwood Tank, Rattlesnake BPS, New A to B BPS	460	285	161	76	129
Sand Canyon Zone C to B PRV	430			63	116

a) The elevations noted are the tentative elevations proposed to be served from the various pressure zones.

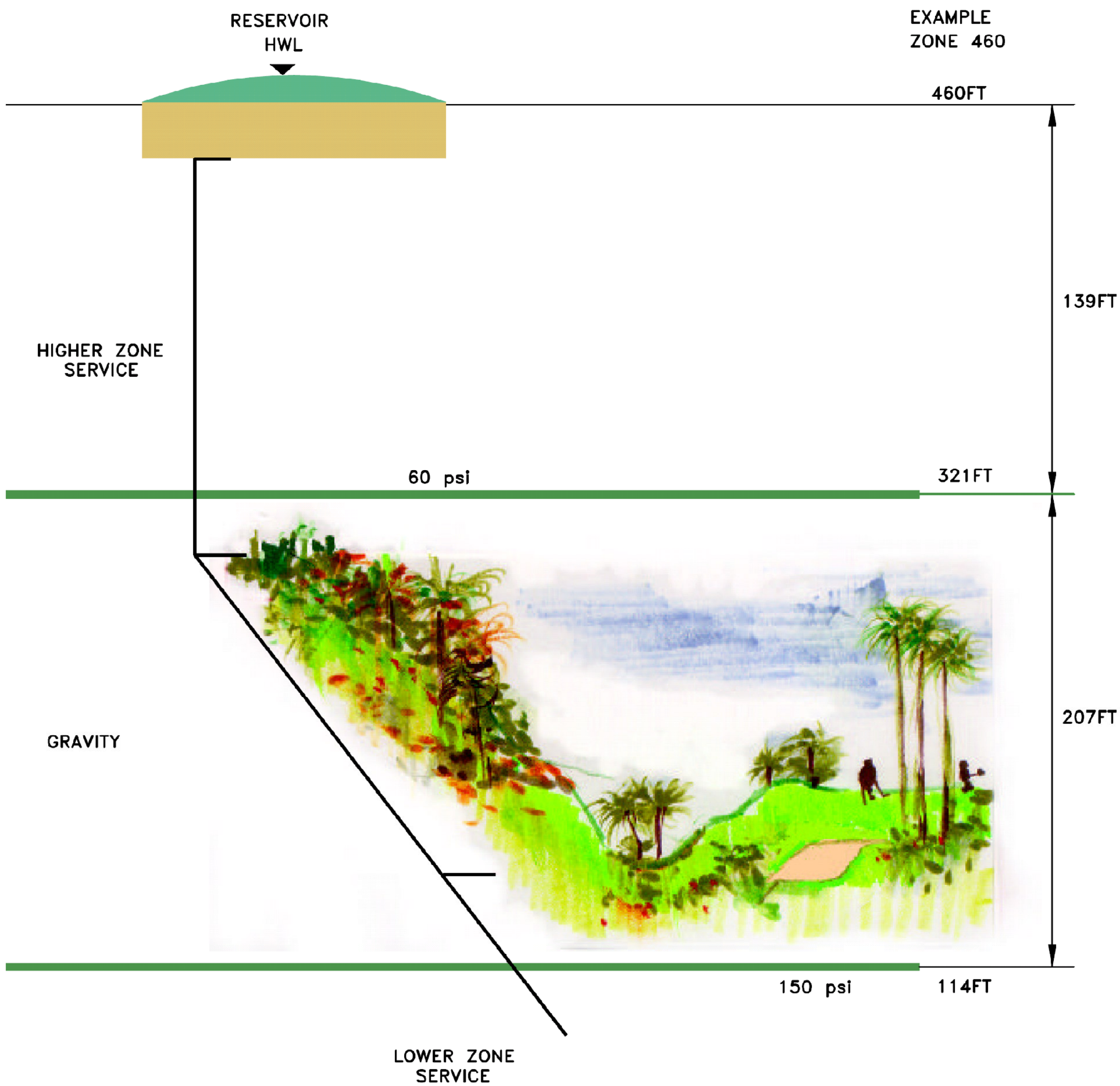
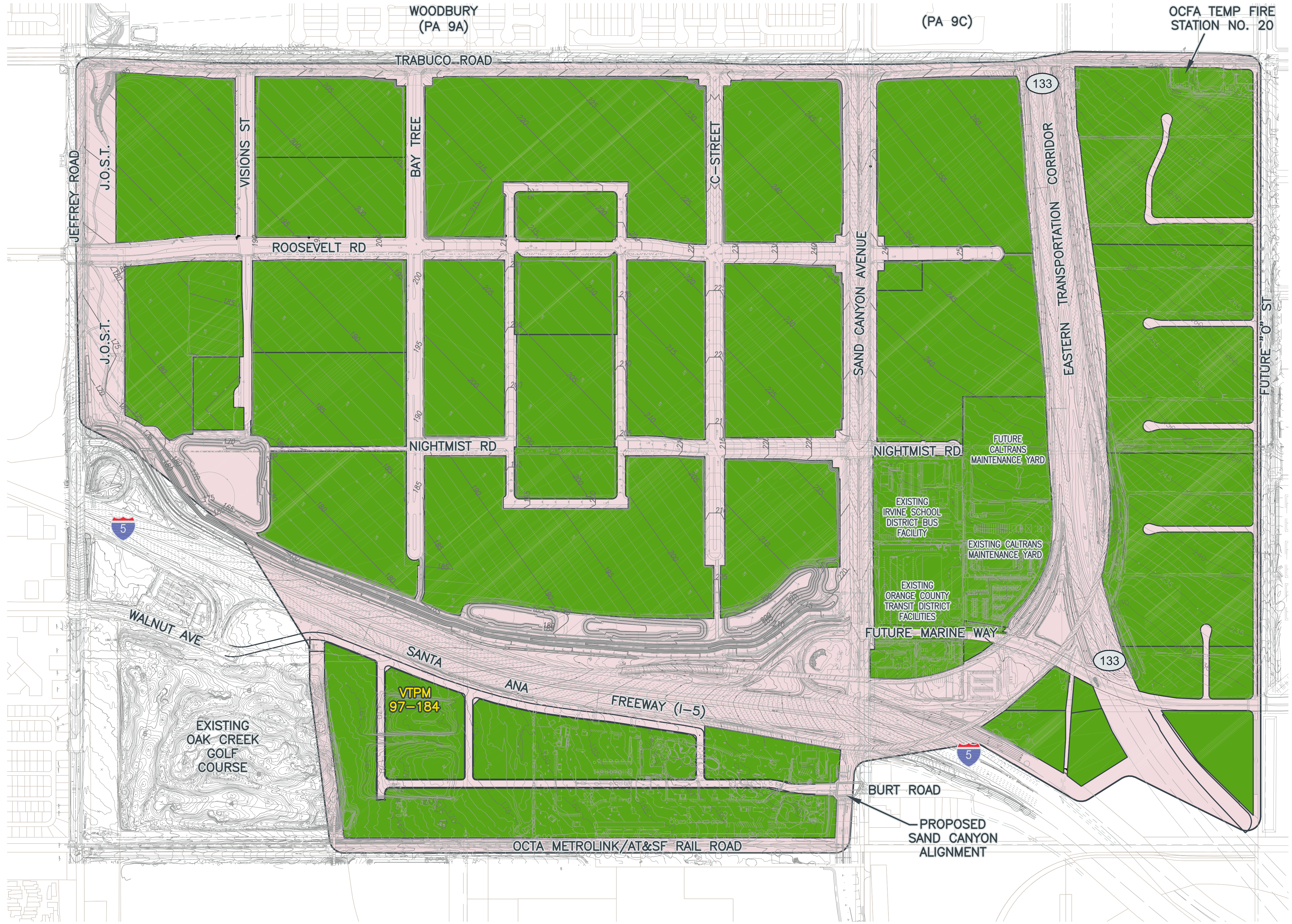


Figure 5-1 Typical Static Nonpotable Water Service Zones



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ZONE B – 460 HGL PRESSURE ZONE

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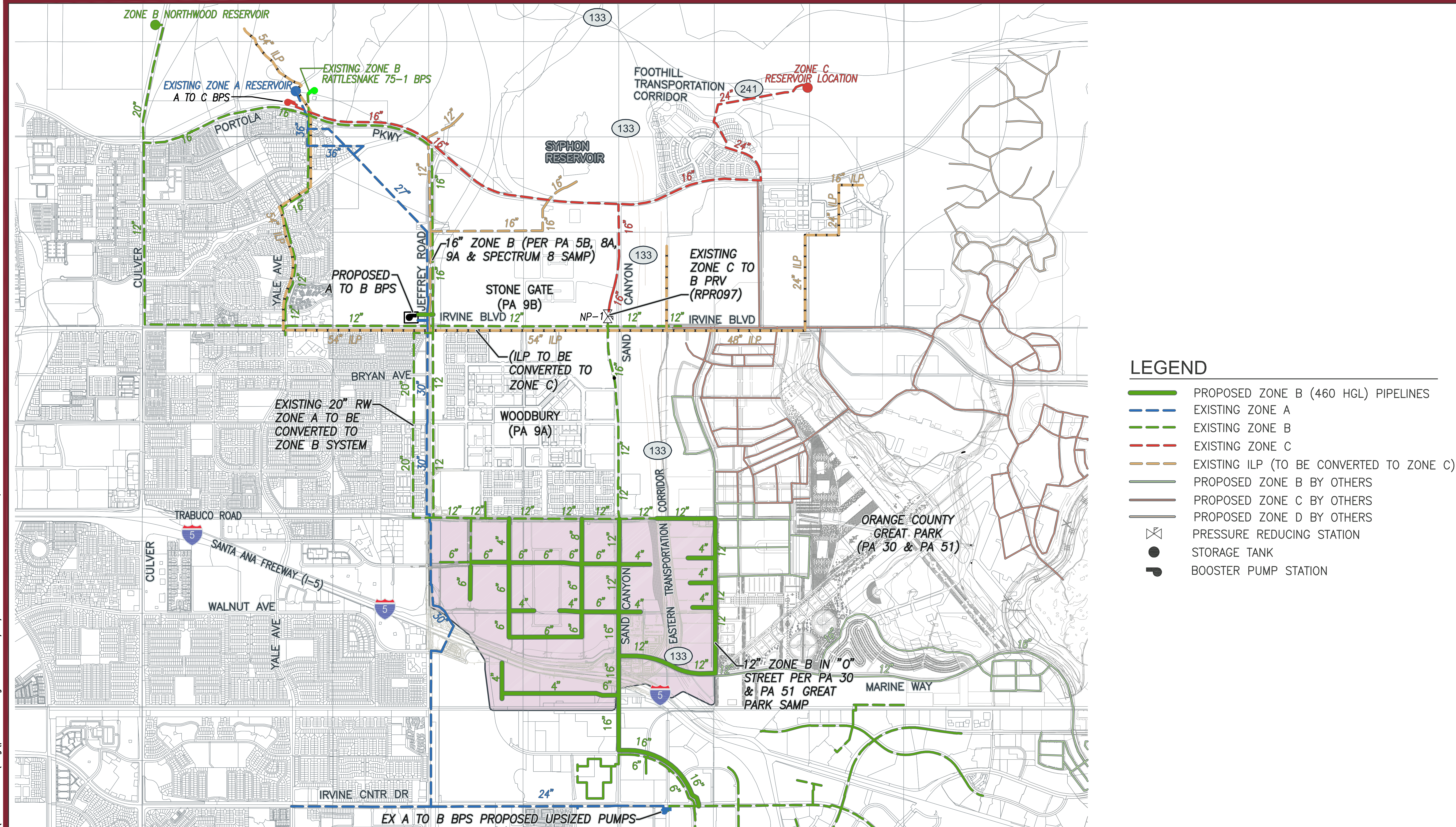
NON-POTABLE WATER PRESSURE ZONES

FIGURE 5-2



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REGIONAL NON-POTABLE WATER SYSTEM FACILITIES

FIGURE 5-3

5.2 Nonpotable Water Uses

Common area landscape irrigation accounts for the vast majority of nonpotable water use within the IRWD nonpotable water distribution system. Nonpotable water is also provided for irrigation of "estate" size residential lots in the Newport Coast and Shady Canyon areas of the District and is used for toilet and urinal flushing in a small number of "high rise" (nonresidential) buildings. The District is aggressively investigating expanding flushing/building, cooling, and other non-irrigation uses for nonpotable water. This includes a potential significant reduction in the threshold building size for dual plumbing, requirements for the use of nonpotable water for cooling, and other appropriate commercial and industrial applications. At this time, the nonpotable water facilities proposed in this SAMP assume only typical common area landscape irrigation demands. However, the status of the potential expansions in nonpotable water uses should be reviewed during the final design of these facilities.

5.3 Nonpotable Water Use Factors

A summary of the water duty factors is presented in Table 5-2 below. The duty factors from the 1999 WRMP were used in this SAMP.

Table 5-2 Nonpotable Water Duty Factors

Land Use	Percent Irrigable	Duty Factor gal/day/acre
Medium Density Residential	20	3,100
Medium-High Density Residential	25	3,600
High Density Residential	20	3,300
Commercial/Industrial	25	4,000
Commercial - Retail	30	3,500
Mixed Use	30	3,500
School	50	2,500
Parks/Recreation	90	3,400
Landscape	100	3,400

5.4 Nonpotable Water Peaking Factors

Peaking factors from the WRMP are summarized in Table 5-3. The peaking factors were based on the relationships to the average day demands as shown in Fig 3-6 of the WRMP.

Table 5-3 Nonpotable Peaking Factor Comparison

Location	Peaking Factors	
	Maximum Day	Peak Hour [a]
SAMP Study Area	2.9	6.0
District Wide	2.5	5.0

a) Based on a 9-hour irrigation period.

5.5 Projected Nonpotable Water Demands

Within the Study Area, common area irrigation demands for the several multi-family residential areas, commercial areas, and industrial areas are anticipated to be met with nonpotable water. Slope landscaping associated with the residential areas, as well as the parks/recreational areas will also be irrigated using the nonpotable water system.

Table 5-4 summarizes the nonpotable water demand calculated from the duty and peaking factors previously discussed. Average day demand within the Study Area, is estimated to be approximately 0.586 MGD, or 407 gpm. Maximum day demand is estimated at 1.70 MGD, or 1,180 gpm with peak hour demands are estimated to be 2,441 gpm. Previous SAMP documents estimated demand for this area to be about 2,357 gpm for peak hour conditions which did not include the PA 12 portion.

Table 5-4 Estimated Nonpotable Water Demand

Land Use	Demand, gpm		
	Average Day	**Max Day**	**Peak Hour**
PA 40 - West of SR-133			
Existing Maintenance Facilities	22	64	133
Proposed Caltrans Maintenance Yard	6	16	33
Commercial/Industrial	8	22	46
Commercial Retail	19	55	114
Day Care Facility	1	3	6
Mixed Use Area	18	52	107
Community Park	79	230	477
School (Middle and Elementary)	26	77	159
Residential - Medium Density	30	86	177
Residential - Medium High Density	58	169	351
Residential - High Density	34	100	206
PA 40 - West of SR-133 Subtotal	**302**	**875**	**1,810**
PA 40 - East of SR-133			
Existing Fire Station	1	3	6
Residential - High Density	25	72	150
Commercial / Industrial	38	110	228
PA 40 - East of SR-133 Subtotal	**64**	**185**	**383**
PA 40 Subtotal	**365**	**1,060**	**2,193**
PA 12 Portion (Travel Land and VTPM 97-184)	41	120	248
PA 40 Study Area Total	**407**	**1,180**	**2,441**

5.6 Nonpotable Water System Evaluation Criteria and Assumptions

All nonpotable pipelines are sized to provide velocities less than five (5) fps and headlosses less than ten (10) feet per 1,000 feet during peak hour conditions. Minimum service pressures are restricted to 50 psi during peak hour demand conditions.

5.7 Proposed Nonpotable Water Facilities

5.7.1 Offsite Facilities

Figure 5-3 shows the existing and proposed offsite, or regional, facilities around the SAMP Study Area. Existing supply facilities that lie outside the Study Area boundary include the existing Northwood Zone B Storage Tank, the Zone A to C booster pump station, the Sand Canyon C to B pressure reducing station. Other future facilities such as the Great Park service area are shown for reference to identify the ultimate system and integration with the Study Area.

The Sand Canyon Zone C to B pressure reducing station located in Sand Canyon Avenue, between Portola Parkway and Irvine Boulevard, has been installed and in operation. Current flows through this station are not significant but flows will increase. Ultimately this station could expect flows as high as 4,000 gpm. Due changes in the Zone C system demands and the need to now service the agricultural raw water service areas with reclaimed water, the Zone C system capacity will be limited and IRWD needs to minimize or eliminate the anticipated flow through this C to B PRV. Additionally, pumping this amount of water from Zone A water up to Zone C and then reduced down to Zone B is an inefficient mode of operation not desired by IRWD.

A new A to B BPS is proposed to help alleviate flows through the Sand Canyon C to B BPS. The location proposed is at the northwest corner of the intersection of Irvine Boulevard and Jeffrey Road. Although an alternative location at Trabuco Road and Irvine Boulevard offers a slightly better location hydraulically, a site for the station is not feasible as this area is built out with recent improvements and other Phase 1 improvements to begin construction at the end of 2010. The location proposed is within the Planning Area 5B and a site will need to be negotiated with the Irvine Company for appropriate planning. Additional facilities needed for this booster pump station is an altitude valve at the existing Northwood storage tank to allow this pump station to operate even when the tank is approaching the full level.

The proposed 12-inch pipeline in the future "O" Street within the Great Park area is considered an offsite facility as this pipeline lies within the Great Park planning areas. As shown in previous SAMP's, this pipeline ultimately was planned to be the Zone B system link between the area west of the SR 133 and the Spectrum area Zone B system connected to the LAWRP facility and existing Zone A to B BPS along Irvine Center Drive. Currently there is no direct connection between these two Zone B service areas.

As the schedule of facilities for the Great Park is unknown and could be increasingly further out in the future, this SAMP proposes a Zone B system connection via a pipeline from the East IIC Zone A to B BPS along Irvine Center Drive, then northerly along Laguna Canyon Road, and northerly along Sand Canyon Avenue to Trabuco Road. The existing East IIC A to B BPS should also be upgraded with additional pumping capacity. As mentioned in Section 5.8, both the new A to B BPS and Sand Canyon Avenue piping improvement with upgrades to the East IIC BPS are recommended for ultimate conditions.

5.7.2 Onsite Facilities

Proposed onsite nonpotable water pipelines are shown on Figure 5-4. The majority of the pipelines are 6-inch IRWD Capital facilities. There is no permanent or ultimate onsite pumping, storage, or pressure reducing stations proposed.

5.8 Alternatives Study for Zone B Service Area Supply

As stated in Section 5.7.1, IRWD needs to alleviate future flows through the C to B PRV station in Sand Canyon Avenue due to additional demands on the Zone C system and limited capacity in Zone C. Additionally, operating to meet Zone B demands after pumping up to Zone C is ultimately an inefficient mode of operation from an energy use standpoint. Therefore, an alternatives study was performed to investigate the options to enable the Sand Canyon C to B PRV to remain closed at all times, even during peak flow conditions. Options investigated included:

A) A new A to B BPS proposed along Jeffrey Road to alleviate flows from Zone C. Pumping directly from Zone A (rather than up to Zone C and then back down to Zone B) is a more efficient mode operation.

B) A new regional supply connection along Sand Canyon Avenue from the existing East Irvine Zone B BPS located along Irvine Center Drive near Laguna Canyon Road. This option would include upsizing of the pump station as necessary.

C) Both proposed facilities including the new A to B BPS and pipeline connection in Sand Canyon Avenue, with East IIC A to B BPS upgrades. (Options A and B combined)

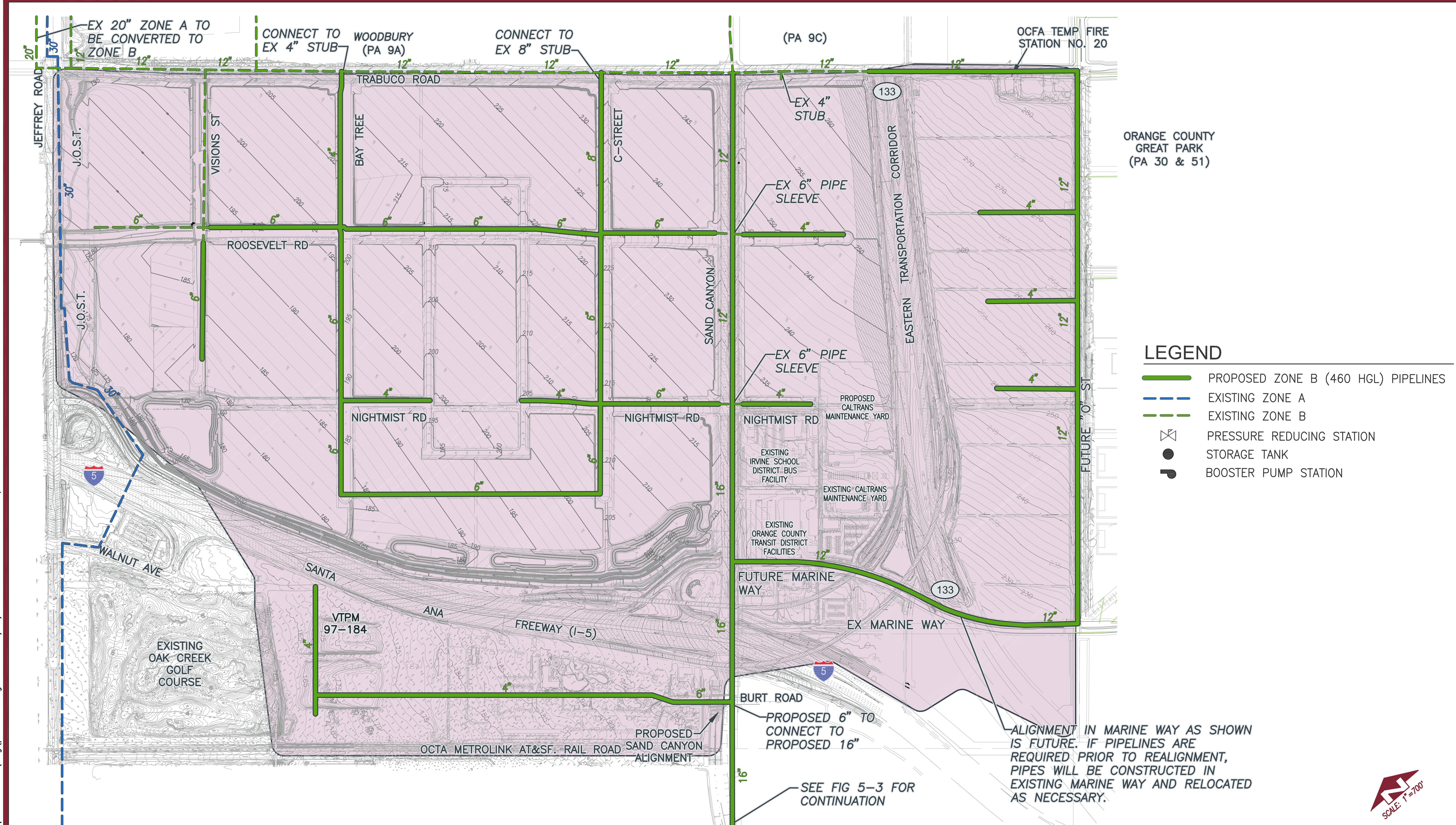
Option A

The hydraulic model was updated to include a new A to B BPS and was evaluated for the location described above and shown in Figure 5-4. The maximum day demands EPS scenario was evaluated for the analysis.

For this station to operate properly with the other Northwood Zone B BPS and tank, the Northwood Zone B BPS operation is required to be reduced. Also, an altitude valve located at the Northwood Zone B tank is recommended to allow the pump station to operate even when the tank is full. Additionally, the pumps are recommended to be equipped with VFD’s in such an operating condition.

The analysis indicates that a pump station capacity required is 7,500 gpm. Despite this flow, the Sand Canyon C to B PRV still opens for about 9 hours of the day with a peak flow of 2,600 gpm.

The existing 12-inch pipelines limit the amount of water that can be pushed through the system with adequate pressures. The analysis included the existing 20-inch Zone A pipeline in Jeffrey Road between Irvine Boulevard and Trabuco Road being converted to Zone C.



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NON-POTABLE WATER SYSTEM FACILITIES

FIGURE 5-4

Option B
The second option investigated was adding a pipeline connection between the East IIC Zone A to B BPS to along Laguna Canyon Road and Sand Canyon Avenue to connect to the existing system at Trabuco Road. This option required upsizing the pump station to operate with five pumps operating during peak demand periods, each of the same size as the existing pumps. There are currently four (4) pumps at this station, and a new fifth pump would need to be added with similar capacity as the existing pumps.

A 20-inch pipeline from the pump station to Burt Road and 16-inch pipeline from Burt Road to Trabuco Road was required. This option resulted in the Sand Canyon C to B PRV opening with flow for about 7 hours with a peak flow of about 2,400 gpm. Total East IIC Zone A to B BPS capacity would need to be 11,500 gpm.

Option C
As neither of the previous options achieved the goal to eliminate flow through the Sand Canyon C to B PRV, a third option was investigated that include both Option A and B. This option for the proposed A to B BPS would need to have a capacity of approximately 7,000 gpm. The pipelines in Sand Canyon Avenue from the East IIC A to B BPS were allowed to be reduced to 16-inch and 12-inch pipelines. The East IIC A to B BPS was assumed to be equipped with the same additional pumping capacity as for Option B. A new fifth pump would need to be added, with similar capacity as the existing four pumps. The results of the analysis show the Sand Canyon C to B PRV staying closed throughout the EPS and adequate service pressures still being provided.

Recommended Option
Option C is the recommended option based on the conclusion that it is the only option of the three studied which achieved the goal of shutting off flow through the Sand Canyon C to B PRV. The minimum Sand Canyon C to B PRV setting was assumed to be set for a downstream HGL of 430-feet.

These recommendations for Zone B improvements, including the upgrades to the East IIC A to B BPS should be coordinated with the Great Park SAMP Update(s).

It should be noted that a pipeline alignment study was completed for the proposed 16-inch pipeline in Sand Canyon Avenue, “Recycled Water Utility Investigation” prepared by Tetra Tech, which confirmed a feasible alignment. A copy of this technical memorandum is provided in the Appendix.

5.8.1 (Travel Land) PA 12 Northern Portion Supply

It should be noted that the development area within the PA 12 area (existing Travel Land site) can be served reclaimed water via the proposed 16-inch pipeline in Sand Canyon Avenue with a 6-inch pipeline connection in Burt Road. (See Figure 5-4) This supply option is viable if the pipeline in Sand Canyon Avenue is installed before or at the time of the redevelopment of the Travel Land area.

If the 16-inch pipeline in Sand Canyon Avenue is not constructed, either by timing or based on IRWD decision to not install the pipeline in Sand Canyon Avenue, the area of PA 12 could be serviced by a Zone A to B BPS from Walnut Avenue or be serviced with entirely domestic water.

For purposes of planning and project cost estimates for this SAMP, it is assumed that the pipeline in Sand Canyon Avenue will be installed to supply reclaimed water to the PA 12 site.

5.9 Nonpotable Onsite Water System Computer Analysis

The hydraulic model was analyzed for the onsite piping network to determine the appropriate pipeline diameters based on the ultimate peak hour demand conditions. To be conservative regarding the timing of the Sand Canyon Avenue pipeline, the model analysis assumes that the Sand Canyon Avenue pipeline is not installed until the future and the system will need to be supported without. Based on the analysis in order to meet the District's design criteria for pressures and pipeline velocities, the majority of the onsite piping system will consist of 4-inch and 6-inch diameter pipes. One 8-inch pipeline segment will be located in "C" Street. The proposed pipelines in "A" Street and "C" Street will connect to existing stubs provided at the intersections of Trabuco Road as illustrated in Figure 5-4.

The model results show that the peak hour demands pressures range from 62 psi to about 102 psi within PA 40. The minimum service pressure within the PA 40 of 62 psi is located at the northeast corner of Trabuco Road and the future "O" Street in the service area east of the SR 133. Maximum pipeline velocities within the PA 40 service area range from 1 fps to 6 fps.

The PA 12 portion of the service area will require a 6-inch pipeline from Sand Canyon Avenue to accommodate the peak flow of 248 gpm. The minimum service pressures anticipated based on the model analysis is about 87 psi to 100 psi. Maximum pipeline velocity is anticipated to be about 3 fps.

5.9.1 Interim Nonpotable Water System Analysis

PA 40 will be developed in phases, with the first phase of development consisting of the high density residential areas west of "A" Street to Jeffrey Road. This first phase of grading operations will begin late 2010. During the interim period between the first phase and the subsequent phases, TIC Agricultural will continue operations within the remaining eastern portion of PA 40 that straddles Sand Canyon Avenue. There will be 180 acres of berries and 50 acres of peppers/beans that will need irrigation water on the eastern half of PA 40.

The current water sources that serve the area come from a combination of the Zone A and ILP from connections from Jeffrey Road and the Zone B along Trabuco Road. (See Figure 5-5) The Zone A, ILP and western most 6" Zone B connections will be severed and lost to Ag when the PA 40 grading commences this December.

To serve the farming operations and protect against frost, a minimum flow of 4,000 gpm for these fields (this will cover about 60-65% of the frost demand) at a pressure of not less than 50 psi. Based on the flow rate and acres reported above, this equates to about 17.4 gpm per acre demand. According to IRWD, the normal peak demand during "non-frost" conditions is about 5.5 gpm per acre.

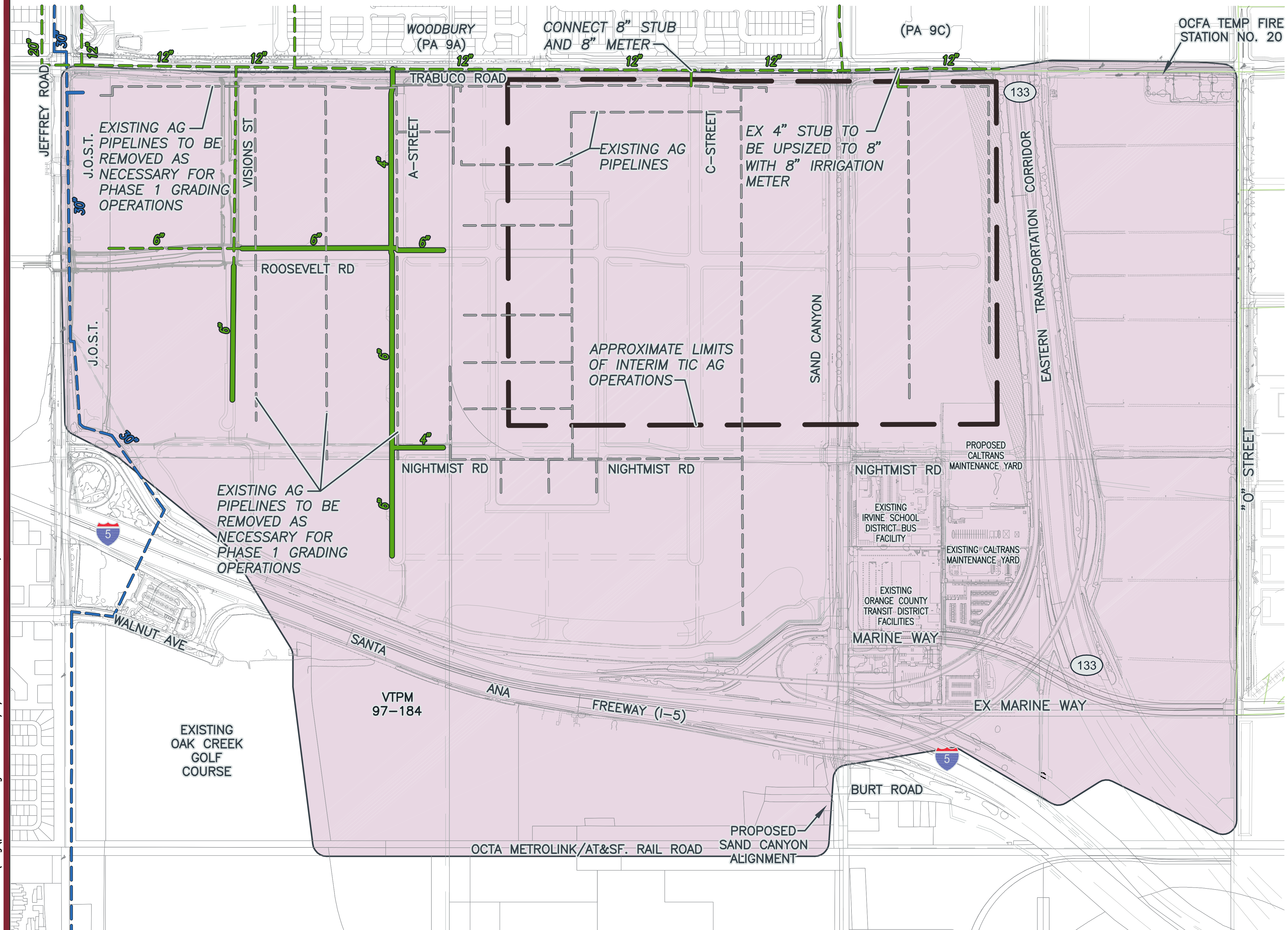
To accommodate this flow requirement, the two proposed connections for supply from Trabuco Road will need to be 8-inch with 8-inch meters. The lateral west of Sand Canyon Avenue is already an 8-inch pipe, but the existing 6-inch meter will need to be replaced with a 8-inch meter. The other lateral east of Sand Canyon Avenue is a 4-inch diameter pipe. This lateral connection will need to be upsized to an 8-inch diameter lateral with an 8-inch meter.

Since these connections will need to be active in December 2010 to replace the lost connections from Jeffrey Road, the Sand Canyon C to B PRV station may initially need to be active to support the needed flows until a temporary A to B BPS can be installed. The model analysis for the average minimum day demands shows that without an A to B BPS, the flows can be met with a minimum pressure of 50 psi and approximately 2,400 gpm is needed through the Sand Canyon C to B PRV (Setting of 50 psi is assumed). Once the temporary A to B BPS is installed the flows can be met without the Sand Canyon C to B PRV, with minimum service pressures between 56 psi and 70 psi. A temporary A to B BPS should have a capacity of 4,500 gpm with TDH of about 170-ft.

It should be noted that the model was also analyzed for peak flows of 5.5 gpm per acre, which is the peak demand rate for non-frost conditions as determined by IRWD. Under this condition for average minimum day demands, the temporary A to B BPS would be sized for a capacity of 2,000 gpm with a TDH of 160-ft. Without the A to B BPS, the Sand Canyon C to B PRV would flow up to 400 gpm.

This temporary A to B BPS should be converted to a permanent BPS once the PA 40 development is built out west of the SR 133 and the interim agricultural needs are no longer required.

In addition to the A to B BPS, an altitude valve at the Northwood Zone B tank should be installed and the existing 20-inch Zone A pipeline in Jeffrey Road between Irvine Boulevard to Trabuco Road should be converted and connected to the Zone B system. The 30-inch pipeline that is now used for ILP supply to PA 40 should be connected to the Zone A system.



LEGEND

- PROPOSED ZONE B (460 HGL) PIPELINES
- EXISTING ZONE A
- EXISTING ZONE B
- EXISTING AG IRRIGATION
- PRESSURE REDUCING STATION
- STORAGE TANK
- BOOSTER PUMP STATION

NOTE:

IN ADDITION TO THE IMPROVEMENTS SHOWN HEREON, A TEMPORARY A TO B BPS LOCATED AT JEFFREY RD AND IRVINE BLVD. IS REQUIRED FOR THE INTERIM AGRICULTURE OPERATIONS AS SHOWN IN FIGURE 5-3.

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INTERIM NON-POTABLE WATER SYSTEM FACILITIES

FIGURE 5-5

6.0 NATURAL TREATMENT SYSTEM

6.1 Introduction

To treat the dry and wet weather runoff from the proposed PA 40 development, The Irvine Company (TIC) is preparing designs for water quality basins (WQ Basins). After construction of the WQ Basins, they will be transferred to IRWD. IRWD will maintain the WQ Basins through the Natural Treatments Systems (NTS) Plan.

IRWD's NTS Plan includes facilities that address water quality issues in the Sand Diego Creek Watershed within IRWD's jurisdiction, including new facilities for new development areas such as PA 40. The primary purpose and overall goal of the NTS Plan is to cost-effectively improve water quality via the use of regional treatment systems that utilize natural treatment processes. NTS Plan facilities that serve new development areas must be comprehensively designed to meet the selection and treatment criteria for regional management programs in the Orange County Model Water Quality Management Plan, as well as IRWD design standards before they are accepted into the NTS Program.

Currently, Geosyntec Consultants is finalizing an update to the IRWD NTS Plan called the "Evaluation of Water Quality BMPs in Portions of the City of Irvine Planning Area 40 for Consistency with Regional Treatment Program Criteria". Basin locations and criteria presented in this Chapter are based on the information provided in this report.

6.2 NTS Plan Facilities

The NTS Plan includes 31 sites that are located throughout the San Diego Creek Watershed. To date, there have been 15 sites constructed with 5 to 7 sites in the planning stages for inclusion in the regional program.

There are three general configurations of NTS facilities:

- **Type I Wetlands**: Constructed wetlands that are adjacent to existing streams or drainage channels (offline facilities)
- **Type 2 Wetlands**: Constructed wetlands that are established within existing flood control channels (inline facilities)
- **Type 3 Wetlands**: Constructed wetlands that are incorporated within flood control detention basins.

The WQ Basins proposed to serve PA 40 are Type I wetlands because they are located within offline water quality detention basins.

6.3 General NTS Design Features

The NTS facilities include constructed water quality treatment wetlands to treat dry weather runoff. During dry wather, the water levels in the wetlands will be in two general regimes:

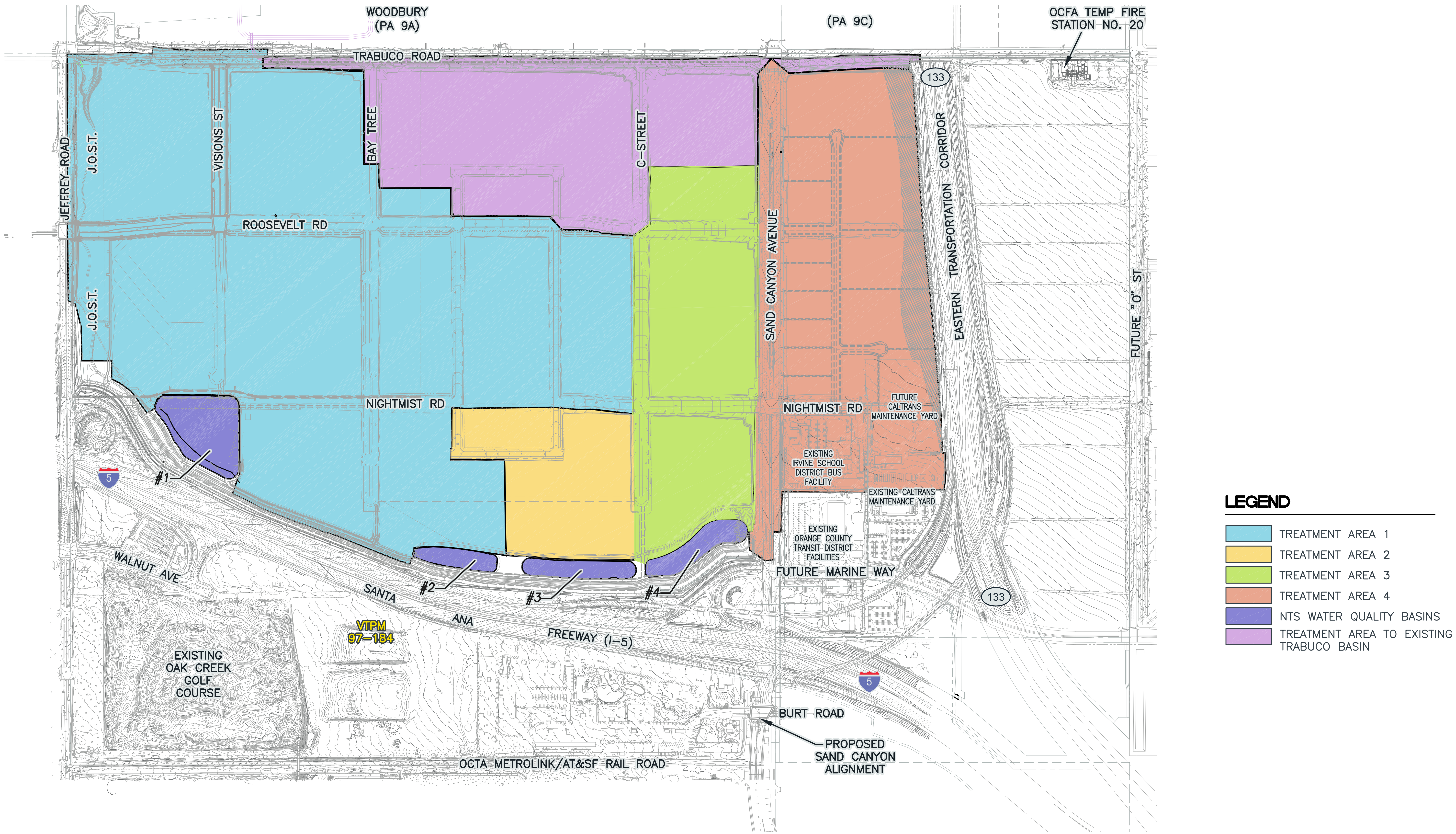
1. Shallow water regions 1 to 2 feet in depth support the growth of emergent wetland vegetation, primarily cattails and bulrushes. These areas are most effective at removing nutrients, and to some extent metals, pathogens, and toxic compounds.

2. Open water regions typically 4 to 6 feet deep are intended to help distribute the flow uniformily through the wetland vegetation and to trap course sediments. These areas are effective at removing sediments and pollutants associated with sediments (ie, metals and some nutrients). Open water areas also facilitate destruction of pathogens.

During wet weather, the NTS facilities will function as stormwater detention basins that detain and treat stormwater runoff. The depth of the stormwater quality pool is typically 4 feet or more above the normal low flow water level, inundating the wetland vegetation for short periods. Extended detention of the stormwater flows provides general treatment of typical pollutants associated with urban runoff, including sediment, metals, organics, and particulate nutrients.

The BMPs serving the new development areas in PA 40 include all required source control, suite design, and treatment control BMPs consistent with the Orange County Model Water Quality Management Plan. Detailed descriptions of the BMPs can be found in the “Evaluation of Water Quality BMPs in Portions of the City of Irvine Planning Area 40 for Consistency with Regional Treatment Program Criteria” prepared by Geosyntec Consultants.

PA 40 is divided into four (4) major drainage regions as shown in Figure 6-1. There are four (4) NTS WQ Basins designed to serve the drainage regions and all are offline stormwater basins that include Type I wetlands.



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PROPOSED NATURAL TREATMENT SYSTEM

FIGURE 6-1

7.0 EASEMENTS

IRWD will require unlimited access to their facilities for routine maintenance, operation, repair, replacements, monitoring, and other critical functions. The majority of the existing and proposed improvements in the PA 40 Study Area are within public right of way. However, there are several areas where IRWD facilities may be within parking areas, private access roads, drive ways, or even perhaps lettered lots.

This SAMP proposes easements that cover both the new water and sewer improvements as described in Chapters 3 and 4. There are no anticipated easements required for the nonpotable water system as shown in Figure 5-4.

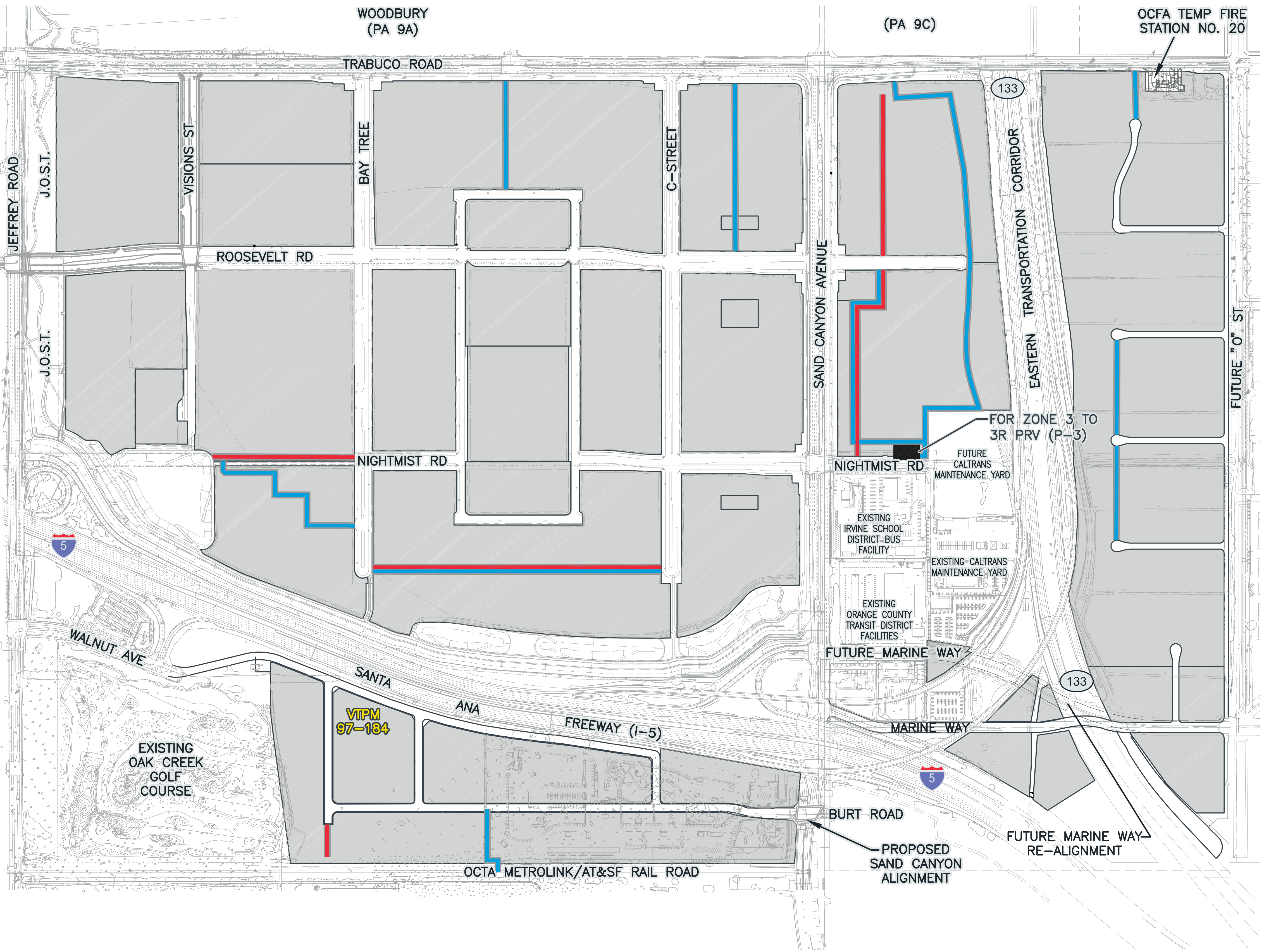
7.1 Easement Requirements

The proposed easements are required for both IRWD water and sewer facilities. The minimum easement width for water shall be ten feet and the minimum easement width for sewer facilities shall be 20 feet. In the case of parallel facilities, the easement width shall not overlap.

7.2 Proposed Easements

The proposed easements are as shown in Figure 7-1. Although not all required pipelines or easements within the individual tracts or parcels may be shown, it is understood that easements for all IRWD maintained facilities will be required in accordance with IRWD guidelines and requirements. Where a proposed easement is required over private roads or driveways for more than one property, a separate permanent easement will be necessary from each property owner.

It should also be noted that some temporary construction easements might be required for construction of the proposed sewer improvements.



NOTE:
IRWD EASEMENTS WILL BE REQUIRED IN ACCORDANCE WITH IRWD REQUIREMENTS & GUIDELINES FOR ALL IRWD MAINTAINED FACILITIES LOCATED OUTSIDE OF PUBLIC RIGHT OF WAY.

LEGEND

- EASEMENT REQUIRED FOR DW
- EASEMENT REQUIRED FOR SS

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EASEMENTS

FIGURE 7-1

8.0 TELEMETRY

Telemetry is required for proper monitoring and maintenance of pumping, storage, and pressure reducing facilities. The active, or primary source, IRWD maintained facilities will be fully telemetered with permanent, metered electrical service to communications to the IRWD Operations Center and where possible be programmable logic controller (PLC) via wireless radio signals. The Design Engineer will be required to apply to the City of Irvine for electrical utility service addresses for the telemetry panels.

The latest updates to the IRWD Construction Manual Standard Drawing E-Series will be the source for telemetry standards and requirements for all facilities.

8.1 Telemetry System Description

Storage reservoirs, pump stations, and pressure reducing stations are primary signal sites for data from the IRWD facilities. From the collection sites, data is typically transferred to the MRWP Operations Center via a licensed microwave band radio system. Signals between the area facilities can also be sent to the telemetry signal collection site via telemetry cable.

Data is transferred from the data collection sites using spread spectrum unlicensed data radios. The radios work well when there is a good line-of-sight between the two antenna sites. Where a facility's antenna is within sight of the data collection site's antenna, wireless communications has proven to be very reliable for IRWD.

Where direct lines-of-sight are not available for wireless radio signals or cabling is more efficient, direct buried cables should be used for data collection. Direct buried cables should consist of heavy-duty telephone cables. These cables shall be installed in the protection zone at the base of the associated pipeline. Where the telemetry cable leaves the protection zone of the pipeline, it should be installed in rigid steel conduit. The bend of the conduit should be strapped to the pipeline at the divergence point to eliminate shifting that might sheer the cable. The conduit should extend to the back of the sidewalk or parkway where it would enter a telemetry pedestal, prior to entering the facility.

8.2 Existing Telemetry System

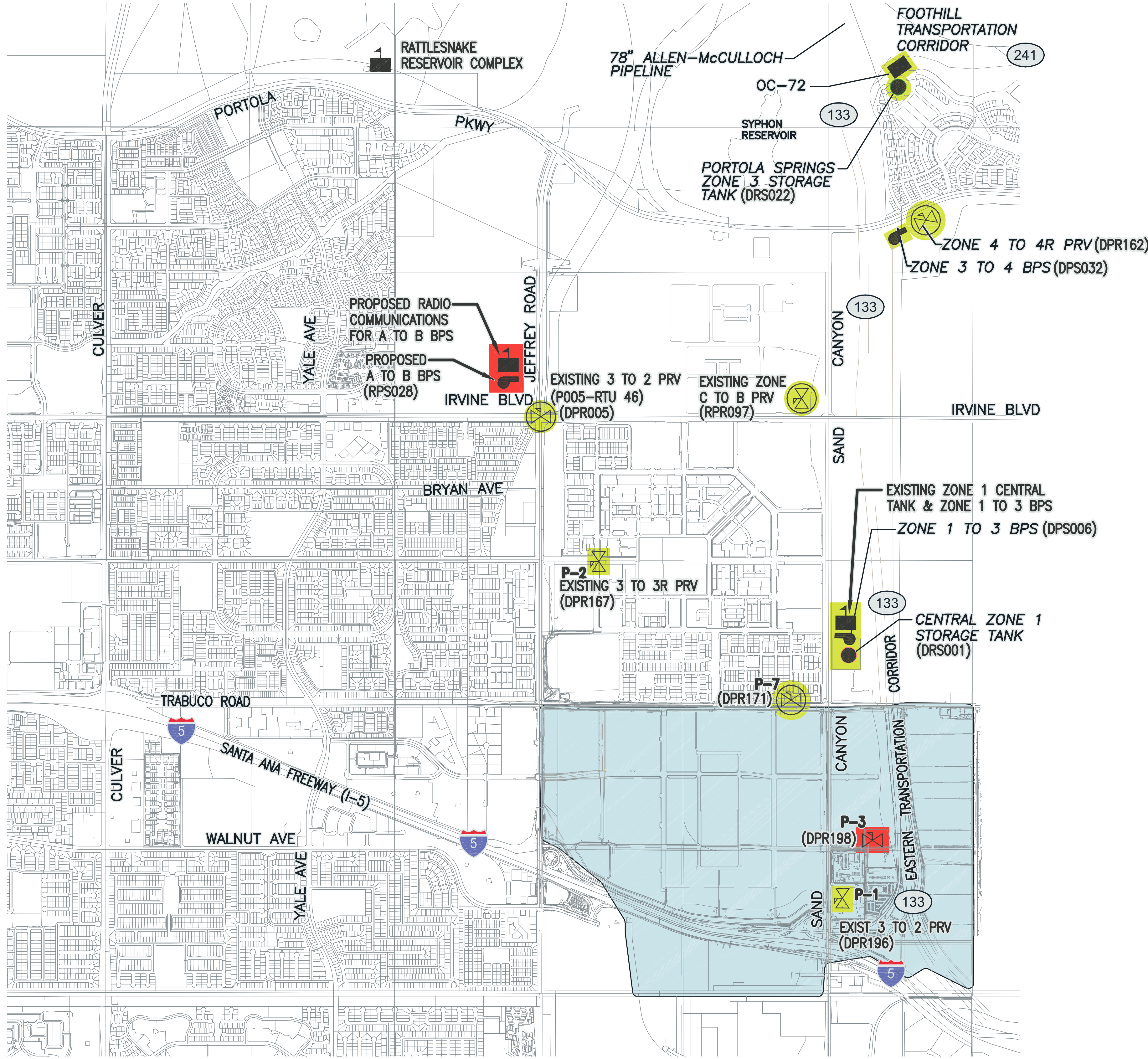
The existing telemetry facilities for the study area that are currently monitored are identified in Figure 8-1. The Zone 3 to 3R PRV station (P-7) in Trabuco Road is the primary source for the proposed PA 40 service area zone and is equipped with existing telemetry.

8.3 Proposed Telemetry System

New telemetry equipment will only be required for the proposed Zone A to B BPS along Jeffrey Road north of Irvine Boulevard. There are no other pumping, pressure reducing, or storage facilities proposed by this SAMP other than the Zone 3 to 3R PRV (P-3) at the east end of Nightmist Road.

It is proposed that the A to B BPS will send telemetry signals to a data collection site via a licensed microwave band radio system. If a direct line of site is not available to the MRWP Operations Center, data collection could possibly be at Rattlesnake Complex facility, which will then relay the signals to the MWRP Operations Center via existing radio communications.

If radio communications or a direct line of sight is not feasible, a secondary option would be to utilize a telemetry cable to the existing RTU 46 site at the existing PRV P005 near the intersection of Jeffrey Road and Irvine Boulevard.



LEGEND

- PRESSURE REDUCING STATION WITH TELEMETRY
- PRESSURE REDUCING STATION
- STORAGE TANK
- BOOSTER PUMP STATION
- RADIO COMMUNICATIONS TOWER
- EXISTING FACILITIES
- PROPOSED FACILITIES

SCALE: 1"=2200'

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Stantec
19 Technology Drive, Irvine, CA 92618 Phone 949.923.6249 Fax 949.923.6188 www.stantec.com

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IRVINE RANCH WATER DISTRICT

PLANNING AREA 40 SAMP

TELEMETRY

FIGURE 8-1

9.0 PHASING AND CONSTRUCTION SCHEDULE

9.1 Proposed Development Schedule

The Study Area is proposed to be developed in five (5) phases. The first phase will include the development area consisting of the school site and high density apartment sites west of “A” Street. Phase 2 will be the residential, school, and parks between “A Street and Sand Canyon Avenue. Phase 3 will be the commercial area, mixed use area, and day care center located between Sand Canyon Avenue and the SR 133. The eastern portion of PA 40, east of the SR 133, will constitute Phase 4. Phase 4 would complete the build out of PA 40. The future development of the existing Travel Land site, or northern portion of PA 12, is assumed to be the last phase, Phase 5. Development scheduling known at this time is limited, but estimations are presented in Table 9-1 below based on information provided TIC.

Table 9-1 PA 40 Study Area Development Schedule

Phase	Begin Grading	Occupancies
Phase 1	December 2010	Early 2012
Phase 2	2012	2013
Phase 3	2016	2017
Phase 4	2018	2019
Phase 5	2018	2019

9.2 Facility Phases

Proposed facilities for each of the domestic water system, sewer collection system, and nonpotable water system are illustrated in Figures 9-1, 9-2, and 9-3. The following is a brief discussion of the facilities required for each phase.

Phase 1

The facilities in the first phase are needed to serve the middle school site and apartments west of “A” Street. Onsite facilities are shown in Figures 9-1, 9-2, and 9-3.

The domestic water system does not require any facilities other than the onsite pipelines shown.

In addition to the onsite sewers, the sewer collection system will also require relocating the 30-inch trunk sewer south of Roosevelt to the manhole north of NTS Basin #1. This relocation is required due to the JOST undercrossing of Roosevelt Road. According to recent discussions, the relocation will be required at the 1,200th occupancy of the apartment sites.

In addition to the onsite piping improvements shown, the nonpotable water system will require an interim facility condition as described in Chapter 5, Section 5.9.1. The interim facilities are required to meet irrigation demands for the agricultural operations east of the phase 1 area. These facilities include a temporary A to B BPS located along Jeffrey Road at Irvine Boulevard, converting the existing 20-inch pipeline in Jeffrey Road to Zone B, and lateral and meter improvements from Trabuco Road.

Onsite pipelines will be constructed concurrently with the onsite street improvements. A minimum of two connection points from existing offsite facilities to the onsite distribution system will be needed to provide adequate looping when more than 28 dwelling units are constructed.

Phase 2

Onsite piping improvements to serve the Phase 2 area is shown in Figures 9-1, 9-2, and 9-3. In addition to the residential areas, the Jeffrey Road Open Space Trail (JOST) will be completed for this phase and Jeffrey Road will need to be widened, including the relocation of the 30-inch trunk sewer and other miscellaneous facilities along Jeffrey Road. The trigger point for the JOST improvements is the 3,000th unit.

The domestic water Zone 3 system at southwest corner of Trabuco Road and Sand Canyon Avenue will need to include a secondary source from Sand Canyon Avenue. It is recommended that either a temporary or the permanent 10-inch pipeline from Trabuco Road to Roosevelt Road in the Phase 3 area be constructed and connected to the existing 10-inch pipe sleeve in Sand Canyon Avenue. As an alternative, a connection could be made to the 48-inch transmission main. However, installation difficulties due to existing pipe material assumed (PCCP) and shutdown scheduling conflicts of the existing 48-inch transmission main do not make this alternative the primary recommendation.

In addition to the onsite nonpotable water facilities, the temporary A to B BPS will need to be converted to a permanent IRWD pump station facility and operational for the completed Phase 2 development.

Onsite pipelines will be constructed concurrently with the onsite street improvements. A minimum of two connection points from existing offsite facilities to the onsite distribution system will be needed to provide adequate looping when more than 28 dwelling units are constructed.

Phase 3

Onsite piping improvements to serve the Phase 3 area between Sand Canyon Avenue and the SR 133 are shown in Figures 9-1, 9-2, and 9-3. Other than the pipelines shown, the Zone 3 to 3R PRV station will be constructed for this phase.

Onsite pipelines will be constructed concurrently with the onsite street improvements. A minimum of two connection points from existing offsite facilities to the onsite distribution system will be needed to provide adequate looping when more than 28 dwelling units are constructed.

Phase 4

Onsite piping improvements to serve the Phase 4 area east of the SR 133 are shown in Figures 9-1, 9-2, and 9-3. This phase includes the offsite facilities proposed in “O” Street. These facilities will need to be coordinated with the street construction and development schedule for the 5-Point Communities development.

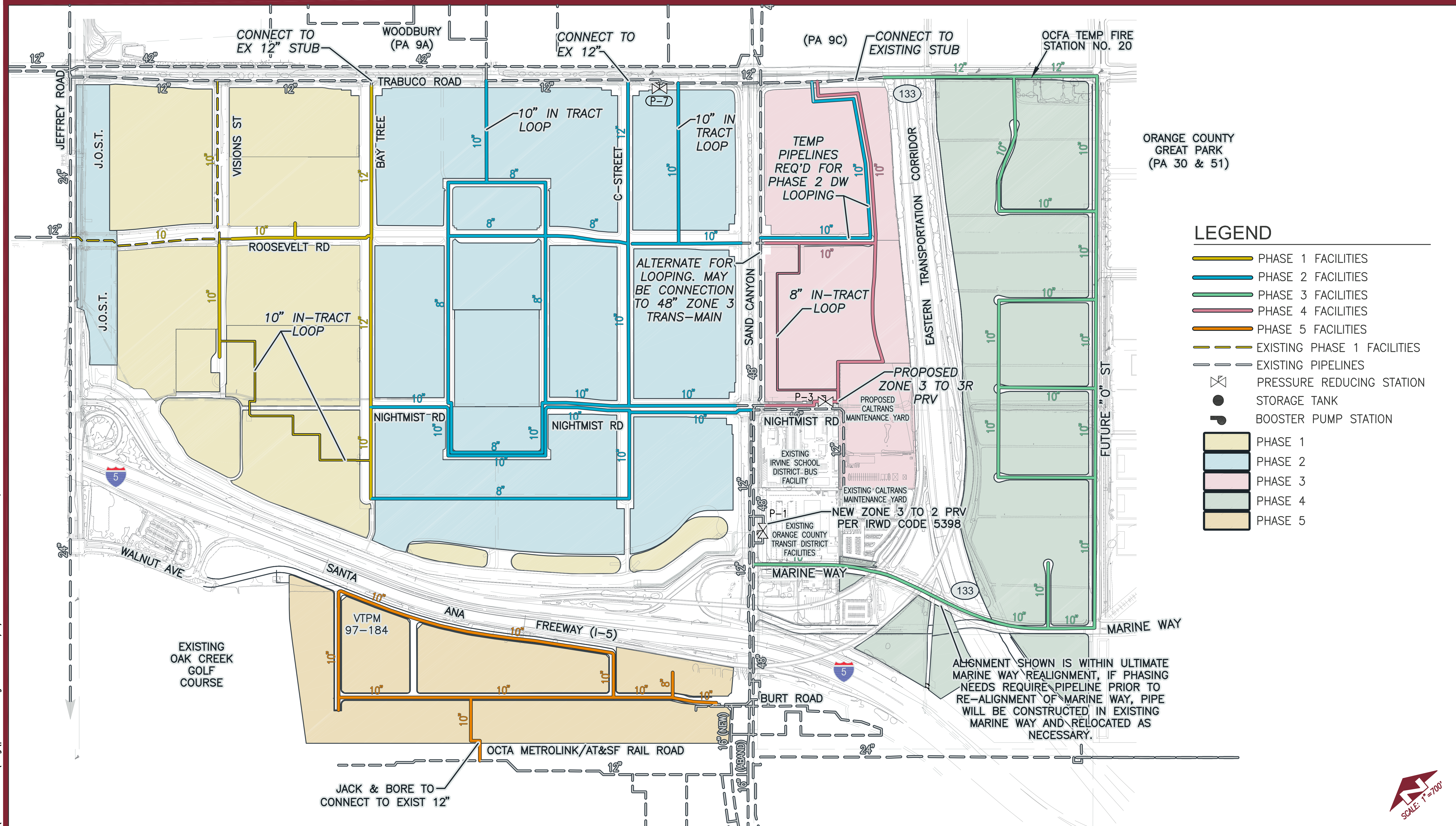
In addition, the offsite facilities for domestic water and nonpotable water shown in Marine Way will need to be coordinated with the future Marine Way realignment project. If the pipelines, or Phase 3 facilities, are needed prior to the Marine Way realignment project, the pipelines will be constructed in the existing Marine Way alignment. The pipelines would then be relocated as necessary with the Marine Way realignment.

With the completion of Phase 4, the offsite pipeline in Sand Canyon Avenue from Trabuco Road to Laguna Canyon Road, the pipeline within Trabuco Road, and the pumping capacity upgrades for the East IIC A to B BPS will be necessary.

Onsite pipelines will constructed concurrently with the onsite street improvements. A minimum of two connection points from existing offsite facilities to the onsite distribution system will be needed to provide adequate looping when more than 28 dwelling units are constructed.

Phase 5

Onsite piping improvements to serve the Phase 5 area within the northern portion of PA 12 are shown in Figures 9-1, 9-2, and 9-3. In addition to the onsite pipes, the jack and bore construction across the railroad from the existing 12-inch is required as shown.



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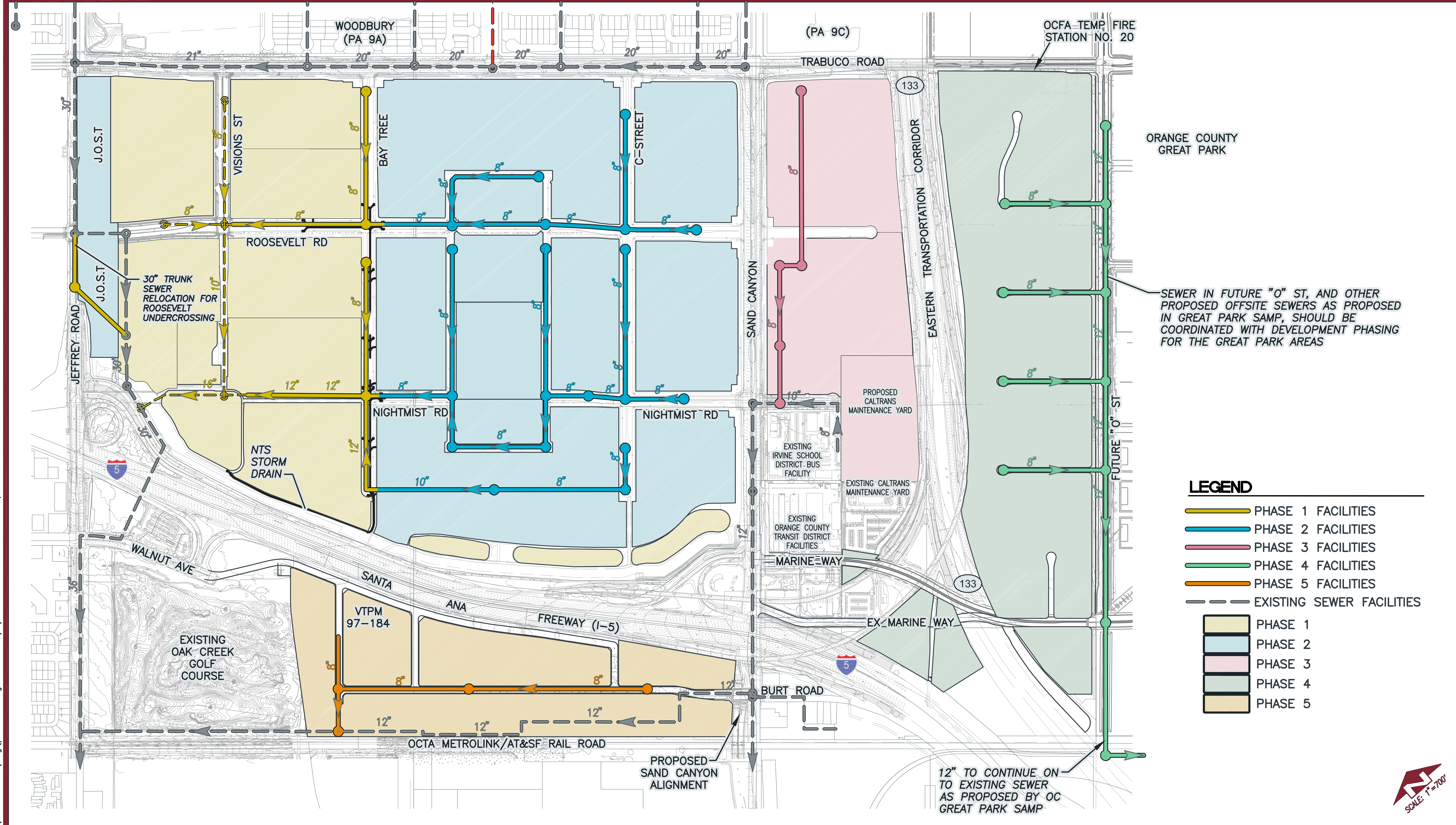
PLANNING AREA 40 SAMP

PHASING PLAN FOR DOMESTIC WATER SYSTEM

FIGURE 9-1



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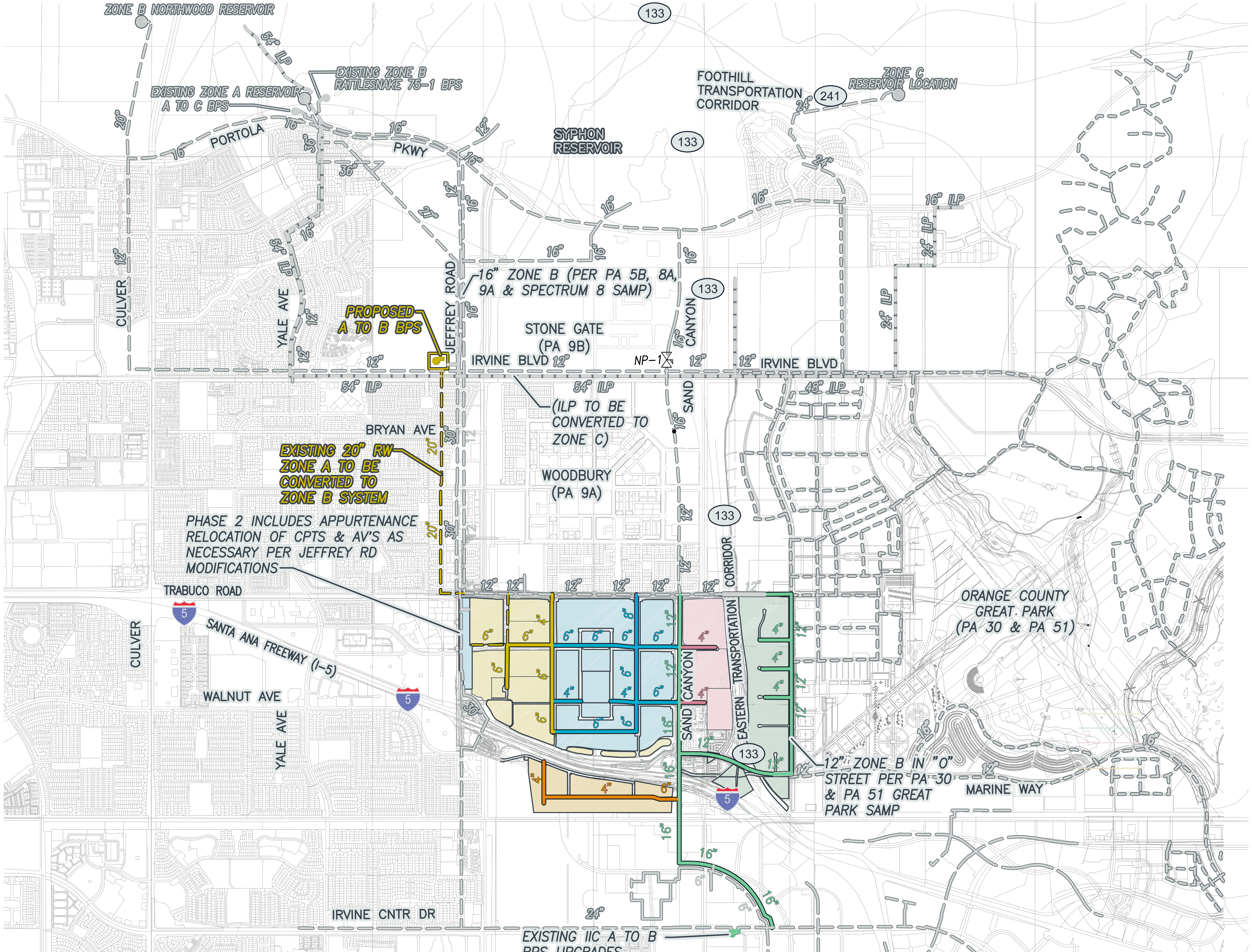
PLANNING AREA 40 SAMP

PHASING PLAN FOR SEWER COLLECTION SYSTEM

FIGURE 9-2



LEGEND

	PHASE 1 FACILITIES
	PHASE 2 FACILITIES
	PHASE 3 FACILITIES
	PHASE 4 FACILITIES
	PHASE 5 FACILITIES
	EXISTING PHASE 1 FACILITIES
	EXISTING FACILITIES
	PRESSURE REDUCING STATION
	STORAGE TANK
	BOOSTER PUMP STATION
	PHASE 1
	PHASE 2
	PHASE 3
	PHASE 4
	PHASE 5

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IRVINE RANCH WATER DISTRICT

PLANNING AREA 40 SAMP

PHASING PLAN FOR NON-POTABLE WATER SYSTEM

FIGURE 9-3

10.0 PROJECT COSTS

10.1 Capital Funding and Developer Funding

IRWD policy is to fund and construct the “backbone” facilities only. The in-tract or smaller facilities are typically funded and constructed by the developer. IRWD uses the criteria shown in Table 10-1 to determine which facilities are IRWD funded “capital” facility projects and which are developer funded projects.

Table 10-1 IRWD Funding Criteria		
System	**IRWD Funded Facilities**	**Developer Funded Facilities**
Domestic Water	Mains 12-inch and larger	Mains 10-inch and smaller
Sewer Collection	Sewers 12-inch and larger	Sewers 10-inch and smaller
Nonpotable Water	Mains 6-inch and larger	Mains 4-inch and smaller

Permanent storage tanks, pumping stations, and imported supply turnouts are generally IRWD funded Capital projects. Active, or primary source, pressure reducing stations that are equipped with telemetry are IRWD funded Capital projects. Pressure reducing stations that are secondary sources (or non-active) are funded according to the interconnected main size criteria shown in Table 10-1. Special consideration is given by IRWD funding of smaller facilities that help achieve a regional objective.

The engineering cost opinions in this chapter are provided for both IRWD funded Capital and developer funded projects. The costs have been categorized using the size and function criteria presented above.

10.1 Project Costs

Unit costs used in this SAMP, which include contractor’s overhead and profit, were taken from the WRMP and recent or similar construction bids for similar projects. For purposes of this SAMP, domestic water and nonpotable water pipeline unit costs for 12-inch and smaller assumed PVC, and pipes larger than 12-inch were based on Ductile Iron pipe costs. For sewer pipelines, PVC sewer pipe was assumed for pipes 12-inch and smaller, but for deep sewers greater than 15-feet PVC C-900 pipe is assumed. For sewers larger than 15-inch, vitrified clay pipe unit costs are assumed.

Tables 10-2, 10-3, and 10-4 are provided to show the project costs for the proposed facilities in this SAMP. The costs are subtotalled by phase as shown in Chapter 9. Total construction costs include an additional 35 percent for design, contract administration, inspection, legal fees, and construction contingencies.

Table 10-2 Proposed Domestic Water Facility Cost Opinion Summary					
Facility Description	**Quantity**	**Unit Cost**	**Total Cost**	**IRWD Cost Share**	**Developer Cost Share**
PA 40 Domestic Water Facilities					
Phase 1					
10-inch Pipe	4,856 lf	$ 70 lf	$ 339,920	-	$ 339,920
12-inch Pipe	2,500 lf	$ 85 lf	$ 212,500	$ 212,500	-
Phase 1 Subtotal			**$ 552,420**	**$ 212,500**	**$ 339,920**
Phase 2					
8-inch Pipe	9,121 Lf	$ 65 lf	$ 592,865	-	$ 592,865
10-inch Pipe	9,843 Lf	$ 70 lf	$ 689,010	-	$ 689,010
Temporary 10-inch Pipe	2,352 Lf	$ 65 lf	$ 152,880		$ 152,880
12-inch Pipe	816 Lf	$ 85 lf	$ 69,360	$ 69,360	-
Phase 2 Subtotal			**$ 1,504,115**	**$ 69,360**	**$ 1,434,755**
Phase 3					
8-inch Pipe	1,786 lf	$ 65 lf	$ 116,090	-	$ 116,090
10-inch Pipe	4,275 lf	$ 70 lf	$ 299,250	-	$ 299,250
Zn 3 to 3R PRV	1 ea	$ 125k ea	$ 125,000	$ 125,000	-
Phase 3 Subtotal			**$ 540,340**	**$ 125,000**	**$ 415,340**
Phase 4					
10-inch Pipe	12,982 lf	$ 70 lf	$ 908,740	-	$ 908,740
12-inch Pipe	1,664 lf	$ 85 lf	$ 174,720	$ 174,720	-
Phase 4 Subtotal			**$ 1,083,460**	**$ 174,720**	**$ 908,740**
PA 40 SubTotal			$ 3,680,335	$ 581,580	$ 3,098,755
PA 40 Total Contingencies, Admin., Engineering			$ 1,288,117	$ 203,553	$ 1,084,564
PA 40 Total			**$ 4,968,500**	**$ 785,200**	**$ 4,183,300**
PA 12 Area Domestic Water Facilities					
Phase 5					
10-inch Pipe	6,787 lf	$ 70 lf	$ 475,090	-	$ 475,090
10-inch Jack and Bore	155 lf	$ 850 lf	$ 131,750	$ 131,750	-
Phase 5 Subtotal			**$ 606,840**	**$ 131,750**	**$ 475,090**
PA 12 Subtotal			$ 606,840	$ 131,750	$ 475,090
PA 12 Total Contingencies, Admin., Engineering			$ 212,394	$ 46,113	$ 166,282
PA 12 Total			**$ 819,300**	**$ 177,900**	**$ 641,400**
Study Area Total			**$ 5,787,800**	**$963,100**	**$ 4,824,700**

1. Total project costs are rounded to the nearest one hundred dollars.

Table 10-3 Proposed Sewer Facility Cost Opinion Summary							
Facility Description	**Quantity**		**Unit Cost**		**Total Cost**	**IRWD Cost Share**	**Developer Cost Share**
PA 40 Sewer Collection Facilities							
Phase 1							
8-inch Pipe	2,852	lf	$ 85	lf	$ 242,420	-	$ 242,420
12-inch Pipe	1,648	lf	$ 175	lf	$ 288,400	$ 288,400	-
30-inch Relocation	965	Lf	$ 280	lf	$ 270,200	$ 270,200	-
			Phase 1 Subtotal		**$ 801,020**	**$ 558,600**	**$ 242,420**
Phase 2							
8-inch Pipe	12,540	Lf	$ 85	lf	$ 1,065,900	-	$ 1,065,900
10-inch Pipe	994	Lf	$ 110	lf	$ 109,340	-	$ 109,340
			Phase 2 Subtotal		**$ 1,175,240**	**-**	**$ 1,175,240**
Phase 3							
8-inch Pipe	2,599	lf	$ 85	lf	$ 220,915	-	$ 220,915
			Phase 3 Subtotal		**$ 220,915**	**-**	**$ 220,915**
Phase 4							
8-inch Pipe	3,168	lf	$ 85	lf	$ 269,280	-	$ 269,280
12-inch Pipe	4,891	lf	$ 175	lf	$ 855,925	$ 855,925	-
			Phase 4 Subtotal		**$ 1,125,205**	**$ 855,925**	**$ 269,280**
			PA 40 SubTotal		$ 3,322,380	$ 1,414,525	$ 1,907,855
			PA 40 Total Contingencies, Admin., Engineering		$ 1,162,833	$ 495,084	$ 667,750
			PA 40 Total		**$ 4,485,200**	**$ 1,909,600**	**$ 2,575,600**
PA 12 Area Sewer Collection Facilities							
Phase 5							
8-inch Pipe	3,136	lf	$ 85	lf	$ 266,560	-	$ 266,560
			Phase 5 Subtotal		**$ 266,560**	**-**	**$ 266,560**
			PA 12 Subtotal		$ 266,560	-	$ 266,560
			PA 12 Total Contingencies, Admin., Engineering		$ 93,296	-	$ 93,296
			PA 12 Total		**$ 359,900**	**-**	**$ 359,900**
			Study Area Total		**$ 4,845,100**	**$ 1,909,600**	**$ 2,935,500**

1. Total project costs are rounded to the nearest one hundred dollars.

Table 10-4 Proposed Nonpotable Facility Cost Opinion Summary								
Facility Description	**Quantity**		**Unit Cost**		**Total Cost**	**IRWD Cost Share**	**Developer Cost Share**
PA 40 Nonpotable Water Facilities							
Phase 1							
4-inch Pipe	1,210	lf	$ 50	lf	$ 60,500	-	$ 60,500
6-inch Pipe	4,164	lf	$ 60	Lf	$ 249,840	$ 249,840	-
Temp A to B BPS	1	ea	$0.25	mil	$ 250,000	-	$ 250,000
Trabuco AG Lateral Upsizing	1	ls	1	Ls	$ 25,000	-	$ 25,000
20-inch Pipe Zone A to B Conversion	1	ls	1	ls	$ 20,000	$ 20,000	-
				Phase 1 Subtotal	**$ 605,340**	**$ 269,840**	**$ 335,500**
Phase 2							
4-inch Pipe	1,304	lf	$ 50	lf	$ 65,200	-	$ 65,200
6-inch Pipe	7,745	lf	$ 60	lf	$ 464,700	$ 464,700	-
8-inch Pipe	1,250	lf	$ 65	lf	$ 81,250	$ 81,250	-
Permanent A to B BPS	1	ea	$1.6	mil	$ 1,600,000	$ 1,600,000	-
Northwood Tank Alt. Valve	1	ls	1	ls	$ 75,000	$ 75,000	-
				Phase 2 Subtotal	**$ 2,286,150**	**$ 2,220,950**	**$ 65,200**
Phase 3							
4-inch Pipe	1,456	lf	$ 50	lf	$ 72,800	-	$ 72,800
				Phase 3 Subtotal	**$ 72,800**	**-**	**$ 72,800**
Phase 4							
4-inch Pipe	2,078	lf	$ 50	lf	$ 103,900	-	$ 103,900
12-inch Pipe ("O" St)	4,294	lf	$ 105	lf	$ 450,870	$ 450,870	-
12-inch Pipe (Trabuco, Sand Canyon, Marine Way)	6,957	lf	$ 130	lf	$ 904,410	$ 904,410	-
16-inch Pipe	6,794	lf	$ 250	lf	$ 1,698,500	$ 1,698,500	-
IIC A to B BPS Upgrades	1	ls	$150k	ls	$ 150,000	$ 150,000	
				Phase 4 Subtotal	**$ 3,307,680**	**$ 3,203,780**	**$ 103,900**
				PA 40 SubTotal	$ 6,271,970	$ 5,694,570	$ 577,400
				PA 40 Total Contingencies, Admin., Engineering	$ 2,195,190	$ 1,993,100	$ 202,090
				PA 40 Total	**$ 8,467,200**	**$ 7,687,700**	**$ 779,500**
PA 12 Area Nonpotable Water Facilities							
Phase 5							
4-inch Pipe	4,234	lf	$ 50	lf	$ 211,700	-	$ 211,700
6-inch Pipe	600	lf	$ 60	lf	$ 36,000	$ 36,000	-
				Phase 5 Subtotal	**$ 247,700**	**$36,000**	**$ 211,700**
				PA 12 Subtotal	$ 247,700	$36,000	$ 211,700
				PA 12 Total Contingencies, Admin., Engineering	$ 86,695	$ 12,600	$ 74,095
				PA 12 Total	**$ 334,400**	**$ 48,600**	**$ 285,800**
				Study Area Total	**$ 8,801,600**	**$ 7,736,300**	**$ 1,065,300**

1. Total project costs are rounded to the nearest one hundred dollars.

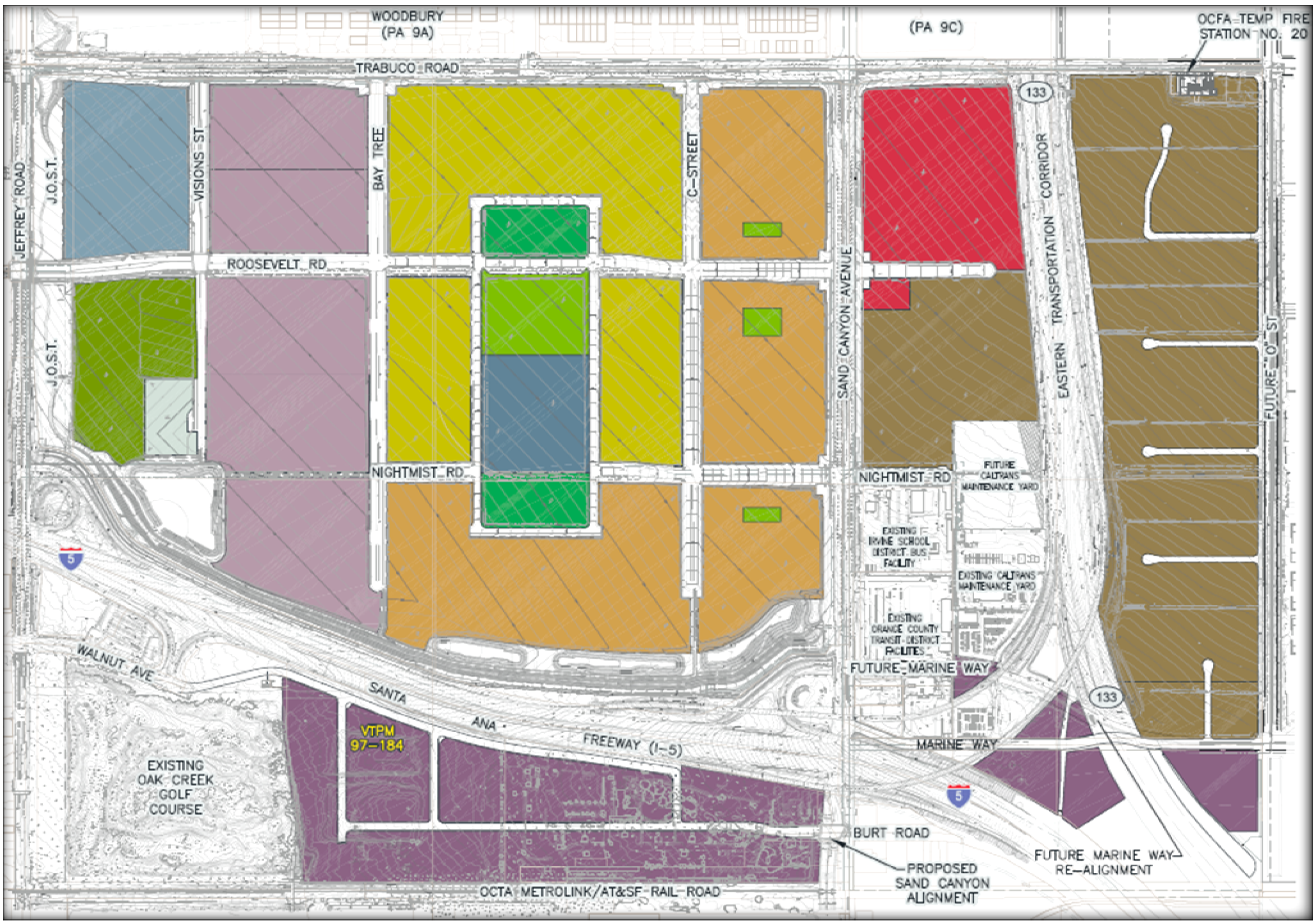
Table 10-5 Summary of Estimated Project Costs			
Planning Area/Phase/System	**Total Estimated Project Costs**	**IRWD Portion**	**Developer Portion**
PA 40			
Domestic Water System	$ 4,968,500	$ 785,200	$ 4,183,300
Wastewater Collection System	$ 4,485,200	$ 1,909,600	$ 2,575,600
Nonpotable Water System	$ 8,467,200	$ 7,687,700	$ 779,500
Subtotal PA 40	**$ 17,920,900**	**$ 10,382,500**	**$ 7,538,400**
PA 12			
Domestic Water System	$ 819,300	$ 177,900	$ 641,400
Wastewater Collection System	359,900	-	$ 359,900
Nonpotable Water System	$ 334,400	$ 48,600	$ 285,800
Subtotal PA 12	**$ 1,513,600**	**$ 226,500**	**$ 1,287,100**
Total	**$ 19,434,500**	**$ 10,609,000**	**$ 8,825,500**

1. Total costs are rounded to the nearest hundred dollars.

Planning Area 40
Sub Area Master Plan

APPENDICES

Project Numbers 11399 & 21399



Prepared for:
Irvine Ranch Water District
15600 Sand Canyon Avenue
Irvine, CA 92618

Prepared by:
Stantec Consulting, Inc.
19 Technology Drive
Irvine, CA 92618

January 2011

PLANNING AREA 40
SUB AREA MASTER PLAN

APPENDICES

Project Numbers 11399 & 21399

Prepared for:
Irvine Ranch Water District
15600 Sand Canyon Avenue
Irvine, CA 92618

Prepared by:
Stantec Consulting, Inc.
19 Technology Drive
Irvine, CA 92618

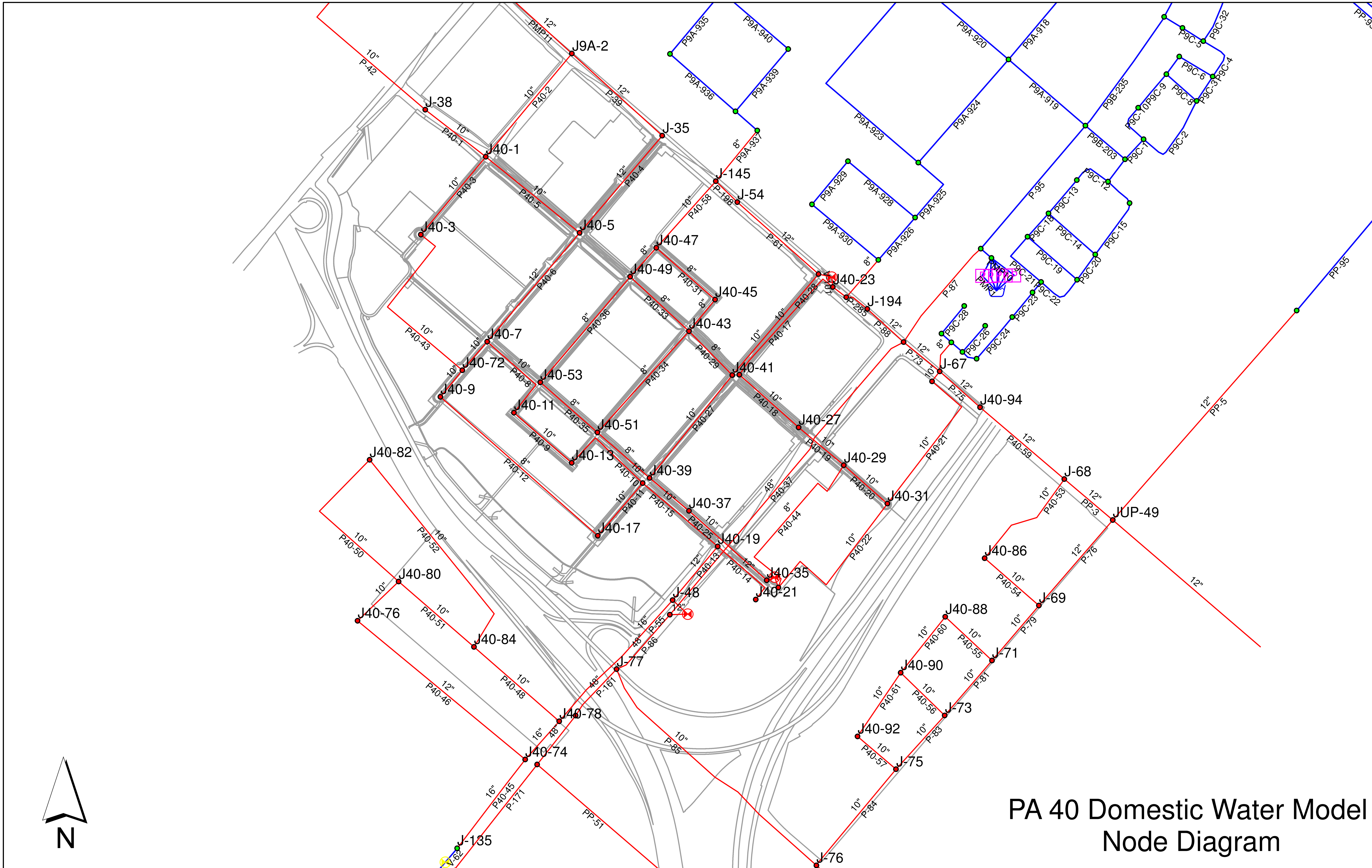
January 2011

Table of Contents

APPENDIX 1

DOMESTIC WATER SYSTEM ANALYSIS

PA 40 Domestic Water Model
Node Diagram



		ID	From Node	To Node	Length (ft)	Diameter (in)	Roughness	Flow (gpm)	Velocity (ft/s)	Headloss (ft)	HL/1000 (ft/kft)
1	☐	P40-1	J-38	J40-1	731.15	10.00	130.00	-80.46	0.33	0.04	0.06
2	☐	P40-2	J40-1	J9A-2	1,281.70	10.00	130.00	-41.96	0.17	0.02	0.02
3	☐	P40-3	J40-1	J40-3	966.02	10.00	130.00	-13.33	0.05	0.00	0.00
4	☐	P40-4	J-35	J40-5	1,215.36	12.00	130.00	38.50	0.11	0.01	0.01
5	☐	P40-5	J40-5	J40-1	1,151.31	10.00	130.00	25.17	0.10	0.01	0.01
6	☐	P40-6	J40-5	J40-7	1,362.35	12.00	130.00	13.33	0.04	0.00	0.00
7	☐	P40-7	J40-7	J40-72	360.55	10.00	130.00	13.33	0.05	0.00	0.00
8	☐	P40-13	J-48	J40-19	667.03	12.00	130.00	0.00	0.00	0.00	0.00
9	☐	P40-14	J40-19	J40-21	738.28	12.00	130.00	0.00	0.00	0.00	0.00
10	☐	P40-42	J40-72	J40-9	328.90	10.00	130.00	0.00	0.00	0.00	0.00
11	☐	P40-43	J40-3	J40-72	1,850.79	10.00	130.00	-13.33	0.05	0.00	0.00

PA 40 Domestic Water - Phase 1 - Peak Hour - Junction Report

		ID	Demand (gpm)	Elevation (ft)	Head (ft)	Pressure (psi)	Water Age (hrs)
1	☐	J40-1	0.00	190.00	343.33	66.44	0.00
2	☐	J40-3	0.00	177.00	343.33	72.07	0.00
3	☐	J40-5	0.00	202.00	343.34	61.24	0.00
4	☐	J40-7	0.00	189.00	343.34	66.88	0.00
5	☐	J40-9	0.00	180.00	343.34	70.77	0.00
6	☐	J40-19	0.00	229.00	333.31	45.20	0.00
7	☐	J40-21	0.00	233.00	333.31	43.46	0.00
8	☐	J40-72	0.00	185.00	343.34	68.61	0.00

PA 40 Domestic Water - Phase 1 - Max Day plus Fire Flow Report

		ID	Static Demand (gpm)	Static Pressure (psi)	Static Head (ft)	Fire-Flow Demand (gpm)	Residual Pressure (psi)	Available Flow at Hydrant (gpm)	Available Flow Pressure (psi)
1	☐	J40-1	3.00	63.07	335.56	3,000.00	33.10	3,707.57	20.14
2	☐	J40-19	0.00	45.23	333.39	3,000.00	39.01	6,391.83	20.41
3	☐	J40-21	53.00	43.49	333.38	3,000.00	30.87	4,252.00	20.18
4	☐	J40-3	216.00	68.53	335.16	3,000.00	28.92	3,589.56	20.11
5	☐	J40-5	216.00	57.79	335.38	3,000.00	25.35	3,491.33	20.11
6	☐	J40-7	88.00	63.35	335.20	3,000.00	25.48	3,330.26	20.11
7	☐	J40-9	132.20	67.21	335.11	3,000.00	20.02	3,129.58	20.09

PA 40 Domestic Water - Phase 2 - Peak Hour - Pipe Report

		ID	From Node	To Node	Length (ft)	Diameter (in)	Roughness	Flow (gpm)	Velocity (ft/s)	Headloss (ft)	HL/1000 (ft/kft)
1		P40-1	J-38	J40-1	731.15	10.00	130.00	132.29	0.54	0.11	0.15
2		P40-2	J40-1	J9A-2	1,281.70	10.00	130.00	-145.54	0.59	0.22	0.17
3		P40-3	J40-1	J40-3	966.02	10.00	130.00	160.95	0.66	0.20	0.21
4		P40-4	J-35	J40-5	1,215.36	12.00	130.00	216.86	0.62	0.18	0.15
5		P40-5	J40-5	J40-1	1,151.31	10.00	130.00	-116.87	0.48	0.13	0.12
6		P40-6	J40-5	J40-7	1,362.35	12.00	130.00	333.73	0.95	0.45	0.33
7		P40-7	J40-7	J40-72	360.55	10.00	130.00	30.93	0.13	0.00	0.01
8		P40-8	J40-7	J40-11	960.24	10.00	130.00	302.80	1.24	0.65	0.67
9		P40-9	J40-11	J40-13	729.33	10.00	130.00	205.56	0.84	0.24	0.33
10		P40-10	J40-13	J40-15	952.75	10.00	130.00	205.56	0.84	0.31	0.33
11		P40-11	J40-15	J40-17	657.20	10.00	130.00	362.12	1.48	0.62	0.94
12		P40-12	J40-17	J40-9	2,001.70	8.00	130.00	-191.88	1.22	1.72	0.86
13		P40-13	J-48	J40-19	667.03	12.00	130.00	156.56	0.44	0.05	0.08
14		P40-14	J40-19	J40-21	738.28	12.00	130.00	0.00	0.00	0.00	0.00
15		P40-15	J40-19	J40-15	935.89	10.00	130.00	156.56	0.64	0.19	0.20
16		P40-17	J40-23	J40-25	1,332.93	10.00	130.00	-267.95	1.09	0.72	0.54
17		P40-18	J40-25	J40-27	754.76	10.00	130.00	-328.95	1.34	0.59	0.79
18		P40-19	J40-27	J40-29	562.63	10.00	130.00	-389.95	1.59	0.61	1.08
19		P40-20	J40-29	J40-31	553.17	10.00	130.00	-450.95	1.84	0.78	1.41
20		P40-21	J40-31	J40-70	1,534.39	10.00	130.00	-511.95	2.09	2.74	1.78
21		P40-26	J40-37	J40-39	488.79	10.00	130.00	-82.00	0.33	0.03	0.06
22		P40-27	J40-39	J40-41	1,257.73	10.00	130.00	-234.61	0.96	0.53	0.42
23		P40-28	J40-41	J-53	1,266.66	10.00	130.00	-514.28	2.10	2.28	1.80
24		P40-29	J40-41	J40-43	587.82	8.00	130.00	197.66	1.26	0.53	0.91
25		P40-30	J40-43	J40-45	391.17	8.00	130.00	30.21	0.19	0.01	0.03
26		P40-31	J40-45	J40-47	746.64	8.00	130.00	-51.79	0.33	0.06	0.08
27		P40-32	J40-47	J40-49	371.13	8.00	130.00	89.93	0.57	0.08	0.21
28		P40-33	J40-49	J40-43	764.36	8.00	130.00	-37.90	0.24	0.03	0.04
29		P40-34	J40-43	J40-51	1,300.72	8.00	130.00	47.55	0.30	0.08	0.06
30		P40-35	J40-51	J40-53	724.22	8.00	130.00	36.17	0.23	0.03	0.04
31		P40-36	J40-53	J40-49	1,322.04	8.00	130.00	-45.83	0.29	0.08	0.06
32		P40-40	J40-39	J40-51	660.47	8.00	130.00	70.61	0.45	0.09	0.13
33		P40-41	J40-70	J-67	120.33	10.00	130.00	-511.95	2.09	0.21	1.78
34		P40-42	J40-72	J40-9	328.90	10.00	130.00	191.88	0.78	0.10	0.29
35		P40-43	J40-3	J40-72	1,850.79	10.00	130.00	160.95	0.66	0.39	0.21

PA 40 Domestic Water - Phase 2 - Peak Hour - Junction Report

		ID	Demand (gpm)	Elevation (ft)	Head (ft)	Pressure (psi)
1	☐	J40-1	0.00	190.00	334.82	62.75
2	☐	J40-3	0.00	177.00	334.62	68.30
3	☐	J40-5	0.00	202.00	334.69	57.49
4	☐	J40-7	0.00	189.00	334.23	62.93
5	☐	J40-9	0.00	180.00	334.13	66.79
6	☐	J40-11	97.24	194.00	333.59	60.48
7	☐	J40-13	0.00	201.00	333.35	57.35
8	☐	J40-15	0.00	214.00	333.03	51.58
9	☐	J40-17	554.00	205.00	332.42	55.21
10	☐	J40-19	0.00	229.00	333.22	45.16
11	☐	J40-21	0.00	233.00	333.22	43.42
12	☐	J40-25	61.00	226.00	440.38	92.89
13	☐	J40-27	61.00	237.00	440.97	88.38
14	☐	J40-29	61.00	247.00	441.58	84.31
15	☐	J40-31	61.00	251.00	442.36	82.91
16	☐	J40-37	82.00	223.00	376.02	66.30
17	☐	J40-39	82.00	214.00	376.05	70.22
18	☐	J40-41	82.00	226.00	376.58	65.25
19	☐	J40-43	82.00	218.00	376.05	68.48
20	☐	J40-45	82.00	230.00	376.04	63.28
21	☐	J40-47	82.00	217.00	376.09	68.93
22	☐	J40-49	82.00	211.00	376.01	71.50
23	☐	J40-51	82.00	196.00	375.96	77.98
24	☐	J40-53	82.00	196.00	375.93	77.97
25	☐	J40-70	0.00	262.00	445.09	79.33
26	☐	J40-72	0.00	185.00	334.23	64.66

PA 40 Domestic Water - Phase 2 - Peak Hour - DPR196 Valve Report

		ID	Diameter (in)	Elevation (ft)	Upstream Pressure (psi)	Downstream Pressure (psi)	Flow (gpm)	Velocity (ft/s)	Headloss (ft)
1	☐	V40-3	12.00	218.00	98.59	50.00	971.56	2.76	112.15

PA 40 Domestic Water - Phase 2 - Max Day plus Fire Flow Report

		ID	Static Demand (gpm)	Static Pressure (psi)	Static Head (ft)	Fire-Flow Demand (gpm)	Residual Pressure (psi)	Available Flow at Hydrant (gpm)	Available Flow Pressure (psi)
1		J40-1	0.00	62.75	334.82	3,000.00	48.70	5,542.48	20.31
2		J40-3	0.00	68.30	334.62	3,000.00	48.17	4,859.80	20.24
3		J40-5	0.00	57.49	334.69	3,000.00	43.27	5,135.65	20.26
4		J40-7	0.00	62.93	334.23	3,000.00	48.57	5,583.22	20.31
5		J40-9	0.00	66.79	334.13	3,000.00	47.47	4,953.51	20.25
6		J40-11	97.24	60.48	333.59	3,000.00	41.50	4,746.89	20.22
7		J40-13	0.00	57.35	333.35	3,000.00	38.73	4,495.77	20.20
8		J40-15	0.00	51.58	333.03	3,000.00	37.75	4,955.58	20.25
9		J40-17	554.00	55.21	332.42	3,000.00	32.18	4,458.02	20.15
10		J40-19	0.00	45.16	333.22	3,000.00	39.95	7,525.68	20.57
11		J40-21	0.00	43.42	333.22	3,000.00	32.01	4,488.66	20.20
12		J40-25	61.00	92.89	440.38	3,000.00	72.51	6,613.85	20.43
13		J40-27	61.00	88.38	440.97	3,000.00	66.53	6,028.21	20.36
14		J40-29	61.00	84.31	441.58	4,000.00	49.84	5,843.22	20.33
15		J40-31	61.00	82.91	442.36	4,000.00	50.68	6,002.13	20.35
16		J40-37	82.00	66.30	376.02	3,000.00	26.13	3,290.60	20.10
17		J40-39	82.00	70.22	376.05	3,000.00	40.52	3,915.99	20.15
18		J40-41	82.00	65.25	376.58	3,000.00	46.17	4,458.27	20.19
19		J40-43	82.00	68.48	376.05	2,500.00	54.68	4,412.06	20.19
20		J40-45	82.00	63.28	376.04	2,500.00	45.33	3,787.14	20.14
21		J40-47	82.00	68.93	376.09	2,500.00	57.58	4,718.26	20.21
22		J40-49	82.00	71.50	376.01	2,500.00	56.14	4,362.23	20.18
23		J40-51	82.00	77.98	375.96	3,000.00	48.09	4,181.93	20.17
24		J40-53	82.00	77.97	375.93	3,000.00	38.70	3,699.22	20.13

PA 40 Domestic Water - Build Out - Peak Hour - Junction Report

		ID	Demand (gpm)	Elevation (ft)	Head (ft)	Pressure (psi)
1	☐	J-130	0.00	200.00	441.52	104.65
2	☐	J-145	171.04	225.00	376.42	65.61
3	☐	J-146	0.00	245.00	436.40	82.93
4	☐	J-194	0.00	250.00	438.16	81.53
5	☐	J-35	0.00	211.00	328.68	50.99
6	☐	J-38	0.00	175.00	328.51	66.52
7	☐	J40-1	0.00	190.00	328.63	60.07
8	☐	J40-11	97.24	194.00	328.78	58.40
9	☐	J40-13	0.00	201.00	329.02	55.47
10	☐	J40-15	0.00	214.00	329.35	49.98
11	☐	J40-17	554.00	205.00	328.32	53.43
12	☐	J40-19	0.00	229.00	332.22	44.72
13	☐	J40-21	0.00	233.00	332.22	42.99
14	☐	J40-23	0.00	245.00	435.55	82.56
15	☐	J40-25	61.00	226.00	435.96	90.98
16	☐	J40-27	61.00	237.00	436.35	86.38
17	☐	J40-29	61.00	247.00	436.77	82.23
18	☐	J40-3	0.00	177.00	328.64	65.70
19	☐	J40-31	61.00	251.00	437.18	80.67
20	☐	J40-33	61.00	235.00	436.97	87.51
21	☐	J40-35	0.00	235.00	376.02	61.10
22	☐	J40-37	82.00	223.00	376.02	66.30
23	☐	J40-39	82.00	214.00	376.05	70.22
24	☐	J40-41	82.00	226.00	376.58	65.25
25	☐	J40-43	82.00	218.00	376.05	68.48
26	☐	J40-45	82.00	230.00	376.04	63.28
27	☐	J40-47	82.00	217.00	376.09	68.93
28	☐	J40-49	82.00	211.00	376.01	71.50
29	☐	J40-5	0.00	202.00	328.67	54.89
30	☐	J40-51	82.00	196.00	375.96	77.98
31	☐	J40-53	82.00	196.00	375.93	77.97
32	☐	J40-55	0.00	218.00	441.53	96.85
33	☐	J40-7	0.00	189.00	328.67	60.52
34	☐	J40-70	0.00	262.00	439.84	77.06
35	☐	J40-72	0.00	185.00	328.65	62.24
36	☐	J40-74	754.00	190.00	331.88	61.48
37	☐	J40-76	61.00	165.00	331.86	72.30
38	☐	J40-78	61.00	198.00	332.08	58.09
39	☐	J40-80	61.00	175.00	331.87	67.97
40	☐	J40-82	0.00	167.00	331.88	71.44
41	☐	J40-84	61.00	185.00	331.89	63.65
42	☐	J40-86	240.00	265.00	437.19	74.61
43	☐	J40-88	240.00	258.00	436.25	77.23
44	☐	J40-9	0.00	180.00	328.63	64.40
45	☐	J40-90	240.00	248.00	436.25	81.57
46	☐	J40-92	240.00	245.00	436.25	82.87
47	☐	J40-94	0.00	0.00	439.34	190.36
48	☐	J-48	0.00	218.00	333.06	49.86
49	☐	J-53	313.05	245.00	378.86	58.00
50	☐	J-54	75.19	228.00	376.88	64.51
51	☐	J-66	0.00	255.00	441.61	80.86
52	☐	J-67	26.73	263.00	440.05	76.72
53	☐	J-68	0.00	280.00	437.87	68.41
54	☐	J-69	23.75	270.00	437.17	72.44
55	☐	J-71	11.88	262.00	436.52	75.62
56	☐	J-73	10.40	254.00	436.45	79.05

		ID	Demand (gpm)	Elevation (ft)	Head (ft)	Pressure (psi)
57	☐	J-75	29.08	245.00	436.52	82.98
58	☐	J-76	32.50	225.00	437.90	92.25
59	☐	J-77	0.00	209.00	441.52	100.75
60	☐	J9A-2	0.00	198.00	328.69	56.63
61	☐	JUP-49	94.50	290.00	437.54	63.93
62	☐	JUP-89	602.73	190.00	441.52	108.98

PA 40 Domestic Water - Build Out - Peak Hour - Pipe Report

		ID	From Node	To Node	Length (ft)	Diameter (in)	Roughness	Flow (gpm)	Velocity (ft/s)	Headloss (ft)	HL/1000 (ft/kft)
1	☐	P40-1	J-38	J40-1	731.15	10.00	130.00	-142.95	0.58	0.12	0.17
2	☐	P40-2	J40-1	J9A-2	1,281.70	10.00	130.00	-68.11	0.28	0.05	0.04
3	☐	P40-3	J40-1	J40-3	966.02	10.00	130.00	-14.45	0.06	0.00	0.00
4	☐	P40-4	J-35	J40-5	1,215.36	12.00	130.00	39.73	0.11	0.01	0.01
5	☐	P40-5	J40-5	J40-1	1,151.31	10.00	130.00	60.38	0.25	0.04	0.03
6	☐	P40-6	J40-5	J40-7	1,362.35	12.00	130.00	-20.65	0.06	0.00	0.00
7	☐	P40-7	J40-7	J40-72	360.55	10.00	130.00	91.03	0.37	0.03	0.07
8	☐	P40-8	J40-7	J40-11	960.24	10.00	130.00	-111.68	0.46	0.10	0.11
9	☐	P40-9	J40-11	J40-13	729.33	10.00	130.00	-208.92	0.85	0.25	0.34
10	☐	P40-10	J40-13	J40-15	952.75	10.00	130.00	-208.92	0.85	0.32	0.34
11	☐	P40-11	J40-15	J40-17	657.20	10.00	130.00	477.43	1.95	1.03	1.57
12	☐	P40-12	J40-17	J40-9	2,001.70	8.00	130.00	-76.57	0.49	0.31	0.16
13	☐	P40-13	J-48	J40-19	667.03	12.00	130.00	686.35	1.95	0.84	1.26
14	☐	P40-14	J40-19	J40-21	738.28	12.00	130.00	0.00	0.00	0.00	0.00
15	☐	P40-15	J40-19	J40-15	935.89	10.00	130.00	686.35	2.80	2.87	3.07
16	☐	P40-17	J40-23	J40-25	1,332.93	10.00	130.00	-199.50	0.81	0.41	0.31
17	☐	P40-18	J40-25	J40-27	754.76	10.00	130.00	-260.50	1.06	0.39	0.51
18	☐	P40-19	J40-27	J40-29	562.63	10.00	130.00	-321.50	1.31	0.42	0.75
19	☐	P40-20	J40-29	J40-31	553.17	10.00	130.00	-318.63	1.30	0.41	0.74
20	☐	P40-21	J40-31	J40-70	1,534.39	10.00	130.00	-504.50	2.06	2.66	1.74
21	☐	P40-22	J40-31	J40-33	1,627.62	10.00	130.00	124.87	0.51	0.21	0.13
22	☐	P40-23	J40-33	V40-1	107.21	12.00	130.00	0.00	0.00	0.00	0.00
23	☐	P40-24	V40-1	J40-35	83.86	12.00	130.00	0.00	0.00	0.00	0.00
24	☐	P40-25	J40-35	J40-37	993.74	10.00	130.00	0.00	0.00	0.00	0.00
25	☐	P40-26	J40-37	J40-39	488.79	10.00	130.00	-82.00	0.33	0.03	0.06
26	☐	P40-27	J40-39	J40-41	1,257.73	10.00	130.00	-234.61	0.96	0.53	0.42
27	☐	P40-28	J40-41	J-53	1,266.66	10.00	130.00	-514.28	2.10	2.28	1.80
28	☐	P40-29	J40-41	J40-43	587.82	8.00	130.00	197.66	1.26	0.53	0.91
29	☐	P40-30	J40-43	J40-45	391.17	8.00	130.00	30.21	0.19	0.01	0.03
30	☐	P40-31	J40-45	J40-47	746.64	8.00	130.00	-51.79	0.33	0.06	0.08
31	☐	P40-32	J40-47	J40-49	371.13	8.00	130.00	89.93	0.57	0.08	0.21
32	☐	P40-33	J40-49	J40-43	764.36	8.00	130.00	-37.90	0.24	0.03	0.04
33	☐	P40-34	J40-43	J40-51	1,300.72	8.00	130.00	47.55	0.30	0.08	0.06
34	☐	P40-35	J40-51	J40-53	724.22	8.00	130.00	36.17	0.23	0.03	0.04
35	☐	P40-36	J40-53	J40-49	1,322.04	8.00	130.00	-45.83	0.29	0.08	0.06
36	☐	P40-40	J40-39	J40-51	660.47	8.00	130.00	70.61	0.45	0.09	0.13
37	☐	P40-41	J40-70	J-67	120.33	10.00	130.00	-504.50	2.06	0.21	1.73
38	☐	P40-42	J40-72	J40-9	328.90	10.00	130.00	76.57	0.31	0.02	0.05
39	☐	P40-43	J40-3	J40-72	1,850.79	8.00	130.00	-14.45	0.09	0.01	0.01
40	☐	P40-44	J40-29	J40-33	1,759.85	8.00	130.00	-63.87	0.41	0.20	0.11
41	☐	P40-46	J40-74	J40-76	2,074.67	12.00	130.00	39.93	0.11	0.01	0.01
42	☐	P40-47	J40-78	J40-74	488.31	16.00	130.00	793.93	1.27	0.20	0.41
43	☐	P40-48	J40-78	J40-84	1,079.27	10.00	130.00	143.07	0.58	0.18	0.17
44	☐	P40-49	J40-80	J40-76	541.90	10.00	130.00	21.07	0.09	0.00	0.00
45	☐	P40-50	J40-80	J40-82	1,694.79	10.00	130.00	-25.99	0.11	0.01	0.01
46	☐	P40-51	J40-84	J40-80	950.45	10.00	130.00	56.08	0.23	0.03	0.03
47	☐	P40-52	J40-82	J40-84	2,255.54	10.00	130.00	-25.99	0.11	0.02	0.01
48	☐	P-55	J-48	J40-78	1,583.93	16.00	130.00	998.00	1.59	0.99	0.62
49	☐	P-86	J-77	J40-55	733.25	48.00	130.00	-1,379.62	0.24	0.00	0.01
50	☐	P40-37	J40-55	J-66	3,438.90	48.00	130.00	-3,063.97	0.54	0.08	0.02
51	☐	P40-38	J40-55	V40-3	50.00	12.00	130.00	1,684.35	4.78	0.33	6.66
52	☐	P40-39	V40-3	J-48	50.00	12.00	130.00	1,684.35	4.78	0.33	6.66
53	☐	P-85	J-76	J-77	2,698.30	10.00	130.00	-439.17	1.79	3.62	1.34
54	☐	P-161	J-77	J-130	592.55	48.00	130.00	940.45	0.17	0.00	0.00
55	☐	P-61	J-53	J-54	1,034.86	12.00	130.00	858.38	2.44	1.98	1.91
56	☐	P40-16	J-146	J40-23	161.22	12.00	130.00	1,486.21	4.22	0.85	5.28

		ID	From Node	To Node	Length (ft)	Diameter (in)	Roughness	Flow (gpm)	Velocity (ft/s)	Headloss (ft)	HL/1000 (ft/kft)
57	☐	V-101	J40-23	V-10	96.70	9,999.00	130.00	1,685.72	0.00	0.00	0.00
58	☐	V-102	V-10	J-53	128.54	9,999.00	130.00	1,685.72	0.00	0.00	0.00
59	☐	P-198	J-54	J-145	285.44	12.00	130.00	783.19	2.22	0.46	1.61
60	☐	P9A-937	J9A-926	J-145	624.78	8.00	130.00	-388.43	2.48	1.98	3.17
61	☐	P40-58	J-145	J40-47	851.72	10.00	130.00	223.72	0.91	0.33	0.38
62	☐	P-39	J-35	J9A-2	1,163.68	12.00	130.00	-39.73	0.11	0.01	0.01
63	☐	PMP11	J9A-2	J-143	1,092.64	12.00	130.00	-107.84	0.31	0.04	0.04
64	☐	P-42	J-37	J-38	2,155.55	10.00	130.00	-142.95	0.58	0.36	0.17
65	☐	P-88	J-66	J-194	469.67	12.00	130.00	1,776.19	5.04	3.45	7.34
66	☐	P-285	J-194	J-146	239.45	12.00	130.00	1,776.19	5.04	1.76	7.34
67	☐	P9A-927	J9A-919	J-146	469.20	8.00	130.00	-289.98	1.85	0.87	1.84
68	☐	P-73	J-66	J-67	442.51	12.00	130.00	1,192.91	3.38	1.55	3.51
69	☐	P-87	J-66	J-78	1,157.48	48.00	130.00	-6,033.07	1.07	0.10	0.08
70	☐	P-75	J-67	J40-94	515.38	12.00	130.00	722.94	2.05	0.72	1.39
71	☐	P9C-30	J9C-24	J-67	315.91	8.00	130.00	61.26	0.39	0.03	0.10
72	☐	P40-53	J-68	J40-86	1,108.89	10.00	130.00	288.32	1.18	0.68	0.62
73	☐	P40-59	J40-94	J-68	1,054.39	12.00	130.00	722.94	2.05	1.47	1.39
74	☐	P-76	JUP-49	J-69	1,076.92	12.00	130.00	340.12	0.96	0.37	0.34
75	☐	PP-3	J-68	JUP-49	604.94	12.00	130.00	434.62	1.23	0.33	0.54
76	☐	PP-5	JUP-47	JUP-49	2,657.39	12.00	130.00	0.00	0.00	0.00	0.00
77	☐	P-79	J-69	J-71	688.21	10.00	130.00	364.69	1.49	0.65	0.95
78	☐	P-81	J-71	J-73	690.31	10.00	130.00	111.15	0.45	0.07	0.11
79	☐	P-83	J-73	J-75	692.04	10.00	130.00	-108.39	0.44	0.07	0.10
80	☐	P-84	J-75	J-76	1,191.14	10.00	130.00	-406.67	1.66	1.39	1.16
81	☐	P40-54	J40-86	J-69	686.25	10.00	130.00	48.32	0.20	0.02	0.02
82	☐	P40-55	J-71	J40-88	610.39	10.00	130.00	241.66	0.99	0.27	0.44
83	☐	P40-56	J-73	J40-90	583.69	10.00	130.00	209.14	0.85	0.20	0.34
84	☐	P40-57	J-75	J40-92	482.10	10.00	130.00	269.20	1.10	0.26	0.54
85	☐	P40-60	J40-88	J40-90	681.66	10.00	130.00	1.66	0.01	0.00	0.00
86	☐	P40-61	J40-90	J40-92	733.09	10.00	130.00	-29.20	0.12	0.01	0.01
87	☐	P40-45	J40-74	J-135	1,065.03	16.00	130.00	0.00	0.00	0.00	0.00
88	☐	PP-53	J-130	JUP-89	593.73	48.00	130.00	940.45	0.17	0.00	0.00
89	☐	P-171	JUP-89	J-136	1,477.82	48.00	130.00	0.00	0.00	0.00	0.00
90	☐	PP-51	JUP-85	JUP-89	7,658.97	24.00	130.00	-337.72	0.24	0.09	0.01

PA 40 Domestic Water - Build Out - Peak Hour - Valve Report

		ID	Diameter (in)	Elevation (ft)	Upstream Pressure (psi)	Downstream Pressure (psi)	Flow (gpm)	Velocity (ft/s)	Headloss (ft)
1	☐	V40-1	8.00	235.00	87.51	61.10	0.00	0.00	0.00
2	☐	V40-3	12.00	218.00	96.71	50.00	1,684.35	4.78	107.80
3	☐	V-10	8.00	245.00	82.56	58.00	1,685.72	10.76	56.69

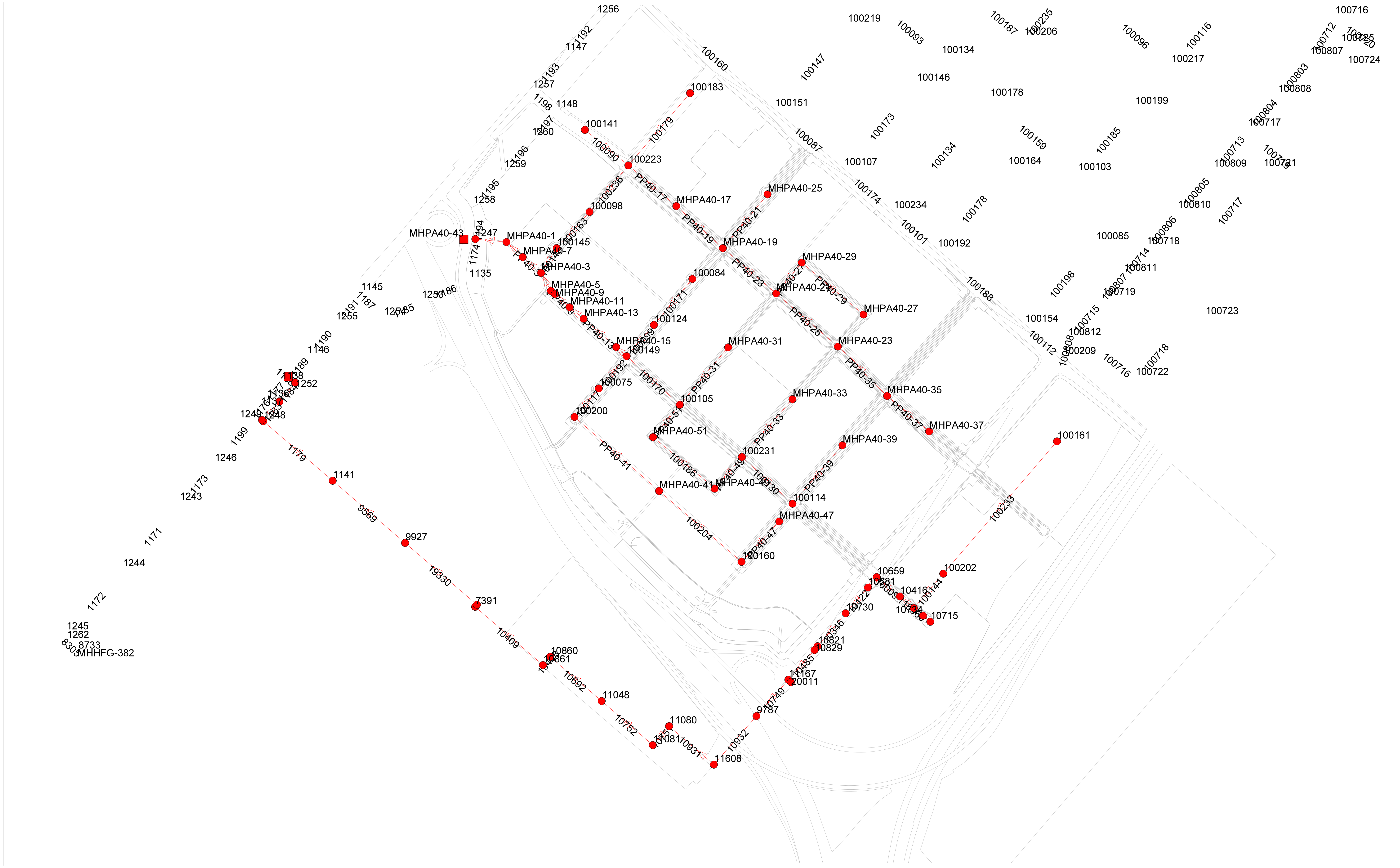
PA 40 Domestic Water - Build Out - Max Day plus Fire Flow Report

		ID	Static Demand (gpm)	Static Pressure (psi)	Static Head (ft)	Fire-Flow Demand (gpm)	Residual Pressure (psi)
1	☐	J-76	23.40	98.54	452.41	4,000.00	61.04
2	☐	J40-1	3.00	59.09	326.38	3,000.00	39.26
3	☐	J40-11	24.30	57.83	327.46	3,000.00	35.96
4	☐	J40-13	24.30	55.11	328.18	3,000.00	33.85
5	☐	J40-15	0.00	49.93	329.23	3,000.00	34.61
6	☐	J40-17	99.30	53.62	328.76	3,000.00	30.37
7	☐	J40-19	0.00	44.75	332.28	3,000.00	38.26
8	☐	J40-21	53.00	43.01	332.27	3,000.00	30.13
9	☐	J40-25	37.50	97.84	451.80	3,000.00	79.81
10	☐	J40-27	37.50	93.13	451.93	3,000.00	73.67
11	☐	J40-29	34.00	88.86	452.07	4,000.00	58.34
12	☐	J40-3	216.00	64.71	326.33	3,000.00	38.34
13	☐	J40-31	69.00	87.18	452.20	4,000.00	58.03
14	☐	J40-33	0.00	94.10	452.17	4,000.00	40.32
15	☐	J40-37	37.50	67.26	378.23	3,000.00	57.44
16	☐	J40-39	37.50	71.16	378.24	3,000.00	61.70
17	☐	J40-41	0.00	66.03	378.38	3,000.00	57.95
18	☐	J40-43	44.00	69.43	378.23	2,500.00	60.38
19	☐	J40-45	44.00	64.23	378.22	2,500.00	50.31
20	☐	J40-47	44.00	69.87	378.24	2,500.00	61.39
21	☐	J40-49	44.00	72.46	378.22	2,500.00	61.12
22	☐	J40-5	216.00	53.93	326.45	3,000.00	34.35
23	☐	J40-51	44.00	78.95	378.20	3,000.00	62.36
24	☐	J40-53	44.00	78.94	378.19	3,000.00	51.14
25	☐	J40-7	88.00	59.64	326.63	3,000.00	40.62
26	☐	J40-80	32.00	68.57	333.26	4,000.00	46.83
27	☐	J40-82	32.00	72.04	333.25	4,000.00	33.73
28	☐	J40-84	32.00	64.24	333.26	4,000.00	43.38
29	☐	J40-86	126.00	81.12	452.20	4,000.00	48.63
30	☐	J40-88	126.00	84.02	451.90	4,000.00	42.29
31	☐	J40-9	132.20	63.54	326.64	3,000.00	39.75
32	☐	J40-90	126.00	88.35	451.90	4,000.00	48.92
33	☐	J40-92	126.00	89.65	451.90	4,000.00	47.26

APPENDIX 2

SANITARY SEWER COLLECTION SYSTEM ANALYSIS

On Site Sewer Collection System - Drainage Areas 1 and 2



PA 40 SAMP - Area 1 Sewer Main Report

		ID	From ID	To ID	Diameter (in)	Length (ft)	Slope	Total Flow (mgd)	Velocity (ft/s)	d/D
1		100085	MHPA40-1	1247	16.000	231.780	0.006	1.280	3.794	0.400
2		100090	100141	100223	8.000	510.741	0.004	0.001	0.465	0.038
3		100099	100124	100149	8.000	377.775	0.030	0.062	3.036	0.146
4		100117	100200	100075	12.000	337.000	0.002	0.137	1.460	0.240
5		100145	100145	MHPA40-3	10.000	266.904	0.006	0.581	3.199	0.512
6		100163	100098	100145	8.000	445.184	0.020	0.536	4.868	0.491
7		100170	100105	100149	8.000	657.102	0.017	0.222	3.609	0.317
8		100171	100084	100124	8.000	546.379	0.016	0.062	2.469	0.168
9		100179	100183	100223	8.000	866.604	0.009	0.001	0.626	0.031
10		100192	100075	100149	12.000	381.000	0.002	0.137	1.474	0.239
11		100204	100160	MHPA40-41	8.000	991.583	0.015	0.065	2.401	0.178
12		100236	100223	100098	8.000	552.897	0.012	0.420	3.839	0.488
13		PP40-1	MHPA40-7	MHPA40-1	16.000	201.622	0.009	1.280	4.378	0.360
14		PP40-3	MHPA40-3	MHPA40-7	16.000	203.000	0.008	1.280	4.246	0.368
15		PP40-5	MHPA40-5	MHPA40-3	16.000	186.881	0.004	0.699	2.846	0.317
16		PP40-7	MHPA40-9	MHPA40-5	12.000	33.000	0.025	0.699	5.510	0.298
17		PP40-9	MHPA40-11	MHPA40-9	12.000	174.000	0.024	0.614	5.282	0.280
18		PP40-11	MHPA40-13	MHPA40-11	12.000	163.000	0.002	0.528	2.123	0.492
19		PP40-13	MHPA40-15	MHPA40-13	12.000	385.000	0.002	0.442	2.019	0.446
20		PP40-15	100149	MHPA40-15	12.000	122.000	0.002	0.442	2.084	0.435
21		PP40-17	MHPA40-17	100223	8.000	573.627	0.028	0.418	5.154	0.388
22		PP40-19	MHPA40-19	MHPA40-17	8.000	572.500	0.014	0.372	3.863	0.443
23		PP40-21	MHPA40-25	MHPA40-19	8.000	638.019	0.005	0.099	1.818	0.291
24		PP40-23	MHPA40-21	MHPA40-19	8.000	637.288	0.011	0.273	3.271	0.397
25		PP40-25	MHPA40-23	MHPA40-21	8.000	743.176	0.012	0.076	2.356	0.201
26		PP40-27	MHPA40-29	MHPA40-21	8.000	365.787	0.014	0.197	3.234	0.315
27		PP40-29	MHPA40-27	MHPA40-29	8.000	735.413	0.018	0.098	2.900	0.207
28		PP40-31	MHPA40-31	100105	8.000	684.417	0.015	0.000	0.000	0.000
29		PP40-33	MHPA40-33	100231	8.000	700.335	0.013	0.000	0.000	0.000
30		PP40-35	MHPA40-35	MHPA40-23	8.000	636.390	0.017	0.076	2.672	0.184
31		PP40-37	MHPA40-37	MHPA40-35	8.000	501.528	0.016	0.076	2.597	0.188
32		PP40-39	MHPA40-39	100114	8.000	700.949	0.014	0.078	2.517	0.196
33		PP40-41	MHPA40-41	100200	10.000	1,025.237	0.004	0.129	1.811	0.256

PA 40 SAMP - Area 1 Sewer Main Report

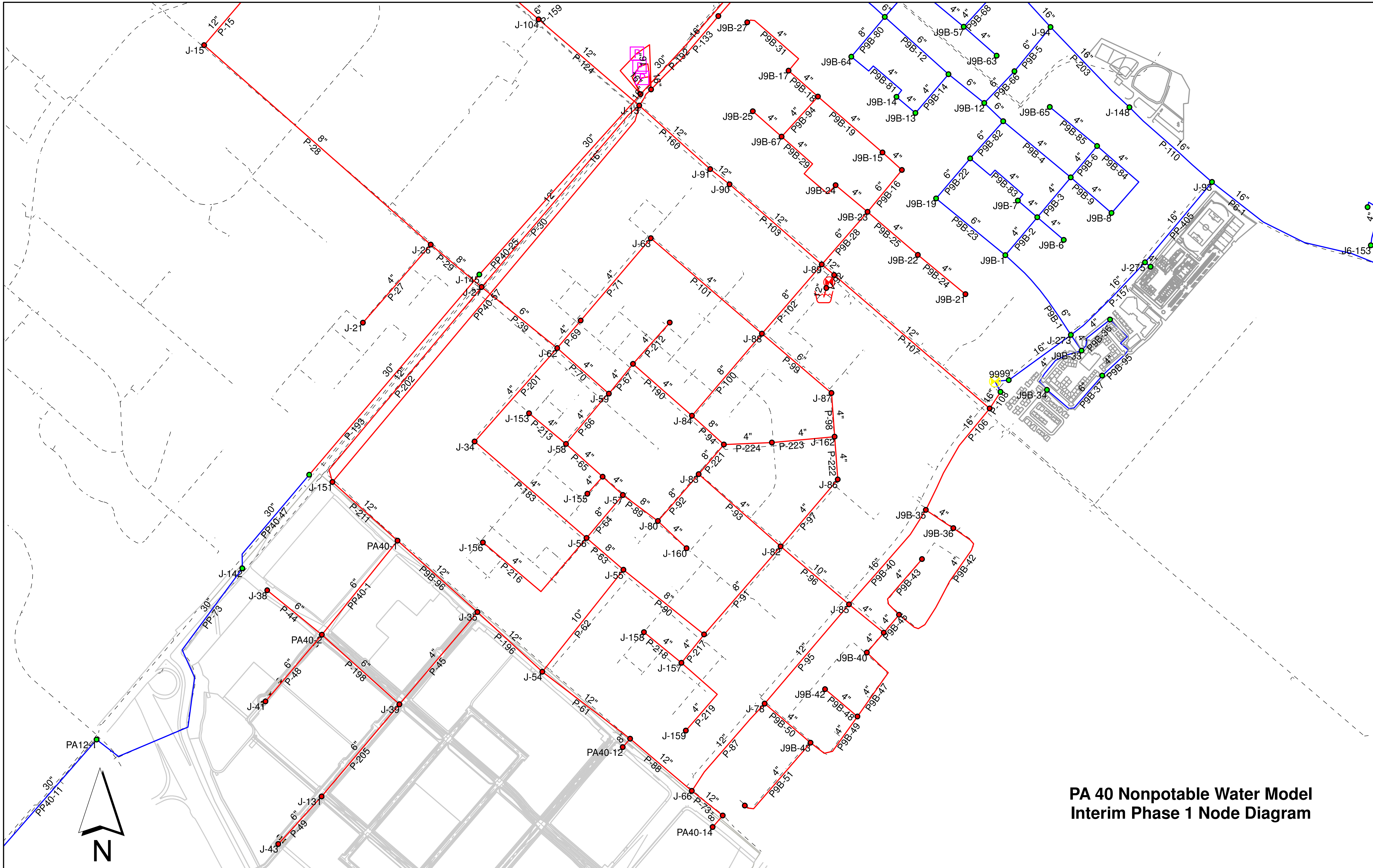
		ID	From ID	To ID	Diameter (in)	Length (ft)	Slope	Total Flow (mgd)	Velocity (ft/s)	d/D
34		PP40-43	1247	MHPA40-43	15.000	104.270	0.012	1.280	5.024	0.358
35		PP40-47	MHPA40-47	100160	8.000	503.373	0.025	0.016	1.921	0.080
36		100130	100114	100231	8.000	630.207	0.022	0.078	2.912	0.177
37		PP40-49	100231	MHPA40-49	8.000	381.476	0.005	0.094	1.860	0.275
38		100186	MHPA40-49	MHPA40-51	8.000	744.630	0.004	0.158	1.908	0.395
39		PP40-51	MHPA40-51	100105	8.000	383.068	0.013	0.222	3.241	0.343

PA 40 SAMP - Area 2 - Sewer Main Report

	ID	From ID	To ID	Diameter (in)	Length (ft)	Slope	Total Flow (mgd)	Velocity (ft/s)	d/D	q/Q
1	1175	1249	1248	12.000	15.001	0.013	0.001	0.541	0.012	0.000
2	1179	1141	1248	12.000	833.791	0.011	0.506	3.710	0.314	0.214
3	1183	1248	1251	12.000	230.387	0.027	0.507	5.197	0.247	0.134
4	1184	1251	1252	12.000	225.060	0.003	0.508	2.361	0.440	0.400
5	1188	1252	1144	12.000	78.730	0.005	0.509	2.804	0.387	0.317
6	7179	7391	7392	12.000	24.839	0.008	0.504	3.367	0.336	0.243
7	9569	9927	1141	12.000	870.109	0.012	0.505	3.876	0.304	0.201
8	9955	10659	10681	12.000	124.752	0.001	0.368	1.652	0.452	0.420
9	10009	10416	10659	10.000	275.000	0.003	0.367	2.109	0.495	0.492
10	10122	10681	10730	12.000	309.696	0.012	0.369	3.538	0.259	0.147
11	10130	10734	110058	10.000	110.156	0.002	0.007	0.594	0.076	0.012
12	10147	10715	10734	10.000	85.280	0.003	0.007	0.652	0.067	0.009
13	10346	10730	10821	12.000	395.220	0.012	0.373	3.536	0.261	0.149
14	10362	10821	10829	12.000	43.809	0.002	0.374	1.963	0.401	0.339
15	10408	10860	10861	12.000	100.141	0.010	0.504	3.637	0.317	0.218
16	10409	10861	7391	12.000	815.659	0.011	0.504	3.752	0.310	0.209
17	10485	10829	11167	12.000	361.656	0.005	0.379	2.542	0.335	0.242
18	10692	11048	10860	12.000	619.066	0.011	0.463	3.661	0.297	0.193
19	10749	11167	9787	12.000	440.594	0.004	0.381	2.370	0.354	0.268
20	10751	11080	11081	12.000	227.615	0.011	0.423	3.634	0.280	0.172
21	10752	11081	11048	12.000	615.324	0.009	0.423	3.298	0.301	0.196
22	10931	11608	11080	12.000	538.043	0.009	0.383	3.274	0.281	0.173
23	10932	9787	11608	12.000	589.035	0.012	0.383	3.600	0.263	0.151
24	19330	7392	9927	12.000	863.872	0.013	0.505	4.001	0.297	0.192
25	20311	20011	11167	10.000	30.763	0.024	0.001	0.680	0.014	0.000
26	100144	100202	110058	8.000	412.165	0.014	0.359	3.878	0.430	0.384
27	100233	100161	100202	8.000	1,591.720	0.011	0.180	2.885	0.320	0.222
28	110060	110058	10416	10.000	164.843	0.003	0.367	2.261	0.469	0.447
29	PP40-45	1144	MHPA40-45	12.000	4.564	0.110	0.509	8.544	0.175	0.067

APPENDIX 3

NONPOTABLE WATER SYSTEM ANALYSIS



PA 40 Nonpotable Water Model
Interim Phase 1 Node Diagram

Interim Phase 1 Nonpotable System - With A to B BPS - 4000 gpm TIC Demand - Pipe Velocity Range

		ID	Max.Value (ft/s)	Max.Time (hrs.)	Min.Value (ft/s)	Min.Time (hrs.)	Average (ft/s)
1	☐	P-100	2.18	04:00	2.02	12:00	2.08
2	☐	P-101	1.60	12:00	1.50	04:00	1.56
3	☐	P-102	2.46	04:00	2.19	12:00	2.30
4	☐	P-103	5.25	04:00	4.94	12:00	5.07
5	☐	P-104	5.25	04:00	4.94	12:00	5.07
6	☐	P-106	2.31	04:00	2.23	12:00	2.26
7	☐	P-107	4.16	04:00	3.96	12:00	4.04
8	☐	P-108	0.03	04:00	0.00	11:00	0.01
9	☐	P-114	3.96	00:00	0.80	17:00	2.00
10	☐	P-115	3.96	00:00	0.80	17:00	2.00
11	☐	P-12	1.40	06:00	0.47	09:00	1.19
12	☐	P-124	2.70	12:00	0.07	07:00	1.58
13	☐	P-125	2.37	12:00	0.80	08:00	2.02
14	☐	P-126	2.70	12:00	0.07	07:00	1.58
15	☐	P-13	2.37	12:00	0.80	08:00	2.02
16	☐	P-132	0.00	07:00	0.00	21:00	0.00
17	☐	P-133	0.00	00:00	0.00	00:00	0.00
18	☐	P-14	2.70	12:00	0.07	07:00	1.58
19	☐	P-15	1.04	12:00	0.48	10:00	0.81
20	☐	P-151	6.90	00:00	0.03	16:00	2.24
21	☐	P-160	5.25	04:00	4.94	12:00	5.07
22	☐	P-164	3.01	00:00	0.00	12:00	1.18
23	☐	P-183	2.32	12:00	2.08	04:00	2.22
24	☐	P-190	1.20	12:00	1.11	04:00	1.16
25	☐	P-191	1.98	00:00	1.28	22:00	1.59
26	☐	P-192	1.61	00:00	1.04	22:00	1.29
27	☐	P-193	0.44	11:00	0.09	12:00	0.30
28	☐	P-194	6.90	00:00	0.03	16:00	2.24
29	☐	P-196	5.73	04:00	5.62	10:00	5.67
30	☐	P-197	0.11	04:00	0.01	15:00	0.05
31	☐	P-198	1.34	04:00	1.01	10:00	1.15
32	☐	P-199	0.11	04:00	0.01	15:00	0.05
33	☐	P-201	2.70	04:00	2.32	10:00	2.49
34	☐	P-202	2.03	24:00	1.83	10:00	1.96
35	☐	P-205	0.58	04:00	0.03	10:00	0.25
36	☐	P-207	0.00	02:00	0.00	09:00	0.00
37	☐	P-209	1.84	00:00	1.16	11:00	1.41
38	☐	P-210	2.01	00:00	1.05	24:00	1.45
39	☐	P-211	6.04	04:00	5.64	10:00	5.81
40	☐	P-212	0.00	15:00	0.00	07:00	0.00
41	☐	P-213	0.00	16:00	0.00	00:00	0.00
42	☐	P-214	1.93	12:00	1.90	04:00	1.92
43	☐	P-215	0.00	08:00	0.00	15:00	0.00
44	☐	P-216	0.00	01:00	0.00	19:00	0.00
45	☐	P-217	0.00	06:00	0.00	11:00	0.00
46	☐	P-218	0.00	03:00	0.00	10:00	0.00
47	☐	P-219	0.00	04:00	0.00	17:00	0.00
48	☐	P-220	0.00	13:00	0.00	01:00	0.00
49	☐	P-221	2.45	04:00	2.36	12:00	2.39
50	☐	P-222	2.23	04:00	2.13	12:00	2.17
51	☐	P-223	0.19	04:00	0.16	12:00	0.17
52	☐	P-224	0.19	04:00	0.16	12:00	0.17
53	☐	P-27	0.12	04:00	0.01	10:00	0.05
54	☐	P-28	2.32	12:00	1.07	09:00	1.77
55	☐	P-29	2.32	12:00	1.07	09:00	1.76
56	☐	P-30	2.37	04:00	1.82	12:00	2.09

Interim Phase 1 Nonpotable System - With A to B BPS - 4000 gpm TIC Demand - Pipe Velocity Range

		ID	Max.Value (ft/s)	Max.Time (hrs.)	Min.Value (ft/s)	Min.Time (hrs.)	Average (ft/s)
57		P-39	3.57	04:00	3.27	10:00	3.42
58		P-44	0.06	04:00	0.00	10:00	0.03
59		P-45	2.21	12:00	1.71	04:00	2.02
60		P-48	0.58	04:00	0.03	10:00	0.25
61		P-49	0.58	04:00	0.03	10:00	0.25
62		P-61	6.76	04:00	6.71	10:00	6.74
63		P-62	1.57	10:00	1.51	04:00	1.54
64		P-63	2.89	13:00	2.83	04:00	2.87
65		P-64	2.36	04:00	2.31	12:00	2.33
66		P-65	1.93	12:00	1.90	04:00	1.92
67		P-66	1.96	24:00	1.91	10:00	1.94
68		P-67	1.20	12:00	1.11	04:00	1.16
69		P-69	1.69	24:00	1.56	10:00	1.64
70		P-70	3.65	04:00	3.47	10:00	3.57
71		P-71	1.69	24:00	1.56	10:00	1.64
72		P-73	5.67	00:00	5.67	00:00	5.67
73		P-87	4.64	08:00	4.63	12:00	4.63
74		P-88	1.08	04:00	1.04	10:00	1.06
75		P-89	1.89	04:00	1.83	12:00	1.85
76		P-90	0.49	24:00	0.44	10:00	0.47
77		P-91	0.46	12:00	0.43	02:00	0.45
78		P-92	1.89	04:00	1.83	12:00	1.85
79		P-93	2.14	04:00	2.12	10:00	2.13
80		P-94	2.40	04:00	2.32	12:00	2.35
81		P-95	4.50	04:00	4.46	12:00	4.47
82		P-96	0.97	12:00	0.96	09:00	0.97
83		P-97	2.13	08:00	2.12	12:00	2.12
84		P-98	2.41	04:00	2.29	12:00	2.34
85		P-99	1.13	04:00	1.02	12:00	1.07
86		P9B-16	0.00	17:00	0.00	24:00	0.00
87		P9B-18	0.00	00:00	0.00	19:00	0.00
88		P9B-19	0.00	06:00	0.00	24:00	0.00
89		P9B-20	0.00	06:00	0.00	24:00	0.00
90		P9B-24	0.00	23:00	0.00	07:00	0.00
91		P9B-25	0.00	22:00	0.00	04:00	0.00
92		P9B-27	0.00	06:00	0.00	16:00	0.00
93		P9B-28	0.00	17:00	0.00	12:00	0.00
94		P9B-29	0.00	06:00	0.00	16:00	0.00
95		P9B-31	0.00	05:00	0.00	08:00	0.00
96		P9B-40	2.26	04:00	2.18	12:00	2.21
97		P9B-41	0.86	04:00	0.78	12:00	0.81
98		P9B-42	0.83	04:00	0.78	12:00	0.80
99		P9B-43	0.03	04:00	0.00	17:00	0.01
100		P9B-44	0.91	04:00	0.79	10:00	0.84
101		P9B-45	0.78	10:00	0.77	04:00	0.77
102		P9B-46	1.64	04:00	1.57	12:00	1.60
103		P9B-47	1.61	04:00	1.57	12:00	1.58
104		P9B-48	0.03	04:00	0.00	12:00	0.01
105		P9B-49	1.57	10:00	1.54	04:00	1.56
106		P9B-50	1.57	10:00	1.51	04:00	1.54
107		P9B-51	0.03	04:00	0.00	11:00	0.01
108		P9B-93	0.00	20:00	0.00	19:00	0.00
109		P9B-94	0.00	06:00	0.00	17:00	0.00
110		P9B-96	5.54	04:00	5.38	10:00	5.45
111		PA_BPUMP2	2.32	01:00	1.24	12:00	1.77
112		PA-BPUMP1	2.32	01:00	1.24	12:00	1.77

Interim Phase 1 Nonpotable System - With A to B BPS - 4000 gpm TIC Demand - Pipe Velocity Range

		ID	Max.Value (ft/s)	Max.Time (hrs.)	Min.Value (ft/s)	Min.Time (hrs.)	Average (ft/s)
113		PP-101	1.40	06:00	0.47	09:00	1.19
114		PP-103	0.84	00:00	0.52	24:00	0.67
115		PP-115	0.52	20:00	0.00	15:00	0.26
116		PP-121	0.00	20:00	0.00	17:00	0.00
117		PP-123	0.23	20:00	0.00	15:00	0.12
118		PP-125	0.52	20:00	0.00	15:00	0.26
119		PP-127	3.61	00:00	0.00	12:00	1.84
120		PP-129	3.96	00:00	0.00	12:00	2.02
121		PP-131	4.21	00:00	0.00	12:00	2.15
122		PP-133	1.66	01:00	0.00	17:00	0.85
123		PP-135	2.33	00:00	0.00	12:00	1.19
124		PP-163	0.00	00:00	0.00	13:00	0.00
125		PP-165	2.36	00:00	0.00	12:00	1.20
126		PP-167	1.68	00:00	0.00	12:00	0.86
127		PP-169	1.50	00:00	0.00	12:00	0.76
128		PP-171	1.97	00:00	0.00	12:00	1.00
129		PP-175	0.84	00:00	0.00	12:00	0.43
130		PP-177	1.21	00:00	0.00	12:00	0.61
131		PP-179	1.22	00:00	0.00	15:00	0.62
132		PP-181	0.52	00:00	0.00	12:00	0.26
133		PP-183	3.07	00:00	0.00	17:00	1.56
134		PP-185	3.13	00:00	0.00	17:00	1.60
135		PP-187	5.05	00:00	0.00	17:00	2.58
136		PP-189	1.31	00:00	0.00	12:00	0.67
137		PP-401	4.16	04:00	3.96	12:00	4.04
138		PP40-1	1.99	04:00	1.04	10:00	1.43
139		PP40-13	0.52	20:00	0.00	17:00	0.26
140		PP40-15	0.00	02:00	0.00	03:00	0.00
141		PP40-25	0.44	11:00	0.09	12:00	0.30
142		PP40-27	6.87	01:00	4.33	12:00	5.58
143		PP40-37	4.55	01:00	3.09	12:00	3.81
144		PP40-39	4.55	01:00	3.09	12:00	3.81
145		PP40-43	0.00	17:00	0.00	10:00	0.00
146		PP40-45	0.00	19:00	0.00	05:00	0.00
147		PP40-57	2.31	04:00	2.05	12:00	2.16
148		PP40-59	12.77	00:00	12.77	00:00	12.77
149		PP40-61	12.77	00:00	12.77	00:00	12.77
150		PP-51	0.47	00:00	0.00	12:00	0.24
151		PP-53	1.31	00:00	0.00	12:00	0.67
152		PP-55	0.52	20:00	0.00	17:00	0.26
153		PP-57	1.58	00:00	0.00	17:00	0.81
154		PP-59	2.68	00:00	0.00	17:00	1.36
155		PP-61	0.69	00:00	0.00	12:00	0.35
156		PP-63	0.82	00:00	0.00	12:00	0.42
157		PP-65	3.37	00:00	0.00	12:00	1.72
158		PP-67	1.56	00:00	0.00	17:00	0.80
159		PP-69	2.81	00:00	0.00	17:00	1.44
160		PP-71	0.14	20:00	0.00	17:00	0.07
161		PP-97	2.29	20:00	0.01	15:00	1.18
162		PP-99	0.78	20:00	0.00	15:00	0.39
163		V-91	0.00	03:00	0.00	10:00	0.00
164		V-92	0.00	17:00	0.00	18:00	0.00

Interim Phase 1 Nonpotable System - With A to B BPS - 4000 gpm TIC Demand - Pipe Flow Range

		ID	Max.Value (gpm)	Max.Time (hrs.)	Min.Value (gpm)	Min.Time (hrs.)	Average (gpm)
1	☐	P-100	341.15	04:00	316.07	12:00	326.45
2	☐	P-101	62.82	12:00	58.92	04:00	61.02
3	☐	P-102	385.54	04:00	343.52	12:00	360.98
4	☐	P-103	1,852.25	04:00	1,741.03	12:00	1,786.79
5	☐	P-104	1,852.25	04:00	1,741.03	12:00	1,786.79
6	☐	P-106	1,449.34	04:00	1,396.66	12:00	1,418.38
7	☐	P-107	1,466.70	04:00	1,397.51	12:00	1,425.82
8	☐	P-108	17.36	04:00	0.85	11:00	7.43
9	☐	P-114	2,481.02	00:00	498.27	17:00	1,253.18
10	☐	P-115	2,481.02	00:00	498.27	17:00	1,253.18
11	☐	P-12	879.26	06:00	294.10	09:00	745.92
12	☐	P-124	953.25	12:00	24.15	07:00	556.82
13	☐	P-125	835.36	12:00	281.38	08:00	713.66
14	☐	P-126	953.25	12:00	24.15	07:00	556.82
15	☐	P-13	835.36	12:00	281.38	08:00	713.66
16	☐	P-132	0.00	07:00	0.00	21:00	0.00
17	☐	P-133	0.00	00:00	0.00	00:00	0.00
18	☐	P-14	953.25	12:00	24.15	07:00	556.82
19	☐	P-15	364.90	12:00	170.15	10:00	287.26
20	☐	P-151	4,321.64	00:00	18.18	16:00	1,401.62
21	☐	P-160	1,852.25	04:00	1,741.03	12:00	1,786.79
22	☐	P-164	2,947.06	00:00	0.00	12:00	1,157.17
23	☐	P-183	91.07	12:00	81.46	04:00	87.12
24	☐	P-190	47.14	12:00	43.28	04:00	45.36
25	☐	P-191	3,540.46	00:00	2,288.50	22:00	2,833.36
26	☐	P-192	3,540.46	00:00	2,288.50	22:00	2,833.36
27	☐	P-193	979.27	11:00	206.05	12:00	665.35
28	☐	P-194	4,325.31	00:00	18.40	16:00	1,403.61
29	☐	P-196	2,018.16	04:00	1,982.82	10:00	1,999.69
30	☐	P-197	68.48	04:00	3.36	15:00	29.32
31	☐	P-198	118.52	04:00	88.94	10:00	101.30
32	☐	P-199	68.48	04:00	3.36	15:00	29.32
33	☐	P-201	105.92	04:00	91.04	10:00	97.59
34	☐	P-202	716.09	24:00	646.63	10:00	691.91
35	☐	P-205	51.48	04:00	2.52	10:00	22.04
36	☐	P-207	0.00	02:00	0.00	09:00	0.00
37	☐	P-209	649.59	00:00	407.85	11:00	495.96
38	☐	P-210	709.03	00:00	369.52	24:00	510.34
39	☐	P-211	2,129.84	04:00	1,988.29	10:00	2,047.52
40	☐	P-212	0.00	15:00	0.00	07:00	0.00
41	☐	P-213	0.00	16:00	0.00	00:00	0.00
42	☐	P-214	75.64	12:00	74.45	04:00	75.06
43	☐	P-215	0.00	08:00	0.00	15:00	0.00
44	☐	P-216	0.00	01:00	0.00	19:00	0.00
45	☐	P-217	0.00	06:00	0.00	11:00	0.00
46	☐	P-218	0.00	03:00	0.00	10:00	0.00
47	☐	P-219	0.00	04:00	0.00	17:00	0.00
48	☐	P-220	0.00	13:00	0.00	01:00	0.00
49	☐	P-221	383.16	04:00	369.25	12:00	375.00
50	☐	P-222	87.20	04:00	83.38	12:00	84.91
51	☐	P-223	7.25	04:00	6.46	12:00	6.83
52	☐	P-224	7.25	04:00	6.46	12:00	6.83
53	☐	P-27	4.62	04:00	0.23	10:00	1.98
54	☐	P-28	363.80	12:00	168.05	09:00	277.58
55	☐	P-29	363.57	12:00	167.49	09:00	275.60
56	☐	P-30	836.78	04:00	642.58	12:00	737.20

Interim Phase 1 Nonpotable System - With A to B BPS - 4000 gpm TIC Demand - Pipe Flow Range

		ID	Max.Value (gpm)	Max.Time (hrs.)	Min.Value (gpm)	Min.Time (hrs.)	Average (gpm)
57	☐	P-39	314.96	04:00	288.05	10:00	301.48
58	☐	P-44	5.72	04:00	0.28	10:00	2.45
59	☐	P-45	86.67	12:00	67.05	04:00	79.26
60	☐	P-48	51.26	04:00	2.51	10:00	21.95
61	☐	P-49	51.48	04:00	2.52	10:00	22.04
62	☐	P-61	2,383.79	04:00	2,366.08	10:00	2,374.22
63	☐	P-62	383.42	10:00	368.86	04:00	375.91
64	☐	P-63	452.35	13:00	444.14	04:00	449.06
65	☐	P-64	370.02	04:00	361.64	12:00	365.08
66	☐	P-65	75.64	12:00	74.45	04:00	75.06
67	☐	P-66	76.66	24:00	75.00	10:00	75.97
68	☐	P-67	47.14	12:00	43.28	04:00	45.36
69	☐	P-69	66.34	24:00	61.28	10:00	64.16
70	☐	P-70	142.79	04:00	135.73	10:00	139.73
71	☐	P-71	66.34	24:00	61.28	10:00	64.16
72	☐	P-73	2,000.00	00:00	2,000.00	00:00	2,000.00
73	☐	P-87	1,634.88	08:00	1,632.60	12:00	1,633.71
74	☐	P-88	380.57	04:00	365.92	10:00	372.84
75	☐	P-89	295.57	04:00	286.01	12:00	290.03
76	☐	P-90	76.37	24:00	68.60	10:00	73.15
77	☐	P-91	72.13	12:00	67.91	02:00	70.01
78	☐	P-92	295.57	04:00	286.01	12:00	290.03
79	☐	P-93	83.93	04:00	83.02	10:00	83.40
80	☐	P-94	375.92	04:00	362.80	12:00	368.17
81	☐	P-95	1,584.68	04:00	1,571.76	12:00	1,577.16
82	☐	P-96	238.38	12:00	234.51	09:00	236.62
83	☐	P-97	83.26	08:00	83.18	12:00	83.21
84	☐	P-98	94.45	04:00	89.83	12:00	91.74
85	☐	P-99	99.65	04:00	90.09	12:00	93.97
86	☐	P9B-16	0.00	17:00	0.00	24:00	0.00
87	☐	P9B-18	0.00	00:00	0.00	19:00	0.00
88	☐	P9B-19	0.00	06:00	0.00	24:00	0.00
89	☐	P9B-20	0.00	06:00	0.00	24:00	0.00
90	☐	P9B-24	0.00	23:00	0.00	07:00	0.00
91	☐	P9B-25	0.00	22:00	0.00	04:00	0.00
92	☐	P9B-27	0.00	06:00	0.00	16:00	0.00
93	☐	P9B-28	0.00	17:00	0.00	12:00	0.00
94	☐	P9B-29	0.00	06:00	0.00	16:00	0.00
95	☐	P9B-31	0.00	05:00	0.00	08:00	0.00
96	☐	P9B-40	1,415.61	04:00	1,366.01	12:00	1,386.49
97	☐	P9B-41	33.73	04:00	30.64	12:00	31.89
98	☐	P9B-42	32.48	04:00	30.58	12:00	31.35
99	☐	P9B-43	1.25	04:00	0.06	17:00	0.53
100	☐	P9B-44	35.47	04:00	31.12	10:00	32.86
101	☐	P9B-45	30.56	10:00	29.99	04:00	30.28
102	☐	P9B-46	64.21	04:00	61.54	12:00	62.61
103	☐	P9B-47	62.96	04:00	61.47	12:00	62.08
104	☐	P9B-48	1.25	04:00	0.06	12:00	0.53
105	☐	P9B-49	61.44	10:00	60.46	04:00	61.01
106	☐	P9B-50	61.38	10:00	59.21	04:00	60.48
107	☐	P9B-51	1.25	04:00	0.06	11:00	0.53
108	☐	P9B-93	0.00	20:00	0.00	19:00	0.00
109	☐	P9B-94	0.00	06:00	0.00	17:00	0.00
110	☐	P9B-96	1,954.34	04:00	1,896.56	10:00	1,921.82
111	☐	PA_BPUMP2	1,453.97	01:00	778.10	12:00	1,109.46
112	☐	PA-BPUMP1	1,453.97	01:00	778.10	12:00	1,109.46

Interim Phase 1 Nonpotable System - With A to B BPS - 4000 gpm TIC Demand - Pipe Flow Range

		ID	Max.Value (gpm)	Max.Time (hrs.)	Min.Value (gpm)	Min.Time (hrs.)	Average (gpm)
113	☐	PP-101	879.26	06:00	294.10	09:00	745.92
114	☐	PP-103	2,666.76	00:00	1,657.67	24:00	2,110.68
115	☐	PP-115	734.02	20:00	3.82	15:00	367.35
116	☐	PP-121	0.00	20:00	0.00	17:00	0.00
117	☐	PP-123	734.02	20:00	3.82	15:00	367.35
118	☐	PP-125	734.02	20:00	3.82	15:00	367.35
119	☐	PP-127	565.45	00:00	0.28	12:00	288.22
120	☐	PP-129	970.39	00:00	1.05	12:00	494.98
121	☐	PP-131	1,030.23	00:00	0.93	12:00	525.42
122	☐	PP-133	146.15	01:00	0.32	17:00	74.50
123	☐	PP-135	205.76	00:00	0.20	12:00	104.94
124	☐	PP-163	3,375.99	00:00	0.00	13:00	1,719.54
125	☐	PP-165	370.30	00:00	0.06	12:00	188.67
126	☐	PP-167	263.03	00:00	0.07	12:00	134.04
127	☐	PP-169	234.66	00:00	0.08	12:00	119.59
128	☐	PP-171	308.73	00:00	0.11	12:00	157.34
129	☐	PP-175	74.08	00:00	0.02	12:00	37.75
130	☐	PP-177	188.95	00:00	0.05	12:00	96.28
131	☐	PP-179	107.27	00:00	0.02	15:00	54.66
132	☐	PP-181	45.71	00:00	0.03	12:00	23.31
133	☐	PP-183	3,005.69	00:00	0.06	17:00	1,530.98
134	☐	PP-185	3,067.25	00:00	0.11	17:00	1,562.40
135	☐	PP-187	1,780.31	00:00	1.21	17:00	908.10
136	☐	PP-189	1,286.94	00:00	1.11	12:00	656.30
137	☐	PP-401	1,466.70	04:00	1,397.51	12:00	1,425.81
138	☐	PP40-1	175.50	04:00	91.73	10:00	125.70
139	☐	PP40-13	734.03	20:00	3.82	17:00	367.35
140	☐	PP40-15	0.00	02:00	0.00	03:00	0.00
141	☐	PP40-25	979.27	11:00	206.05	12:00	665.35
142	☐	PP40-27	4,304.58	01:00	2,714.23	12:00	3,498.70
143	☐	PP40-37	2,850.62	01:00	1,936.12	12:00	2,389.25
144	☐	PP40-39	2,850.62	01:00	1,936.12	12:00	2,389.25
145	☐	PP40-43	0.00	17:00	0.00	10:00	0.00
146	☐	PP40-45	0.00	19:00	0.00	05:00	0.00
147	☐	PP40-57	1,444.58	04:00	1,283.87	12:00	1,355.61
148	☐	PP40-59	2,000.00	00:00	2,000.00	00:00	2,000.00
149	☐	PP40-61	2,000.00	00:00	2,000.00	00:00	2,000.00
150	☐	PP-51	457.74	00:00	0.24	12:00	233.33
151	☐	PP-53	1,286.94	00:00	1.11	12:00	656.30
152	☐	PP-55	734.03	20:00	3.82	17:00	367.35
153	☐	PP-57	556.93	00:00	0.28	17:00	284.11
154	☐	PP-59	419.53	00:00	0.04	17:00	213.79
155	☐	PP-61	107.71	00:00	0.04	12:00	54.90
156	☐	PP-63	201.02	00:00	0.07	12:00	102.45
157	☐	PP-65	824.47	00:00	0.74	12:00	420.48
158	☐	PP-67	137.40	00:00	0.24	17:00	70.32
159	☐	PP-69	990.50	00:00	1.51	17:00	506.59
160	☐	PP-71	203.65	20:00	0.54	17:00	103.98
161	☐	PP-97	3,231.97	20:00	9.00	15:00	1,657.32
162	☐	PP-99	762.90	20:00	3.96	15:00	381.87
163	☐	V-91	0.00	03:00	0.00	10:00	0.00
164	☐	V-92	0.00	17:00	0.00	18:00	0.00

Interim Phase 1 Nonpotable System - With A to B BPS - 4000 gpm TIC Demand - Junction Range

		ID	Max.Value (psi)	Max.Time (hrs.)	Min.Value (psi)	Min.Time (hrs.)	Average (psi)	Difference (psi)
1	☐	J-11	114.38	17:00	99.27	08:00	107.28	15.11
2	☐	J-12	120.86	17:00	107.50	00:00	114.22	13.35
3	☐	J-13	102.55	17:00	93.48	00:00	98.14	9.07
4	☐	J-15	137.75	17:00	124.67	00:00	131.25	13.08
5	☐	J-21	125.99	17:00	115.56	01:00	120.88	10.43
6	☐	J-26	119.92	17:00	109.50	01:00	114.82	10.42
7	☐	J-27	115.59	17:00	105.75	01:00	110.80	9.84
8	☐	J-34	110.48	17:00	99.24	01:00	105.09	11.24
9	☐	J-35	107.82	17:00	97.48	01:00	102.83	10.34
10	☐	J-38	127.10	17:00	115.91	02:00	121.74	11.19
11	☐	J-39	116.29	17:00	104.82	02:00	110.82	11.46
12	☐	J-41	131.43	17:00	120.13	02:00	126.04	11.30
13	☐	J-43	122.79	17:00	111.08	02:00	117.23	11.70
14	☐	J-53	82.87	17:00	72.37	01:00	77.81	10.50
15	☐	J-54	96.72	17:00	86.28	01:00	91.69	10.43
16	☐	J-55	93.44	17:00	82.98	01:00	88.40	10.46
17	☐	J-56	97.44	17:00	86.95	01:00	92.38	10.49
18	☐	J-57	97.30	17:00	86.84	01:00	92.26	10.46
19	☐	J-58	103.24	17:00	92.73	01:00	98.18	10.51
20	☐	J-59	101.17	17:00	90.69	01:00	96.11	10.48
21	☐	J-60	99.10	17:00	88.66	01:00	94.07	10.44
22	☐	J-61	106.35	17:00	96.05	01:00	101.36	10.30
23	☐	J-62	109.06	17:00	98.80	01:00	104.09	10.26
24	☐	J-63	99.52	17:00	89.10	01:00	94.49	10.42
25	☐	J-66	78.39	17:00	67.88	01:00	73.33	10.51
26	☐	J-67	73.23	17:00	62.72	01:00	68.17	10.51
27	☐	J-78	77.41	17:00	66.90	01:00	72.35	10.50
28	☐	J-80	96.37	17:00	85.93	01:00	91.34	10.44
29	☐	J-81	86.01	17:00	75.54	01:00	80.97	10.47
30	☐	J-82	83.33	17:00	72.87	01:00	78.29	10.46
31	☐	J-83	93.43	17:00	83.02	01:00	88.41	10.41
32	☐	J-84	94.52	17:00	84.18	01:00	89.53	10.34
33	☐	J-85	75.35	17:00	64.90	01:00	70.31	10.45
34	☐	J-86	80.34	17:00	69.88	01:00	75.30	10.45
35	☐	J-87	85.71	17:00	75.45	01:00	80.76	10.26
36	☐	J-88	90.84	17:00	80.65	01:00	85.93	10.19
37	☐	J-89	84.99	17:00	75.04	01:00	80.18	9.95
38	☐	J-90	93.37	17:00	83.87	01:00	88.76	9.51
39	☐	J-91	95.06	17:00	85.64	01:00	90.48	9.42
40	☐	J-92	63.21	17:00	52.84	01:00	58.21	10.37
41	☐	J-97	92.41	17:00	75.86	00:00	84.32	16.55
42	☐	J-104	107.45	17:00	96.85	00:00	102.24	10.61
43	☐	J-105	119.05	17:00	105.53	08:00	112.33	13.52
44	☐	J-106	113.91	17:00	101.96	00:00	108.00	11.95
45	☐	J-110	96.88	17:00	81.18	08:00	89.68	15.70
46	☐	J-124	182.85	12:00	164.01	00:00	177.44	18.85
47	☐	J-131	121.92	17:00	110.30	02:00	116.39	11.62
48	☐	J-132	117.76	17:00	97.18	00:00	108.28	20.58
49	☐	J-147	72.62	17:00	56.92	08:00	65.41	15.70
50	☐	J-150	128.48	17:00	111.71	00:00	120.49	16.78
51	☐	J-151	124.84	17:00	115.12	01:00	120.12	9.72
52	☐	J-152	97.37	17:00	86.93	01:00	92.34	10.44
53	☐	J-153	102.37	17:00	91.87	01:00	97.31	10.51
54	☐	J-154	100.04	17:00	89.56	01:00	94.99	10.48
55	☐	J-155	98.74	17:00	88.26	01:00	93.69	10.48
56	☐	J-156	103.50	17:00	93.01	01:00	98.45	10.49

Interim Phase 1 Nonpotable System - With A to B BPS - 4000 gpm TIC Demand - Junction Range

		ID	Max.Value (psi)	Max.Time (hrs.)	Min.Value (psi)	Min.Time (hrs.)	Average (psi)	Difference (psi)
57	☐	J-157	88.17	17:00	77.71	01:00	83.13	10.47
58	☐	J-158	89.91	17:00	79.44	01:00	84.87	10.47
59	☐	J-159	86.44	17:00	75.98	01:00	81.40	10.47
60	☐	J-160	94.20	17:00	83.76	01:00	89.17	10.44
61	☐	J-161	92.65	17:00	82.28	01:00	87.65	10.38
62	☐	J-162	77.95	17:00	67.58	01:00	72.95	10.37
63	☐	J-163	86.60	17:00	76.23	01:00	81.60	10.37
64	☐	J-164	151.22	00:00	151.22	00:00	151.22	0.00
65	☐	JUP-41	91.85	24:00	75.44	19:00	82.75	16.41
66	☐	JUP-43	91.89	24:00	75.44	19:00	82.77	16.44
67	☐	JUP-45	94.35	24:00	77.61	19:00	85.10	16.74
68	☐	JUP-49	110.39	24:00	104.70	00:00	106.51	5.69
69	☐	JUP-51	97.29	24:00	91.48	19:00	93.06	5.82
70	☐	JUP-53	84.30	24:00	67.64	19:00	75.09	16.65
71	☐	JUP-55	98.55	24:00	90.61	19:00	93.35	7.95
72	☐	JUP-57	114.73	24:00	109.04	00:00	110.84	5.69
73	☐	JUP-65	93.16	24:00	87.44	00:00	89.43	5.72
74	☐	J-2	113.21	17:00	97.99	08:00	106.09	15.21
75	☐	JUP-71	49.90	24:00	44.19	00:00	46.14	5.71
76	☐	JUP-75	109.72	24:00	104.01	00:00	105.94	5.71
77	☐	JUP-77	94.84	24:00	84.11	19:00	88.35	10.74
78	☐	JUP-79	98.25	24:00	88.44	19:00	92.19	9.81
79	☐	JUP-81	93.40	24:00	79.78	19:00	85.58	13.62
80	☐	JUP-91	78.44	24:00	59.41	19:00	68.14	19.03
81	☐	JUP-93	75.94	24:00	57.68	19:00	65.99	18.27
82	☐	JUP-95	87.68	24:00	70.24	19:00	78.11	17.43
83	☐	JUP-97	78.71	24:00	60.71	19:00	68.88	18.00
84	☐	JUP-99	92.37	24:00	74.14	19:00	82.44	18.23
85	☐	JUP-101	85.82	24:00	68.94	19:00	76.51	16.88
86	☐	J-271	84.20	17:00	74.21	01:00	79.37	9.98
87	☐	J9B-15	76.33	17:00	66.37	01:00	71.51	9.95
88	☐	J9B-16	81.53	17:00	71.57	01:00	76.71	9.95
89	☐	J9B-17	81.96	17:00	72.00	01:00	77.15	9.95
90	☐	J9B-18	75.89	17:00	65.94	01:00	71.08	9.95
91	☐	J9B-21	75.46	17:00	65.51	01:00	70.65	9.95
92	☐	J9B-22	77.19	17:00	67.24	01:00	72.38	9.95
93	☐	J9B-23	80.66	17:00	70.70	01:00	75.85	9.95
94	☐	J9B-24	82.39	17:00	72.44	01:00	77.58	9.95
95	☐	J9B-25	84.99	17:00	75.04	01:00	80.18	9.95
96	☐	J9B-27	80.66	17:00	70.70	01:00	75.85	9.95
97	☐	J9B-35	70.35	17:00	59.94	01:00	65.33	10.41
98	☐	J9B-36	68.49	17:00	58.05	01:00	63.46	10.44
99	☐	J9B-37	72.66	17:00	62.16	01:00	67.60	10.50
100	☐	J9B-38	70.49	17:00	59.99	01:00	65.44	10.50
101	☐	J9B-39	73.87	17:00	63.37	01:00	68.81	10.50
102	☐	J9B-40	73.49	17:00	62.97	01:00	68.43	10.53
103	☐	J9B-41	72.74	17:00	62.17	01:00	67.66	10.57
104	☐	J9B-42	74.91	17:00	64.34	01:00	69.82	10.57
105	☐	J9B-43	74.80	17:00	64.25	01:00	69.72	10.55
106	☐	J9B-44	78.26	17:00	67.71	01:00	73.18	10.55
107	☐	J9B-67	86.29	17:00	76.34	01:00	81.48	9.95
108	☐	PA40-1	203.43	17:00	193.28	01:00	198.52	10.15
109	☐	PA40-2	202.92	17:00	191.74	02:00	197.57	11.19
110	☐	PA40-7	80.42	24:00	74.72	00:00	76.57	5.69
111	☐	PA40-8	201.74	24:00	196.05	00:00	197.89	5.69
112	☐	J-BPS	27.88	22:00	26.98	00:00	27.50	0.90

Interim Phase 1 Nonpotable System - With A to B BPS - 4000 gpm TIC Demand - Junction Range

		ID	Max.Value (psi)	Max.Time (hrs.)	Min.Value (psi)	Min.Time (hrs.)	Average (psi)	Difference (psi)
113	☐	J-A_B1	100.33	17:00	91.75	00:00	96.15	8.57
114	☐	PA40-12	79.39	17:00	68.89	01:00	74.33	10.50
115	☐	PA40-14	68.48	17:00	57.97	01:00	63.42	10.51

Interim Phase 1 Nonpotable System - With A to B BPS - 4000 gpm TIC Demand - A to B Pump Flow

		Time	A_BPUMP (gpm)	A_BPUMP2 (gpm)
1		00:00 hrs	1,452.56	2,848.86
2		01:00 hrs	1,453.97	2,850.62
3		02:00 hrs	1,446.67	2,841.52
4		03:00 hrs	1,433.14	2,824.63
5		04:00 hrs	1,425.06	2,814.53
6		05:00 hrs	1,405.91	2,790.52
7		06:00 hrs	1,394.37	2,776.00
8		07:00 hrs	1,351.12	2,721.27
9		08:00 hrs	1,432.83	2,824.25
10		09:00 hrs	1,409.51	2,795.04
11		10:00 hrs	1,391.29	2,772.11
12		11:00 hrs	1,380.94	2,759.06
13		12:00 hrs	778.10	1,936.12
14		13:00 hrs	778.27	1,936.38
15		14:00 hrs	778.44	1,936.62
16		15:00 hrs	778.59	1,936.86
17		16:00 hrs	778.74	1,937.09
18		17:00 hrs	778.89	1,937.30
19		18:00 hrs	798.62	1,966.79
20		19:00 hrs	827.74	2,009.90
21		20:00 hrs	835.83	2,021.78
22		21:00 hrs	850.60	2,043.40
23		22:00 hrs	872.16	2,074.74
24		23:00 hrs	919.73	2,143.07
25		24:00 hrs	983.33	2,232.75

Interim Phase 1 Nonpotable System - With A to B BPS - 4000 gpm TIC Demand - Sand Canyon PRV Report

		Time	Upstream Pressure	Downstream Pressure	Flow (gpm)	Velocity (ft/s)	Headloss (ft)
1		00:00 hrs	148.39	47.79	0.00	0.00	0.00
2		01:00 hrs	148.76	47.64	0.00	0.00	0.00
3		02:00 hrs	149.15	47.68	0.00	0.00	0.00
4		03:00 hrs	149.54	47.88	0.00	0.00	0.00
5		04:00 hrs	150.22	47.94	0.00	0.00	0.00
6		05:00 hrs	151.16	48.26	0.00	0.00	0.00
7		06:00 hrs	152.05	48.39	0.00	0.00	0.00
8		07:00 hrs	187.53	49.28	0.00	0.00	0.00
9		08:00 hrs	187.99	48.96	0.00	0.00	0.00
10		09:00 hrs	188.03	49.43	0.00	0.00	0.00
11		10:00 hrs	188.05	49.78	0.00	0.00	0.00
12		11:00 hrs	188.05	49.92	0.00	0.00	0.00
13		12:00 hrs	188.05	57.91	0.00	0.00	0.00
14		13:00 hrs	188.05	57.93	0.00	0.00	0.00
15		14:00 hrs	188.05	57.95	0.00	0.00	0.00
16		15:00 hrs	188.05	57.97	0.00	0.00	0.00
17		16:00 hrs	188.05	57.99	0.00	0.00	0.00
18		17:00 hrs	188.05	58.01	0.00	0.00	0.00
19		18:00 hrs	188.05	57.65	0.00	0.00	0.00
20		19:00 hrs	188.04	57.11	0.00	0.00	0.00
21		20:00 hrs	171.71	56.98	0.00	0.00	0.00
22		21:00 hrs	187.95	56.71	0.00	0.00	0.00
23		22:00 hrs	187.89	56.32	0.00	0.00	0.00
24		23:00 hrs	187.74	55.45	0.00	0.00	0.00
25		24:00 hrs	187.46	54.30	0.00	0.00	0.00

Interim Phase 1 Nonpotable System - 4000 gpm - NO A to B BPS - Junction Range Report

		ID	Max.Value (psi)	Max.Time (hrs.)	Min.Value (psi)	Min.Time (hrs.)	Average (psi)	Difference (psi)
1	☐	J-11	103.37	07:00	95.76	08:00	98.71	7.60
2	☐	J-12	104.25	07:00	101.27	08:00	102.35	2.98
3	☐	J-13	81.52	07:00	81.02	08:00	81.20	0.49
4	☐	J-15	120.82	07:00	118.07	08:00	119.07	2.74
5	☐	J-21	106.46	07:00	105.57	08:00	105.89	0.88
6	☐	J-26	100.40	07:00	99.51	08:00	99.83	0.89
7	☐	J-27	95.52	07:00	95.02	01:00	95.20	0.50
8	☐	J-34	95.03	17:00	94.01	02:00	94.65	1.02
9	☐	J-35	92.05	20:00	91.43	01:00	91.79	0.62
10	☐	J-38	109.39	17:00	108.08	02:00	108.91	1.31
11	☐	J-39	98.78	17:00	97.30	02:00	98.23	1.48
12	☐	J-41	113.72	17:00	112.30	04:00	113.20	1.42
13	☐	J-43	105.28	17:00	103.53	04:00	104.64	1.75
14	☐	J-53	70.32	20:00	69.79	02:00	70.12	0.53
15	☐	J-54	82.79	20:00	82.21	02:00	82.55	0.58
16	☐	J-55	80.85	20:00	80.32	02:00	80.64	0.53
17	☐	J-56	84.64	20:00	84.09	02:00	84.42	0.55
18	☐	J-57	84.44	20:00	83.92	02:00	84.23	0.52
19	☐	J-58	89.65	20:00	89.11	02:00	89.43	0.53
20	☐	J-59	86.95	20:00	86.44	01:00	86.73	0.51
21	☐	J-60	85.22	20:00	84.73	01:00	85.01	0.49
22	☐	J-61	89.36	20:00	88.87	01:00	89.12	0.49
23	☐	J-62	91.55	20:00	91.05	01:00	91.31	0.50
24	☐	J-63	84.09	20:00	83.64	01:00	83.87	0.46
25	☐	J-66	65.98	20:00	65.45	02:00	65.78	0.53
26	☐	J-67	60.82	20:00	60.29	02:00	60.62	0.53
27	☐	J-78	66.19	20:00	65.76	02:00	66.03	0.42
28	☐	J-80	83.52	20:00	83.02	02:00	83.32	0.49
29	☐	J-81	74.48	20:00	74.03	02:00	74.30	0.45
30	☐	J-82	73.01	20:00	72.69	02:00	72.88	0.32
31	☐	J-83	80.59	20:00	80.13	02:00	80.40	0.46
32	☐	J-84	81.34	20:00	80.88	01:00	81.14	0.46
33	☐	J-85	65.40	20:00	65.13	02:00	65.30	0.27
34	☐	J-86	68.42	20:00	68.01	02:00	68.25	0.41
35	☐	J-87	72.53	20:00	72.11	01:00	72.34	0.41
36	☐	J-88	77.52	20:00	77.13	01:00	77.34	0.39
37	☐	J-89	71.76	07:00	71.48	08:00	71.60	0.28
38	☐	J-90	76.21	07:00	75.82	08:00	75.97	0.39
39	☐	J-91	77.10	07:00	76.68	08:00	76.84	0.41
40	☐	J-92	54.92	20:00	54.87	01:00	54.89	0.05
41	☐	J-97	79.82	07:00	74.01	08:00	76.19	5.81
42	☐	J-104	88.01	07:00	86.62	08:00	87.12	1.39
43	☐	J-105	103.36	07:00	99.62	08:00	101.01	3.74
44	☐	J-106	95.85	07:00	93.69	08:00	94.47	2.17
45	☐	J-110	87.78	07:00	78.60	08:00	82.19	9.18
46	☐	J-124	177.19	17:00	157.93	02:00	167.65	19.26
47	☐	J-131	104.41	17:00	102.76	04:00	103.80	1.65
48	☐	J-132	100.55	24:00	96.95	00:00	99.15	3.61
49	☐	J-147	63.52	07:00	54.33	08:00	57.92	9.19
50	☐	J-150	111.15	07:00	108.89	00:00	109.89	2.26
51	☐	J-151	105.25	20:00	104.78	01:00	105.00	0.48
52	☐	J-152	83.49	20:00	83.00	01:00	83.28	0.49
53	☐	J-153	88.78	20:00	88.25	02:00	88.56	0.53
54	☐	J-154	86.92	20:00	86.40	02:00	86.71	0.52
55	☐	J-155	85.62	20:00	85.10	02:00	85.41	0.52
56	☐	J-156	90.71	20:00	90.16	02:00	90.49	0.55

Interim Phase 1 Nonpotable System - 4000 gpm - NO A to B BPS - Junction Range Report

		ID	Max.Value (psi)	Max.Time (hrs.)	Min.Value (psi)	Min.Time (hrs.)	Average (psi)	Difference (psi)
57	☐	J-157	76.64	20:00	76.19	02:00	76.47	0.45
58	☐	J-158	78.38	20:00	77.93	02:00	78.20	0.45
59	☐	J-159	74.91	20:00	74.46	02:00	74.73	0.45
60	☐	J-160	81.35	20:00	80.86	02:00	81.15	0.49
61	☐	J-161	79.67	20:00	79.22	01:00	79.48	0.46
62	☐	J-162	65.26	20:00	64.84	01:00	65.08	0.42
63	☐	J-163	73.75	20:00	73.30	01:00	73.56	0.44
64	☐	J-164	151.22	00:00	151.22	00:00	151.22	0.00
65	☐	JUP-41	91.85	24:00	75.44	19:00	82.75	16.41
66	☐	JUP-43	91.89	24:00	75.44	19:00	82.77	16.44
67	☐	JUP-45	94.35	24:00	77.61	19:00	85.10	16.74
68	☐	JUP-49	110.39	24:00	104.70	00:00	106.51	5.69
69	☐	JUP-51	97.29	24:00	91.48	19:00	93.06	5.82
70	☐	JUP-53	84.30	24:00	67.64	19:00	75.09	16.65
71	☐	JUP-55	98.55	24:00	90.61	19:00	93.35	7.95
72	☐	JUP-57	114.73	24:00	109.04	00:00	110.84	5.69
73	☐	JUP-65	93.16	24:00	87.44	00:00	89.43	5.72
74	☐	J-2	102.53	07:00	94.65	08:00	97.71	7.88
75	☐	JUP-71	49.90	24:00	44.19	00:00	46.14	5.71
76	☐	JUP-75	109.72	24:00	104.01	00:00	105.94	5.71
77	☐	JUP-77	94.84	24:00	84.11	19:00	88.35	10.74
78	☐	JUP-79	98.25	24:00	88.44	19:00	92.19	9.81
79	☐	JUP-81	93.40	24:00	79.78	19:00	85.58	13.62
80	☐	JUP-91	78.44	24:00	59.41	19:00	68.14	19.03
81	☐	JUP-93	75.94	24:00	57.68	19:00	65.99	18.27
82	☐	JUP-95	87.68	24:00	70.24	19:00	78.11	17.43
83	☐	JUP-97	78.71	24:00	60.71	19:00	68.88	18.00
84	☐	JUP-99	92.37	24:00	74.14	19:00	82.44	18.23
85	☐	JUP-101	85.82	24:00	68.94	19:00	76.51	16.88
86	☐	J-271	71.33	07:00	71.07	08:00	71.18	0.27
87	☐	J9B-15	63.10	07:00	62.81	08:00	62.93	0.28
88	☐	J9B-16	68.30	07:00	68.01	08:00	68.13	0.28
89	☐	J9B-17	68.73	07:00	68.45	08:00	68.57	0.28
90	☐	J9B-18	62.66	07:00	62.38	08:00	62.50	0.28
91	☐	J9B-21	62.23	07:00	61.95	08:00	62.07	0.28
92	☐	J9B-22	63.96	07:00	63.68	08:00	63.80	0.28
93	☐	J9B-23	67.43	07:00	67.15	08:00	67.27	0.28
94	☐	J9B-24	69.16	07:00	68.88	08:00	69.00	0.28
95	☐	J9B-25	71.76	07:00	71.48	08:00	71.60	0.28
96	☐	J9B-27	67.43	07:00	67.15	08:00	67.27	0.28
97	☐	J9B-35	61.23	20:00	61.06	02:00	61.16	0.16
98	☐	J9B-36	59.23	20:00	59.03	02:00	59.15	0.20
99	☐	J9B-37	62.81	20:00	62.50	02:00	62.70	0.31
100	☐	J9B-38	60.64	20:00	60.33	02:00	60.53	0.31
101	☐	J9B-39	63.93	20:00	63.62	02:00	63.81	0.31
102	☐	J9B-40	63.41	17:00	63.06	02:00	63.28	0.35
103	☐	J9B-41	62.21	17:00	61.76	02:00	62.04	0.44
104	☐	J9B-42	64.37	17:00	63.93	02:00	64.21	0.44
105	☐	J9B-43	63.89	20:00	63.44	02:00	63.73	0.44
106	☐	J9B-44	67.35	20:00	66.91	02:00	67.19	0.44
107	☐	J9B-67	73.06	07:00	72.78	08:00	72.90	0.28
108	☐	PA40-1	185.62	20:00	185.00	01:00	185.34	0.62
109	☐	PA40-2	185.22	17:00	183.91	02:00	184.74	1.31
110	☐	PA40-7	80.42	24:00	74.72	00:00	76.57	5.69
111	☐	PA40-8	201.74	24:00	196.05	00:00	197.89	5.69
112	☐	J-BPS	28.56	24:00	28.29	00:00	28.45	0.27

Interim Phase 1 Nonpotable System - 4000 gpm - NO A to B BPS - Junction Range Report

		ID	Max.Value (psi)	Max.Time (hrs.)	Min.Value (psi)	Min.Time (hrs.)	Average (psi)	Difference (psi)
113	☐	J-A_B1	78.92	07:00	78.42	08:00	78.60	0.49
114	☐	PA40-12	66.84	20:00	66.31	02:00	66.64	0.53
115	☐	PA40-14	56.07	20:00	55.55	02:00	55.87	0.53

Interim Phase 1 Nonpotable System - 4000 gpm - NO A to B BPS - Sand Canyon PRV Report

		Time	Upstream Pressure (psi)	Downstream Pressure	Flow (gpm)	Velocity (ft/s)	Headloss (ft)
1	☐	00:00 hrs	132.97	50.00	2,561.63	7.27	191.48
2	☐	01:00 hrs	132.91	50.00	2,571.12	7.29	191.34
3	☐	02:00 hrs	133.01	50.00	2,560.75	7.26	191.58
4	☐	03:00 hrs	133.25	50.00	2,534.84	7.19	192.14
5	☐	04:00 hrs	133.62	50.00	2,525.36	7.16	192.99
6	☐	05:00 hrs	134.48	50.00	2,485.55	7.05	194.97
7	☐	06:00 hrs	135.14	50.00	2,469.32	7.00	196.48
8	☐	07:00 hrs	136.50	50.00	2,360.01	6.69	199.63
9	☐	08:00 hrs	136.27	50.00	2,520.11	7.15	199.10
10	☐	09:00 hrs	137.21	50.00	2,477.26	7.03	201.27
11	☐	10:00 hrs	138.04	50.00	2,450.60	6.95	203.20
12	☐	11:00 hrs	138.68	50.00	2,448.96	6.95	204.67
13	☐	12:00 hrs	170.89	50.00	2,447.35	6.94	279.00
14	☐	13:00 hrs	170.91	50.00	2,445.76	6.94	279.05
15	☐	14:00 hrs	170.93	50.00	2,444.19	6.93	279.10
16	☐	15:00 hrs	170.95	50.00	2,442.65	6.93	279.14
17	☐	16:00 hrs	170.97	50.00	2,441.13	6.92	279.19
18	☐	17:00 hrs	170.99	50.00	2,439.64	6.92	279.24
19	☐	18:00 hrs	170.45	50.00	2,463.56	6.99	277.98
20	☐	19:00 hrs	169.62	50.00	2,499.70	7.09	276.06
21	☐	20:00 hrs	139.82	50.00	2,338.23	6.63	207.28
22	☐	21:00 hrs	170.37	50.00	2,343.66	6.65	277.79
23	☐	22:00 hrs	169.62	50.00	2,358.58	6.69	276.07
24	☐	23:00 hrs	167.69	50.00	2,407.85	6.83	271.61
25	☐	24:00 hrs	164.90	50.00	2,477.53	7.03	265.17

Interim Phase 1 Nonpotable System 5.5 gpm/acre - Junction Range - Report

		ID	Max.Value (psi)	Max.Time (hrs.)	Min.Value (psi)	Min.Time (hrs.)	Average (psi)
1		J-11	125.65	23:00	96.33	08:00	101.24
2		J-12	130.41	23:00	102.34	08:00	105.37
3		J-13	108.87	23:00	83.12	00:00	85.30
4		J-15	147.11	23:00	119.26	08:00	122.20
5		J-21	133.84	23:00	107.77	08:00	110.04
6		J-26	127.78	23:00	101.71	08:00	103.98
7		J-27	123.13	23:00	97.38	00:00	99.56
8		J-34	123.44	23:00	98.00	01:00	100.26
9		J-35	122.84	23:00	97.49	00:00	99.59
10		J-38	138.82	23:00	113.19	01:00	115.56
11		J-39	128.28	23:00	102.68	01:00	105.07
12		J-41	143.11	23:00	117.42	01:00	119.86
13		J-43	134.69	23:00	108.96	01:00	111.48
14		J-53	106.29	23:00	81.19	01:00	83.20
15		J-54	114.79	23:00	89.60	01:00	91.64
16		J-55	110.98	23:00	85.90	01:00	87.89
17		J-56	114.16	23:00	89.05	01:00	91.06
18		J-57	113.42	23:00	88.30	01:00	90.31
19		J-58	118.00	23:00	92.80	01:00	94.85
20		J-59	114.76	23:00	89.51	01:00	91.57
21		J-60	112.99	23:00	87.77	01:00	89.81
22		J-61	116.95	23:00	91.45	00:00	93.59
23		J-62	119.25	23:00	93.71	00:00	95.86
24		J-63	111.37	23:00	86.00	00:00	88.10
25		J-66	101.93	23:00	76.84	01:00	78.84
26		J-67	98.17	23:00	73.09	01:00	75.09
27		J-78	98.16	23:00	73.16	01:00	75.11
28		J-80	112.19	23:00	87.06	01:00	89.07
29		J-81	103.59	23:00	78.57	01:00	80.53
30		J-82	100.98	23:00	76.03	01:00	77.94
31		J-83	108.82	23:00	83.68	01:00	85.69
32		J-84	109.01	23:00	83.85	01:00	85.86
33		J-85	93.15	23:00	68.24	01:00	70.14
34		J-86	96.15	23:00	71.07	01:00	73.05
35		J-87	99.62	23:00	74.45	00:00	76.46
36		J-88	104.47	23:00	79.29	00:00	81.29
37		J-89	97.77	23:00	72.60	00:00	74.57
38		J-90	102.90	23:00	77.43	00:00	79.51
39		J-91	103.92	23:00	78.40	00:00	80.49
40		J-92	79.95	23:00	55.19	00:00	57.00
41		J-97	104.11	23:00	74.35	08:00	78.61
42		J-104	114.93	23:00	88.38	08:00	90.83
43		J-105	128.89	23:00	100.61	08:00	103.95
44		J-106	122.41	23:00	95.11	08:00	97.85
45		J-110	108.77	23:00	79.00	08:00	84.56
46		J-124	182.83	17:00	163.15	00:00	176.54
47		J-131	133.85	23:00	108.17	01:00	110.64
48		J-132	129.15	23:00	97.13	00:00	101.66
49		J-147	84.51	23:00	54.74	08:00	60.30
50		J-150	138.74	23:00	109.27	00:00	112.69
51		J-151	133.51	23:00	107.85	00:00	110.02
52		J-152	111.26	23:00	86.03	01:00	88.08
53		J-153	117.13	23:00	91.93	01:00	93.98
54		J-154	115.68	23:00	90.52	01:00	92.55
55		J-155	114.38	23:00	89.22	01:00	91.25
56		J-156	120.23	23:00	95.12	01:00	97.13

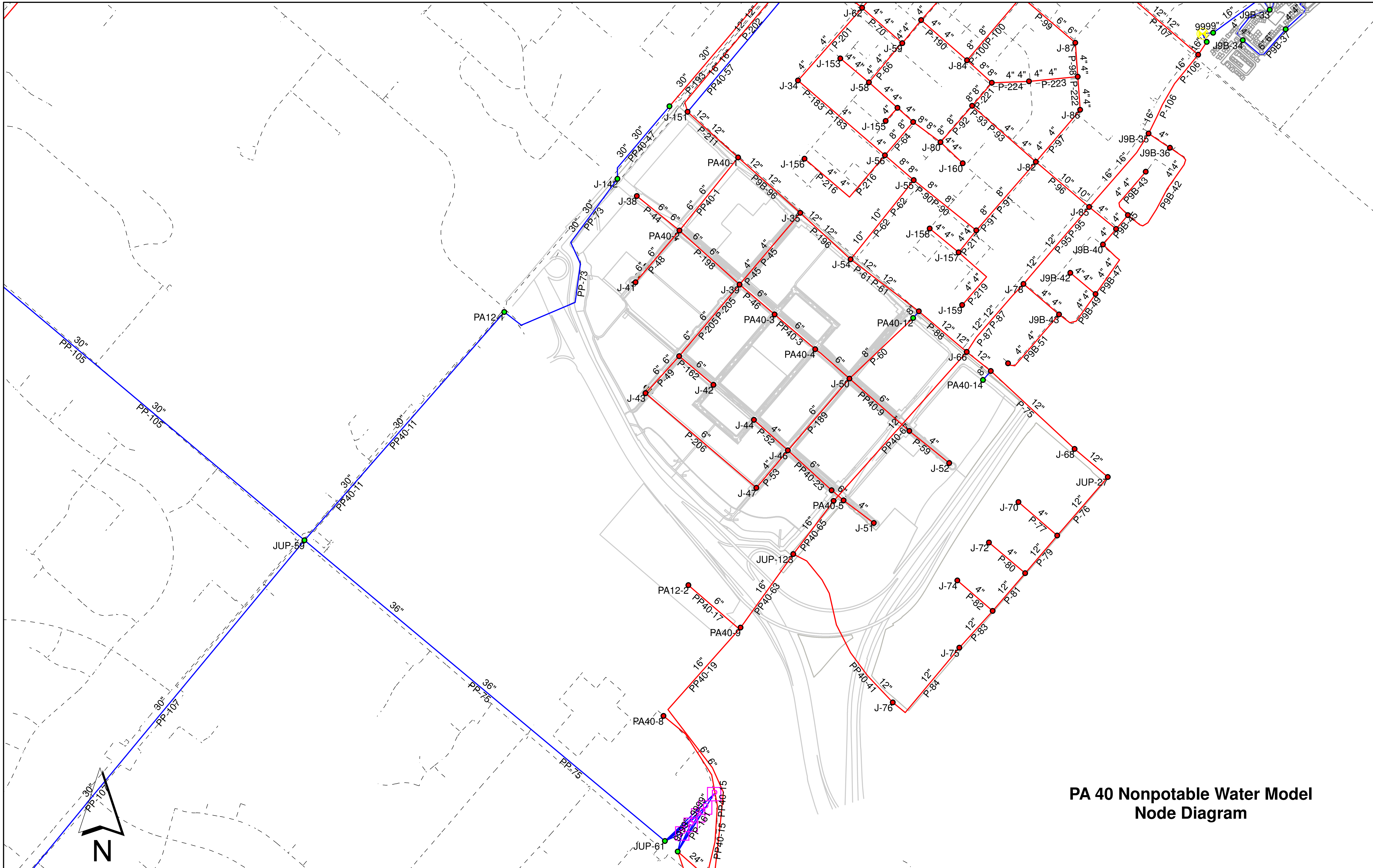
Interim Phase 1 Nonpotable System 5.5 gpm/acre - Junction Range - Report

		ID	Max.Value (psi)	Max.Time (hrs.)	Min.Value (psi)	Min.Time (hrs.)	Average (psi)
57	☐	J-157	105.76	23:00	80.74	01:00	82.70
58	☐	J-158	107.49	23:00	82.47	01:00	84.43
59	☐	J-159	104.03	23:00	79.01	01:00	80.96
60	☐	J-160	110.02	23:00	84.89	01:00	86.90
61	☐	J-161	107.61	23:00	82.46	01:00	84.47
62	☐	J-162	92.88	23:00	67.75	01:00	69.75
63	☐	J-163	101.55	23:00	76.40	01:00	78.41
64	☐	J-164	151.22	00:00	151.22	00:00	151.22
65	☐	JUP-41	91.85	24:00	75.44	19:00	82.75
66	☐	JUP-43	91.89	24:00	75.44	19:00	82.77
67	☐	JUP-45	94.35	24:00	77.61	19:00	85.10
68	☐	JUP-49	110.39	24:00	104.70	00:00	106.51
69	☐	JUP-51	97.29	24:00	91.48	19:00	93.06
70	☐	JUP-53	84.30	24:00	67.64	19:00	75.09
71	☐	JUP-55	98.55	24:00	90.61	19:00	93.35
72	☐	JUP-57	114.73	24:00	109.04	00:00	110.84
73	☐	JUP-65	93.16	24:00	87.44	00:00	89.43
74	☐	J-2	124.59	23:00	95.18	08:00	100.21
75	☐	JUP-71	49.90	24:00	44.19	00:00	46.14
76	☐	JUP-75	109.72	24:00	104.01	00:00	105.94
77	☐	JUP-77	94.84	24:00	84.11	19:00	88.35
78	☐	JUP-79	98.25	24:00	88.44	19:00	92.19
79	☐	JUP-81	93.40	24:00	79.78	19:00	85.58
80	☐	JUP-91	78.44	24:00	59.41	19:00	68.14
81	☐	JUP-93	75.94	24:00	57.68	19:00	65.99
82	☐	JUP-95	87.68	24:00	70.24	19:00	78.11
83	☐	JUP-97	78.71	24:00	60.71	19:00	68.88
84	☐	JUP-99	92.37	24:00	74.14	19:00	82.44
85	☐	JUP-101	85.82	24:00	68.94	19:00	76.51
86	☐	J-271	97.27	23:00	72.13	00:00	74.09
87	☐	J9B-15	89.11	23:00	63.93	00:00	65.91
88	☐	J9B-16	94.31	23:00	69.13	00:00	71.11
89	☐	J9B-17	94.74	23:00	69.56	00:00	71.54
90	☐	J9B-18	88.67	23:00	63.50	00:00	65.47
91	☐	J9B-21	88.24	23:00	63.06	00:00	65.04
92	☐	J9B-22	89.97	23:00	64.80	00:00	66.77
93	☐	J9B-23	93.44	23:00	68.26	00:00	70.24
94	☐	J9B-24	95.17	23:00	70.00	00:00	71.97
95	☐	J9B-25	97.77	23:00	72.60	00:00	74.57
96	☐	J9B-27	93.44	23:00	68.26	00:00	70.24
97	☐	J9B-35	87.63	23:00	62.79	01:00	64.65
98	☐	J9B-36	85.87	23:00	61.02	01:00	62.88
99	☐	J9B-37	90.52	23:00	65.61	01:00	67.51
100	☐	J9B-38	88.35	23:00	63.44	01:00	65.35
101	☐	J9B-39	91.80	23:00	66.89	01:00	68.80
102	☐	J9B-40	91.73	23:00	66.80	01:00	68.72
103	☐	J9B-41	91.95	23:00	66.98	01:00	68.93
104	☐	J9B-42	94.12	23:00	69.15	01:00	71.10
105	☐	J9B-43	94.83	23:00	69.83	01:00	71.79
106	☐	J9B-44	98.29	23:00	73.30	01:00	75.26
107	☐	J9B-67	99.07	23:00	73.90	00:00	75.87
108	☐	PA40-1	215.06	23:00	189.53	00:00	191.69
109	☐	PA40-2	214.65	23:00	189.02	01:00	191.39
110	☐	PA40-7	80.42	24:00	74.72	00:00	76.57
111	☐	PA40-8	201.74	24:00	196.05	00:00	197.89
112	☐	J-BPS	28.56	24:00	28.29	00:00	28.45

Interim Phase 1 Nonpotable System 5.5 gpm/acre - Junction Range - Report

		ID	Max.Value (psi)	Max.Time (hrs.)	Min.Value (psi)	Min.Time (hrs.)	Average (psi)
113	☐	J-A_B1	106.27	23:00	80.52	00:00	82.70
114	☐	PA40-12	105.69	23:00	80.60	01:00	82.60
115	☐	PA40-14	97.36	23:00	72.28	01:00	74.28

		Time	Upstream Pressure	Downstream Pressure	Flow (gpm)	Velocity (ft/s)	Headloss (ft)
1	☐	00:00 hrs	146.61	50.00	328.09	0.93	222.97
2	☐	01:00 hrs	146.96	50.00	327.42	0.93	223.78
3	☐	02:00 hrs	147.45	50.00	306.04	0.87	224.89
4	☐	03:00 hrs	147.99	50.00	271.76	0.77	226.15
5	☐	04:00 hrs	148.66	50.00	255.44	0.72	227.70
6	☐	05:00 hrs	149.81	50.00	211.79	0.60	230.34
7	☐	06:00 hrs	150.78	50.00	191.27	0.54	232.58
8	☐	07:00 hrs	152.40	50.00	81.52	0.23	236.32
9	☐	08:00 hrs	187.63	50.00	228.84	0.65	317.64
10	☐	09:00 hrs	187.84	50.00	184.81	0.52	318.11
11	☐	10:00 hrs	187.93	50.00	156.73	0.44	318.32
12	☐	11:00 hrs	187.93	50.00	153.27	0.43	318.33
13	☐	12:00 hrs	187.95	50.00	149.86	0.43	318.38
14	☐	13:00 hrs	187.96	50.00	146.51	0.42	318.39
15	☐	14:00 hrs	187.96	50.00	143.22	0.41	318.40
16	☐	15:00 hrs	187.96	50.00	139.97	0.40	318.40
17	☐	16:00 hrs	187.97	50.00	136.78	0.39	318.41
18	☐	17:00 hrs	187.97	50.00	133.64	0.38	318.42
19	☐	18:00 hrs	187.93	50.00	155.55	0.44	318.32
20	☐	19:00 hrs	187.84	50.00	189.50	0.54	318.13
21	☐	20:00 hrs	171.41	50.00	28.47	0.08	280.20
22	☐	21:00 hrs	187.91	50.00	32.21	0.09	318.28
23	☐	22:00 hrs	187.83	50.00	45.20	0.13	318.10
24	☐	23:00 hrs	187.74	74.75	0.00	0.00	0.00
25	☐	24:00 hrs	187.46	70.32	0.00	0.00	0.00



PA 40 Nonpotable Water Model Node Diagram

PA 40 Nodes - Ultimate Build out - Junction Report

		ID	Max.Value (psi)	Max.Time (hrs.)	Min.Value (psi)	Min.Time (hrs.)	Average (psi)	Difference (psi)
1		JUP-27	75.97	17:00	59.54	06:00	70.47	16.43
2		J-68	80.41	17:00	63.87	06:00	74.85	16.54
3		J-69	84.45	17:00	68.32	06:00	79.11	16.13
4		J-70	87.91	17:00	69.93	06:00	81.93	17.98
5		J-71	87.80	17:00	71.97	06:00	82.60	15.84
6		J-51	102.41	17:00	72.47	06:00	92.03	29.94
7		PA40-6	95.48	17:00	72.66	06:00	87.57	22.83
8		J-52	98.08	17:00	73.40	06:00	89.52	24.68
9		PA40-5	103.29	17:00	74.71	06:00	93.38	28.58
10		J-72	92.56	17:00	75.02	06:00	86.77	17.55
11		PA40-10	103.72	17:00	75.22	06:00	93.84	28.50
12		J-73	91.16	17:00	75.77	06:00	86.15	15.40
13		J-74	96.36	17:00	79.27	06:00	90.76	17.08
14		J-75	94.96	17:00	80.19	06:00	90.20	14.77
15		J-46	110.22	17:00	82.02	06:00	100.44	28.20
16		J-50	105.02	17:00	82.59	06:00	97.24	22.43
17		J-47	113.79	17:00	84.18	06:00	103.49	29.61
18		J-44	115.41	17:00	85.57	06:00	105.07	29.85
19		J-76	103.43	17:00	90.13	06:00	99.24	13.30
20		J-42	119.95	17:00	90.49	06:00	109.68	29.46
21		PA40-15	101.89	17:00	91.21	06:00	98.68	10.68
22		J-39	116.59	17:00	92.53	06:00	108.17	24.06
23		J-131	122.12	17:00	93.24	06:00	112.05	28.88
24		J-43	122.95	17:00	93.30	06:00	112.62	29.65
25		JUP-123	109.57	17:00	99.40	06:00	106.57	10.17
26		J-38	127.24	17:00	102.36	06:00	118.49	24.88
27		PA12-2	114.50	20:00	106.00	24:00	112.18	8.50
28		J-41	131.58	17:00	106.62	06:00	122.79	24.95
29		PA40-2	203.07	17:00	179.00	06:00	194.60	24.07
30		PA40-3	202.72	17:00	179.18	06:00	194.51	23.54
31		PA40-4	202.61	17:00	179.67	06:00	194.63	22.94
32		PA40-9	200.29	20:00	191.79	24:00	197.98	8.50

PA 40 Nodes - Ultimate Build out - Junction Report - Zone B

		ID	Max.Value (psi)	Max.Time (hrs.)	Min.Value (psi)	Min.Time (hrs.)	Average (psi)	Difference (psi)
1	☐	J-38	127.24	17:00	102.36	06:00	118.49	24.88
2	☐	J-39	116.59	17:00	92.53	06:00	108.17	24.06
3	☐	J-41	131.58	17:00	106.62	06:00	122.79	24.95
4	☐	J-42	119.95	17:00	90.49	06:00	109.68	29.46
5	☐	J-43	122.95	17:00	93.30	06:00	112.62	29.65
6	☐	J-44	115.41	17:00	85.57	06:00	105.07	29.85
7	☐	J-46	110.22	17:00	82.02	06:00	100.44	28.20
8	☐	J-47	113.79	17:00	84.18	06:00	103.49	29.61
9	☐	J-50	105.02	17:00	82.59	06:00	97.24	22.43
10	☐	J-51	102.41	17:00	72.47	06:00	92.03	29.94
11	☐	J-52	98.08	17:00	73.40	06:00	89.52	24.68
12	☐	J-68	80.41	17:00	63.87	06:00	74.85	16.54
13	☐	J-69	84.45	17:00	68.32	06:00	79.11	16.13
14	☐	J-70	87.91	17:00	69.93	06:00	81.93	17.98
15	☐	J-71	87.80	17:00	71.97	06:00	82.60	15.84
16	☐	J-72	92.56	17:00	75.02	06:00	86.77	17.55
17	☐	J-73	91.16	17:00	75.77	06:00	86.15	15.40
18	☐	J-74	96.36	17:00	79.27	06:00	90.76	17.08
19	☐	J-75	94.96	17:00	80.19	06:00	90.20	14.77
20	☐	J-76	103.43	17:00	90.13	06:00	99.24	13.30
21	☐	J-131	122.12	17:00	93.24	06:00	112.05	28.88
22	☐	JUP-27	75.97	17:00	59.54	06:00	70.47	16.43
23	☐	PA40-2	203.07	17:00	179.00	06:00	194.60	24.07
24	☐	PA40-3	202.72	17:00	179.18	06:00	194.51	23.54
25	☐	PA40-4	202.61	17:00	179.67	06:00	194.63	22.94
26	☐	PA40-5	103.29	17:00	74.71	06:00	93.38	28.58
27	☐	PA40-6	95.48	17:00	72.66	06:00	87.57	22.83
28	☐	PA40-10	103.72	17:00	75.22	06:00	93.84	28.50
29	☐	JUP-123	109.57	17:00	99.40	06:00	106.57	10.17
30	☐	PA12-2	114.50	20:00	106.00	24:00	112.18	8.50
31	☐	PA40-9	200.29	20:00	191.79	24:00	197.98	8.50
32	☐	PA40-15	101.89	17:00	91.21	06:00	98.68	10.68
33	☐	J-11	99.46	17:00	88.03	06:00	95.37	11.43
34	☐	J-12	108.56	17:00	95.69	06:00	103.92	12.86
35	☐	J-13	97.03	17:00	82.82	06:00	91.85	14.21
36	☐	J-15	126.03	17:00	111.41	06:00	120.82	14.61
37	☐	J-21	119.88	17:00	97.46	06:00	111.86	22.42
38	☐	J-26	113.84	17:00	97.08	06:00	107.79	16.75
39	☐	J-27	110.76	17:00	93.62	06:00	104.56	17.14
40	☐	J-34	112.19	17:00	88.54	06:00	103.84	23.65
41	☐	J-35	111.72	17:00	93.66	06:00	105.33	18.06
42	☐	J-53	96.31	17:00	78.60	06:00	90.16	17.71
43	☐	J-54	104.08	17:00	85.97	06:00	97.71	18.11
44	☐	J-55	100.20	17:00	81.30	06:00	93.56	18.90
45	☐	J-56	103.29	17:00	83.41	06:00	96.30	19.88
46	☐	J-57	102.48	17:00	82.33	06:00	95.38	20.15
47	☐	J-58	106.91	17:00	84.98	06:00	99.17	21.93
48	☐	J-59	103.55	17:00	81.31	06:00	95.68	22.24
49	☐	J-60	101.80	17:00	80.13	06:00	94.13	21.68
50	☐	J-61	105.17	17:00	84.05	06:00	97.65	21.12
51	☐	J-62	107.39	17:00	87.27	06:00	100.21	20.13
52	☐	J-63	99.81	17:00	75.72	06:00	91.28	24.09
53	☐	J-66	91.62	17:00	74.75	06:00	85.87	16.87
54	☐	J-67	88.08	17:00	71.27	06:00	82.36	16.80
55	☐	J-78	87.62	17:00	70.10	06:00	81.56	17.52
56	☐	J-80	101.21	17:00	80.97	06:00	94.07	20.24

PA 40 Nodes - Ultimate Build out - Junction Report - Zone B

		ID	Max.Value (psi)	Max.Time (hrs.)	Min.Value (psi)	Min.Time (hrs.)	Average (psi)	Difference (psi)
57	☐	J-81	92.81	17:00	73.94	06:00	86.18	18.87
58	☐	J-82	90.19	17:00	71.82	06:00	83.73	18.37
59	☐	J-83	97.78	17:00	77.42	06:00	90.59	20.36
60	☐	J-84	97.88	17:00	77.36	06:00	90.61	20.52
61	☐	J-85	82.36	17:00	64.37	06:00	76.04	18.00
62	☐	J-86	85.15	17:00	64.59	06:00	77.90	20.56
63	☐	J-87	88.42	17:00	67.66	06:00	81.06	20.76
64	☐	J-88	93.24	17:00	73.06	06:00	86.08	20.18
65	☐	J-89	86.48	17:00	68.25	06:00	79.99	18.24
66	☐	J-90	91.33	17:00	75.12	06:00	85.50	16.21
67	☐	J-91	92.30	17:00	76.50	06:00	86.60	15.80
68	☐	J-92	69.06	17:00	50.98	06:00	62.69	18.09
69	☐	J-97	75.62	17:00	67.46	06:00	72.75	8.16
70	☐	J-104	99.50	17:00	85.77	06:00	94.52	13.73
71	☐	J-105	106.32	17:00	93.69	06:00	101.77	12.63
72	☐	J-106	103.83	17:00	90.53	06:00	99.02	13.30
73	☐	J-110	84.28	17:00	71.15	06:00	79.48	13.13
74	☐	J-124	182.77	14:00	141.50	06:00	158.27	41.27
75	☐	J-132	99.62	22:00	94.04	06:00	97.61	5.58
76	☐	J-147	58.19	17:00	46.87	06:00	54.08	11.32
77	☐	J-150	113.35	17:00	102.42	06:00	109.55	10.93
78	☐	J-151	121.58	17:00	104.72	06:00	115.50	16.86
79	☐	J-152	100.07	17:00	78.39	06:00	92.40	21.68
80	☐	J-153	106.04	17:00	84.11	06:00	98.31	21.93
81	☐	J-154	104.68	17:00	83.90	06:00	97.35	20.78
82	☐	J-155	103.38	17:00	82.60	06:00	96.05	20.78
83	☐	J-156	109.36	17:00	89.48	06:00	102.37	19.88
84	☐	J-157	94.97	17:00	76.11	06:00	88.35	18.87
85	☐	J-158	96.71	17:00	77.84	06:00	90.08	18.87
86	☐	J-159	93.24	17:00	74.37	06:00	86.61	18.87
87	☐	J-160	99.04	17:00	78.81	06:00	91.91	20.24
88	☐	J-161	96.53	17:00	76.08	06:00	89.30	20.44
89	☐	J-162	81.80	17:00	61.17	06:00	74.50	20.63
90	☐	J-163	90.46	17:00	69.94	06:00	83.21	20.52
91	☐	J-164	151.22	00:00	151.22	00:00	151.22	0.00
92	☐	JUP-41	77.65	17:00	63.08	06:00	73.42	14.57
93	☐	JUP-43	77.65	17:00	63.15	06:00	73.45	14.50
94	☐	JUP-45	79.82	17:00	65.53	06:00	75.69	14.29
95	☐	JUP-49	110.94	05:00	101.96	24:00	107.33	8.99
96	☐	JUP-51	94.35	20:00	85.55	24:00	92.05	8.80
97	☐	JUP-53	69.85	17:00	55.19	06:00	65.59	14.66
98	☐	JUP-55	93.10	20:00	81.59	06:00	89.77	11.51
99	☐	JUP-57	115.16	05:00	106.29	24:00	111.60	8.87
100	☐	JUP-65	94.28	05:00	87.28	24:00	90.56	7.00
101	☐	J-2	98.14	17:00	86.96	06:00	94.14	11.18
102	☐	JUP-71	52.00	05:00	43.96	24:00	47.66	8.04
103	☐	JUP-75	112.36	05:00	103.84	24:00	107.66	8.53
104	☐	JUP-77	86.33	17:00	71.75	06:00	82.09	14.57
105	☐	JUP-79	90.72	20:00	77.09	06:00	86.78	13.63
106	☐	JUP-81	81.99	17:00	67.49	06:00	77.78	14.50
107	☐	JUP-91	61.62	17:00	47.31	06:00	57.48	14.31
108	☐	JUP-93	59.89	17:00	45.13	06:00	55.59	14.76
109	☐	JUP-95	72.45	17:00	57.67	06:00	68.15	14.79
110	☐	JUP-97	62.92	17:00	48.13	06:00	58.62	14.79
111	☐	JUP-99	76.36	20:00	62.18	06:00	72.26	14.18
112	☐	JUP-101	71.16	20:00	57.01	06:00	67.07	14.15

		ID	Max.Value (psi)	Max.Time (hrs.)	Min.Value (psi)	Min.Time (hrs.)	Average (psi)	Difference (psi)
113		J-271	86.01	17:00	67.79	06:00	79.52	18.23
114		J9B-15	77.78	17:00	51.53	06:00	68.51	26.26
115		J9B-16	82.97	17:00	53.76	06:00	72.67	29.21
116		J9B-17	83.40	17:00	52.70	06:00	72.58	30.70
117		J9B-18	77.36	17:00	52.16	06:00	68.45	25.20
118		J9B-21	76.89	17:00	44.45	06:00	65.47	32.45
119		J9B-22	78.64	17:00	48.60	06:00	68.05	30.04
120		J9B-23	82.12	17:00	57.65	06:00	73.47	24.47
121		J9B-24	83.85	17:00	56.83	06:00	74.31	27.01
122		J9B-25	86.44	17:00	57.10	06:00	76.10	29.34
123		J9B-27	82.09	17:00	49.77	06:00	70.71	32.33
124		J9B-35	76.80	17:00	58.75	06:00	70.44	18.05
125		J9B-36	75.04	17:00	56.58	06:00	68.55	18.46
126		J9B-37	79.73	17:00	60.94	06:00	73.14	18.79
127		J9B-38	77.57	17:00	58.68	06:00	70.94	18.89
128		J9B-39	81.03	17:00	62.26	06:00	74.44	18.77
129		J9B-40	80.98	17:00	62.15	06:00	74.38	18.83
130		J9B-41	81.28	17:00	62.49	06:00	74.73	18.79
131		J9B-42	83.45	17:00	64.59	06:00	76.87	18.85
132		J9B-43	84.22	17:00	65.69	06:00	77.79	18.53
133		J9B-44	87.69	17:00	68.99	06:00	81.19	18.70
134		J9B-67	87.74	17:00	58.72	06:00	77.51	29.02
135		PA40-1	203.51	17:00	185.79	06:00	197.19	17.71
136		PA40-7	82.53	05:00	72.32	24:00	78.01	10.21
137		PA40-8	203.85	05:00	193.65	24:00	199.34	10.21
138		J-BPS	28.09	10:00	24.25	06:00	26.94	3.84
139		J-A_B1	94.71	17:00	81.13	06:00	89.75	13.58

PA 40 Nodes - Ultimate Build out - Pipe Report

		ID	Max.Value (gpm)	Max.Time (hrs.)	Min.Value (gpm)	Min.Time (hrs.)	Average (gpm)
1		P-44	162.43	04:00	7.96	10:00	69.56
2		P-45	127.08	04:00	23.54	10:00	62.17
3		P-46	129.75	04:00	0.95	08:00	67.13
4		P-48	151.79	04:00	7.44	10:00	65.00
5		P-49	169.79	04:00	29.19	10:00	81.60
6		P-52	90.88	04:00	4.45	10:00	38.92
7		P-53	77.72	04:00	0.21	09:00	36.29
8		P-57	90.88	04:00	4.45	10:00	38.92
9		P-59	90.88	04:00	4.45	10:00	38.92
10		P-60	661.87	04:00	8.66	18:00	275.33
11		P-75	385.26	17:00	14.99	05:00	231.56
12		P-76	409.61	05:00	16.05	23:00	261.84
13		P-77	90.88	04:00	4.45	10:00	38.92
14		P-79	583.35	05:00	11.04	21:00	311.58
15		P-80	90.88	04:00	4.45	10:00	38.92
16		P-81	757.10	05:00	6.39	20:00	369.09
17		P-82	90.88	04:00	4.45	10:00	38.92
18		P-83	930.84	05:00	12.16	08:00	431.72
19		P-84	1,017.71	05:00	34.43	08:00	464.33
20		P-162	151.79	04:00	7.44	10:00	65.00
21		P-189	350.36	04:00	3.69	10:00	144.17
22		P-198	69.25	17:00	40.34	21:00	59.60
23		P-205	321.58	04:00	36.63	10:00	146.60
24		P-206	23.52	17:00	6.64	08:00	14.53
25		PP-31	380.81	17:00	4.21	01:00	210.24
26		PP40-1	378.98	04:00	79.60	10:00	194.16
27		PP40-3	129.75	04:00	0.95	08:00	67.13
28		PP40-5	129.75	04:00	0.95	08:00	67.13
29		PP40-7	90.88	04:00	4.45	10:00	38.92
30		PP40-9	90.88	04:00	4.45	10:00	38.92
31		PP40-23	90.88	04:00	4.45	10:00	38.92
32		PP40-63	2,556.42	05:00	43.65	20:00	1,219.26
33		PP40-65	1,451.84	05:00	6.91	21:00	734.92
34		PP40-17	0.00	07:00	0.00	08:00	0.00
35		PP40-19	2,556.42	05:00	43.65	20:00	1,219.26
36		PP40-41	1,105.10	04:00	56.71	08:00	496.94
37		PP40-67	1,451.84	05:00	6.91	21:00	734.92

PA 40 Nodes - Ultimate Build out - Pipe Flow Range Report - Zone B

		ID	Max.Value (gpm)	Max.Time (hrs.)	Min.Value (gpm)	Min.Time (hrs.)	Average (gpm)	Difference (gpm)
1	☐	P-44	162.43	04:00	7.96	10:00	69.56	154.46
2	☐	P-45	127.08	04:00	23.54	10:00	62.17	103.53
3	☐	P-46	129.75	04:00	0.95	08:00	67.13	128.80
4	☐	P-48	151.79	04:00	7.44	10:00	65.00	144.35
5	☐	P-49	169.79	04:00	29.19	10:00	81.60	140.60
6	☐	P-52	90.88	04:00	4.45	10:00	38.92	86.43
7	☐	P-53	77.72	04:00	0.21	09:00	36.29	77.51
8	☐	P-57	90.88	04:00	4.45	10:00	38.92	86.43
9	☐	P-59	90.88	04:00	4.45	10:00	38.92	86.43
10	☐	P-60	661.87	04:00	8.66	18:00	275.33	653.22
11	☐	P-75	385.26	17:00	14.99	05:00	231.56	370.28
12	☐	P-76	409.61	05:00	16.05	23:00	261.84	393.56
13	☐	P-77	90.88	04:00	4.45	10:00	38.92	86.43
14	☐	P-79	583.35	05:00	11.04	21:00	311.58	572.31
15	☐	P-80	90.88	04:00	4.45	10:00	38.92	86.43
16	☐	P-81	757.10	05:00	6.39	20:00	369.09	750.70
17	☐	P-82	90.88	04:00	4.45	10:00	38.92	86.43
18	☐	P-83	930.84	05:00	12.16	08:00	431.72	918.68
19	☐	P-84	1,017.71	05:00	34.43	08:00	464.33	983.28
20	☐	P-162	151.79	04:00	7.44	10:00	65.00	144.35
21	☐	P-189	350.36	04:00	3.69	10:00	144.17	346.67
22	☐	P-198	69.25	17:00	40.34	21:00	59.60	28.90
23	☐	P-205	321.58	04:00	36.63	10:00	146.60	284.95
24	☐	P-206	23.52	17:00	6.64	08:00	14.53	16.88
25	☐	PP-31	380.81	17:00	4.21	01:00	210.24	376.60
26	☐	PP40-1	378.98	04:00	79.60	10:00	194.16	299.38
27	☐	PP40-3	129.75	04:00	0.95	08:00	67.13	128.80
28	☐	PP40-5	129.75	04:00	0.95	08:00	67.13	128.80
29	☐	PP40-7	90.88	04:00	4.45	10:00	38.92	86.43
30	☐	PP40-9	90.88	04:00	4.45	10:00	38.92	86.43
31	☐	PP40-23	90.88	04:00	4.45	10:00	38.92	86.43
32	☐	PP40-63	2,556.42	05:00	43.65	20:00	1,219.26	2,512.77
33	☐	PP40-65	1,451.84	05:00	6.91	21:00	734.92	1,444.93
34	☐	PP40-17	0.00	07:00	0.00	08:00	0.00	0.00
35	☐	PP40-19	2,556.42	05:00	43.65	20:00	1,219.26	2,512.77
36	☐	PP40-41	1,105.10	04:00	56.71	08:00	496.94	1,048.39
37	☐	PP40-67	1,451.84	05:00	6.91	21:00	734.92	1,444.93
38	☐	P-12	1,189.98	04:00	19.77	19:00	549.74	1,170.21
39	☐	P-13	549.94	04:00	22.16	22:00	348.21	527.79
40	☐	P-14	852.05	10:00	460.46	24:00	683.27	391.59
41	☐	P-15	738.37	06:00	14.71	19:00	339.43	723.67
42	☐	P-27	130.52	04:00	6.40	10:00	55.89	124.12
43	☐	P-28	255.23	10:00	5.49	23:00	161.63	249.74
44	☐	P-29	263.38	09:00	13.30	06:00	159.21	250.08
45	☐	P-30	1,115.41	06:00	412.71	10:00	684.23	702.70
46	☐	P-39	285.65	06:00	76.30	10:00	156.69	209.35
47	☐	P-61	532.16	17:00	20.47	01:00	307.36	511.69
48	☐	P-62	445.34	04:00	10.49	09:00	187.78	434.85
49	☐	P-63	465.03	04:00	7.05	19:00	204.90	457.98
50	☐	P-64	199.62	04:00	4.50	20:00	103.25	195.12
51	☐	P-65	82.21	04:00	0.07	19:00	35.94	82.14
52	☐	P-66	30.19	05:00	1.74	21:00	17.77	28.45
53	☐	P-67	65.53	04:00	0.75	09:00	26.85	64.78
54	☐	P-69	90.55	04:00	16.77	10:00	45.55	73.78
55	☐	P-70	101.44	06:00	33.81	10:00	59.44	67.63
56	☐	P-71	90.55	04:00	16.77	10:00	45.55	73.78

PA 40 Nodes - Ultimate Build out - Pipe Flow Range Report - Zone B

		ID	Max.Value (gpm)	Max.Time (hrs.)	Min.Value (gpm)	Min.Time (hrs.)	Average (gpm)	Difference (gpm)
57	☐	P-73	385.57	17:00	8.91	05:00	233.80	376.66
58	☐	P-87	590.16	05:00	51.72	22:00	374.89	538.44
59	☐	P-88	870.59	05:00	45.17	22:00	498.91	825.43
60	☐	P-89	117.41	04:00	0.57	21:00	68.90	116.84
61	☐	P-90	43.83	17:00	5.26	23:00	27.41	38.58
62	☐	P-91	199.49	04:00	0.44	19:00	84.95	199.05
63	☐	P-92	117.41	04:00	0.57	21:00	68.90	116.84
64	☐	P-93	69.02	04:00	0.45	08:00	33.03	68.57
65	☐	P-94	98.15	17:00	2.26	22:00	66.96	95.89
66	☐	P-95	463.40	17:00	56.53	24:00	315.47	406.87
67	☐	P-96	352.01	04:00	7.63	19:00	155.55	344.37
68	☐	P-97	83.50	04:00	1.97	19:00	37.76	81.52
69	☐	P-98	25.86	17:00	3.86	07:00	14.38	22.00
70	☐	P-99	121.59	04:00	30.61	10:00	65.94	90.99
71	☐	P-100	200.04	06:00	95.45	10:00	132.27	104.59
72	☐	P-101	89.25	04:00	1.21	18:00	37.13	88.04
73	☐	P-102	499.86	04:00	122.50	10:00	268.16	377.36
74	☐	P-103	1,354.16	06:00	539.44	10:00	849.39	814.73
75	☐	P-104	1,354.16	06:00	539.44	10:00	849.39	814.73
76	☐	P-106	415.62	19:00	113.18	05:00	315.06	302.44
77	☐	P-107	489.68	24:00	203.63	05:00	355.58	286.04
78	☐	P-108	91.81	04:00	4.50	15:00	39.32	87.31
79	☐	P-114	1,744.59	10:00	117.24	07:00	1,175.89	1,627.35
80	☐	P-115	1,744.59	10:00	117.24	07:00	1,175.89	1,627.35
81	☐	P-124	852.05	10:00	460.46	24:00	683.27	391.59
82	☐	P-125	549.94	04:00	22.16	22:00	348.21	527.79
83	☐	P-126	852.05	10:00	460.46	24:00	683.27	391.59
84	☐	P-132	1,398.02	10:00	163.31	02:00	910.93	1,234.72
85	☐	P-133	1,398.02	10:00	163.31	02:00	910.93	1,234.72
86	☐	P-151	4,437.63	07:00	242.66	15:00	3,433.35	4,194.97
87	☐	P-160	1,354.16	06:00	539.44	10:00	849.39	814.73
88	☐	P-164	3,965.83	04:00	22.19	22:00	2,231.74	3,943.64
89	☐	P-183	85.61	04:00	2.76	19:00	38.25	82.86
90	☐	P-190	65.53	04:00	0.75	09:00	26.85	64.78
91	☐	P-191	5,877.29	06:00	1,963.32	13:00	3,257.73	3,913.97
92	☐	P-192	5,877.29	06:00	1,963.32	13:00	3,257.73	3,913.97
93	☐	P-193	1,800.86	08:00	575.00	00:00	1,351.42	1,225.86
94	☐	P-194	4,460.09	07:00	244.16	15:00	3,446.43	4,215.93
95	☐	P-196	680.87	24:00	328.25	07:00	457.04	352.62
96	☐	P-197	1,390.72	10:00	20.88	02:00	847.12	1,369.84
97	☐	P-199	1,390.72	10:00	20.88	02:00	847.12	1,369.84
98	☐	P-201	94.18	04:00	25.72	10:00	51.70	68.46
99	☐	P-202	344.55	05:00	1.42	19:00	131.25	343.12
100	☐	P-207	0.00	06:00	0.00	14:00	0.00	0.00
101	☐	P-209	836.73	04:00	79.84	22:00	550.80	756.89
102	☐	P-210	662.66	10:00	49.90	07:00	393.01	612.76
103	☐	P-211	1,161.32	24:00	552.82	10:00	747.19	608.49
104	☐	P-212	0.00	22:00	0.00	07:00	0.00	0.00
105	☐	P-213	0.00	15:00	0.00	12:00	0.00	0.00
106	☐	P-214	82.21	04:00	0.07	19:00	35.94	82.14
107	☐	P-215	0.00	12:00	0.00	09:00	0.00	0.00
108	☐	P-216	0.00	07:00	0.00	19:00	0.00	0.00
109	☐	P-217	0.00	06:00	0.00	23:00	0.00	0.00
110	☐	P-218	0.00	11:00	0.00	00:00	0.00	0.00
111	☐	P-219	0.00	11:00	0.00	00:00	0.00	0.00
112	☐	P-220	0.00	03:00	0.00	12:00	0.00	0.00

PA 40 Nodes - Ultimate Build out - Pipe Flow Range Report - Zone B

		ID	Max.Value (gpm)	Max.Time (hrs.)	Min.Value (gpm)	Min.Time (hrs.)	Average (gpm)	Difference (gpm)
113	☐	P-221	98.99	17:00	4.02	22:00	73.94	94.97
114	☐	P-222	25.02	17:00	10.58	07:00	18.19	14.44
115	☐	P-223	20.08	04:00	0.16	08:00	7.61	19.92
116	☐	P-224	20.08	04:00	0.16	08:00	7.61	19.92
117	☐	V-91	0.00	07:00	0.00	15:00	0.00	0.00
118	☐	V-92	0.00	24:00	0.00	20:00	0.00	0.00
119	☐	PP-51	639.52	04:00	18.59	17:00	272.18	620.93
120	☐	PP-53	1,040.48	04:00	18.69	17:00	441.43	1,021.79
121	☐	PP-55	6,097.66	04:00	131.14	19:00	2,393.57	5,966.52
122	☐	PP-57	1,344.01	04:00	78.71	10:00	578.35	1,265.30
123	☐	PP-59	516.31	04:00	34.36	10:00	222.88	481.95
124	☐	PP-61	64.63	04:00	4.10	10:00	27.73	60.53
125	☐	PP-63	174.70	04:00	9.21	10:00	74.87	165.49
126	☐	PP-65	386.43	04:00	32.16	10:00	167.54	354.26
127	☐	PP-67	191.23	04:00	13.15	10:00	82.90	178.08
128	☐	PP-69	1,683.11	04:00	97.45	10:00	722.23	1,585.66
129	☐	PP-71	2,345.96	00:00	13.26	08:00	782.57	2,332.71
130	☐	PP-97	3,515.89	24:00	0.00	04:00	1,086.44	3,515.89
131	☐	PP-99	1,953.44	24:00	62.46	18:00	457.73	1,890.98
132	☐	PP-101	1,189.98	04:00	19.77	19:00	549.74	1,170.21
133	☐	PP-103	6,378.43	06:00	88.72	10:00	2,644.65	6,289.71
134	☐	PP-115	3,794.39	00:00	36.20	09:00	1,309.14	3,758.19
135	☐	PP-121	4,549.80	24:00	0.00	07:00	1,891.64	4,549.80
136	☐	PP-123	5,009.28	00:00	152.45	09:00	1,902.31	4,856.83
137	☐	PP-125	2,649.77	24:00	131.15	19:00	926.38	2,518.62
138	☐	PP-127	30.58	24:00	0.55	22:00	13.69	30.02
139	☐	PP-129	1,086.08	04:00	68.84	10:00	467.11	1,017.24
140	☐	PP-131	40.85	24:00	0.50	22:00	17.26	40.35
141	☐	PP-133	152.00	04:00	9.83	10:00	65.04	142.17
142	☐	PP-135	151.79	04:00	10.57	10:00	65.47	141.22
143	☐	PP-163	0.00	00:00	0.00	12:00	0.00	0.00
144	☐	PP-165	154.08	04:00	6.53	17:00	65.91	147.54
145	☐	PP-167	194.02	04:00	8.23	17:00	83.00	185.80
146	☐	PP-169	9.07	24:00	0.12	20:00	2.17	8.96
147	☐	PP-171	112.03	04:00	7.07	10:00	48.09	104.96
148	☐	PP-175	11.79	04:00	0.19	17:00	5.01	11.60
149	☐	PP-177	54.94	04:00	1.80	17:00	23.48	53.14
150	☐	PP-179	39.95	04:00	1.69	17:00	17.09	38.26
151	☐	PP-181	75.83	04:00	3.18	17:00	32.44	72.64
152	☐	PP-183	154.08	04:00	6.54	17:00	65.91	147.54
153	☐	PP-185	397.14	04:00	17.65	17:00	169.96	379.49
154	☐	PP-187	1,684.06	04:00	48.42	17:00	716.92	1,635.64
155	☐	PP-189	1,286.92	04:00	30.77	17:00	546.96	1,256.15
156	☐	PP-401	489.68	24:00	203.63	05:00	355.58	286.04
157	☐	P9B-16	177.41	04:00	8.70	10:00	75.97	168.71
158	☐	P9B-18	107.24	04:00	5.26	10:00	45.93	101.99
159	☐	P9B-19	101.62	04:00	4.98	10:00	43.52	96.64
160	☐	P9B-20	110.80	04:00	5.43	10:00	47.45	105.37
161	☐	P9B-24	108.61	04:00	5.32	10:00	46.51	103.29
162	☐	P9B-25	164.44	04:00	8.06	10:00	70.42	156.38
163	☐	P9B-27	138.10	04:00	6.77	10:00	59.14	131.33
164	☐	P9B-28	493.33	04:00	24.18	10:00	211.26	469.15
165	☐	P9B-29	77.20	04:00	3.78	10:00	33.06	73.42
166	☐	P9B-31	75.42	04:00	3.70	10:00	32.30	71.72
167	☐	P9B-40	399.73	17:00	46.41	05:00	280.86	353.32
168	☐	P9B-41	59.68	04:00	10.97	10:00	29.70	48.71

PA 40 Nodes - Ultimate Build out - Pipe Flow Range Report - Zone B

		ID	Max.Value (gpm)	Max.Time (hrs.)	Min.Value (gpm)	Min.Time (hrs.)	Average (gpm)	Difference (gpm)
169	☐	P9B-42	25.01	04:00	9.27	10:00	14.85	15.73
170	☐	P9B-43	17.60	04:00	0.86	10:00	7.54	16.73
171	☐	P9B-44	70.81	04:00	12.48	10:00	34.69	58.33
172	☐	P9B-45	12.62	04:00	0.10	20:00	7.47	12.52
173	☐	P9B-46	31.55	06:00	13.70	21:00	21.81	17.85
174	☐	P9B-47	19.01	17:00	8.11	22:00	14.55	10.89
175	☐	P9B-48	19.61	04:00	0.96	10:00	8.40	18.65
176	☐	P9B-49	25.27	04:00	0.67	20:00	15.48	24.59
177	☐	P9B-50	67.48	04:00	3.04	19:00	30.75	64.44
178	☐	P9B-51	20.40	04:00	1.00	10:00	8.74	19.40
179	☐	P9B-93	47.19	04:00	2.31	10:00	20.21	44.87
180	☐	P9B-94	30.02	04:00	1.47	10:00	12.86	28.55
181	☐	P9B-96	844.13	24:00	473.22	10:00	553.03	370.90
182	☐	PP40-13	3,924.99	00:00	411.93	09:00	1,617.75	3,513.06
183	☐	PP40-15	0.00	19:00	0.00	07:00	0.00	0.00
184	☐	PP40-25	1,800.86	08:00	575.00	00:00	1,351.42	1,225.86
185	☐	PP40-27	4,390.52	06:00	2,315.87	17:00	3,071.50	2,074.65
186	☐	PA-BPUMP1	0.00	11:00	0.00	06:00	0.00	0.00
187	☐	PA_BPUMP2	0.00	15:00	0.00	04:00	0.00	0.00
188	☐	PP40-37	4,560.01	06:00	3,599.01	17:00	3,982.43	960.99
189	☐	PP40-39	4,560.01	06:00	3,599.01	17:00	3,982.43	960.99
190	☐	PP40-43	0.00	22:00	0.00	08:00	0.00	0.00
191	☐	PP40-45	0.00	18:00	0.00	10:00	0.00	0.00

PA 40 Nodes - Ultimate Build out - Pipe Report

		ID	Max.Value (gpm)	Max.Time (hrs.)	Min.Value (gpm)	Min.Time (hrs.)	Average (gpm)
1		P-44	162.43	04:00	7.96	10:00	69.56
2		P-45	127.08	04:00	23.54	10:00	62.17
3		P-46	129.75	04:00	0.95	08:00	67.13
4		P-48	151.79	04:00	7.44	10:00	65.00
5		P-49	169.79	04:00	29.19	10:00	81.60
6		P-52	90.88	04:00	4.45	10:00	38.92
7		P-53	77.72	04:00	0.21	09:00	36.29
8		P-57	90.88	04:00	4.45	10:00	38.92
9		P-59	90.88	04:00	4.45	10:00	38.92
10		P-60	661.87	04:00	8.66	18:00	275.33
11		P-75	385.26	17:00	14.99	05:00	231.56
12		P-76	409.61	05:00	16.05	23:00	261.84
13		P-77	90.88	04:00	4.45	10:00	38.92
14		P-79	583.35	05:00	11.04	21:00	311.58
15		P-80	90.88	04:00	4.45	10:00	38.92
16		P-81	757.10	05:00	6.39	20:00	369.09
17		P-82	90.88	04:00	4.45	10:00	38.92
18		P-83	930.84	05:00	12.16	08:00	431.72
19		P-84	1,017.71	05:00	34.43	08:00	464.33
20		P-162	151.79	04:00	7.44	10:00	65.00
21		P-189	350.36	04:00	3.69	10:00	144.17
22		P-198	69.25	17:00	40.34	21:00	59.60
23		P-205	321.58	04:00	36.63	10:00	146.60
24		P-206	23.52	17:00	6.64	08:00	14.53
25		PP-31	380.81	17:00	4.21	01:00	210.24
26		PP40-1	378.98	04:00	79.60	10:00	194.16
27		PP40-3	129.75	04:00	0.95	08:00	67.13
28		PP40-5	129.75	04:00	0.95	08:00	67.13
29		PP40-7	90.88	04:00	4.45	10:00	38.92
30		PP40-9	90.88	04:00	4.45	10:00	38.92
31		PP40-23	90.88	04:00	4.45	10:00	38.92
32		PP40-63	2,556.42	05:00	43.65	20:00	1,219.26
33		PP40-65	1,451.84	05:00	6.91	21:00	734.92
34		PP40-17	0.00	07:00	0.00	08:00	0.00
35		PP40-19	2,556.42	05:00	43.65	20:00	1,219.26
36		PP40-41	1,105.10	04:00	56.71	08:00	496.94
37		PP40-67	1,451.84	05:00	6.91	21:00	734.92

PA 40 Nodes - Ultimate Build out - Pipe Velocity Range Report - Zone B

		ID	Max.Value (ft/s)	Max.Time (hrs.)	Min.Value (ft/s)	Min.Time (hrs.)	Average (ft/s)	Difference (ft/s)
1	☐	P-44	1.84	04:00	0.09	10:00	0.79	1.75
2	☐	P-45	3.24	04:00	0.60	10:00	1.59	2.64
3	☐	P-46	1.47	04:00	0.01	08:00	0.76	1.46
4	☐	P-48	1.72	04:00	0.08	10:00	0.74	1.64
5	☐	P-49	1.93	04:00	0.33	10:00	0.93	1.60
6	☐	P-52	2.32	04:00	0.11	10:00	0.99	2.21
7	☐	P-53	1.98	04:00	0.01	09:00	0.93	1.98
8	☐	P-57	2.32	04:00	0.11	10:00	0.99	2.21
9	☐	P-59	2.32	04:00	0.11	10:00	0.99	2.21
10	☐	P-60	4.22	04:00	0.06	18:00	1.76	4.17
11	☐	P-75	1.09	17:00	0.04	05:00	0.66	1.05
12	☐	P-76	1.16	05:00	0.05	23:00	0.74	1.12
13	☐	P-77	2.32	04:00	0.11	10:00	0.99	2.21
14	☐	P-79	1.65	05:00	0.03	21:00	0.88	1.62
15	☐	P-80	2.32	04:00	0.11	10:00	0.99	2.21
16	☐	P-81	2.15	05:00	0.02	20:00	1.05	2.13
17	☐	P-82	2.32	04:00	0.11	10:00	0.99	2.21
18	☐	P-83	2.64	05:00	0.03	08:00	1.22	2.61
19	☐	P-84	2.89	05:00	0.10	08:00	1.32	2.79
20	☐	P-162	1.72	04:00	0.08	10:00	0.74	1.64
21	☐	P-189	3.98	04:00	0.04	10:00	1.64	3.93
22	☐	P-198	0.79	17:00	0.46	21:00	0.68	0.33
23	☐	P-205	3.65	04:00	0.42	10:00	1.66	3.23
24	☐	P-206	0.27	17:00	0.08	08:00	0.16	0.19
25	☐	PP-31	1.08	17:00	0.01	01:00	0.60	1.07
26	☐	PP40-1	4.30	04:00	0.90	10:00	2.20	3.40
27	☐	PP40-3	1.47	04:00	0.01	08:00	0.76	1.46
28	☐	PP40-5	1.47	04:00	0.01	08:00	0.76	1.46
29	☐	PP40-7	1.03	04:00	0.05	10:00	0.44	0.98
30	☐	PP40-9	1.03	04:00	0.05	10:00	0.44	0.98
31	☐	PP40-23	1.03	04:00	0.05	10:00	0.44	0.98
32	☐	PP40-63	4.08	05:00	0.07	20:00	1.95	4.01
33	☐	PP40-65	2.32	05:00	0.01	21:00	1.17	2.31
34	☐	PP40-17	0.00	07:00	0.00	08:00	0.00	0.00
35	☐	PP40-19	4.08	05:00	0.07	20:00	1.95	4.01
36	☐	PP40-41	3.13	04:00	0.16	08:00	1.41	2.97
37	☐	PP40-67	4.12	05:00	0.02	21:00	2.08	4.10
38	☐	P-12	1.90	04:00	0.03	19:00	0.88	1.87
39	☐	P-13	1.56	04:00	0.06	22:00	0.99	1.50
40	☐	P-14	2.42	10:00	1.31	24:00	1.94	1.11
41	☐	P-15	2.09	06:00	0.04	19:00	0.96	2.05
42	☐	P-27	3.33	04:00	0.16	10:00	1.43	3.17
43	☐	P-28	1.63	10:00	0.04	23:00	1.03	1.59
44	☐	P-29	1.68	09:00	0.08	06:00	1.02	1.60
45	☐	P-30	3.16	06:00	1.17	10:00	1.94	1.99
46	☐	P-39	3.24	06:00	0.87	10:00	1.78	2.38
47	☐	P-61	1.51	17:00	0.06	01:00	0.87	1.45
48	☐	P-62	1.82	04:00	0.04	09:00	0.77	1.78
49	☐	P-63	2.97	04:00	0.04	19:00	1.31	2.92
50	☐	P-64	1.27	04:00	0.03	20:00	0.66	1.25
51	☐	P-65	2.10	04:00	0.00	19:00	0.92	2.10
52	☐	P-66	0.77	05:00	0.04	21:00	0.45	0.73
53	☐	P-67	1.67	04:00	0.02	09:00	0.69	1.65
54	☐	P-69	2.31	04:00	0.43	10:00	1.16	1.88
55	☐	P-70	2.59	06:00	0.86	10:00	1.52	1.73
56	☐	P-71	2.31	04:00	0.43	10:00	1.16	1.88

PA 40 Nodes - Ultimate Build out - Pipe Velocity Range Report - Zone B

		ID	Max.Value (ft/s)	Max.Time (hrs.)	Min.Value (ft/s)	Min.Time (hrs.)	Average (ft/s)	Difference (ft/s)
57	☐	P-73	1.09	17:00	0.03	05:00	0.66	1.07
58	☐	P-87	1.67	05:00	0.15	22:00	1.06	1.53
59	☐	P-88	2.47	05:00	0.13	22:00	1.42	2.34
60	☐	P-89	0.75	04:00	0.00	21:00	0.44	0.75
61	☐	P-90	0.28	17:00	0.03	23:00	0.17	0.25
62	☐	P-91	1.27	04:00	0.00	19:00	0.54	1.27
63	☐	P-92	0.75	04:00	0.00	21:00	0.44	0.75
64	☐	P-93	1.76	04:00	0.01	08:00	0.84	1.75
65	☐	P-94	0.63	17:00	0.01	22:00	0.43	0.61
66	☐	P-95	1.31	17:00	0.16	24:00	0.89	1.15
67	☐	P-96	1.44	04:00	0.03	19:00	0.64	1.41
68	☐	P-97	2.13	04:00	0.05	19:00	0.96	2.08
69	☐	P-98	0.66	17:00	0.10	07:00	0.37	0.56
70	☐	P-99	1.38	04:00	0.35	10:00	0.75	1.03
71	☐	P-100	1.28	06:00	0.61	10:00	0.84	0.67
72	☐	P-101	2.28	04:00	0.03	18:00	0.95	2.25
73	☐	P-102	3.19	04:00	0.78	10:00	1.71	2.41
74	☐	P-103	3.84	06:00	1.53	10:00	2.41	2.31
75	☐	P-104	3.84	06:00	1.53	10:00	2.41	2.31
76	☐	P-106	0.66	19:00	0.18	05:00	0.50	0.48
77	☐	P-107	1.39	24:00	0.58	05:00	1.01	0.81
78	☐	P-108	0.15	04:00	0.01	15:00	0.06	0.14
79	☐	P-114	2.78	10:00	0.19	07:00	1.88	2.60
80	☐	P-115	2.78	10:00	0.19	07:00	1.88	2.60
81	☐	P-124	2.42	10:00	1.31	24:00	1.94	1.11
82	☐	P-125	1.56	04:00	0.06	22:00	0.99	1.50
83	☐	P-126	2.42	10:00	1.31	24:00	1.94	1.11
84	☐	P-132	2.23	10:00	0.26	02:00	1.45	1.97
85	☐	P-133	2.23	10:00	0.26	02:00	1.45	1.97
86	☐	P-151	7.08	07:00	0.39	15:00	5.48	6.69
87	☐	P-160	3.84	06:00	1.53	10:00	2.41	2.31
88	☐	P-164	4.05	04:00	0.02	22:00	2.28	4.03
89	☐	P-183	2.19	04:00	0.07	19:00	0.98	2.12
90	☐	P-190	1.67	04:00	0.02	09:00	0.69	1.65
91	☐	P-191	3.29	06:00	1.10	13:00	1.83	2.19
92	☐	P-192	2.67	06:00	0.89	13:00	1.48	1.78
93	☐	P-193	0.82	08:00	0.26	00:00	0.61	0.56
94	☐	P-194	7.12	07:00	0.39	15:00	5.50	6.73
95	☐	P-196	1.93	24:00	0.93	07:00	1.30	1.00
96	☐	P-197	2.22	10:00	0.03	02:00	1.35	2.19
97	☐	P-199	2.22	10:00	0.03	02:00	1.35	2.19
98	☐	P-201	2.40	04:00	0.66	10:00	1.32	1.75
99	☐	P-202	0.98	05:00	0.00	19:00	0.37	0.97
100	☐	P-207	0.00	06:00	0.00	14:00	0.00	0.00
101	☐	P-209	2.37	04:00	0.23	22:00	1.56	2.15
102	☐	P-210	1.88	10:00	0.14	07:00	1.11	1.74
103	☐	P-211	3.29	24:00	1.57	10:00	2.12	1.73
104	☐	P-212	0.00	22:00	0.00	07:00	0.00	0.00
105	☐	P-213	0.00	15:00	0.00	12:00	0.00	0.00
106	☐	P-214	2.10	04:00	0.00	19:00	0.92	2.10
107	☐	P-215	0.00	12:00	0.00	09:00	0.00	0.00
108	☐	P-216	0.00	07:00	0.00	19:00	0.00	0.00
109	☐	P-217	0.00	06:00	0.00	23:00	0.00	0.00
110	☐	P-218	0.00	11:00	0.00	00:00	0.00	0.00
111	☐	P-219	0.00	11:00	0.00	00:00	0.00	0.00
112	☐	P-220	0.00	03:00	0.00	12:00	0.00	0.00

PA 40 Nodes - Ultimate Build out - Pipe Velocity Range Report - Zone B

		ID	Max.Value (ft/s)	Max.Time (hrs.)	Min.Value (ft/s)	Min.Time (hrs.)	Average (ft/s)	Difference (ft/s)
113	☐	P-221	0.63	17:00	0.03	22:00	0.47	0.61
114	☐	P-222	0.64	17:00	0.27	07:00	0.46	0.37
115	☐	P-223	0.51	04:00	0.00	08:00	0.19	0.51
116	☐	P-224	0.51	04:00	0.00	08:00	0.19	0.51
117	☐	V-91	0.00	07:00	0.00	15:00	0.00	0.00
118	☐	V-92	0.00	24:00	0.00	20:00	0.00	0.00
119	☐	PP-51	0.65	04:00	0.02	17:00	0.28	0.63
120	☐	PP-53	1.06	04:00	0.02	17:00	0.45	1.04
121	☐	PP-55	4.32	04:00	0.09	19:00	1.70	4.23
122	☐	PP-57	3.81	04:00	0.22	10:00	1.64	3.59
123	☐	PP-59	3.30	04:00	0.22	10:00	1.42	3.08
124	☐	PP-61	0.41	04:00	0.03	10:00	0.18	0.39
125	☐	PP-63	0.71	04:00	0.04	10:00	0.31	0.68
126	☐	PP-65	1.58	04:00	0.13	10:00	0.68	1.45
127	☐	PP-67	2.17	04:00	0.15	10:00	0.94	2.02
128	☐	PP-69	4.77	04:00	0.28	10:00	2.05	4.50
129	☐	PP-71	1.66	00:00	0.01	08:00	0.55	1.65
130	☐	PP-97	2.49	24:00	0.00	04:00	0.77	2.49
131	☐	PP-99	1.99	24:00	0.06	18:00	0.47	1.93
132	☐	PP-101	1.90	04:00	0.03	19:00	0.88	1.87
133	☐	PP-103	2.01	06:00	0.03	10:00	0.83	1.98
134	☐	PP-115	2.69	00:00	0.03	09:00	0.93	2.67
135	☐	PP-121	1.43	24:00	0.00	07:00	0.60	1.43
136	☐	PP-123	1.58	00:00	0.05	09:00	0.60	1.53
137	☐	PP-125	1.88	24:00	0.09	19:00	0.66	1.79
138	☐	PP-127	0.20	24:00	0.00	22:00	0.09	0.19
139	☐	PP-129	4.44	04:00	0.28	10:00	1.91	4.16
140	☐	PP-131	0.17	24:00	0.00	22:00	0.07	0.16
141	☐	PP-133	1.72	04:00	0.11	10:00	0.74	1.61
142	☐	PP-135	1.72	04:00	0.12	10:00	0.74	1.60
143	☐	PP-163	0.00	00:00	0.00	12:00	0.00	0.00
144	☐	PP-165	0.98	04:00	0.04	17:00	0.42	0.94
145	☐	PP-167	1.24	04:00	0.05	17:00	0.53	1.19
146	☐	PP-169	0.06	24:00	0.00	20:00	0.01	0.06
147	☐	PP-171	0.72	04:00	0.05	10:00	0.31	0.67
148	☐	PP-175	0.13	04:00	0.00	17:00	0.06	0.13
149	☐	PP-177	0.35	04:00	0.01	17:00	0.15	0.34
150	☐	PP-179	0.45	04:00	0.02	17:00	0.19	0.43
151	☐	PP-181	0.86	04:00	0.04	17:00	0.37	0.82
152	☐	PP-183	0.16	04:00	0.01	17:00	0.07	0.15
153	☐	PP-185	0.41	04:00	0.02	17:00	0.17	0.39
154	☐	PP-187	4.78	04:00	0.14	17:00	2.03	4.64
155	☐	PP-189	1.31	04:00	0.03	17:00	0.56	1.28
156	☐	PP-401	1.39	24:00	0.58	05:00	1.01	0.81
157	☐	P9B-16	2.01	04:00	0.10	10:00	0.86	1.91
158	☐	P9B-18	2.74	04:00	0.13	10:00	1.17	2.60
159	☐	P9B-19	2.59	04:00	0.13	10:00	1.11	2.47
160	☐	P9B-20	2.83	04:00	0.14	10:00	1.21	2.69
161	☐	P9B-24	2.77	04:00	0.14	10:00	1.19	2.64
162	☐	P9B-25	4.20	04:00	0.21	10:00	1.80	3.99
163	☐	P9B-27	3.53	04:00	0.17	10:00	1.51	3.35
164	☐	P9B-28	5.60	04:00	0.27	10:00	2.40	5.32
165	☐	P9B-29	1.97	04:00	0.10	10:00	0.84	1.87
166	☐	P9B-31	1.93	04:00	0.09	10:00	0.82	1.83
167	☐	P9B-40	0.64	17:00	0.07	05:00	0.45	0.56
168	☐	P9B-41	1.52	04:00	0.28	10:00	0.76	1.24

PA 40 Nodes - Ultimate Build out - Pipe Velocity Range Report - Zone B

		ID	Max.Value (ft/s)	Max.Time (hrs.)	Min.Value (ft/s)	Min.Time (hrs.)	Average (ft/s)	Difference (ft/s)
169	☐	P9B-42	0.64	04:00	0.24	10:00	0.38	0.40
170	☐	P9B-43	0.45	04:00	0.02	10:00	0.19	0.43
171	☐	P9B-44	1.81	04:00	0.32	10:00	0.89	1.49
172	☐	P9B-45	0.32	04:00	0.00	20:00	0.19	0.32
173	☐	P9B-46	0.81	06:00	0.35	21:00	0.56	0.46
174	☐	P9B-47	0.49	17:00	0.21	22:00	0.37	0.28
175	☐	P9B-48	0.50	04:00	0.02	10:00	0.21	0.48
176	☐	P9B-49	0.65	04:00	0.02	20:00	0.40	0.63
177	☐	P9B-50	1.72	04:00	0.08	19:00	0.79	1.65
178	☐	P9B-51	0.52	04:00	0.03	10:00	0.22	0.50
179	☐	P9B-93	1.20	04:00	0.06	10:00	0.52	1.15
180	☐	P9B-94	0.77	04:00	0.04	10:00	0.33	0.73
181	☐	P9B-96	2.39	24:00	1.34	10:00	1.57	1.05
182	☐	PP40-13	2.78	00:00	0.29	09:00	1.15	2.49
183	☐	PP40-15	0.00	19:00	0.00	07:00	0.00	0.00
184	☐	PP40-25	0.82	08:00	0.26	00:00	0.61	0.56
185	☐	PP40-27	7.01	06:00	3.70	17:00	4.90	3.31
186	☐	PA-BPUMP1	0.00	11:00	0.00	06:00	0.00	0.00
187	☐	PA_BPUMP2	0.00	15:00	0.00	04:00	0.00	0.00
188	☐	PP40-37	7.28	06:00	5.74	17:00	6.35	1.53
189	☐	PP40-39	7.28	06:00	5.74	17:00	6.35	1.53
190	☐	PP40-43	0.00	22:00	0.00	08:00	0.00	0.00
191	☐	PP40-45	0.00	18:00	0.00	10:00	0.00	0.00

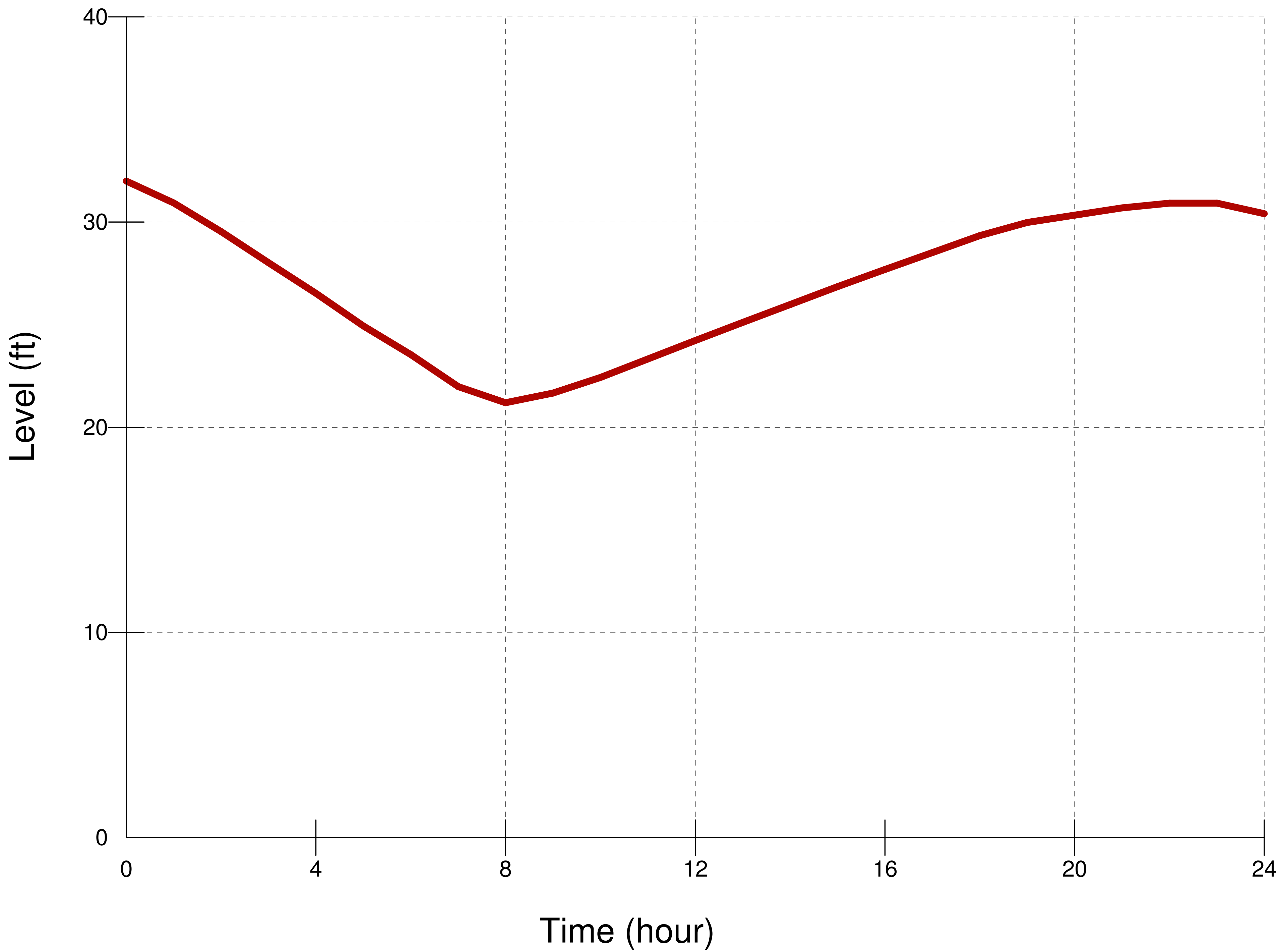
PA 40 - Ultimate Build out - Zone A to B Pump Flow Report

		Time	A_BPUMP	A_BPUMP2 (gpm)
1		00:00 hrs	0.00	4,078.68
2		01:00 hrs	0.00	4,267.25
3		02:00 hrs	0.00	4,368.18
4		03:00 hrs	0.00	4,399.15
5		04:00 hrs	0.00	4,484.48
6		05:00 hrs	0.00	4,434.23
7		06:00 hrs	0.00	4,560.01
8		07:00 hrs	0.00	4,266.82
9		08:00 hrs	0.00	4,052.03
10		09:00 hrs	0.00	3,868.56
11		10:00 hrs	0.00	3,734.97
12		11:00 hrs	0.00	3,715.61
13		12:00 hrs	0.00	3,696.25
14		13:00 hrs	0.00	3,676.82
15		14:00 hrs	0.00	3,657.40
16		15:00 hrs	0.00	3,637.92
17		16:00 hrs	0.00	3,618.46
18		17:00 hrs	0.00	3,599.01
19		18:00 hrs	0.00	3,700.18
20		19:00 hrs	0.00	3,843.31
21		20:00 hrs	0.00	3,784.38
22		21:00 hrs	0.00	3,826.76
23		22:00 hrs	0.00	3,891.23
24		23:00 hrs	0.00	4,050.74
25		24:00 hrs	0.00	4,348.30

PA 40 Nodes - Ultimate Build out - Sand Canyon PRV Report

		Time	Upstream Pressure (psi)	Downstream Pressure (psi)	Flow (gpm)	Velocity (ft/s)	Headloss (ft)
1	☐	00:00 hrs	140.96	54.62	0.00	0.00	0.00
2	☐	01:00 hrs	139.10	50.97	0.00	0.00	0.00
3	☐	02:00 hrs	137.77	49.19	0.00	0.00	0.00
4	☐	03:00 hrs	136.85	48.87	0.00	0.00	0.00
5	☐	04:00 hrs	135.56	47.58	0.00	0.00	0.00
6	☐	05:00 hrs	135.05	49.11	0.00	0.00	0.00
7	☐	06:00 hrs	134.04	45.78	0.00	0.00	0.00
8	☐	07:00 hrs	135.77	52.45	0.00	0.00	0.00
9	☐	08:00 hrs	144.44	58.81	0.00	0.00	0.00
10	☐	09:00 hrs	147.24	61.15	0.00	0.00	0.00
11	☐	10:00 hrs	149.23	62.71	0.00	0.00	0.00
12	☐	11:00 hrs	150.17	62.88	0.00	0.00	0.00
13	☐	12:00 hrs	149.20	63.04	0.00	0.00	0.00
14	☐	13:00 hrs	150.16	63.21	0.00	0.00	0.00
15	☐	14:00 hrs	187.90	63.37	0.00	0.00	0.00
16	☐	15:00 hrs	187.38	63.54	0.00	0.00	0.00
17	☐	16:00 hrs	187.38	63.70	0.00	0.00	0.00
18	☐	17:00 hrs	187.38	63.87	0.00	0.00	0.00
19	☐	18:00 hrs	159.95	62.50	0.00	0.00	0.00
20	☐	19:00 hrs	150.86	60.40	0.00	0.00	0.00
21	☐	20:00 hrs	148.50	61.55	0.00	0.00	0.00
22	☐	21:00 hrs	146.34	60.87	0.00	0.00	0.00
23	☐	22:00 hrs	145.89	59.77	0.00	0.00	0.00
24	☐	23:00 hrs	143.74	56.74	0.00	0.00	0.00
25	☐	24:00 hrs	141.07	50.55	0.00	0.00	0.00

Northwood Zone B Tank [EPS1]

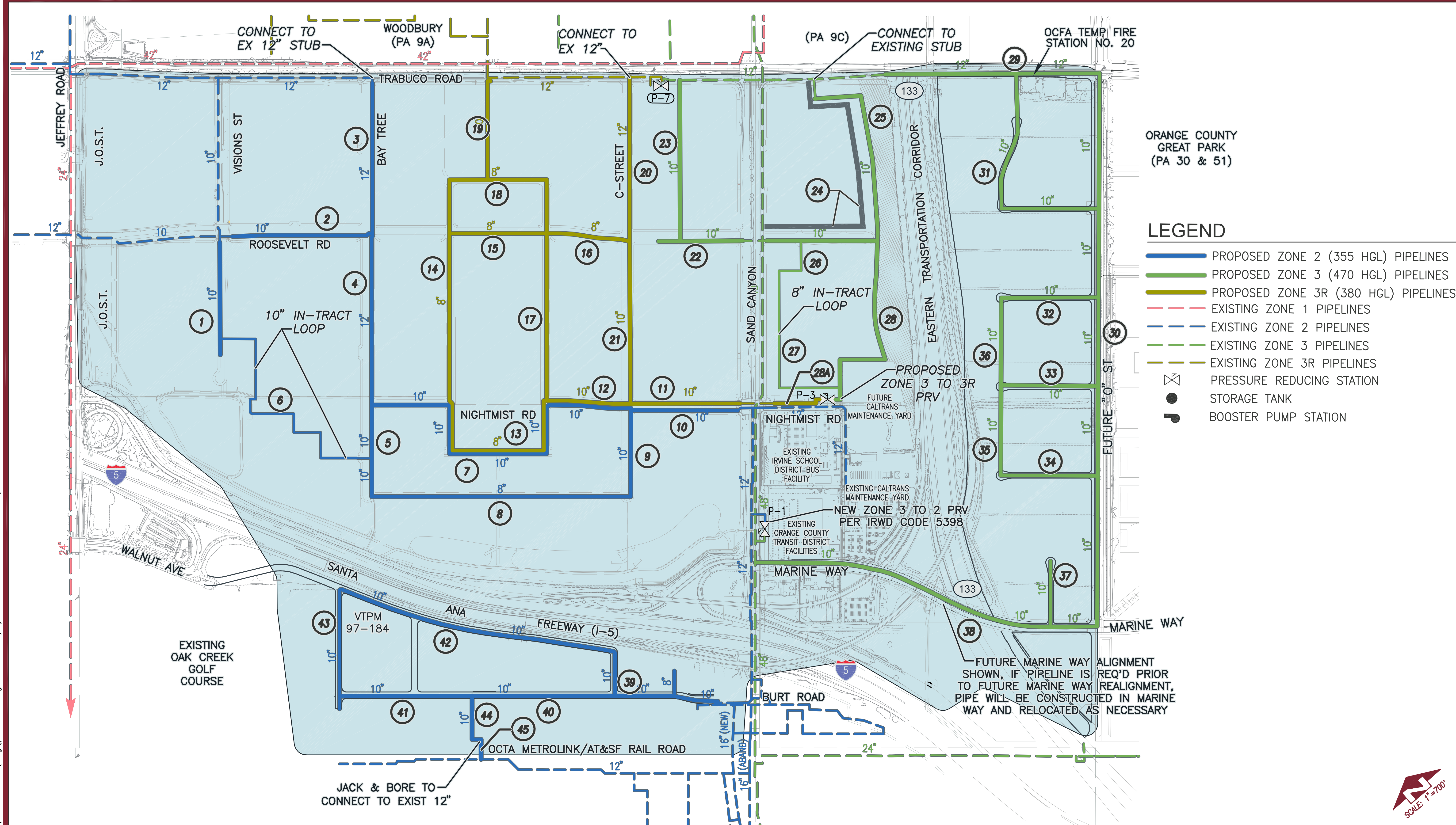


APPENDIX 4

PIPELINE QUANTITIES AND COSTS

Domestic Water - Pipeline Facilities

PA	Phase	Segment Number	Pipe Diameter	Location	Quantity		Unit Cost		Total Cost	IRWD Cost Share	Developer Cost Share
PA 40	1	1	10-inch	Visions Street	873	lf	$ 70	lf	$ 61,110	$ -	$ 61,110
PA 40	1	2	10-inch	Roosevelt Rd	1,089	lf	$ 70	lf	$ 76,230	$ -	$ 76,230
PA 40	1	5	10-inch	"A" Street	712	lf	$ 70	lf	$ 49,840	$ -	$ 49,840
PA 40	1	6	10-inch	In-Tract	2,182	lf	$ 70	lf	$ 152,740	$ -	$ 152,740
			10-inch Total		4,856				**$ 339,920**	**$ -**	**$ 339,920**
PA 40	1	3	12-inch	"A" Street	1,164	lf	$ 85	lf	$ 98,940	$ 98,940	$ -
PA 40	1	4	12-inch	"A" Street	1,336	lf	$ 85	lf	$ 113,560	$ 113,560	$ -
			12-inch Total		2,500				**$ 212,500**	**$ 212,500**	**$ -**
	1 Total								**$ 552,420**	**$ 212,500**	**$ 339,920**
PA 40	2	8	8-inch	In-Tract	2,012	lf	$ 65	lf	$ 130,780	$ -	$ 130,780
PA 40	2	13	8-inch	Nightmist	710	lf	$ 65	lf	$ 46,150	$ -	$ 46,150
PA 40	2	14	8-inch	In-Tract	2,111	lf	$ 65	lf	$ 137,215	$ -	$ 137,215
PA 40	2	15	8-inch	Roosevelt Rd	756	lf	$ 65	lf	$ 49,140	$ -	$ 49,140
PA 40	2	16	8-inch	Roosevelt Rd	648	lf	$ 65	lf	$ 42,120	$ -	$ 42,120
PA 40	2	17	8-inch	In-Tract	2,128	lf	$ 65	lf	$ 138,320	$ -	$ 138,320
PA 40	2	18	8-inch	In-Tract	756	lf	$ 65	lf	$ 49,140	$ -	$ 49,140
			8-inch Total		9,121				**$ 592,865**	**$ -**	**$ 592,865**
PA 40	2	7	10-inch	Nightmist - In-Tract between "A" St and "C" St	2,753	lf	$ 70	lf	$ 192,710	$ -	$ 192,710
PA 40	2	9	10-inch	"C" Street	672	lf	$ 70	lf	$ 47,040	$ -	$ 47,040
PA 40	2	10	10-inch	Nightmist (Zn 2)	954	lf	$ 70	lf	$ 66,780	$ -	$ 66,780
PA 40	2	11	10-inch	Nightmist (ZN 3R)	830	lf	$ 70	lf	$ 58,100	$ -	$ 58,100
PA 40	2	12	10-inch	Nightmist	651	lf	$ 70	lf	$ 45,570	$ -	$ 45,570
PA 40	2	19	10-inch	In-Tract	816	lf	$ 70	lf	$ 57,120	$ -	$ 57,120
PA 40	2	21	10-inch	"C" Street - Roosevelt to Nightmist	1,262	lf	$ 70	lf	$ 88,340	$ -	$ 88,340
PA 40	2	22	10-inch	Roosevelt Rd	653	lf	$ 70	lf	$ 45,710	$ -	$ 45,710
PA 40	2	23	10-inch	In-Tract	1,252	lf	$ 70	lf	$ 87,640	$ -	$ 87,640
PA 40	2	24	10-inch	Temporary Pipeline	2,352	lf	$ 65	lf	$ 152,880	$ -	$ 152,880
			10-inch Total		12,195				**$ 841,890**	**$ -**	**$ 841,890**
PA 40	2	20	12-inch	"C" Street - Trabuco to Roosevelt	816	lf	$ 85	lf	$ 69,360	$ 69,360	$ -
			12-inch Total		816				**$ 69,360**	**$ 69,360**	**$ -**
	2 Total								**$ 1,504,115**	**$ 69,360**	**$ 1,434,755**
PA 40	3	27	8-inch	In-Tract	1,786	lf	$ 65	lf	$ 116,090	$ -	$ 116,090
			8-inch Total		1,786				$ 116,090	$ -	$ 116,090
PA 40	3	25	10-inch	In-Tract	1,492	lf	$ 70	lf	$ 104,440	$ -	$ 104,440
PA 40	3	26	10-inch	In-Tract	654	lf	$ 70	lf	$ 45,780	$ -	$ 45,780
PA 40	3	28	10-inch	In-Tract	1,632	lf	$ 70	lf	$ 114,240	$ -	$ 114,240
PA 40	3	28A	10-inch	Nightmist Rd east of Sand Canyon	496	lf	$ 70	lf	$ 34,720	$ -	$ 34,720
			10-inch Total		4,274				**$ 299,180**	**$ -**	**$ 299,180**
PA 40	3	P-3	PRV	Zone 3 to 3R PRV Station at Nightmist Rd	1	ea	$ 125,000	ea	$ 125,000	$ -	$ 125,000
			PRV Total		1				**$ 125,000**	**$ 125,000**	**$ -**
	3 Total								**$ 540,270**	**$ 125,000**	**$ 415,270**
PA 40	4	30	10-inch	"O" Street - Trabuco to Marine Way	4,300	lf	$ 70	lf	$ 301,000	$ -	$ 301,000
PA 40	4	31	10-inch	In-Tract	1,785	lf	$ 70	lf	$ 124,950	$ -	$ 124,950
PA 40	4	32	10-inch	In-Tract	756	lf	$ 70	lf	$ 52,920	$ -	$ 52,920
PA 40	4	33	10-inch	In-Tract	755	lf	$ 70	lf	$ 52,850	$ -	$ 52,850
PA 40	4	34	10-inch	In-Tract	755	lf	$ 70	lf	$ 52,850	$ -	$ 52,850
PA 40	4	35	10-inch	In-Tract	701	lf	$ 70	lf	$ 49,070	$ -	$ 49,070
PA 40	4	36	10-inch	In-Tract	676	lf	$ 70	lf	$ 47,320	$ -	$ 47,320
PA 40	4	37	10-inch	In-Tract	510	lf	$ 70	lf	$ 35,700	$ -	$ 35,700
PA 40	4	38	10-inch	In-Tract	2,744	lf	$ 70	lf	$ 192,080	$ -	$ 192,080
			10-inch Total		12,982				**$ 908,740**	**$ -**	**$ 908,740**
PA 40	4	29	12-inch	Trabuco - SR 133 to "O" St	1,664	lf	$ 105	lf	$ 174,720	$ 174,720	$ -
			12-inch Total		1,664				**$ 174,720**	**$ 174,720**	**$ -**
	4 Total								**$ 1,083,460**	**$ 174,720**	**$ 908,740**
PA12	5	39	10-inch	In-Tract	333	lf	$ 70	lf	$ 23,310	$ -	$ 23,310
PA12	5	40	10-inch	In-Tract	1,925	lf	$ 70	lf	$ 134,750	$ -	$ 134,750
PA12	5	41	10-inch	In-Tract	1,030	lf	$ 70	lf	$ 72,100	$ -	$ 72,100
PA12	5	42	10-inch	In-Tract	2,221	lf	$ 70	lf	$ 155,470	$ -	$ 155,470
PA12	5	43	10-inch	In-Tract	871	lf	$ 70	lf	$ 60,970	$ -	$ 60,970
PA12	5	44	10-inch	In-Tract	407	lf	$ 70	lf	$ 28,490	$ -	$ 28,490
PA12	5	45	10-inch	Jack and Bore across ATS&F RR	155	lf	$ 850	lf	$ 131,750	$ 131,750	$ -
			10-inch Total		6,942				**$ 606,840**	**$ 131,750**	**$ 475,090**
	5 Total								**$ 606,840**	**$ 131,750**	**$ 475,090**



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PREPARED FOR THE:

IRVINE RANCH WATER DISTRICT

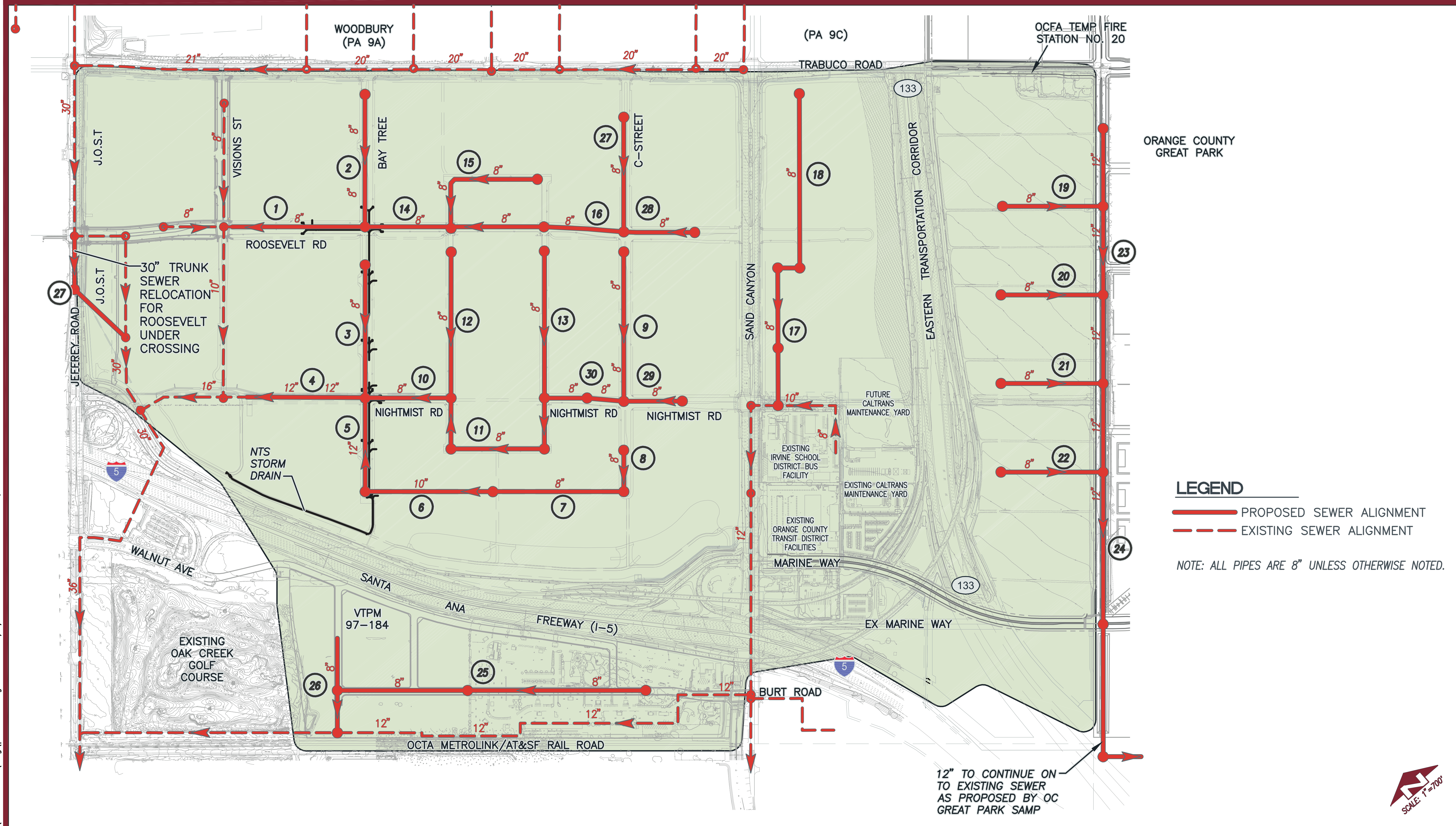
PLANNING AREA 40 SAMP

DOMESTIC WATER PROJECT COST FACILITY SEGMENTS

FIGURE 10-1

Sewer Collection System

Planning Area	Phase	Segment Number	Pipe Diameter	Location	Quantity		Unit Cost		Total Cost	IRWD Cost Share	Developer Cost Share
PA 40	1	1	8-inch	Roosevelt Rd	783	lf	$ 85	lf	$ 66,555	$ -	$ 66,555
PA 40	1	2	8-inch	"A" Street	1,032	lf	$ 85	lf	$ 87,720	$ -	$ 87,720
PA 40	1	3	8-inch	"A" Street	1,037	lf	$ 85	lf	$ 88,145	$ -	$ 88,145
			8-inch Total		**2,852**				**$ 242,420**	**$ -**	**$ 242,420**
PA 40	1	4	12-inch	In-Tract	920	lf	$ 175	lf	$ 161,000	$ 161,000	$ -
PA 40	1	5	12-inch	"A" Street	728	lf	$ 175	lf	$ 127,400	$ 127,400	$ -
			12-inch Total		**1,648**				**$ 288,400**	**$ 288,400**	**$ -**
	1 Total								**$ 530,820**	**$ 288,400**	**$ 242,420**
PA 40	2	7	8-inch	In-Tract	1,019	lf	$ 85	lf	$ 86,615	$ -	$ 86,615
PA 40	2	8	8-inch	"C" Street	322	lf	$ 85	lf	$ 27,370	$ -	$ 27,370
PA 40	2	9	8-inch	"C" Street	1,164	lf	$ 85	lf	$ 98,940	$ -	$ 98,940
PA 40	2	10	8-inch	Nightmist	668	lf	$ 85	lf	$ 56,780	$ -	$ 56,780
PA 40	2	11	8-inch	Nightmist	727	lf	$ 85	lf	$ 61,795	$ -	$ 61,795
PA 40	2	12	8-inch	In-Tract	1,138	lf	$ 85	lf	$ 96,730	$ -	$ 96,730
PA 40	2	13	8-inch	In-Tract	1,144	lf	$ 85	lf	$ 97,240	$ -	$ 97,240
PA 40	2	14	8-inch	Roosevelt Rd	670	lf	$ 85	lf	$ 56,950	$ -	$ 56,950
PA 40	2	15	8-inch	In-Tract	1,034	lf	$ 85	lf	$ 87,890	$ -	$ 87,890
PA 40	2	27	8-inch	In-Tract	893	lf	$ 85	lf	$ 75,905	$ -	$ 75,905
PA 40	2	28	8-inch	In-Tract	552	lf	$ 85	lf	$ 46,920	$ -	$ 46,920
PA 40	2	29	8-inch	In-Tract	455	lf	$ 85	lf	$ 38,675	$ -	$ 38,675
PA 40	2	30	8-inch	In-Tract	619	lf	$ 85	lf	$ 52,615	$ -	$ 52,615
PA 40	2	16	8-inch	Roosevelt Rd	2,135	lf	$ 85	lf	$ 181,475	$ -	$ 181,475
			8-inch Total		**12,540**				**$ 1,065,900**	**$ -**	**$ 1,065,900**
PA 40	2	6	10-inch	In-Tract	994	lf	$ 110	lf	$ 109,340	$ -	$ 109,340
			10-inch Total		**994**				$ 109,340	$ -	$ 109,340
	2 Total								**$ 1,175,240**	**$ -**	**$ 1,175,240**
PA 40	3	17	8-inch	In-Tract	1,242	lf	$ 85	lf	$ 105,570	$ -	$ 105,570
PA 40	3	18	8-inch	In-Tract	1,357	lf	$ 85	lf	$ 115,345	$ -	$ 115,345
			8-inch Total		**2,599**				**$ 220,915**	**$ -**	**$ 220,915**
	3 Total								**$ 220,915**	**$ -**	**$ 220,915**
PA 40	4	19	8-inch	In-Tract	783	lf	$ 85	lf	$ 66,555	$ -	$ 66,555
PA 40	4	20	8-inch	In-Tract	795	lf	$ 85	lf	$ 67,575	$ -	$ 67,575
PA 40	4	21	8-inch	In-Tract	795	lf	$ 85	lf	$ 67,575	$ -	$ 67,575
PA 40	4	22	8-inch	In-Tract	795	lf	$ 85	lf	$ 67,575	$ -	$ 67,575
			8-inch Total		**3,168**				**$ 269,280**	**$ -**	**$ 269,280**
PA 40	4	23	12-inch	"O" Street	2,675	lf	$ 175	lf	$ 468,125	$ 468,125	$ -
PA 40	4	24	12-inch	"O" Street	2,216	lf	$ 175	lf	$ 387,800	$ 387,800	$ -
			12-inch Total		**4,891**				**$ 855,925**	**$ 855,925**	**$ -**
	4 Total								**$ 1,125,205**	**$ 855,925**	**$ 269,280**
PA 12	5	25	8-inch	In-Tract	2,400	lf	$ 85	lf	$ 204,000	$ -	$ 204,000
PA 12	5	26	8-inch	In-Tract	736	lf	$ 85	lf	$ 62,560	$ -	$ 62,560
			8-inch Total		**3,136**				$ 266,560	$ -	$ 266,560
	5 Total								**$ 266,560**	**$ -**	**$ 266,560**



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PREPARED FOR THE:
IRVINE RANCH WATER DISTRICT

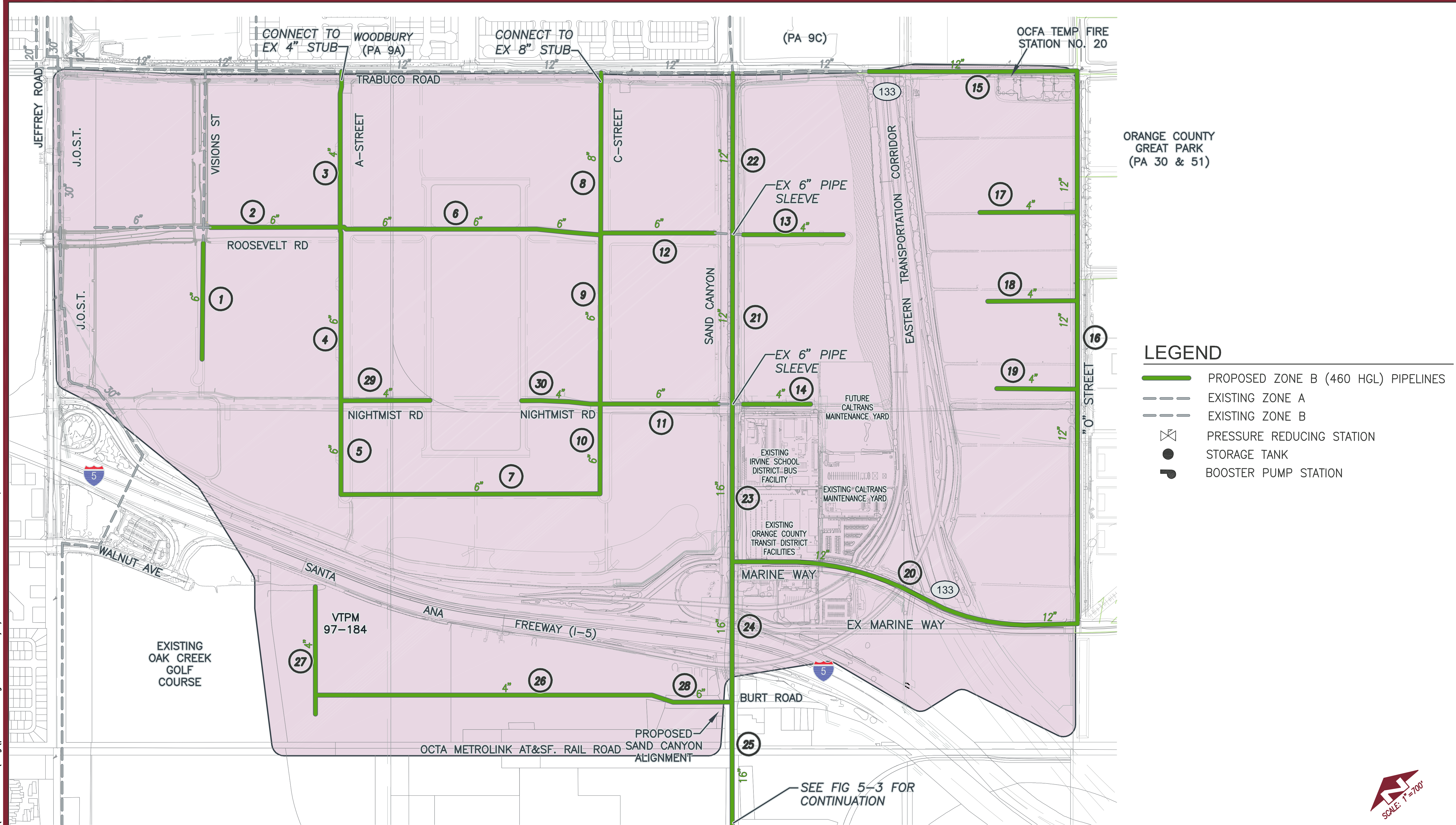
PLANNING AREA 40 SAMP

SEWER COLLECTION PROJECT COST FACILITY SEGMENTS

FIGURE 10-2

Nonpotable Water System - Pipeline Facilities

Planning Area	Phase	Segment Number	Pipe Diameter	Location	Quantity		Unit Cost		Total Cost	IRWD Cost Share	Developer Cost Share
PA 40	1	3	4-inch	"A" Street	1,210	lf	$ 50	lf	$ 60,500	$ -	$ 60,500
			4-inch Total		**1,210**				**$ 60,500**	**$ -**	**$ 60,500**
PA 40	1	1	6-inch	Visions Street	1,023	lf	$ 60	lf	$ 61,380	$ 61,380	$ -
PA 40	1	2	6-inch	Roosevelt Rd	1,063	lf	$ 60	lf	$ 63,780	$ 63,780	$ -
PA 40	1	4	6-inch	"A" Street	1,348	lf	$ 60	lf	$ 80,880	$ 80,880	$ -
PA 40	1	5	6-inch	"A" Street	730	lf	$ 60	lf	$ 43,800	$ 43,800	$ -
			6-inch Total		**4,164**				**$ 249,840**	**$ 249,840**	**$ -**
	1 Total								**$ 310,340**	**$ 249,840**	**$ 60,500**
	2	29	4-inch	Nightmist	692	lf	$ 50	lf	$ 34,600	$ -	$ 34,600
	2	30	4-inch	Nightmist	612	lf	$ 50	lf	$ 30,600	$ -	$ 30,600
			4-inch Total		**1,304**				**$ 65,200**	**$ -**	**$ 65,200**
PA 40	2	6	6-inch	Roosevelt Rd	1,970	lf	$ 60	lf	$ 118,200	$ 118,200	$ -
PA 40	2	7	6-inch	Nightmist	1,920	lf	$ 60	lf	$ 115,200	$ 115,200	$ -
PA 40	2	9	6-inch	"C" Street	1,317	lf	$ 60	lf	$ 79,020	$ 79,020	$ -
PA 40	2	10	6-inch	"C" Street	704	lf	$ 60	lf	$ 42,240	$ 42,240	$ -
PA 40	2	11	6-inch	Nightmist	917	lf	$ 60	lf	$ 55,020	$ 55,020	$ -
PA 40	2	12	6-inch	Roosevelt Rd	917	lf	$ 60	lf	$ 55,020	$ 55,020	$ -
			6-inch Total		**7,745**				**$ 464,700**	**$ 464,700**	**$ -**
PA 40	2	8	8-inch	"C" Street	1,250	lf	$ 65	lf	$ 81,250	$ 81,250	$ -
			8-inch Total		**1,250**				**$ 81,250**	**$ 81,250**	**$ -**
	2 Total								**$ 545,950**	**$ 545,950**	**$ -**
PA 40	3	13	4-inch	Roosevelt Rd	851	lf	$ 50	lf	$ 42,550	$ -	$ 42,550
PA 40	3	14	4-inch	Nightmist	605	lf	$ 50	lf	$ 30,250	$ -	$ 30,250
			4-inch Total		**1,456**				**$ 72,800**	**$ -**	**$ 72,800**
	3 Total								**$ 72,800**	**$ -**	**$ 72,800**
PA 40	4	17	4-inch	In-Tract	756	lf	$ 50	lf	$ 37,800	$ -	$ 37,800
PA 40	4	18	4-inch	In-Tract	695	lf	$ 50	lf	$ 34,750	$ -	$ 34,750
PA 40	4	19	4-inch	In-Tract	627	lf	$ 50	lf	$ 31,350	$ -	$ 31,350
			4-inch Total		**2,078**				**$ 103,900**	**$ -**	**$ 103,900**
PA 40	4	15	12-inch	Trabuco Rd - SR133 to "O" Street	1,617	lf	$ 130	lf	$ 210,210	$ 210,210	$ -
PA 40	4	16	12-inch	"O" Street - Trabuco to Marine Way	4,294	lf	$ 105	lf	$ 450,870	$ 450,870	$ -
PA 40	4	20	12-inch	Marine Way	2,766	lf	$ 130	lf	$ 359,580	$ 359,580	$ -
PA 40	4	21	12-inch	Sand Canyon Avenue - Roosevelt to Trabuco	1,321	lf	$ 130	lf	$ 171,730	$ 171,730	$ -
PA 40	4	22	12-inch	Sand Canyon Avenue - Nightmist to Roosevelt	1,253	lf	$ 130	lf	$ 162,890	$ 162,890	$ -
			12-inch Total		**11,251**				**$ 1,355,280**	**$ 1,355,280**	**$ -**
PA 40	4	23	16-inch	Sand Canyon Avenue - Marine Way to Nightmist	1,223	lf	$ 250	lf	$ 305,750	$ 305,750	$ -
PA 40	4	24	16-inch	Sand Canyon Avenue - Burt Rd to Marine Way	1,090	lf	$ 250	lf	$ 272,500	$ 272,500	$ -
PA 40	4	25	16-inch	Laguna Canyon and Sand Canyon to Burt Rd	4,481	lf	$ 250	lf	$ 1,120,250	$ 1,120,250	$ -
			16-inch Total		**6,794**				**$ 1,698,500**	**$ 1,698,500**	**$ -**
	4 Total								**$ 3,157,680**	**$ 3,053,780**	**$ 103,900**
PA 12	5	26	4-inch	In-Tract	2,787	lf	$ 50	lf	$ 139,350	$ -	$ 139,350
PA 12	5	27	4-inch	In-Tract	988	lf	$ 50	lf	$ 49,400	$ -	$ 49,400
			4-inch Total		**3,775**				**$ 188,750**	**$ -**	**$ 188,750**
PA 12	5	28	6-inch	In-Tract	460	lf	$ 60	lf	$ 27,600	$ 27,600	$ -
			6-inch Total		**460**				**$ 27,600**	**$ 27,600**	**$ -**
	5 Total								**$ 216,350**	**$ 27,600**	**$ 188,750**



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PREPARED FOR THE:
IRVINE RANCH WATER DISTRICT

PLANNING AREA 40 SAMP

NON-POTABLE WATER PROJECT COST FACILITY SEGEMNTS

FIGURE 10-3

APPENDIX 5

SAN CANYON AVE RW PIPELINE ALIGNMENT STUDY

TETRA TECH

MEMORANDUM

TO: Patty Uematsu, IRWD

FROM: Tom Epperson, P.E., Tetra Tech

JOB TITLE: Sand Canyon and I-5 Recycled Water Utility Investigation

PROJECT NO: ___________________________

SUBJECT: Recycled Water Utility Investigation

DATE: November 24, 2010

This memorandum is to address the feasibility of providing recycled water service along Sand Canyon from Oak Canyon to Marine Way for Planning Area 40.

16-inch Recycled Waterline

IRWD is currently developing the Planning Area 40 SAMP. The PA 40 area is primarily north of the I-5 freeway along Sand Canyon. As an additional source of water to the area, the District has asked Tetra Tech to determine if an alignment is available along Sand Canyon from Oak Canyon to Nightmist. The recycled water line is sized for 16-inches.

The City of Irvine has a project out to bid within Sand Canyon Avenue to provide a grade separation with the railroad. Tetra Tech was the design engineer for the relocation of the domestic water and sewer services for this project. The scope of the grade separation project includes maintaining two lanes of traffic each way along Sand Canyon. This has resulted in eight major phases with several sub-phases.

There is a corridor available for the 16-inch recycled water line. See Figures 1 to 3. From Oak Canyon, the pipeline will be in the northbound lane of Sand Canyon from St. Sta. 261+00 to St. Sta. 267+30 along the existing Sand Canyon alignment. At St. Sta. 267+30 the pipeline will switch from the existing Sand Canyon alignment to the future roadway and stay in the southbound Sand Canyon lanes until Nightmist.

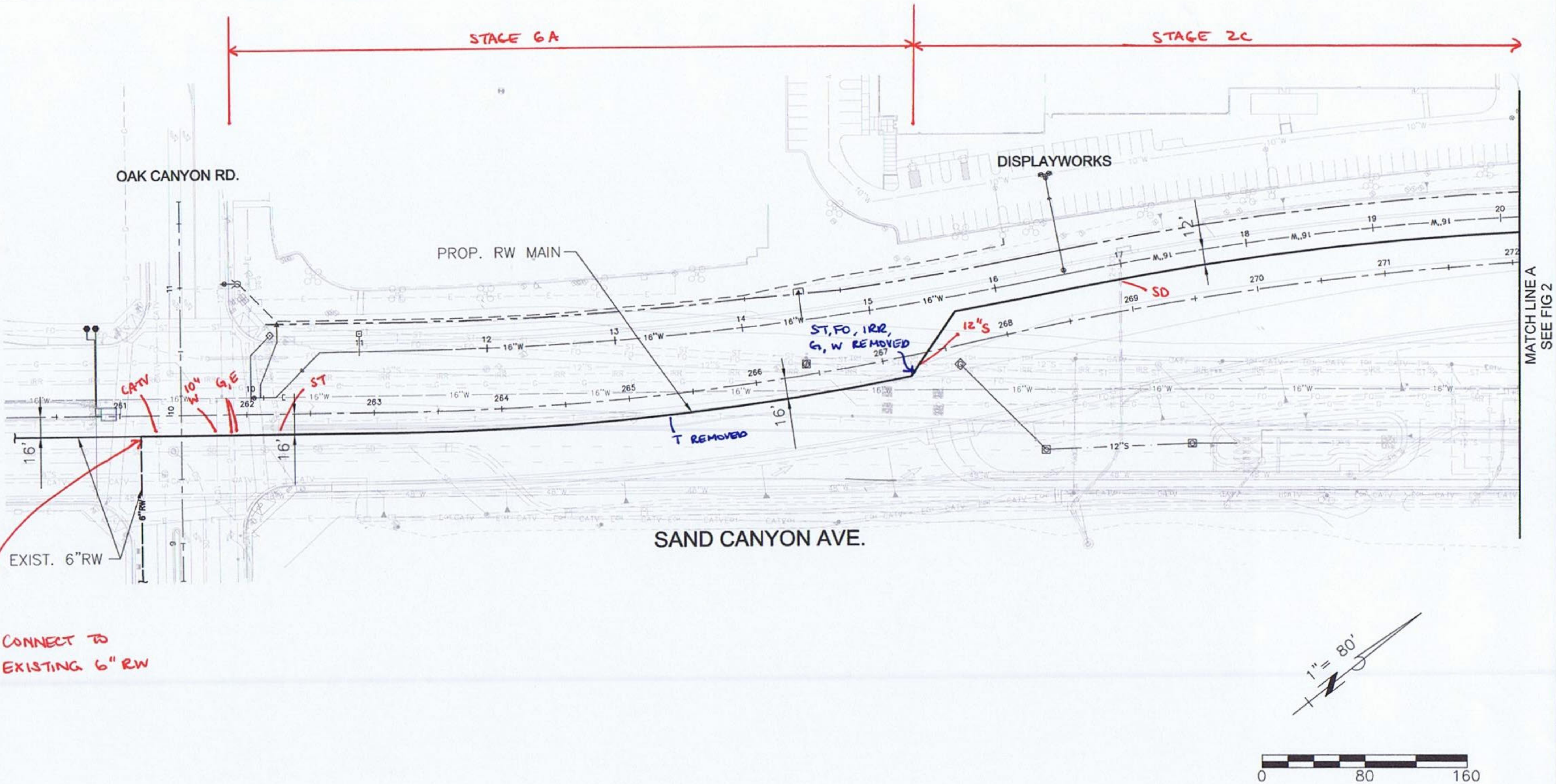
There are several utility crossings but the major crossing will be the 72-inch storm drain at St. Sta. 291+00 north of the I-5 northbound on/off ramp. The remaining crossings vary from electrical conduits up to 16-inch water lines. The alignment will be in corridors parallel to the 84-inch storm drain at Oak Canyon and the 8-inch high pressure gas from St. Sta. 290+00 to St. Sta. 295+00 north of the I-5 northbound on/off ramp. There is adequate separation between the utilities for the alignment.

The pipeline corridor on the southbound Sand Canyon will cross two freeway on/off-ramps. Both of these will likely need to be bore and jack portions. We are looking at a bore and jack of approximately 170 feet at the I-5 southbound off-ramp and 280 feet at the I-5 northbound on/off-ramp.

The construction of the recycled water line will follow the Sand Canyon Grade Separation traffic staging from St. Sta. 262+00 to St. Sta. 281+50 which between the I-5 southbound off-ramp and the freeway. Traffic control would be needed for the portion under the freeway up to Nightmist and also the intersection of Sand Canyon and Oak Canyon.

Recommendation

It is recommended that the recycled water improvements be added to the Sand Canyon Grade Separation Project due to the traffic issues of maintaining two lanes of traffic each way.



TETRA TECH

IRVINE RANCH WATER DISTRICT

RECYCLED WATER ALIGNMENT
IN SAND CANYON AVE

NOVEMBER 2010

FIGURE
1

REFERENCE FILES: ZRHA.dwg ZRBA.dwg ZRVA.dwg 337utility.dwg 2337-sd-10t.dwg ZRTO.dwg 2337-estimated-ct-row.dwg 337mbs-10s.dwg ZRUT.dwg

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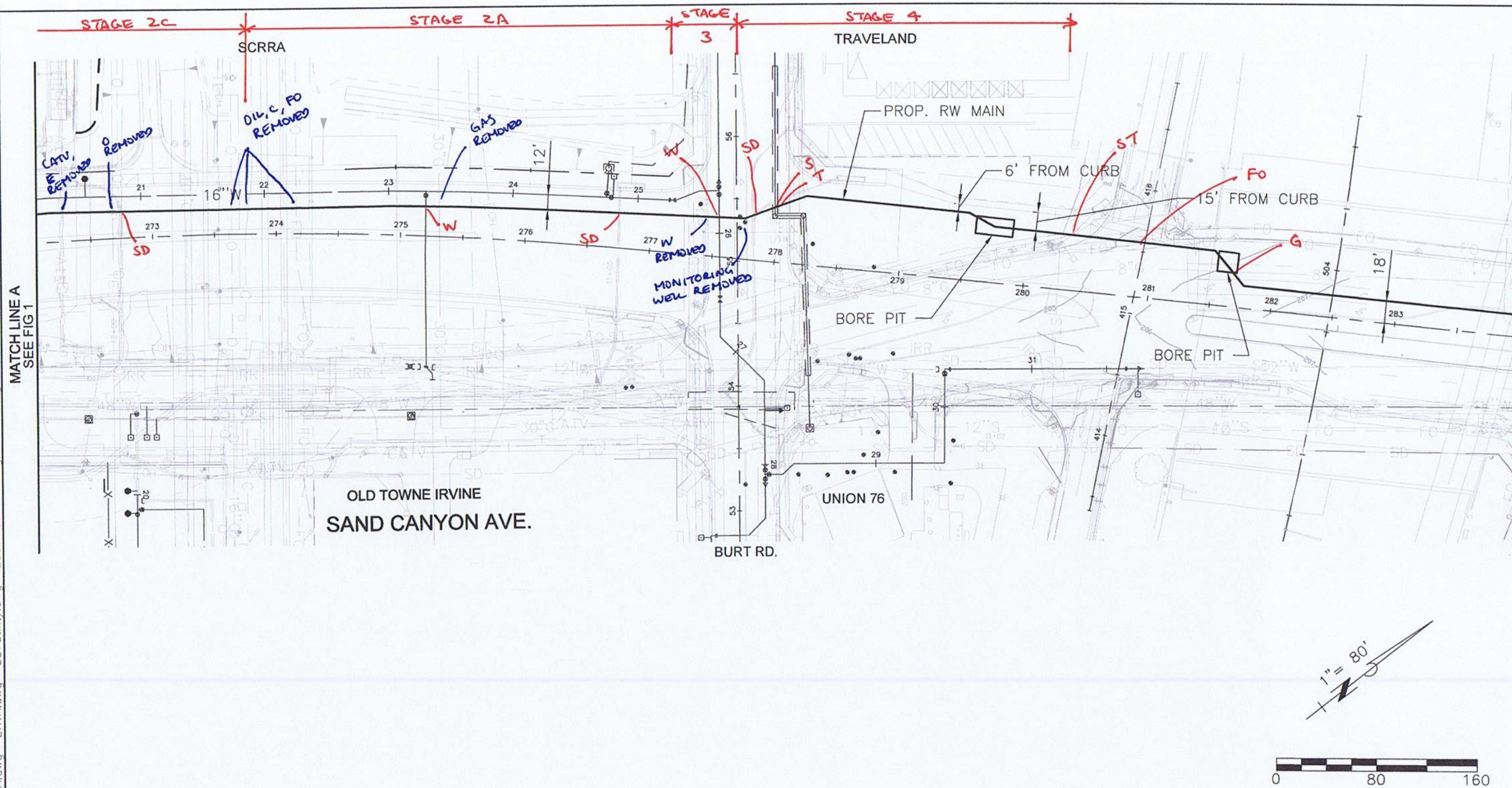

TETRA TECH

IRVINE RANCH WATER DISTRICT

RECYCLED WATER ALIGNMENT
IN SAND CANYON AVE

NOVEMBER 2010

FIGURE
2

REFERENCE FILES: ZRHA.dwg ZRBA.dwg ZRVA.dwg 337utility.dwg 2337-sd-10t.dwg ZRTO.dwg 2337-estimated-ct-row.dwg 337mbs-10s.dwg ZRUT.dwg

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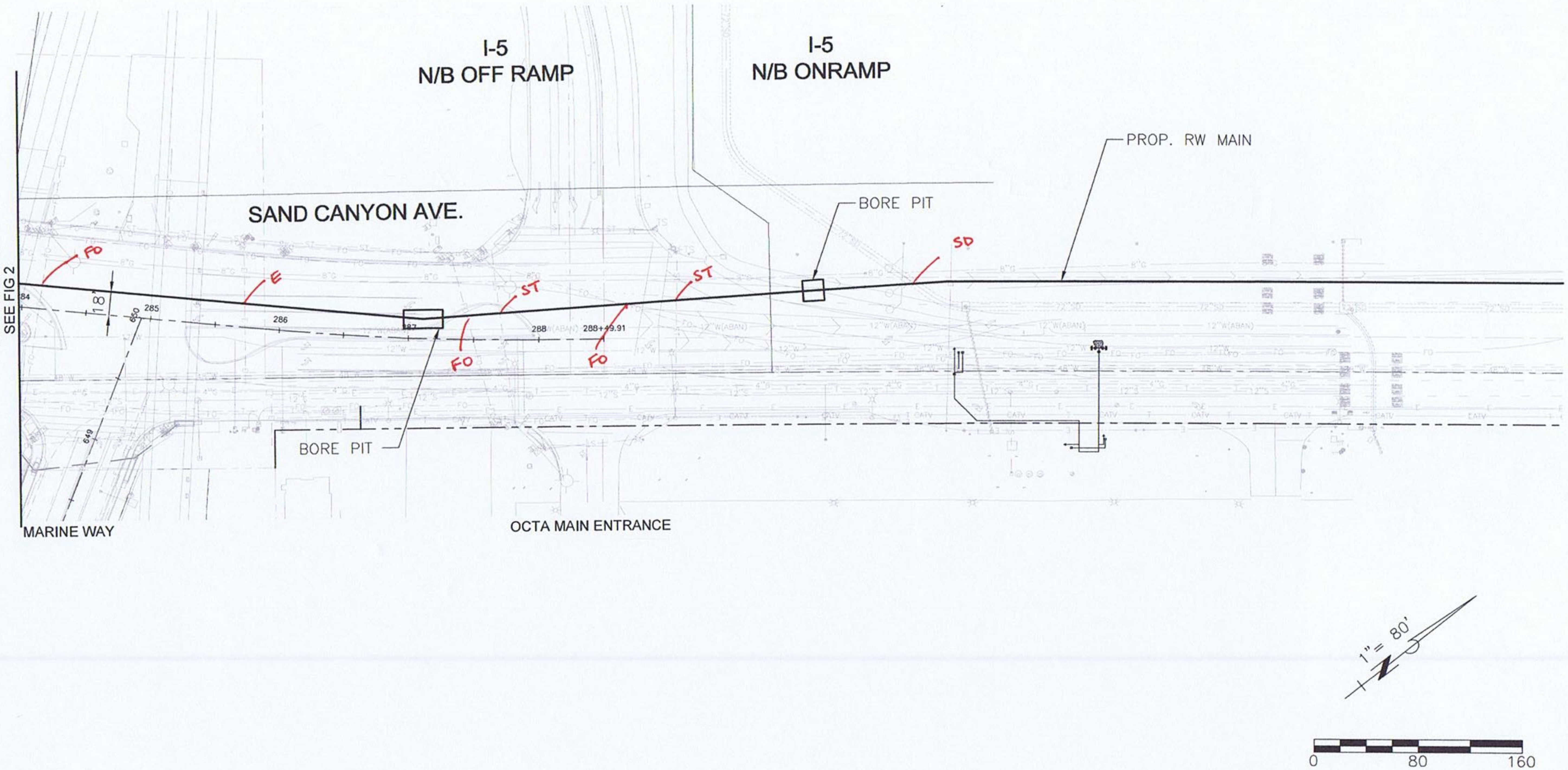

IRVINE RANCH WATER DISTRICT

TETRA TECH

RECYCLED WATER ALIGNMENT
IN SAND CANYON AVE

NOVEMBER 2010

FIGURE
3

REFERENCE FILES: ZRHA.dwg ZRBA.dwg ZRVA.dwg 337utility.dwg 2337-sd-10t.dwg ZRTO.dwg 2337-estimated-ct-row.dwg 337mbs-10s.dwg ZRUT.dwg

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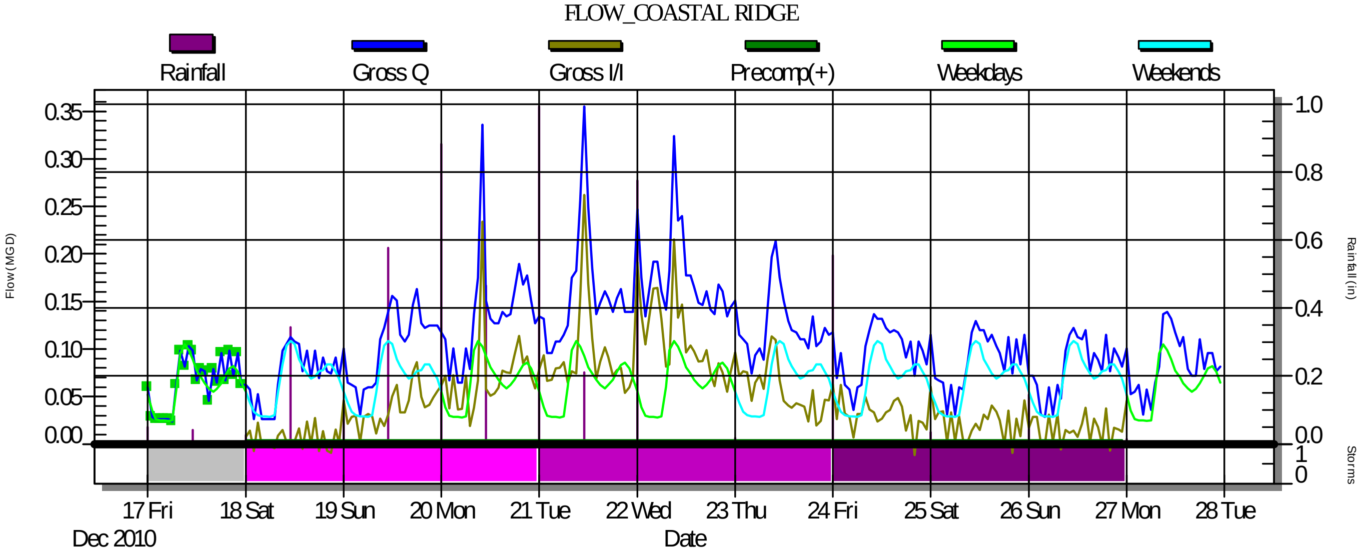
APPENDIX J3

Preliminary Rainfall Dependent Inflow and Infiltration
Analysis Report, November 2012

IRWD

Wastewater Collection System Preliminary Infiltration & Inflow Study, Selected Lift Stations

Storm Event - 12/18/2010



Flow Data Period
January 1, 2010 – March 31, 2012

Prepared For:

Irvine Ranch Water District
3512 Michelson Drive
Irvine, CA 92612-1799

Prepared By:

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15205 Springdale Street • Huntington Beach, California 92649
PHONE: 714.379.9778 • FAX: 714.379.9588

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November 21, 2012

Mr. Greg Springman
Collection Systems Manager
Irvine Ranch Water District
3512 Michelson Drive
Irvine, CA 92612-1799

Subject: IRWD Preliminary Sewer Flow RDII Evaluation – Selected Lift Stations

Dear Mr. Springman,

Enclosed please find a copy of the subject preliminary report. This report contains an evaluation of available sewer flow monitoring data from selected lift station sites for preliminary Rain Dependent Infiltration and Inflow (RDII) during the period from January 2010 through March 2012.

We would be happy to answer any questions about the report. I can be reached at (714) 379-9778 ext 223. Thank you for choosing ADS products and services to meet your flow monitoring needs.

Sincerely,
ADS Environmental Services, Inc.

Paul S. Mitchell, PE
Regional Engineer

TABLE OF CONTENTS

1 BACKGROUND AND SUMMARY

IRWD has adopted a proactive initiative to evaluate operational impacts associated with Rainfall Dependent Infiltration and Inflow (RDII) throughout the sanitary collection system. Some wet weather collection system performance data were collected as a part of the 2005 master planning and modeling work. However, IRWD is interested in obtaining a more comprehensive understanding of RDII impacts to the system. This report represents an initial step toward that goal.

IRWD operates and maintains 27 sanitary sewer lift stations throughout the system; most of which are small stations with very limited tributary areas (e.g. shopping center, or small isolated residential area). IRWD also operates three (3) long term open channel flow monitoring sites; two (2) of which represent reasonably large well defined tributary areas. Some of the lift stations also represent reasonably large, well defined tributary areas. Many of these larger lift stations have flow monitoring devices connected to the SCADA system and have several years of historical flow data available for review. IRWD also operates and maintains several rain gauging stations throughout the IRWD service area and historical daily total rainfall data are available for most of these locations.

IRWD elected to conduct an initial or preliminary review of RDII performance using available existing data from a select number of lift stations and two (2) of the open channel flow monitoring sites (i.e. those representing well defined tributary areas) to serve as a limited sampling of RDII performance in some areas of the system. Future phases of RDII performance evaluation would likely involve installation of several seasonal open channel flow monitoring devices (and supplemental rain gauging stations) to represent additional isolated flow basins throughout the predominantly gravity flow system.

1.1 Project Objectives

This report provides the results of an evaluation of RDII volumes entering tributary zones of the selected lift stations and open channel monitoring sites during a wet weather evaluation period from January 1, 2010 through March 31, 2012. The flow data along with available rain data were evaluated to determine RDII performance from the associated tributary areas or “basins” on a normalized basis (e.g. excess RDII in gallons per inch of rain per foot of basin tributary piping) to enable relative performance of the basins to be compared. Although this preliminary study represents a very small portion of the collection system (about 7% of the system piping), it provides insight into how future RDII study basins can be evaluated; representing a much larger percentage of the collection system.

1.2 Scope of Work

The scope of work for this preliminary RDII evaluation includes the following tasks:

- Assemble the flow and rain data provided by IRWD into a Profile™ database;
- Conduct an RDII analysis of the rainfall and flow data using Sli/icer ™ software;
- Quantify RDII basin performance;
- Provide recommendations for expanded RDII evaluation.

1.3 Report Layout

This report presents two (2) aspects of sewer flow hydraulic performance information for each of the evaluated tributary areas or basins:

- General net daily flow information for each basin;
- Wet weather flow information for each basin including quantification of net flows during each evaluated storm event that were in excess of normal dry period flows (i.e. RDII).

Chapter 1 of this report presents project background information and a summary of the findings of this study. Chapter 2 outlines the project approach, and flow monitoring/ rainfall evaluation procedures and data. Chapter 3 presents net flow information for each evaluated basin during dry periods. Chapter 4 presents wet weather data and RDII quantification and results. Chapter 5 presents summary conclusions and recommendations regarding flow performance for the period evaluated.

1.4 Basin Flow Analysis

IRWD elected to conduct a review of RDII performance from basins associated with four (4) lift stations and basins associated with the above indicated two (2) open channel flow monitoring sites to serve as a limited sampling of RDII performance from 6 small isolated basins. They include basins tributary to Coastal Ridge Lift Station, NCLS, Coyote Canyon Lift Station and University Lift Station (representing the southwestern hilly terrain along the 73 Freeway), and basins tributary to Canada Lift station and Site 07ENGCYN flow meter (representing two small areas of the southeastern-most part of the system). Originally, a seventh basin associated with Portola Hills Lift Station was to be included in the evaluation. However, this lift station only records pump cycles and no specific flow information, so it was not included in this evaluation.

Figure 1.1 shows the delineated tributary area basins associated with each of the 6 flow measurement locations. The tributary for Portola LS is shown just for reference purposes.

Table 1.1 summarizes the 6 meter/basin locations and their associated basin size metrics including total feet of mainline piping in each basin, acreage of each basin typical daily flow volume or Average Dry [weather] Day Flow (ADDF).

Figure 1.1 – Evaluated Tributary Basins in IRWD System

Table 1.1 - Basins Sizes and ADDF

Meter/Basin	Upstream Meter/Basins	Basin Size (Acres)	Basin Size (LF of pipe)	ADDF Weekday (MGD)
CANADA LS		237	33,666	0.25
COASTAL RIDGE		224	33,053	0.06
COYOTE CANYON		652	86,824	0.31
UNIVERSITY LS	COYOTE	704	88,257	0.73
Site_07ENGCYN		700	90,000	0.63
Site NCLS	COASTAL RIDGE	656	115,906	0.47
TOTAL		3,173	447,706	2.45

1.5 RDII Analysis

An analysis was performed to quantify Rain Dependent Inflow and Infiltration (RDII) produced by each evaluated basin. A chart of the highest “normalized” RDII results measured for the six (6) basins is summarized in Figure 1.2. The term “normalized” means that the RDII (the volume of flows measured to be above the normal expected dry weather flows) was divided by rainfall volume and basin size (in terms of typical daily flow rate) to enable an apples-to-apples comparison of results among basins.

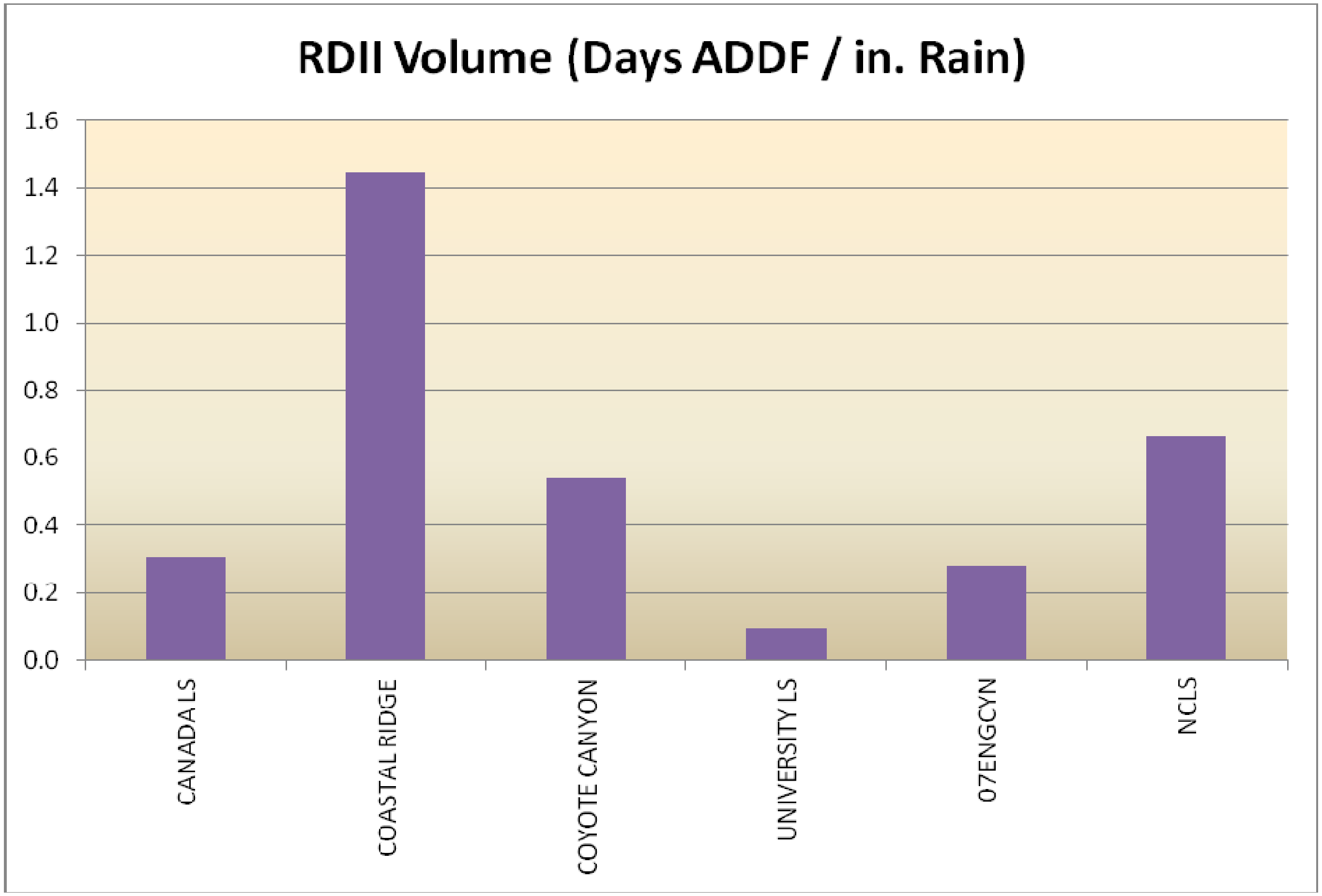


Figure 1.2 - Normalized RDII (Equivalent Days of Average Dry-weather Day Flow volume per Inch of Rainfall)

1.6 Conclusions and Recommendations

- Normalized volumetric RDII responses from the evaluated tributary basins are considered moderate. RDII peak factors associated with the Canada, Coastal Ridge and Coyote lift stations suggest that peak flows leading to the wet wells of those stations were likely significant during the 2 large, system-stressing storms evaluated.

- Evaluate peak flow pumping capacity at each of the evaluated lift stations to confirm they are capable of transporting the peak RDII rates observed during the December 2010 storm.

- Sewage pumping station tributary areas account for a small percentage of the collection system piping. A more comprehensive evaluation of system performance would require installation of supplemental flow monitors installed at various locations throughout the open channel gravity flow piping.

- Install enough gravity flow monitoring devices to hydraulically isolate additional basins within zones of the system where more comprehensive RDII performance is desired. A general rule is to place enough flow monitors so that average basin size is 20,000 lf of piping or less for a highly focused study and about 50,000 lf per basin for a more general performance study. For example, the eastern most zone of the system (bounded by Bake Parkway, the 5 Freeway, and El Toro Road) could be broken into about 20 basins using about that number of flow meters. The flow metering devices should remain in place for 3 to 4 months to enable ample dry weather and wet weather data to be collected.

- If determination of peak RDII rates into each of the lift stations evaluated herein are desired, supplemental gravity flow meters could be installed at locations just upstream of their respective wet wells.

- Accurate rainfall data is important to properly compare performance among evaluation basins. To assure adequate representation of rainfall in any future RDII study, additional temporary rain gauging stations should be considered for deployment. These rain gauging stations should be able to log rainfall accumulations at 15-minute intervals and should be spaced at approximately 1 gauge every 4 square miles.

2 PROJECT APPROACH

Rain Dependent Inflow and Infiltration (RDII) is defined as rainwater that enters a sanitary sewer system during or just after a storm event. Inflow is defined as water that directly enters a system through roof leaders, clean-outs, foundation drains, sump pumps, and cellar, yard, and area drains. Infiltration is defined as water that enters a sewer system from the ground through defective pipes (including laterals), pipe joints, damaged lateral connections or manhole walls.

Most collection systems have been designed to convey some quantity of RDII. Although it is not practical to eliminate all RDII from entering a sewer system, removing excessive amounts of RDII can positively impact a collection system in the following ways:

- Increase available collection system capacity;
- Reduce the possibility of sanitary sewer overflows;
- Reduce treatment and transportation costs.

The most cost effective means of identifying, quantifying, and prioritizing RDII entering a collection system is through a comprehensive RDII investigation program comprised of the following major components:

- Collection system review and basin identification;
- Simultaneous flow monitoring and rain gauging;
- Data analysis and ranking of basins against one another based on normalized units (such as % Rainfall entering each basin within the system) often referred to as basin prioritization;
- Sanitary Sewer Evaluation Surveys (SSES) including smoke testing, manhole inspection, flow isolation, dye water flooding, closed circuit television, etc.

ADS conducted a limited evaluation of RDII performance using the first three components of an RDII evaluation based mostly on flow data provided from IRWD staff from selected lift stations and from two (2) open channel flow monitoring locations. The data evaluation period is from January 1, 2010 through March 31, 2012.

2.1 Basin Identification

IRWD operates and maintains 27 sanitary sewer lift stations throughout the system; most of which are small stations with very limited tributary areas (e.g. shopping center, or small isolated residential area). Some of the lift stations have reasonably large, well defined tributary areas or “basins”. Many of these larger lift stations have flow monitoring devices connected to the SCADA system and have several years of historical flow data available for review.

IRWD also operates three (3) long term open channel flow monitoring sites; two (2) of which represent well defined tributary basin areas. One site (Site NCLS) represents the flow from (tributary to) the Newport Coast Lift Station (NCLS) and the other site (Site 07ENGCYN) represents all flow entering the system from the east along Los Alisos Blvd.

IRWD elected to conduct a review of RDII performance from basins associated with four (4) lift stations and basins associated with the above indicated two (2) open channel flow monitoring sites to serve as a limited sampling of RDII performance from 6 small isolated basins. They include basins tributary to Coastal Ridge Lift Station, NCLS, Coyote Canyon Lift Station and University Lift Station (representing the southwestern hilly terrain along the 73 Freeway), and basins tributary to Canada Lift station and Site 07ENGCYN flow meter (representing two small areas of the southeastern-most part of the system). Originally, a seventh basin associated with Portola Hills Lift Station was to be included in the evaluation. However, this lift station only records pump cycles and no specific flow information, so it was not included in this evaluation.

Figure 1.1 shows the delineated tributary area basins associated with each of the 6 flow measurement locations. The tributary for Portola LS is shown just for reference purposes.

Table 2.1 summarizes the 6 meter/basin locations and their associated basin size metrics including total feet of mainline piping in each basin, acreage of each basin typical daily flow volume or Average Dry [weather] Day Flow (ADDF). The basin associated with the University LS also takes all flows from Coyote Canyon LS, so the University basin is determined by subtracting flow from the Coyote basin as indicated in the second field of Table 2.1. Similarly, net flow from the NCLS basin is based on subtracting flow from upstream Coastal Ridge LS.

Table 2.1 - Basin Sizes and Associated Meter Sites

Meter/Basin	Upstream Meter/Basins	Basin Size (Acres)	Basin Size (LF of pipe)	ADDF Weekday (MGD)
CANADA LS		237	33,666	0.25
COASTAL RIDGE		224	33,053	0.06
COYOTE CANYON		652	86,824	0.31
UNIVERSITY LS	COYOTE	704	88,257	0.73
Site_07ENGCYN		700	90,000	0.63
Site NCLS	COASTAL RIDGE	656	115,906	0.47
TOTAL		3,173	447,706	2.45

2.2 Open Channel Flow Monitoring Equipment

The equipment used for flow measurement at sites 07ENGCYN and NCLS are ADS Model FlowShark open-channel flow monitors. These flow monitors consist of depth and velocity sensors and a battery-powered microcomputer. The microcomputer includes a processor unit, data storage, and an on-board clock to control and synchronize the sensor recordings. Each monitor acquires and stores depth of flow and velocity readings at 15-minute intervals. The depth data are converted to wetted cross section of flow (A) in the pipe and the recorded average velocity (V) is applied to the cross section to determine flow rate (Q) based on the continuity equation (Q = A x V). Data are retrieved remotely via cellular modem, and finalized (QA checked) data are posted on IRWD's Web-based IntelliServe.™ data portal.

A typical open channel flow monitor installation generalized cross section is shown in Figure 2.1.

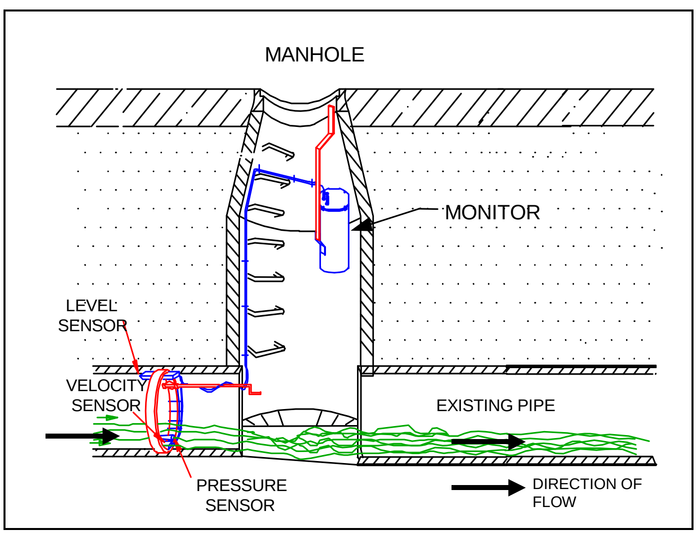


Figure 2.1 - Typical Installation Diagram of an Open Channel Flow Monitor

The installation presented in Figure 2.1 is typical of the configuration used in short term and long term flow studies and is customarily used on circular or oval pipes up to approximately 42-inches in diameter or height. In this type of installation, depth and velocity sensors are mounted on an expandable ring and installed upstream of the pipe/manhole connection in the incoming sewer pipe. The installation into the incoming pipe reduces the affects of turbulence caused by the manhole.

2.3 Rain Gauges and Rainfall Data

An important part of an RDII study is the collection and analysis of rainfall data (volume and distribution).

IRWD operates and maintains several rain gauging stations throughout the IRWD service area and historical daily total rainfall data are available for most of these locations. IRWD provided daily rainfall data from 6 gauging station locations: Rattlesnake, Sand Canyon, San Joaquin, Los Trancos, Irvine Park, and from a location representing Central Irvine. Rain data provided from the San Joaquin location appeared to have corrupted time stamps resulting in rainfall offset by several months from actual time of occurrence, so data was not used from that location. Also, rainfall for most of the evaluation period from the Los Trancos station appeared to be missing. Therefore, the majority of the rainfall data associated with the evaluated basins is based on data provided for the Central area.

Rain events that have historically been significant for an RDII analysis are those events yielding greater than 1.0 inch of rain, and lasting ½ day or more. There were seven (7) rain events that occurred during the study period that exceeded these criteria at one or more of the rain gauging stations. The 7 rain events are summarized in Table 2.2 showing rainfall measured at the Central location.

Table 2.2 – Evaluated Storm Events Summary

Storm	Start Date	Rainfall (inches) Central	Storm Type Magnitude, Duration
1	1/16/2010	5.60	~ 8 year, 5 day
2	2/4/2010	1.63	< 1 year, 5 day
3	10/15/2010	1.45	< 1 year, 5 day
4	12/18/2010	7.15	~25 year, 5 day
5	2/26/2011	1.15	< 1 year, 5 day
6	3/19/2011	1.84	< 1 year, 5 day
7	3/16/2012	1.14	< 1 year, 5 day
Annual Mean		14	--

A rainfall accumulation chart was prepared (called a DDF chart) based on the rain data provided for the Central area and is depicted in Figure 2.2. This chart was used to compare captured rainfall to historical rainfall statistics for the area (dashed curves on the DDF chart).[1] Of the storms evaluated, two (2) would be considered larger than typical. The earliest storm starting on January 16, 2010 could be classified as having an approximate 8 year return frequency over a total of 5 days of accumulation. The storm starting December 18, 2010 could be classified as having a nearly 25 year return frequency over a similar duration of 5 days.

[1] NOAA Web-based Precipitation Data Server, based on Atlas 14, Volume 6, Version 2, Tustin-Irvine Ranch Site ID 04-9087.

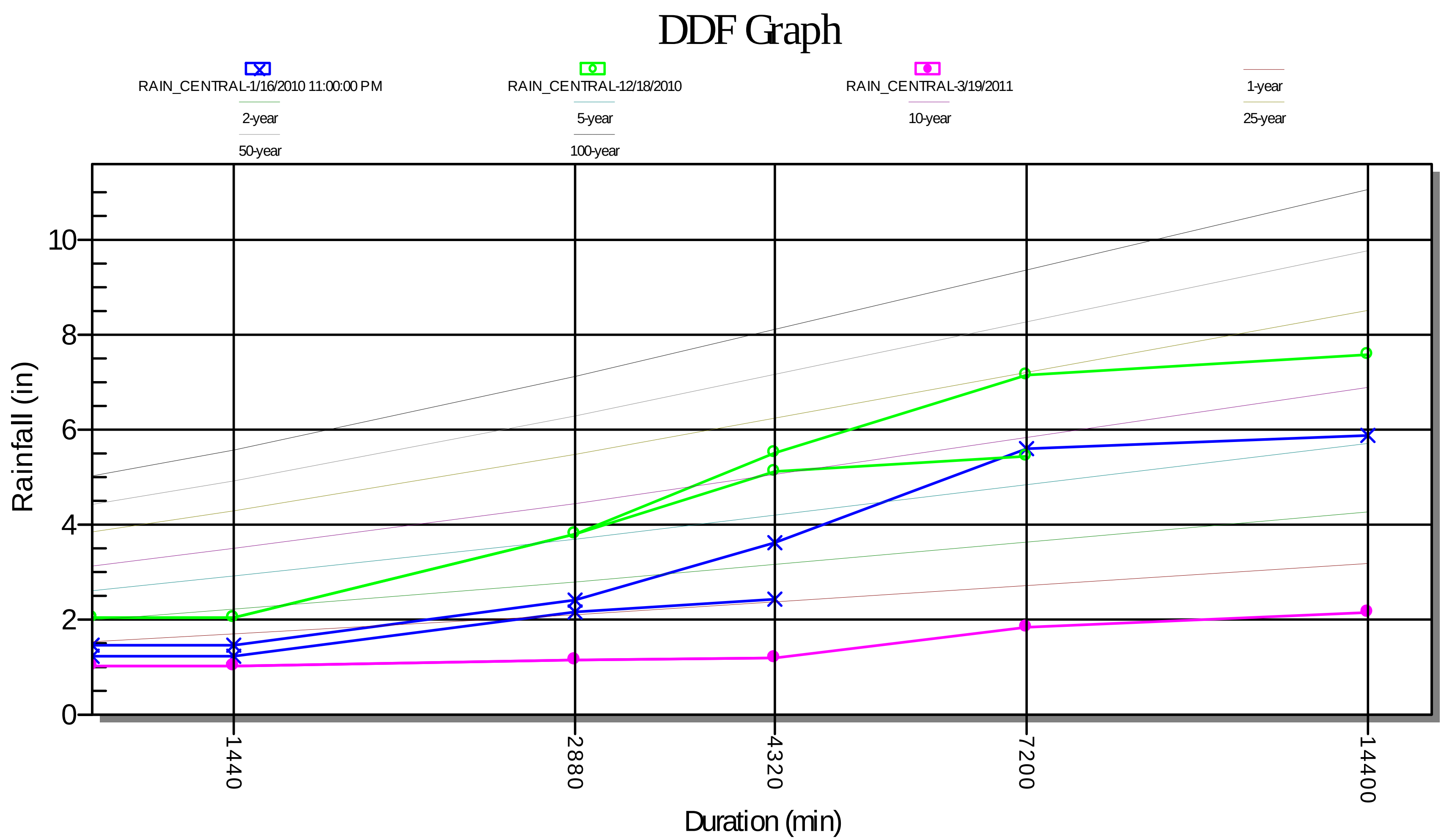


Figure 2.2 – Rainfall Depth Duration Frequency Chart – Central Area

Each evaluated basin was assigned rainfall amounts in proportion to the distance each rain gauge was located from the approximate center (centroid) of each basin. The Inverse-Distance Squared method was used to assign weighting factors for each rain gauge to each basin. This means that rainfall data that is collected 1 mile from a basin would be assigned 4 times the weight as rainfall data that is collected 2 miles from that same basin.

To illustrate, for the Canada LS basin, rainfall attributed to the Central area is about equally weighted with rainfall from the Sand Canyon location (both roughly equidistant to the basin and getting a relative weight of 4), whereas rainfall associated with Coastal Ridge LS is weighted more heavily toward rain from San Canyon vs. Central since Sand Canyon is much closer to that basin. Relative weighting factors for all rain gauging locations with respect to each of the basins were computed and are summarized in Table 2.3.

Table 2.3 – Rain Gauge Relative Weighting per Basin

Basin	CENTRAL	IRVINE_PARK	LOS_TRANCOS	RATTLESNAKE	SAND_CANYON
Canada	4	1	2	2	4
Coastal	3	1	21	1	10
Coyote	4	1	9	1	17
University	3	1	5	1	8
07ENGCYN	2	1	1	2	2
NCLS	3	1	21	1	10

3 BASIN DRY WEATHER FLOW ANALYSIS

3.1 Net Dry Weather Flows

Net basin flows are those associated only with the basin. In some cases, net flows must be obtained after subtracting flows coming into the associated basin from an upstream site. Net flow from two basins was determined based on subtracting upstream flow from another evaluated basin. As shown in Table 2.1, University LS basin was isolated by subtracting flows coming in from upstream from Coyote Canyon LS. Also, NCLS was isolated by subtracting flow entering from upstream from Coastal Ridge LS. Dry weather days were defined based on the following set of minimum criteria:

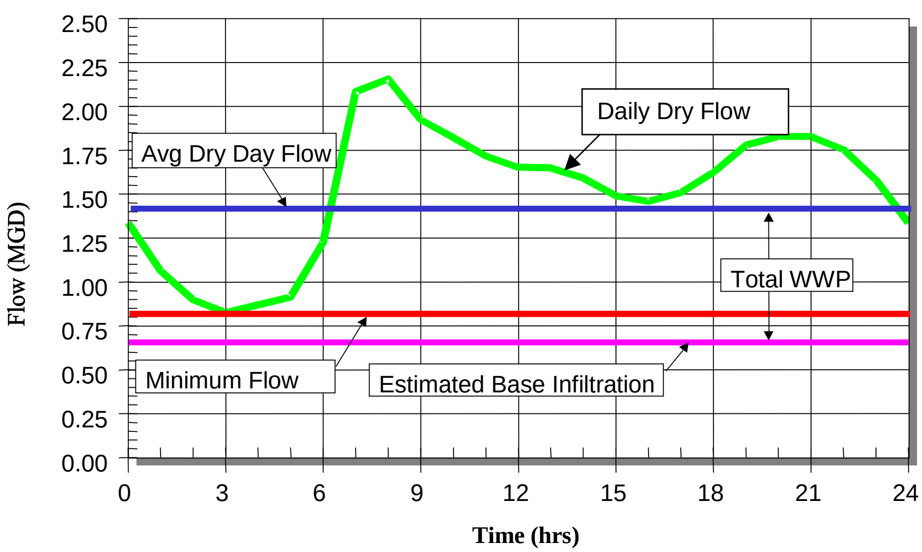
- Little or no rain occurring within the previous 3-day period;
- Selected days must exhibit average-day flows within 85% - 115% of the average-day flows of remaining dry days;
- In addition, those dry days that exhibited unusual flow patterns were not used to generate net dry day flow values for a basin.

The net average dry day weather flow (ADDF) for each basin is summarized in Table 2.1.

3.2 Base Infiltration

Base Infiltration (BI) is the flow that remains after domestic Wastewater Production (WWP) is subtracted from Average Dry Day Flow (ADDF) at a meter site as illustrated in the example in Figure 3.1. WWP is the portion of total flow that is considered to be solely wastewater. Like WWP, the BI value is an estimate.

Figure 3.1 Dry Weather Flow Components



Since BI estimates are heavily reliant on accurate minimum (early morning hours typically) flow rates from a given area, these values could not be computed to any degree of reasonable accuracy. This is due to the fact that the hourly flow rate data are based on on/off pump cycles during those minimum flow periods and there is no discernible true minimum natural flow rate (via gravity) from the tributary piping. In many cases, the minimum flow drops to zero due to extended periods of no pumping.

4 WET WEATHER FLOWS & RDII ANALYSIS

An analysis was performed to determine the quantity of Rain Dependent Inflow and Infiltration (RDII) produced by each basin in the study. The analysis involved subtracting each basin's net Average Dry Day Flow (ADDF) from its net Wet Weather Flow (WWF) taking into consideration weekday or weekend (includes holidays) flows and accounting for infiltration immediately prior to a storm. Compensation for the pre-storm elevated flows is termed precompensation. The process of breaking down the hydraulic impact on a basin associated with rainfall is termed decomposition. The output for the Coastal Ridge basin during the December 2010 storm event is depicted in Figure 4.1. The "Gross I/I" response hydrograph shown in Figure 4.1 represents all RDII from upstream of the Coastal Ridge LS. In the case of the University LS basin, storm decomposition involves evaluation of "Net I/I" which represents the RDII only from University basin (by subtracting upstream site flows from the Coyote Canyon basin).

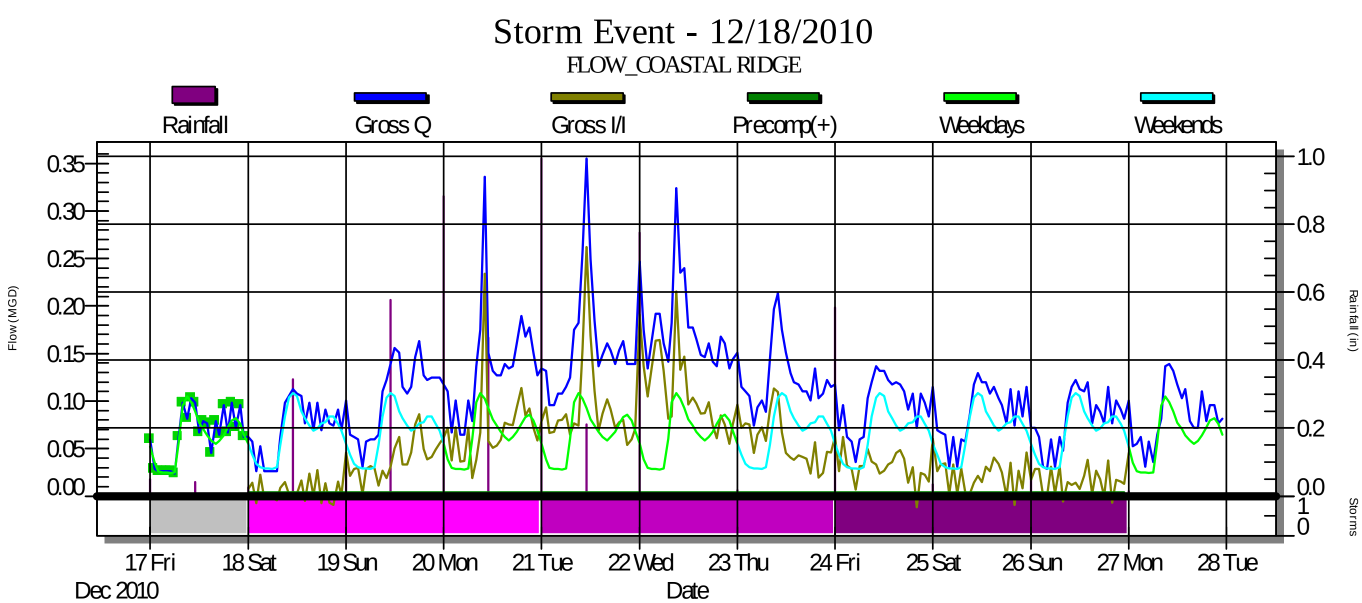


Figure 4.1 – Coastal Ridge Basin Decomposition Hydrograph

The graph in Figure 4.1 shows that Coastal Ridge basin produced a measurable RDII response during this storm event. In Figure 4.1, the gray highlighted time period prior to the storm period is the period during which precompensation is determined. In this case, little to no precompensation was needed since flows were not elevated in advance of the evaluated storm. The light purple period is the storm period. The two darker purple periods following the storm period are the recovery periods R1 and R2. The storm period is set at a duration that typically captures most of the rainfall (in this case, 3 days). The recovery periods are then set for durations necessary for the flows to recover to nearly normal dry weather flow conditions if possible (if not followed closely by a subsequent storm).

For this evaluation, a total of seven (7) storms were evaluated. Two (2) of those storms would be considered heavy or system-stressing rainfall events and the other five (5) would be considered small rainfall events. Due to limited data availability (and NCLS was not installed yet), only two sites were evaluated for the first heavy storm event starting on January 16, 2010. All sites except NCLS (not installed yet) had data available for evaluation during the second heavy rainfall event starting on December 18, 2010.

The RDII hydrographs for each basin during the two (2) strong wet weather events (if data were available) and two smaller rain events are included in Appendix A.

4.1 Net RDII Analysis

Net RDII or raw volume of RDII in millions of gallons (MG) from each basin was determined for the storm event periods. The net RDII volume from each basin is summarized for 3 of the storms in Table 4.1.

Table 4.1
Summary of Net RDII (MG) per Storm Event

Basin	Storm 1 Avg Rain 5.6 in 1/16/10	Storm 4 Avg Rain 7.2 in 12/18/10	Storm 7 Avg Rain 1.2 in 3/16/12
CANADA LS	n/a	0.563	n/a
COASTAL RIDGE LS	0.287	0.447	0.03
COYOTE CANYON LS	n/a	1.163	0.028
UNIVERSITY LS	n/a	0.465	0.068
Site_07ENGCYN	1.076	1.338	0.159
Site NCLS	n/a	n/a	0.388
TOTAL	--	3.98	0.67

"n/a" – indicates flow data unavailable for indicated storm.

4.2 Q vs. i diagrams

There is a relationship between rainfall volume (in.) during a storm event and net RDII volume (MG) in each basin. This correlation between net RDII in each basin to rainfall can be depicted graphically and is termed a Q vs. i diagram. The Q vs. i diagram for Coastal Ridge basin is presented in Figure 4.2.

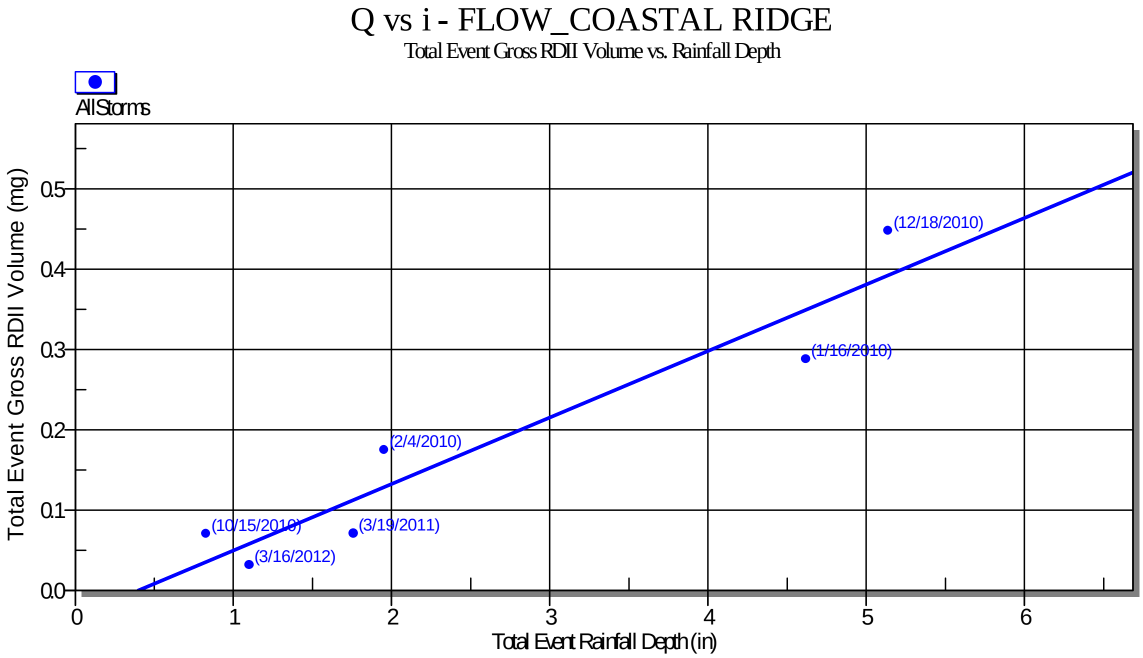


Figure 4.2 - Q vs. i Diagram for Coastal Ridge Basin

The volume-based Q vs. i data points above describe the relation between net event (rainfall period plus recovery periods) RDII volume and total event rainfall and serve as an indication of the overall performance of the basin regarding rainfall ingress. The Q vs. i diagram for Coastal Ridge basin indicates a reasonable correlation between total rainfall and resulting RDII from the basin. In this case, about 5 inches of rainfall generates about 40,000 gallons of RDII (or about 8,000 gallons of RDII per inch of rain).

The Q vs. i diagram can be a useful tool for determining degree of success of RDII elimination efforts. Volume-based Q vs. i diagrams for each basin are in Appendix A.

4.3 Normalized RDII Analysis

To enable a comparison of RDII between basins of differing sizes, the net RDII volumes for each basin were "normalized". This means that the RDII (or the volume of flows measured to be above the normal expected dry weather flows) was divided by rainfall volume and by basin size to enable an apples-to-apples comparison of results among basins. There are two methods of size normalization used. One method is to divide RDII per unit rainfall by average daily flow rate and the other is to divide RDII per unit rainfall by total pipe footage in each basin.

A summary of the pipe footage-normalized net RDII for six (6) of the storm events is provided in Figure 4.3.

Based upon published sewer rehabilitation results from 99 basins worldwide[2], sanitary sewer basin are considered to be performing adequately if consistently less than 5% of the rainfall enters the sewer during heavy rain events. Basins generating between 2% and 5% rainfall ingress may warrant further investigation depending upon Agency specific economic or cost-benefit analyses. For systems exhibiting primarily inflow responses (i.e. short lived peak excess flow following the rainfall closely), rainfall ingress values of 1% or more can create system flow spikes causing capacity issues; particularly during storms containing intense periods of rainfall. Numeric values of percent rainfall ingress can be equated directly to numeric units of gallons per foot of pipe per inch of rain (gal/ft/in-rain as normalized herein) in basins with typical ratios of about 250 feet of sewer pipe per developed acre.

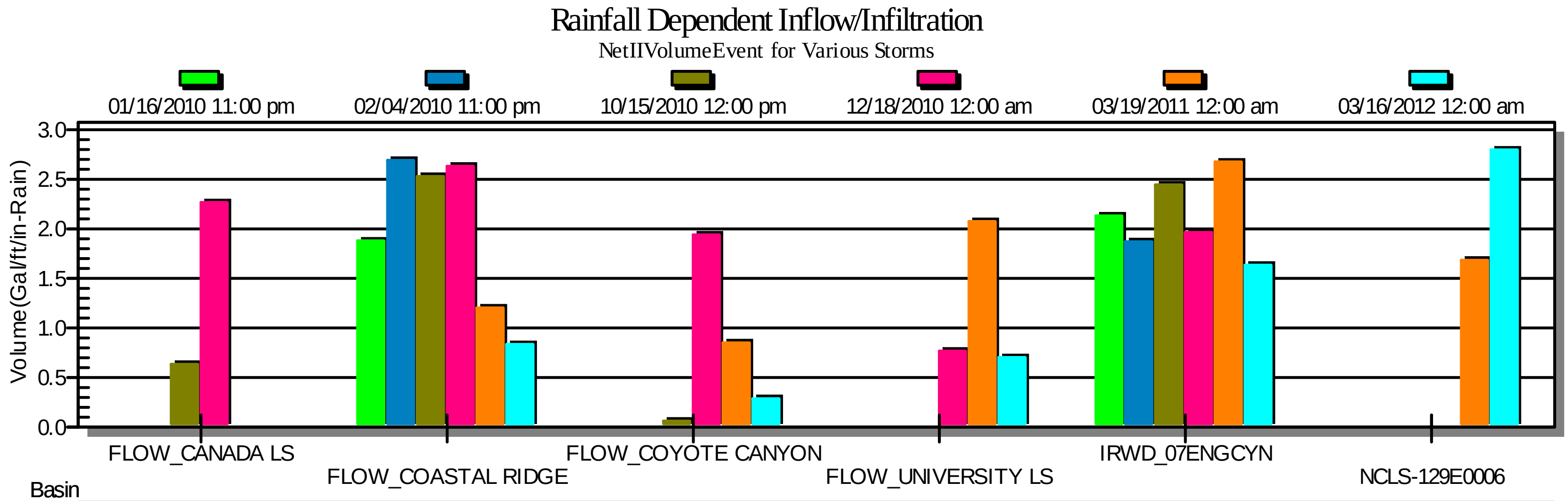
All but the Coyote Canyon basin produced between 2 and 3 gal/ ft/ in. of rainfall ingress during at least one of the evaluated storms.

A summary of the maximum observed flow-normalized net RDII (i.e. volume of RDII per unit rainfall divided by the ADDF for the basin) observed from each evaluated basin is provided in Figure 4.4. This normalization method effectively eliminates any uncertainty associated with assumed physical basin size (whether in terms of area or pipe footage) and instead computes RDII in terms of number of normal flow days worth of RDII produced per inch of rain falling. Using this method, the Coastal Ridge basin appears to stand out as the relative poorest performing basin with just over 1.4 equivalent ADDF flow days added for each 1 inch of rain falling. This suggests that an average seasonal rainfall volume of 14 inches would yield about 20 extra days of flow from this basin (or about 1.2 MG of RDII volume for the typical rain season).

RDII peak factor was also evaluated. Since only daily summary rainfall data was available, this method of normalization only compares excess peak hourly flows observed during each storm without normalizing for peak hourly rainfall. The RDII peak factor is determined by taking the observed peak RDII rate during each storm event and comparing to typical dry day flow rate (Peak RDII + ADDF) / ADDF). A summary of the maximum observed RDII peak factor for each basin is provided in Figure 4.5. Using the peak flow criteria, Coastal Ridge is still highest at just over 5; but is followed closely by the Canada and Coyote basins at nearly 5 and just over 4, respectively. This suggests that the pumps at those 3 lift stations are cycling 5 times more frequently during the heaviest storm in December 2010. It is important to note that the RDII peak factor for NCLS does not reflect either of the 2 largest storms since this location was not installed until January 2011. It is possible that NCLS would also be among the highest RDII peak factors given the response from upstream Coastal Ridge and its other normalized responses described above.

A highlighted priority basin map is depicted in Figure 4.6 showing graduated colors according to equivalent days of ADDF per inch of rain (based on values shown in Figure 4.4).

[2] Keefe, P.N. "Test Basins for I/I Reduction and SSO Elimination", 1998, WEF Wet Weather Specialty Conference, Cleveland, Ohio.



Basin	FLOW_CANADA LS	FLOW_COASTAL RIDGE	FLOW_COYOTE CANYON	FLOW_UNIVERSITY LS	IRWD_07ENGCYN	NCLS-129E0006
01/16/2010 11:00 pm		1.878			2.131	
02/04/2010 11:00 pm		2.690			1.870	
10/15/2010 12:00 pm	0.633	2.528	0.061		2.443	
12/18/2010 12:00 am	2.265	2.630	1.940	0.766	1.964	
03/19/2011 12:00 am		1.202	0.852	2.074	2.676	1.682
03/16/2012 12:00 am		0.833	0.288	0.702	1.634	2.795

Figure 4.3 – Normalized RDII (gallons per foot of pipe per in. rainfall)

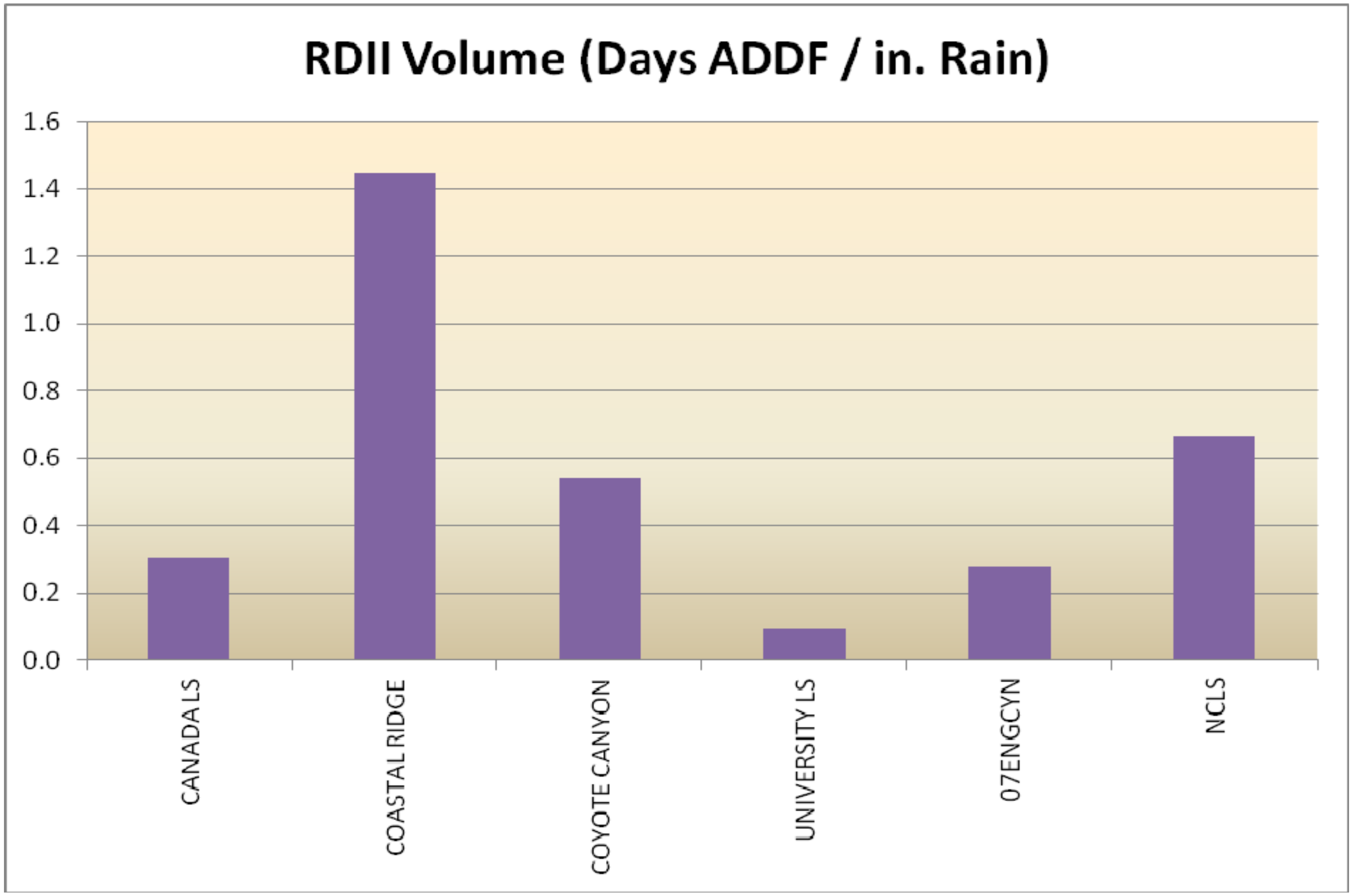


Figure 4.4 – Normalized RDII (Days ADDF per in. rainfall)

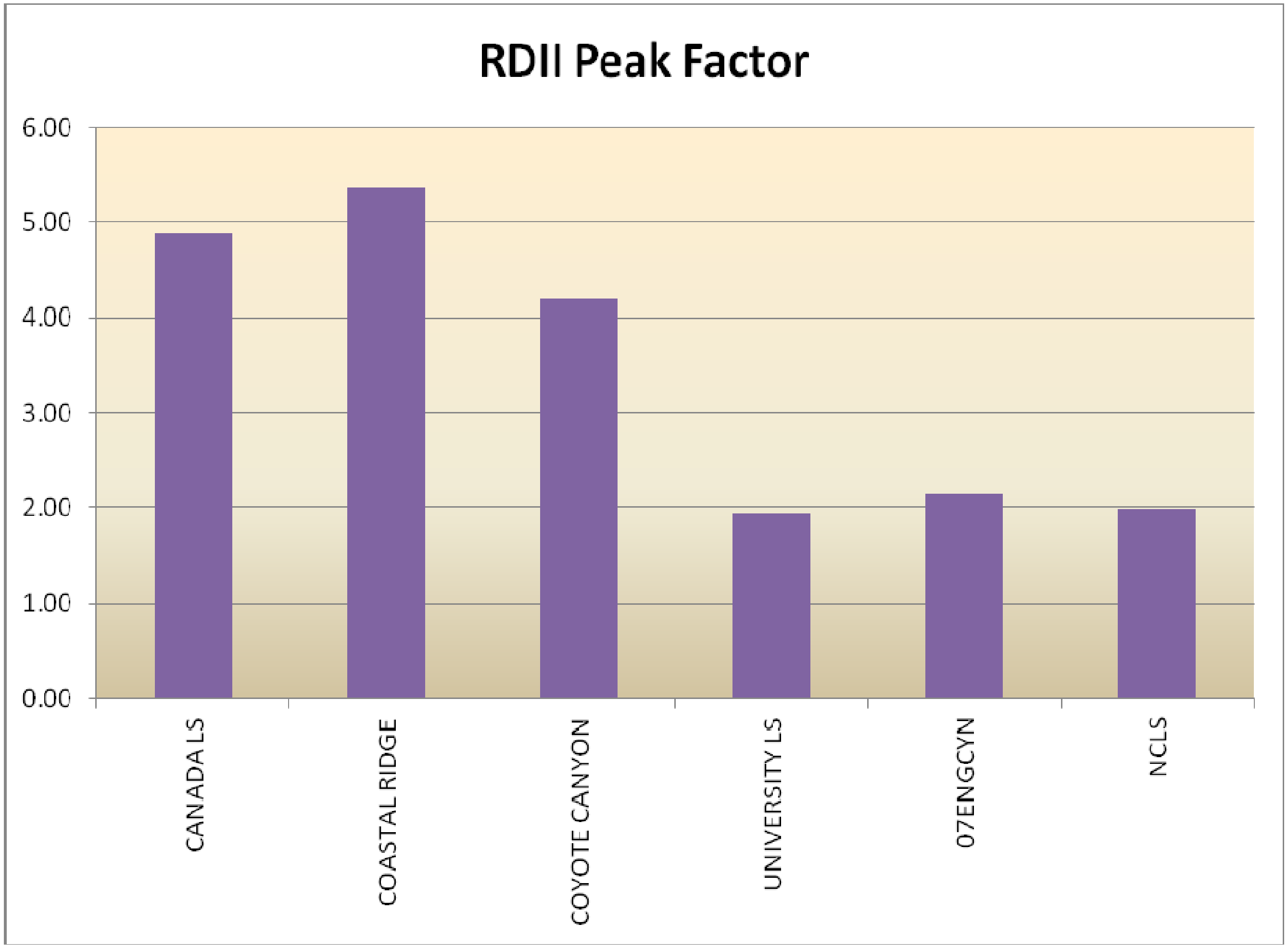


Figure 4.5 – RDII Peak Factor

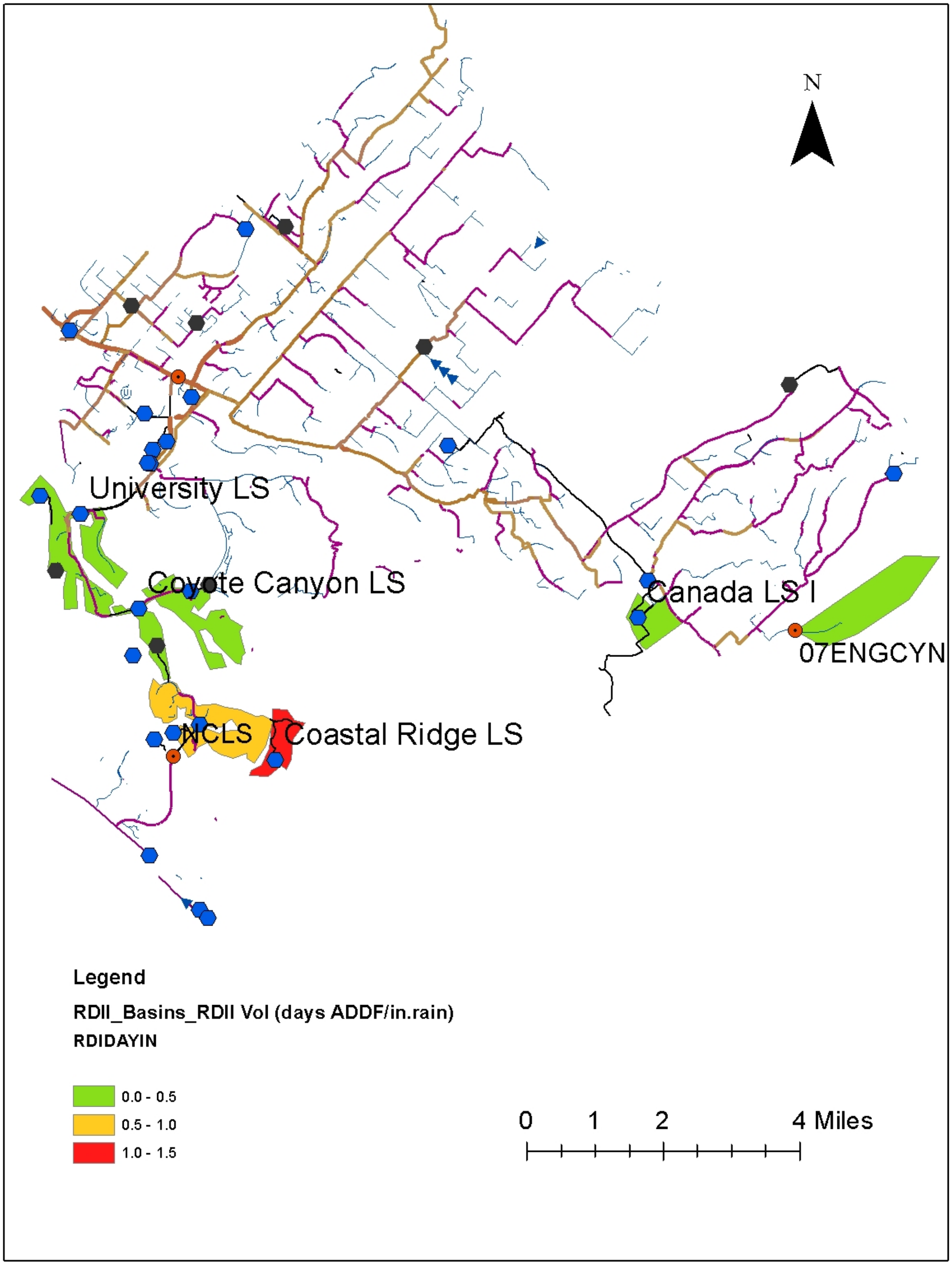


Figure 4.6 – Basin RDII Performance (Days ADDF per in. rainfall)

5 CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

Normalized volumetric RDII responses from the evaluated tributary basins are considered moderate. RDII peak factors associated with the Canada, Coastal Ridge and Coyote lift stations suggest that peak flows leading to the wet wells of those stations were likely significant during the 2 large system-stressing storms evaluated.

Limited data were available from the Canada, Coyote and University lift stations; enabling 3, 5 and 4 of the seven (7) total storms to be evaluated for each of those basins, respectively (see hydrographs in Appendix A for periods of flow data availability for each location). Fortunately, data were available for the largest storm (December 2010) from all locations except NCLS (not installed yet) and the data provided appeared to be stable and useful for RDII performance evaluation.

Sewage pumping station tributary areas account for a small percentage of the collection system piping. A more comprehensive evaluation of system performance would require installation of supplemental flow monitors installed at various locations throughout the open channel gravity flow piping.

Rainfall data availability was limited for this study. Only daily totals were available from the 6 rainfall monitoring locations used in this study. Rain data from the San Joaquin location was not usable due to apparent corrupted time stamps and rainfall from the Los Trancos station was missing for most of the period of evaluation. It is beneficial to use rainfall accumulation data on more frequent intervals (e.g. minimum hourly and preferably 15-min. intervals) for an RDII evaluation to enable evaluation of rainfall intensity vs. peak RDII rates observed. Shorter intervals of rainfall data also enable much more effective QA/QC of the rainfall data provided from each rain gauge (e.g. a plugged gauge that is under-reporting is much more discernible using shorter interval data).

5.2 Recommendations

Based on the results of this study, ADS recommends the following:

- Evaluate peak flow pumping capacity at each of the evaluated lift stations to confirm they are capable of transporting the peak RDII rates observed during the December 2010 storm.

- Install enough gravity flow monitoring devices to hydraulically isolate additional basins within zones of the system where more comprehensive RDII performance is desired. A general rule is to place enough flow monitors so that average basin size is 20,000 lf of piping or less for a highly focused study and about 50,000 lf per basin for a more general performance study. For example, the eastern most zone of the system (bounded by Bake Parkway, the 5 Freeway, and El Toro Road) could be broken into about 20 basins using about that number of flow meters. The flow metering devices should remain in place for 3 to 4 months to enable ample dry weather and wet weather data to be collected.

- If determination of peak RDII rates into each of the lift stations evaluated herein are desired, supplemental gravity flow meters could be installed at locations just upstream of their respective wet wells.

- Accurate rainfall data is important to properly compare performance among evaluation basins. To assure adequate representation of rainfall in any future RDII study, additional temporary rain gauging stations should be considered for deployment. These rain gauging stations should be able to log rainfall accumulations at 15-minute intervals and should be spaced at approximately 1 gauge every 4 square miles.

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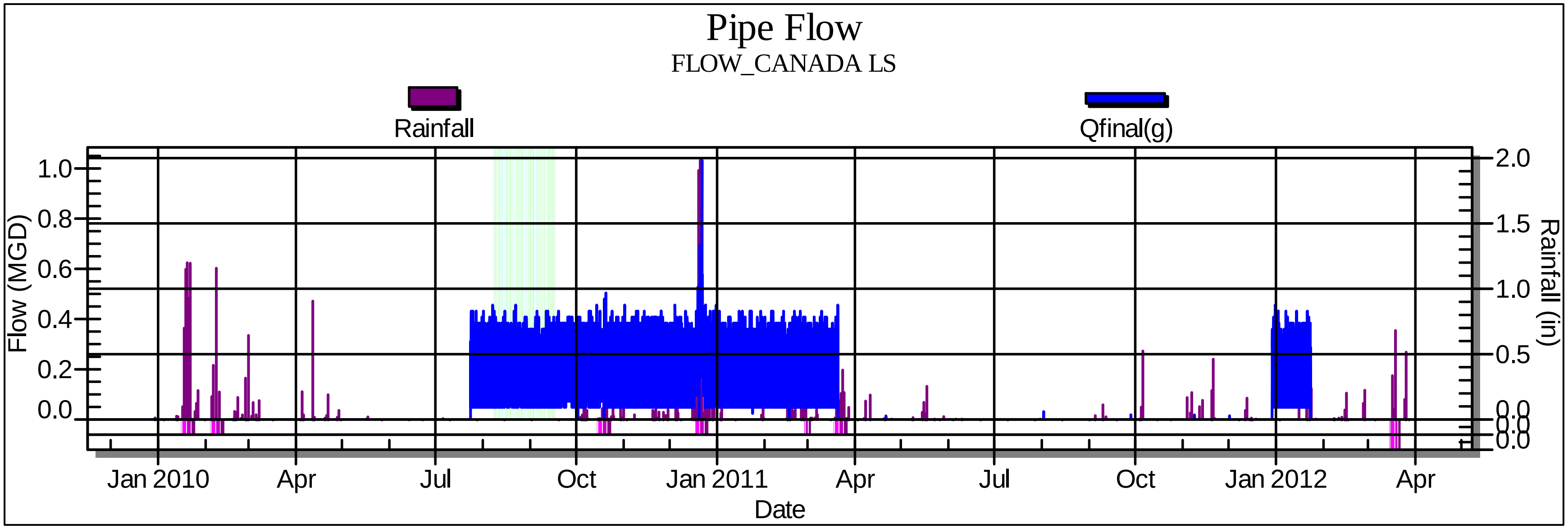
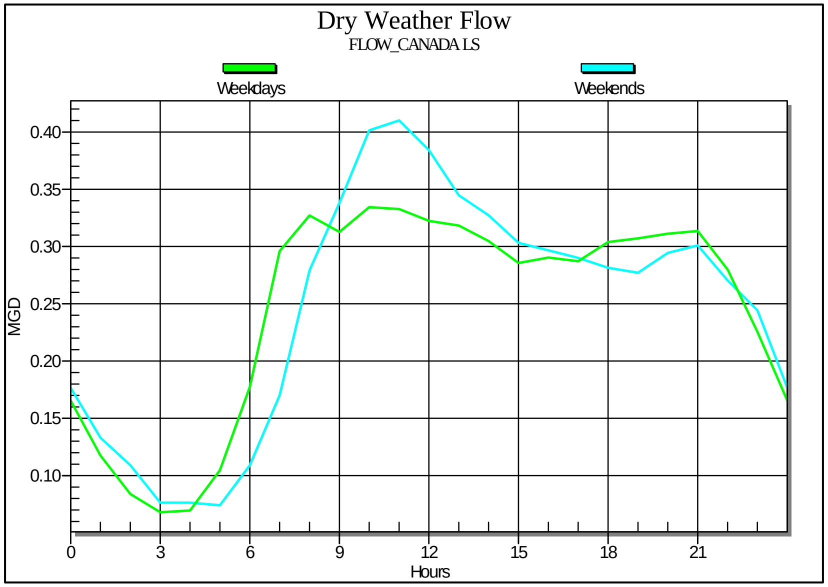
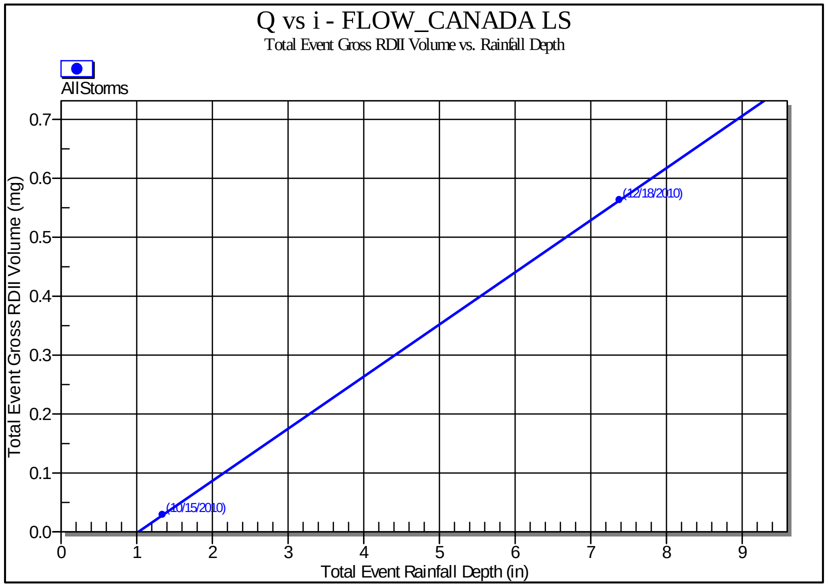
APPENDIX A

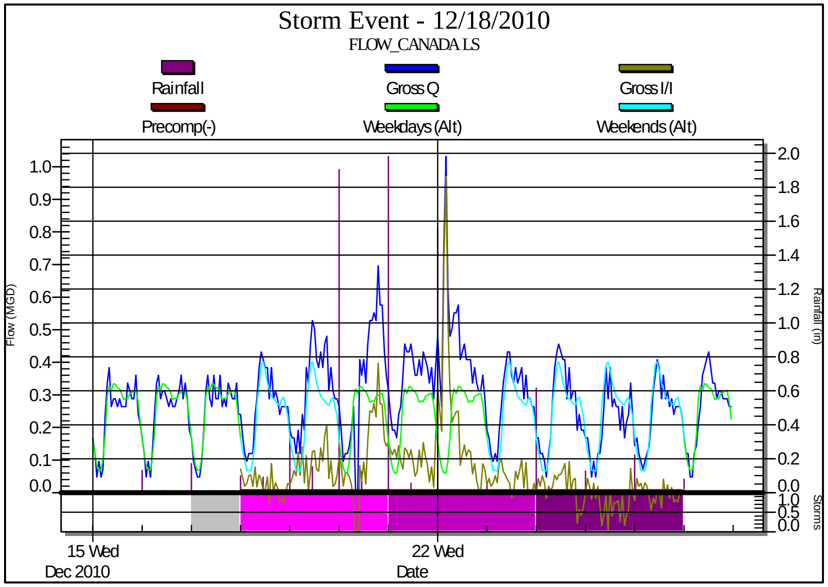
Flow Hydrographs, Dry Day Hydrographs,

Storm Hydrographs and Q vs i Diagrams

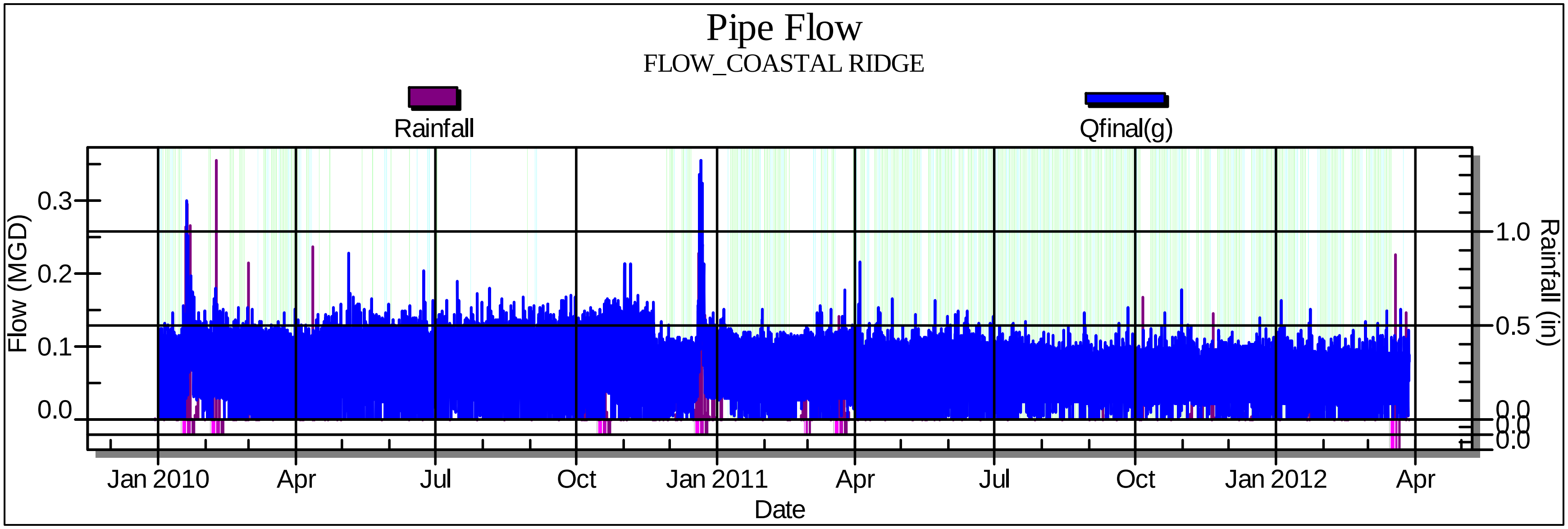

Pipe Flow
FLOW_CANADA LS
Rainfall
Qfinal(g)
Flow (MGD)
Rainfall (in)
1.0
0.8
0.6
0.4
0.2
0.0
2.0
1.5
1.0
0.5
0.0
Jan 2010
Apr
Jul
Oct
Jan 2011
Apr
Jul
Oct
Jan 2012
Apr
Date

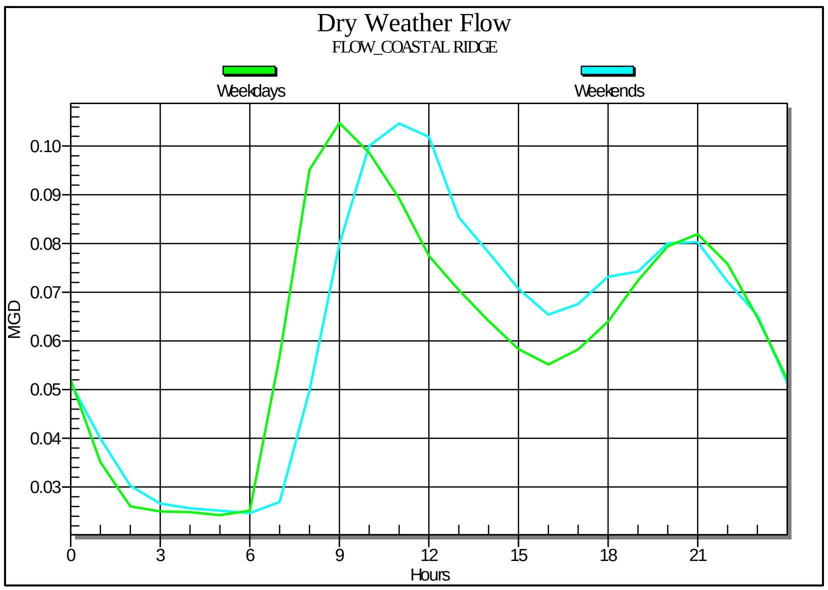

Dry Weather Flow
FLOW_CANADA LS
Weekdays
Weekends
MGD
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0
3
6
9
12
15
18
21
Hours

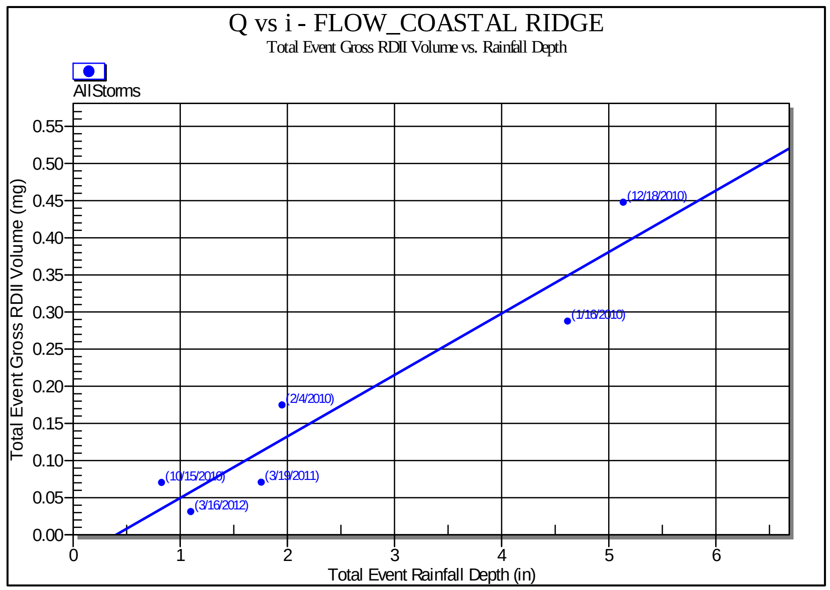

Q vs i - FLOW_CANADA LS
Total Event Gross RDII Volume vs. Rainfall Depth
All Storms
Total Event Gross RDII Volume (mg)
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
(12/18/2010)
(10/15/2010)
0
1
2
3
4
5
6
7
8
9
Total Event Rainfall Depth (in)

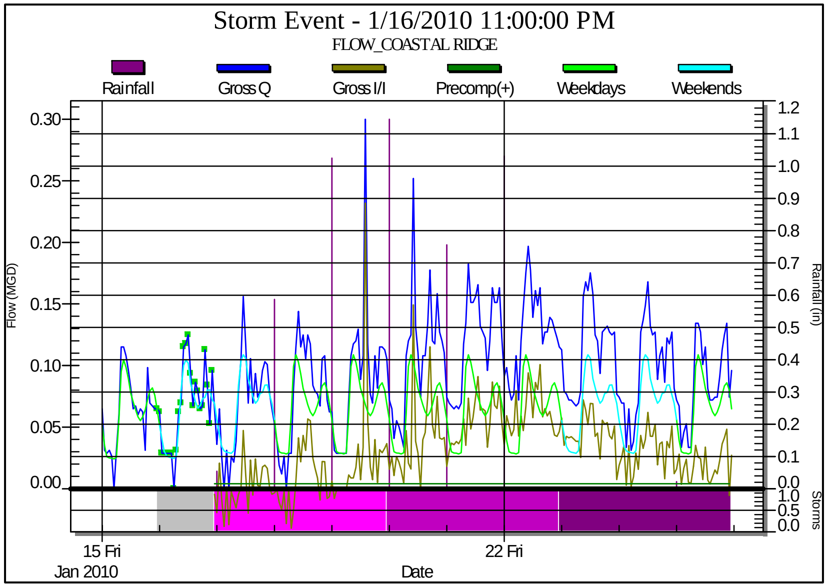


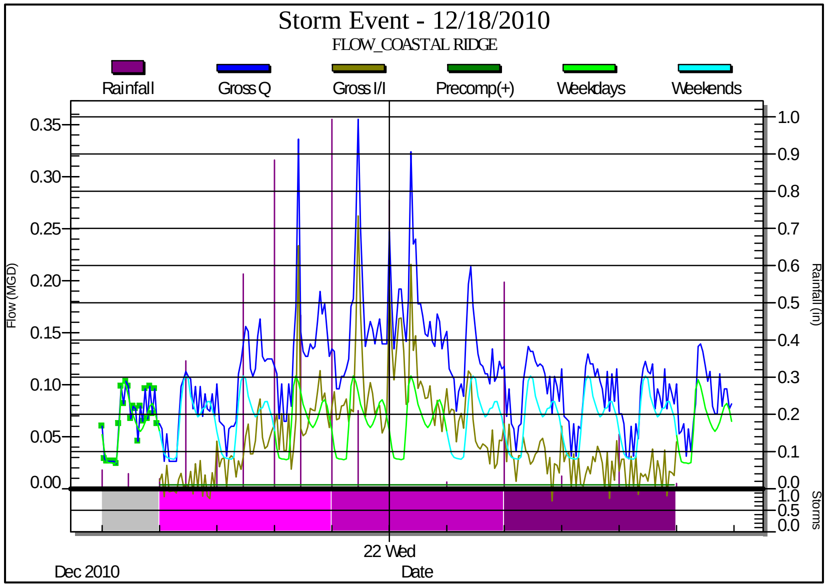
Storm Event - 12/18/2010
FLOW_CANADA LS
Rainfall
Gross Q
Gross I/I
Precomp(-)
Weekdays (Alt)
Weekends (Alt)
Flow (MGD)
Rainfall (in)
Storms
15 Wed
22 Wed
Dec 2010
Date

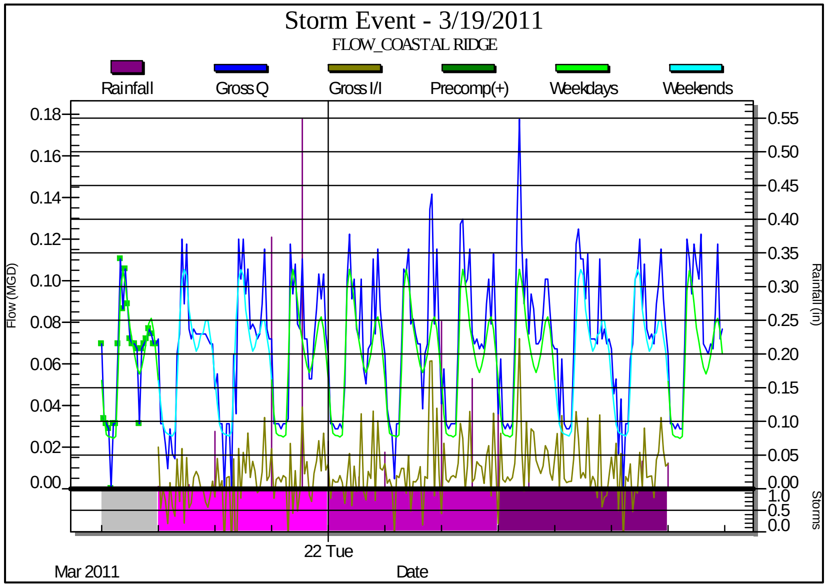

Pipe Flow
FLOW_COASTAL RIDGE
Rainfall
Qfinal(g)
Flow (MGD)
0.3
0.2
0.1
0.0
Rainfall (in)
1.0
0.5
0.0
Jan 2010
Apr
Jul
Oct
Jan 2011
Apr
Jul
Oct
Jan 2012
Apr
Date

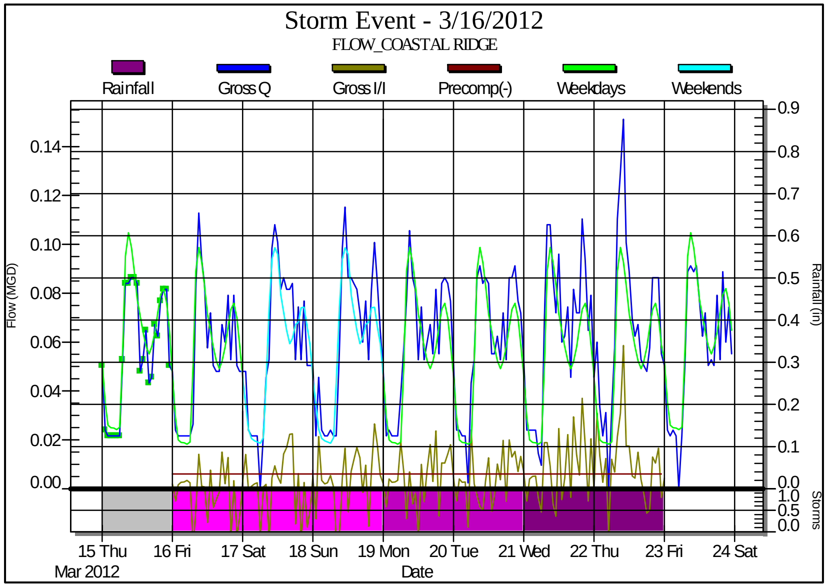

Dry Weather Flow
FLOW_COASTAL RIDGE
Weekdays
Weekends
MGD
0.10
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0
3
6
9
12
15
18
21
Hours

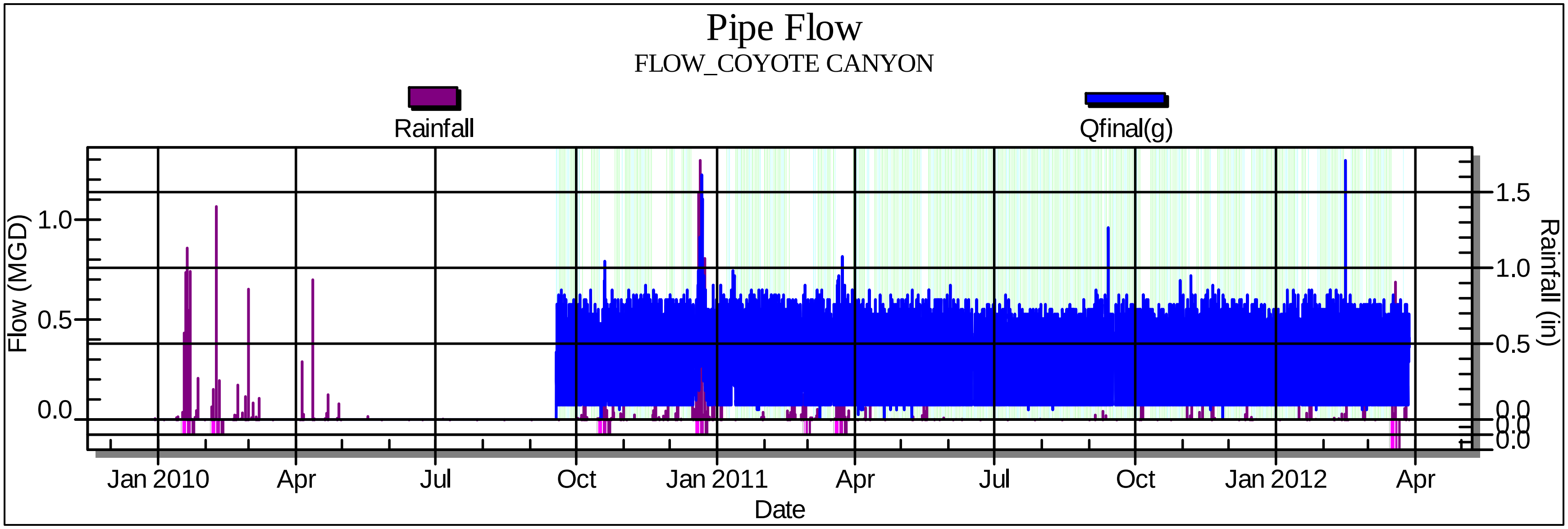

Q vs i - FLOW_COASTAL RIDGE
Total Event Gross RDII Volume vs. Rainfall Depth
All Storms
Total Event Gross RDII Volume (mg)
0.55
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
(12/18/2010)
(1/16/2010)
(2/4/2010)
(10/15/2010)
(3/19/2011)
(3/16/2012)
0
1
2
3
4
5
6
Total Event Rainfall Depth (in)

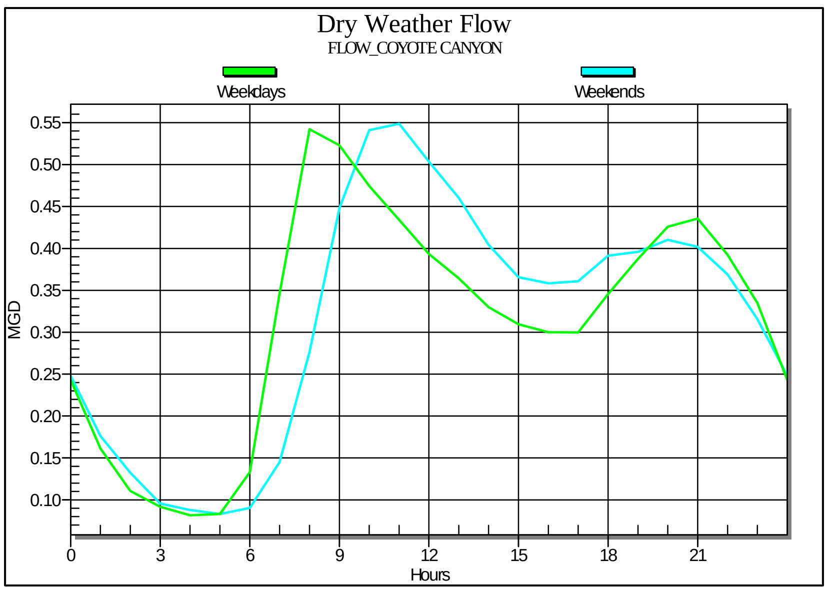

Storm Event - 1/16/2010 11:00:00 PM
FLOW_COASTAL RIDGE
Rainfall
Gross Q
Gross I/I
Precomp(+)
Weekdays
Weekends
Flow (MGD)
Rainfall (in)
Storms
15 Fri
22 Fri
Jan 2010
Date

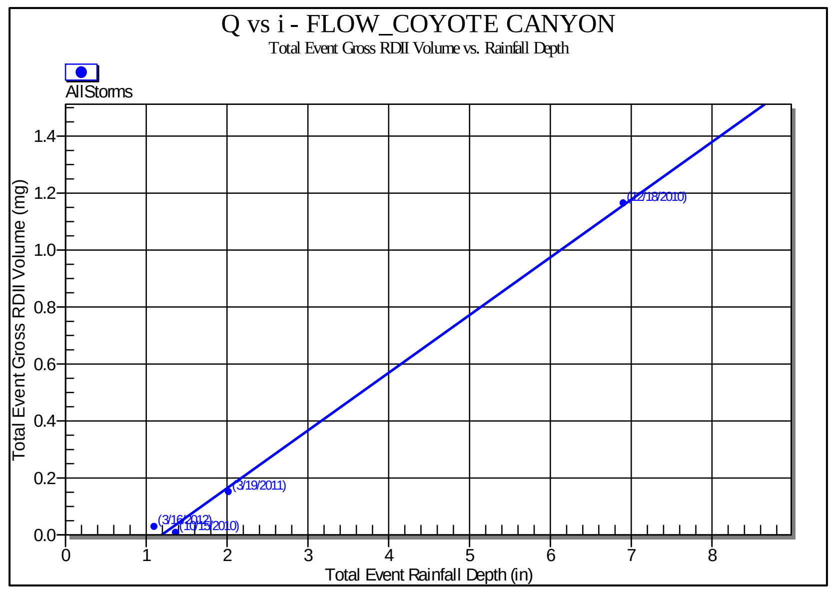

Storm Event - 12/18/2010
FLOW_COASTAL RIDGE
Rainfall
Gross Q
Gross I/I
Precomp(+)
Weekdays
Weekends
Flow (MGD)
Rainfall (in)
Storms
22 Wed
Dec 2010
Date

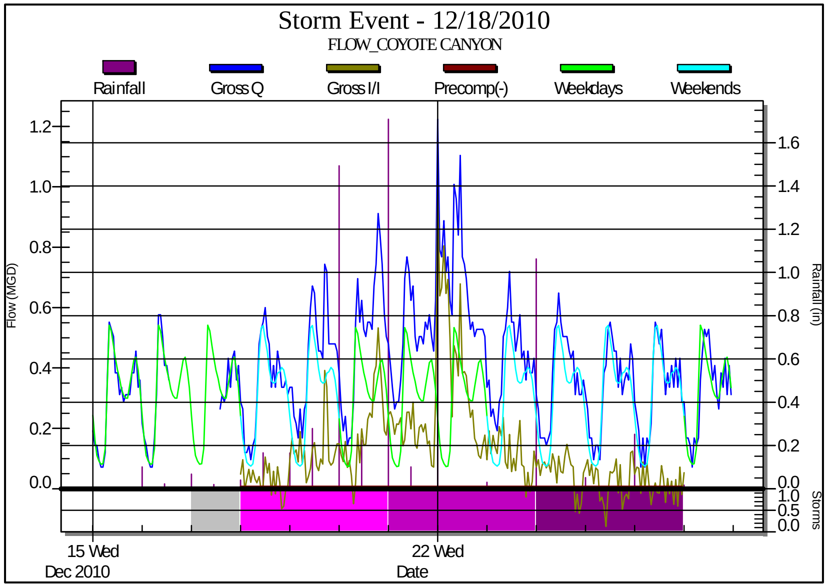

Storm Event - 3/19/2011
FLOW_COASTAL RIDGE
Rainfall
Gross Q
Gross I/I
Precomp(+)
Weekdays
Weekends
Flow (MGD)
Rainfall (in)
Storms
22 Tue
Mar 2011
Date

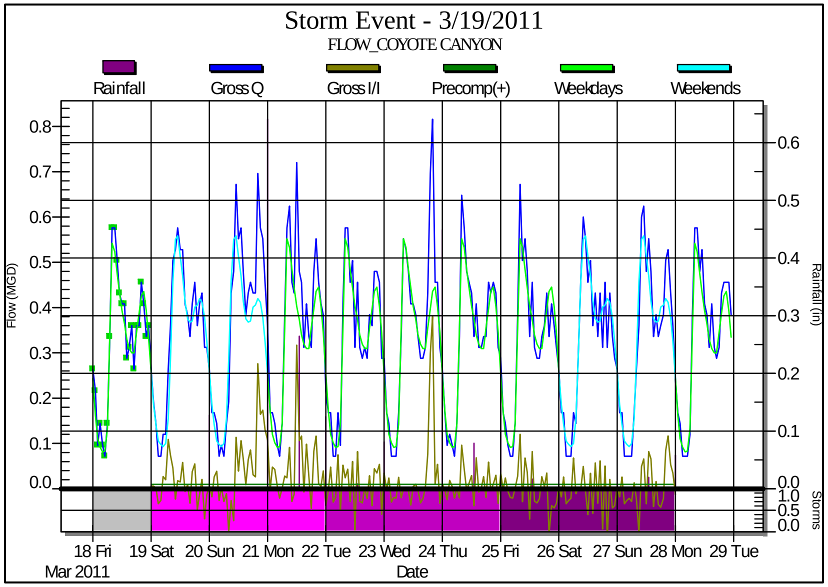

Storm Event - 3/16/2012
FLOW_COASTAL RIDGE
Rainfall
Gross Q
Gross I/I
Precomp(-)
Weekdays
Weekends
Flow (MGD)
Rainfall (in)
Storms
15 Thu
16 Fri
17 Sat
18 Sun
19 Mon
20 Tue
21 Wed
22 Thu
23 Fri
24 Sat
Mar 2012
Date

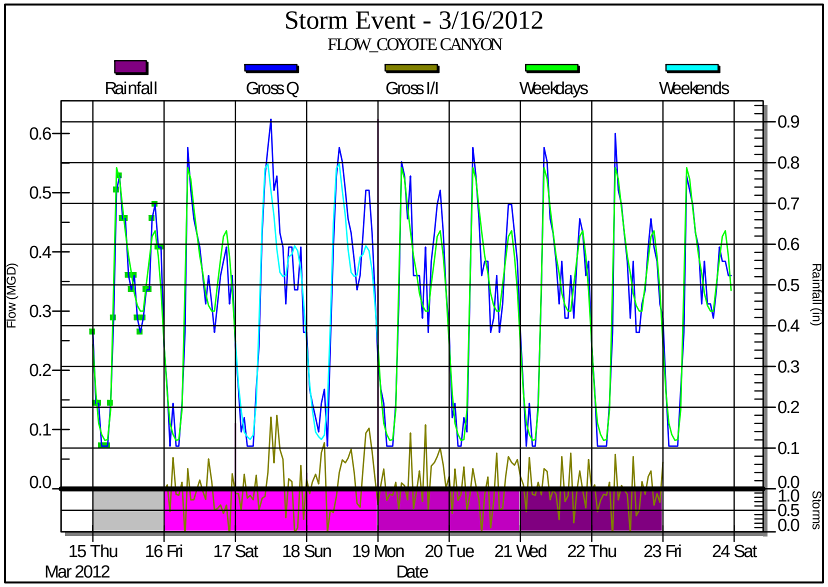

Pipe Flow
FLOW_COYOTE CANYON
Rainfall
Qfinal(g)
Flow (MGD)
Rainfall (in)
Date
Jan 2010
Apr
Jul
Oct
Jan 2011
Apr
Jul
Oct
Jan 2012
Apr

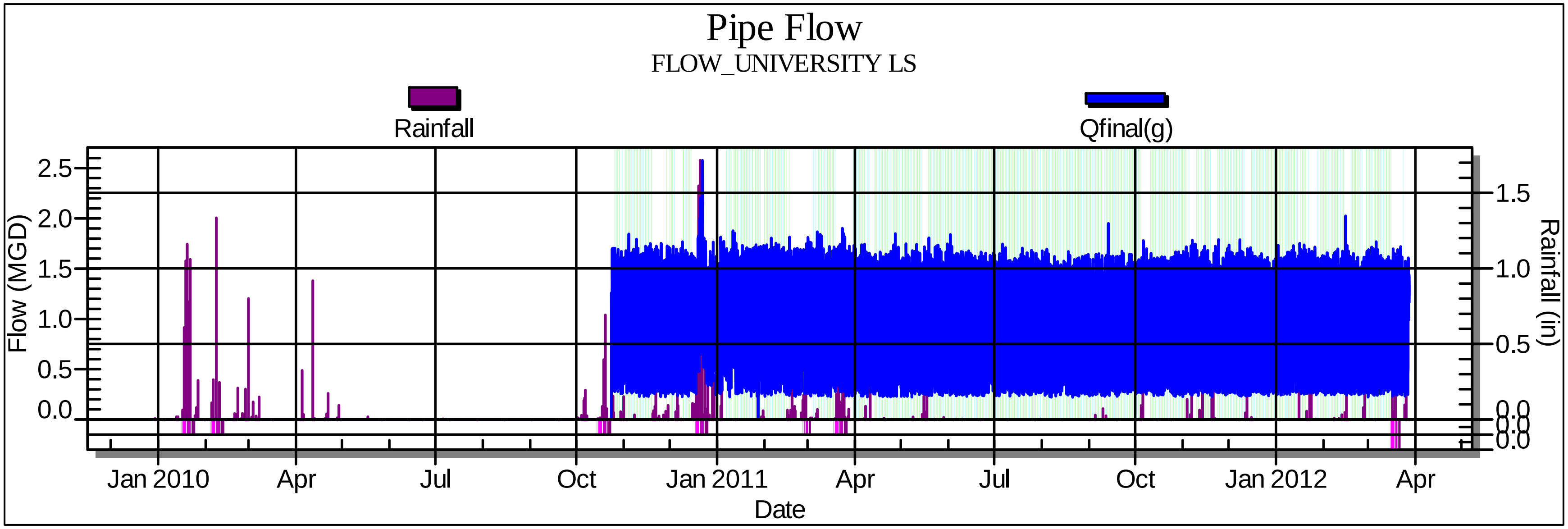

Dry Weather Flow
FLOW_COYOTE CANYON
Weekdays
Weekends
MGD
Hours

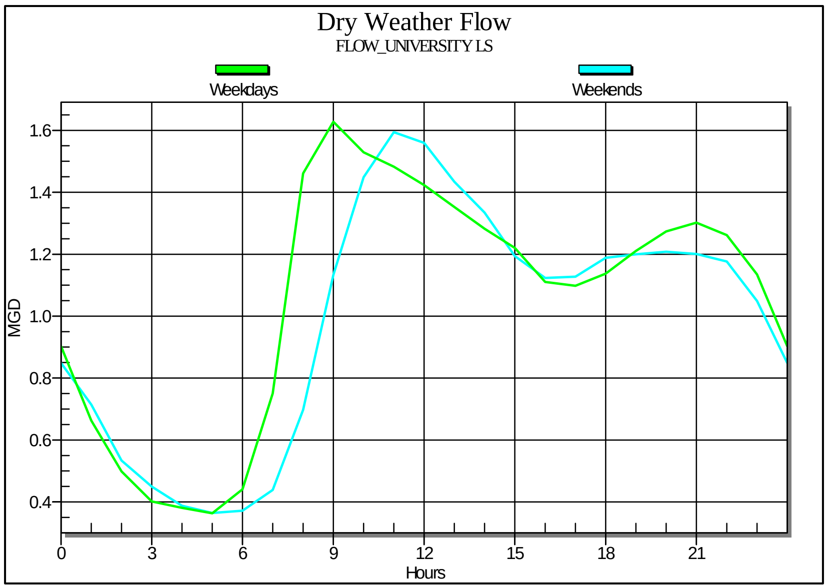

Q vs i - FLOW_COYOTE CANYON
Total Event Gross RDII Volume vs. Rainfall Depth
All Storms
Total Event Gross RDII Volume (mg)
Total Event Rainfall Depth (in)
(12/18/2010)
(3/19/2011)

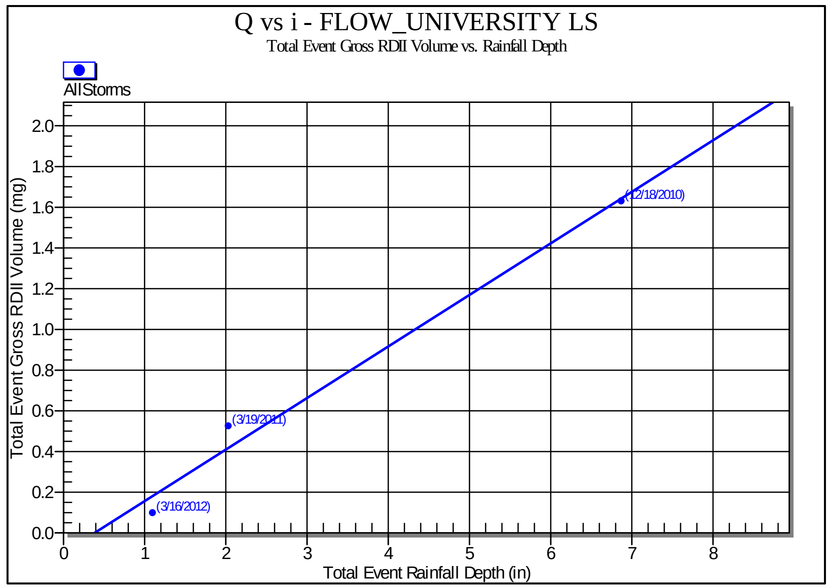

Storm Event - 12/18/2010
FLOW_COYOTE CANYON
Rainfall
Gross Q
Gross I/I
Precomp(-)
Weekdays
Weekends
Flow (MGD)
Rainfall (in)
Storms
15 Wed
22 Wed
Dec 2010
Date

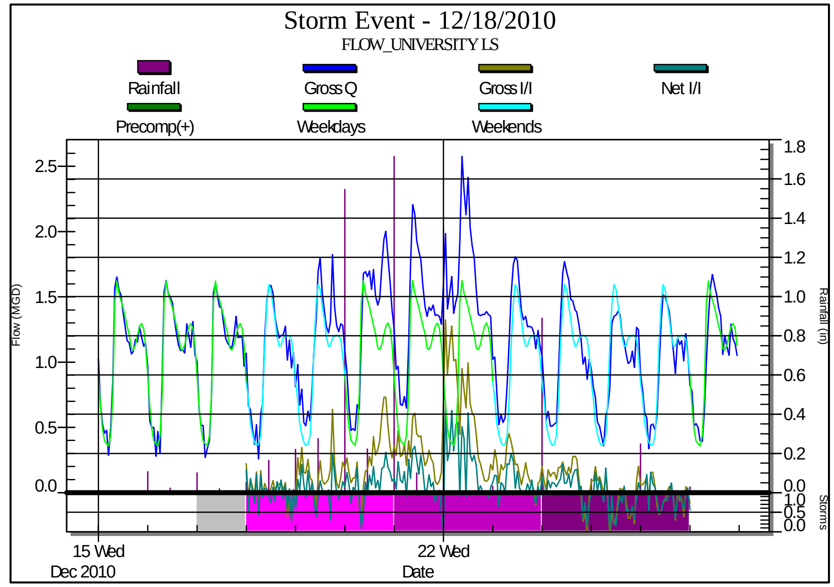

Storm Event - 3/19/2011
FLOW_COYOTE CANYON
Rainfall
Gross Q
Gross I/I
Precomp(+)
Weekdays
Weekends
Flow (MGD)
Rainfall (in)
Storms
18 Fri
19 Sat
20 Sun
21 Mon
22 Tue
23 Wed
24 Thu
25 Fri
26 Sat
27 Sun
28 Mon
29 Tue
Mar 2011
Date

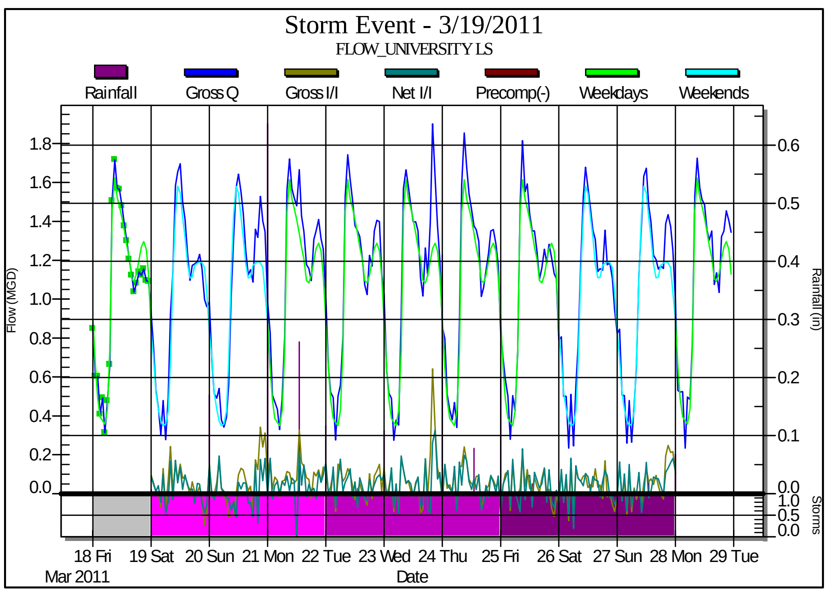

Storm Event - 3/16/2012
FLOW_COYOTE CANYON
Rainfall
Gross Q
Gross I/I
Weekdays
Weekends
Flow (MGD)
Rainfall (in)
Storms
15 Thu
16 Fri
17 Sat
18 Sun
19 Mon
20 Tue
21 Wed
22 Thu
23 Fri
24 Sat
Mar 2012
Date

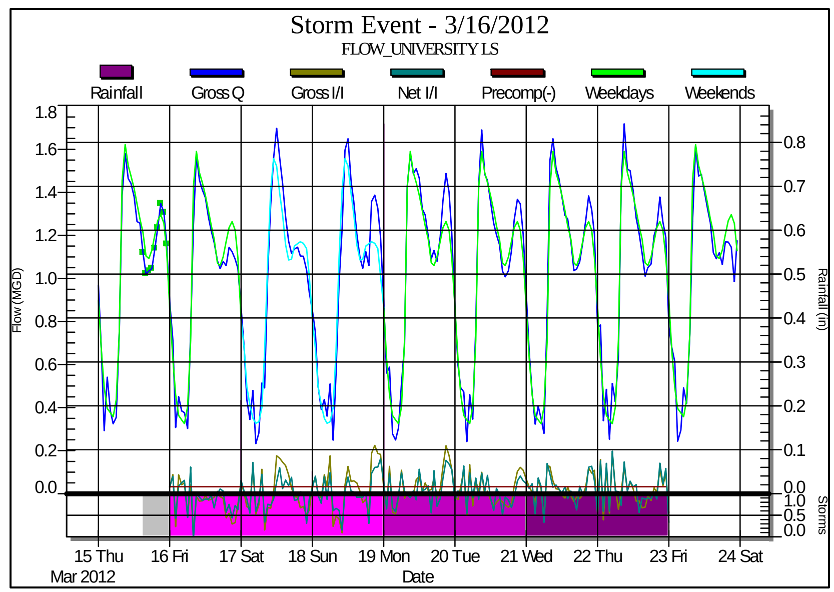

Pipe Flow
FLOW_UNIVERSITY LS
Rainfall
Qfinal(g)
Flow (MGD)
2.5
2.0
1.5
1.0
0.5
0.0
Rainfall (in)
1.5
1.0
0.5
0.0
Jan 2010
Apr
Jul
Oct
Jan 2011
Apr
Jul
Oct
Jan 2012
Apr
Date

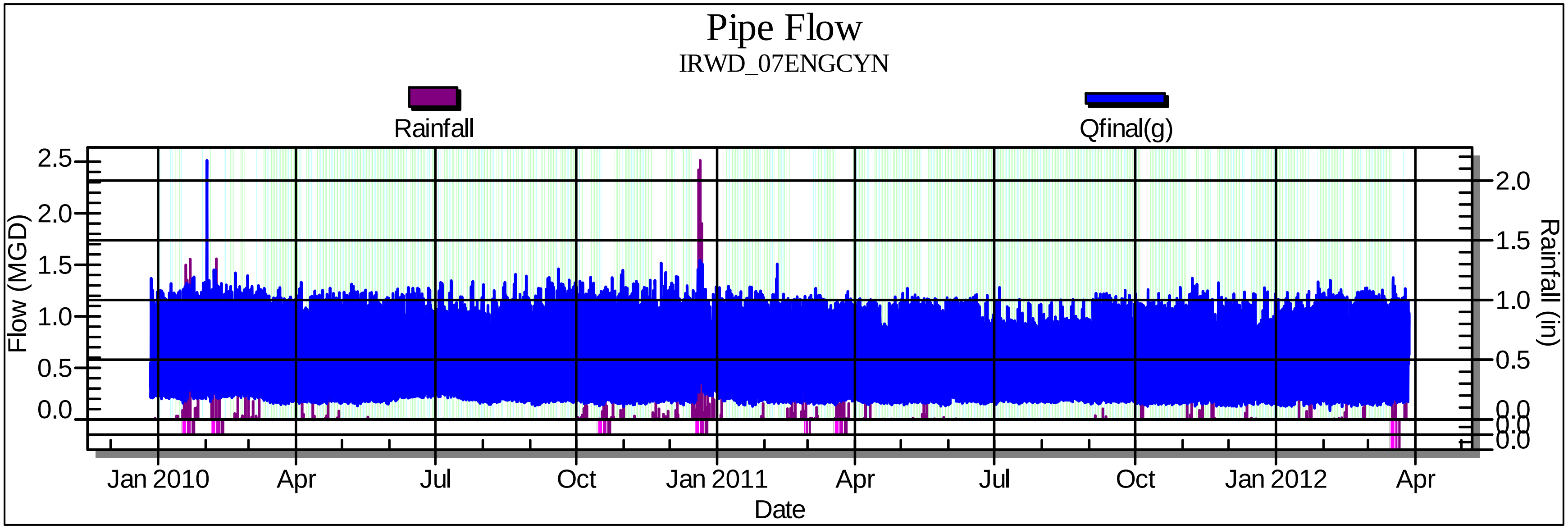

Dry Weather Flow
FLOW_UNIVERSITY LS
Weekdays
Weekends
MGD
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0
3
6
9
12
15
18
21
Hours

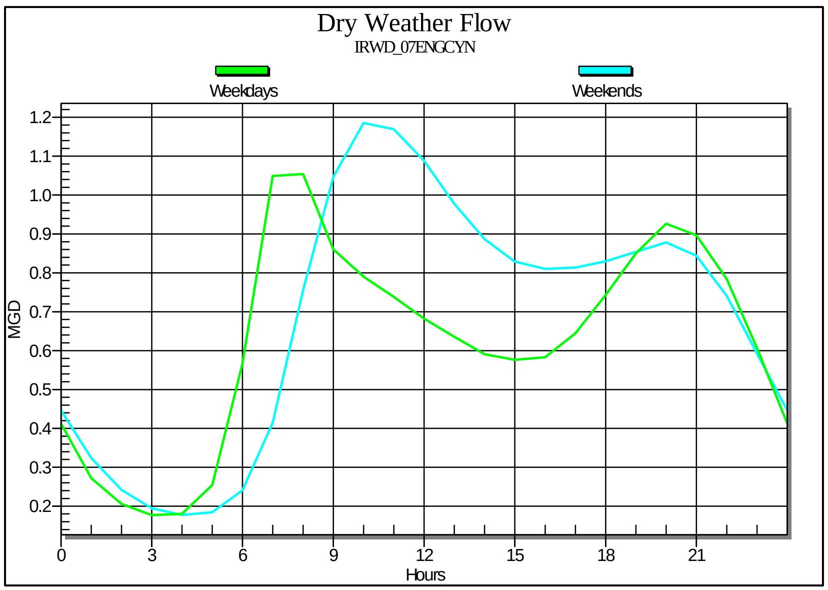

Q vs i - FLOW_UNIVERSITY LS
Total Event Gross RDII Volume vs. Rainfall Depth
All Storms
Total Event Gross RDII Volume (mg)
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
(12/18/2010)
(3/19/2011)
(3/16/2012)
0
1
2
3
4
5
6
7
8
Total Event Rainfall Depth (in)

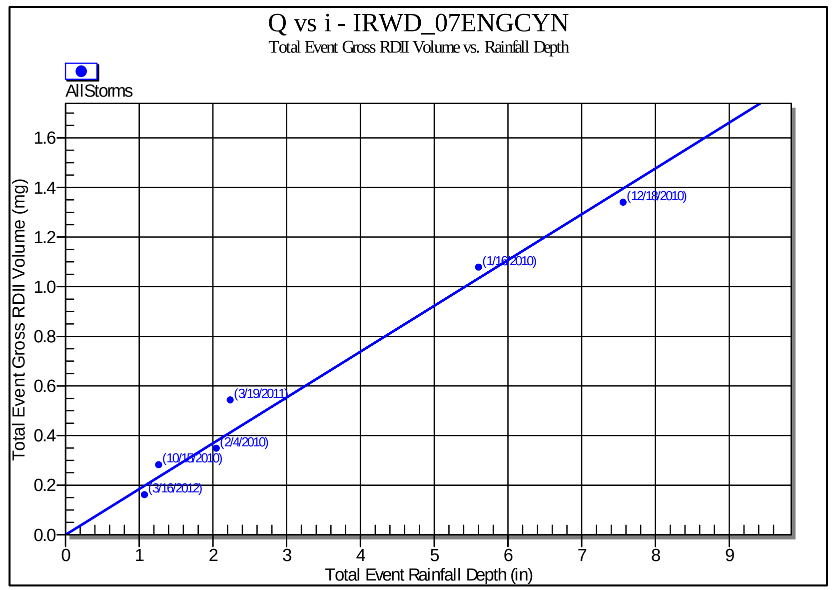

Storm Event - 12/18/2010
FLOW_UNIVERSITY LS
Rainfall
Gross Q
Gross I/I
Net I/I
Precomp(+)
Weekdays
Weekends
Flow (MGD)
Rainfall (in)
Storms
15 Wed
22 Wed
Dec 2010
Date

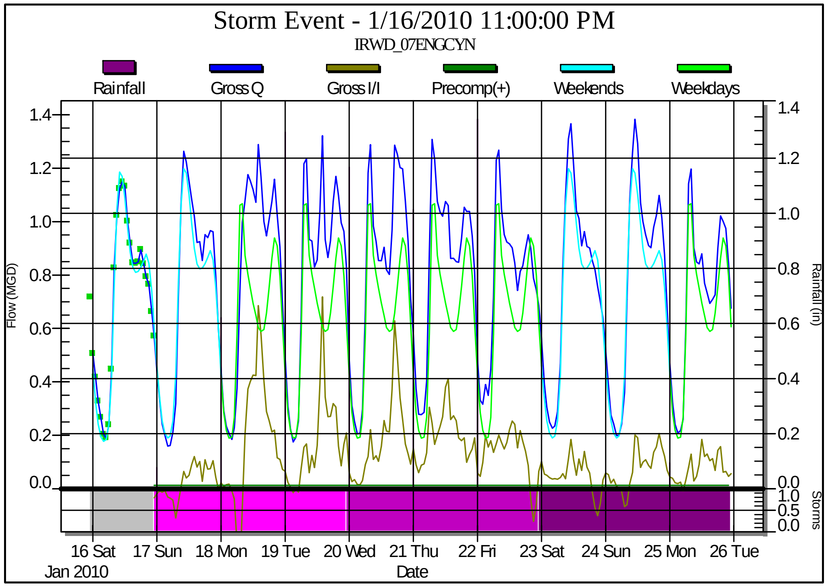

Storm Event - 3/19/2011
FLOW_UNIVERSITY LS
Rainfall
Gross Q
Gross I/I
Net I/I
Precomp(-)
Weekdays
Weekends
Flow (MGD)
Rainfall (in)
Storms
18 Fri
19 Sat
20 Sun
21 Mon
22 Tue
23 Wed
24 Thu
25 Fri
26 Sat
27 Sun
28 Mon
29 Tue
Mar 2011
Date

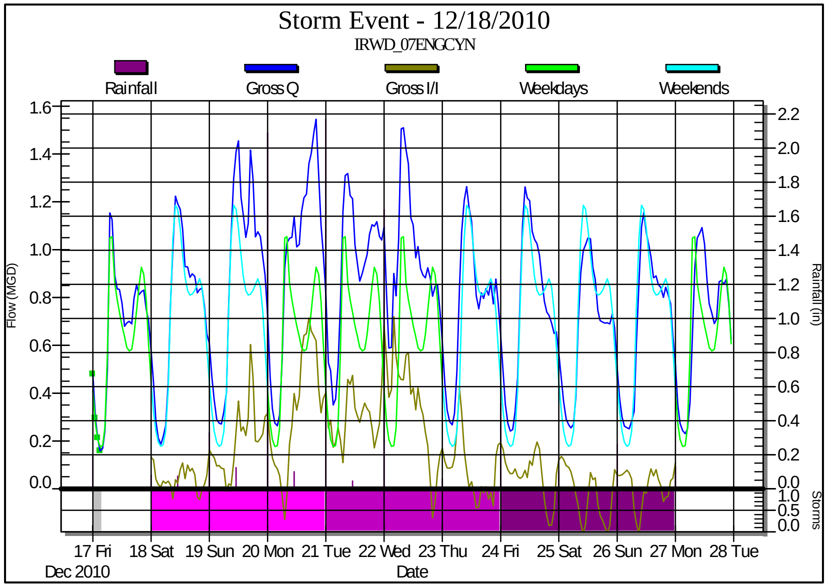

Storm Event - 3/16/2012
FLOW_UNIVERSITY LS
Rainfall
Gross Q
Gross I/I
Net I/I
Precomp(-)
Weekdays
Weekends
Flow (MGD)
Rainfall (in)
Storms
15 Thu
16 Fri
17 Sat
18 Sun
19 Mon
20 Tue
21 Wed
22 Thu
23 Fri
24 Sat
Mar 2012
Date

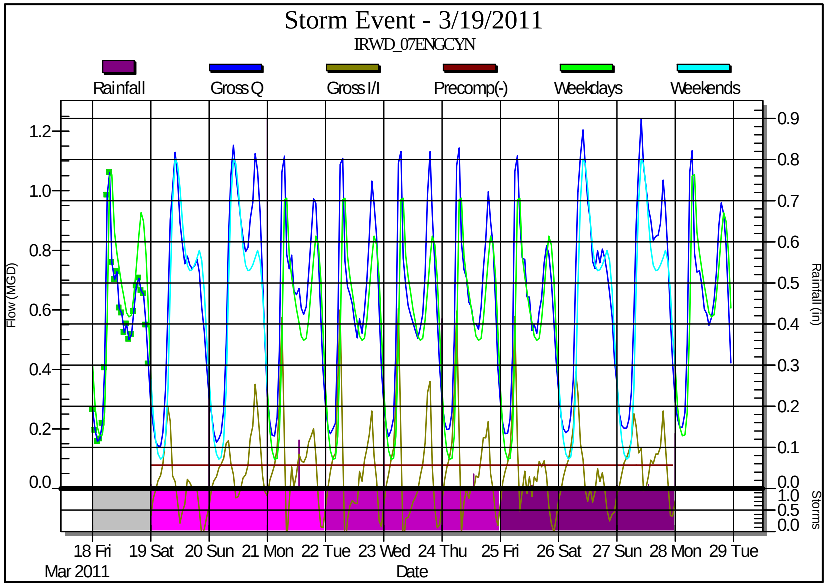

Pipe Flow
IRWD_07ENGCYN
Rainfall
Qfinal(g)
Flow (MGD)
Rainfall (in)
Jan 2010
Apr
Jul
Oct
Jan 2011
Apr
Jul
Oct
Jan 2012
Apr
Date

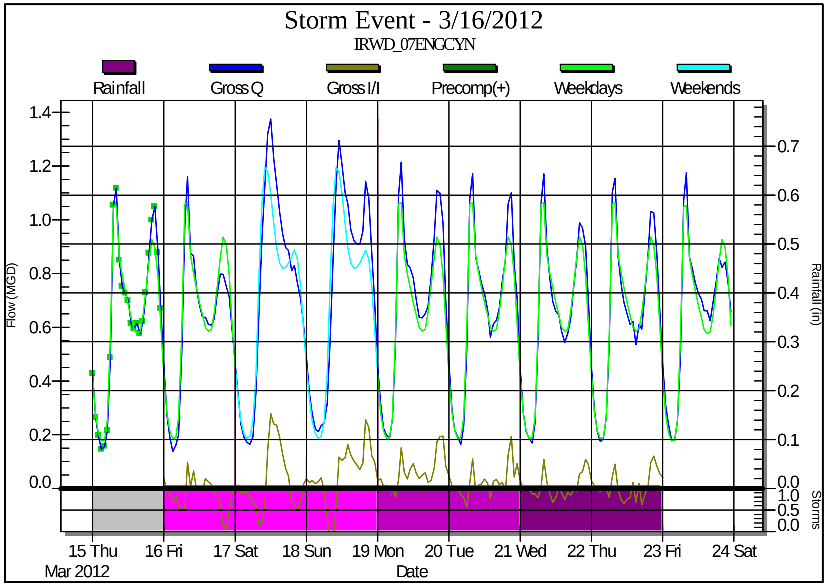

Dry Weather Flow
IRWD_07ENGCYN
Weekdays
Weekends
MGD
Hours

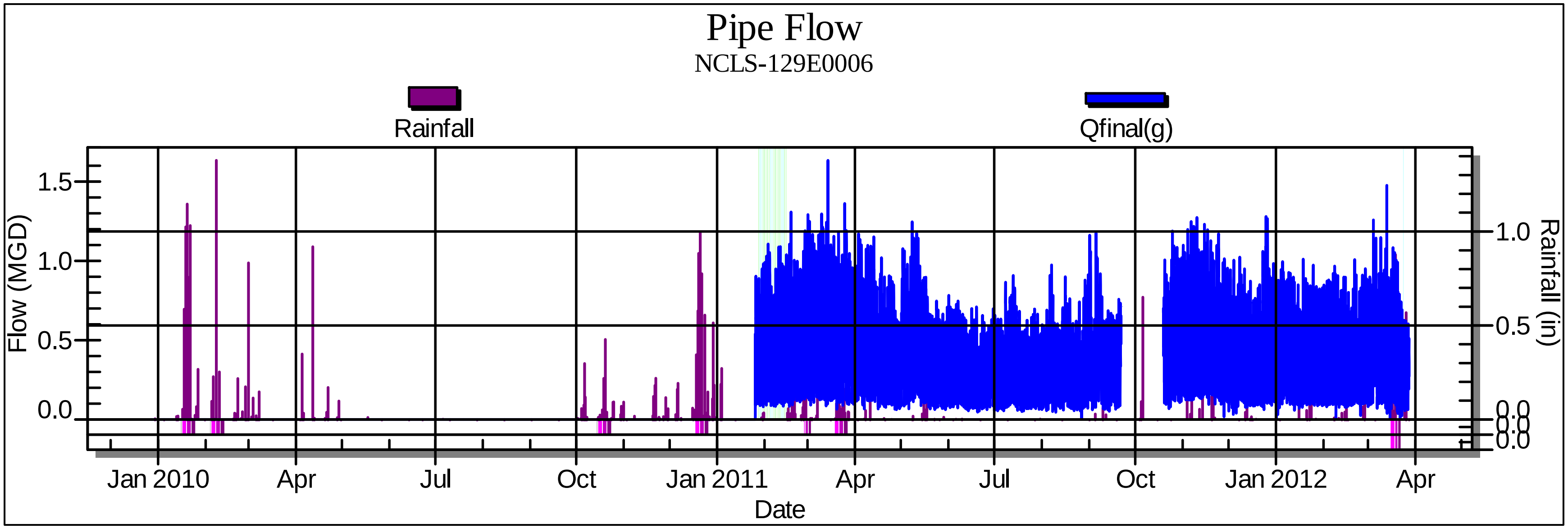

Q vs i - IRWD_07ENGCYN
Total Event Gross RDII Volume vs. Rainfall Depth
All Storms
Total Event Gross RDII Volume (mg)
Total Event Rainfall Depth (in)

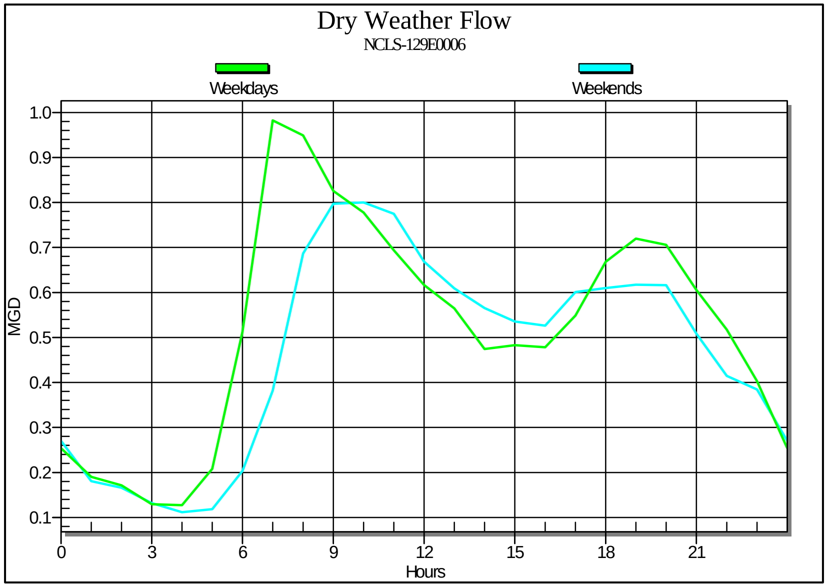

Storm Event - 1/16/2010 11:00:00 PM
IRWD_07ENGCYN
Rainfall
Gross Q
Gross I/I
Precomp(+)
Weekends
Weekdays
Flow (MGD)
Rainfall (in)
Storms
16 Sat
17 Sun
18 Mon
19 Tue
20 Wed
21 Thu
22 Fri
23 Sat
24 Sun
25 Mon
26 Tue
Jan 2010
Date

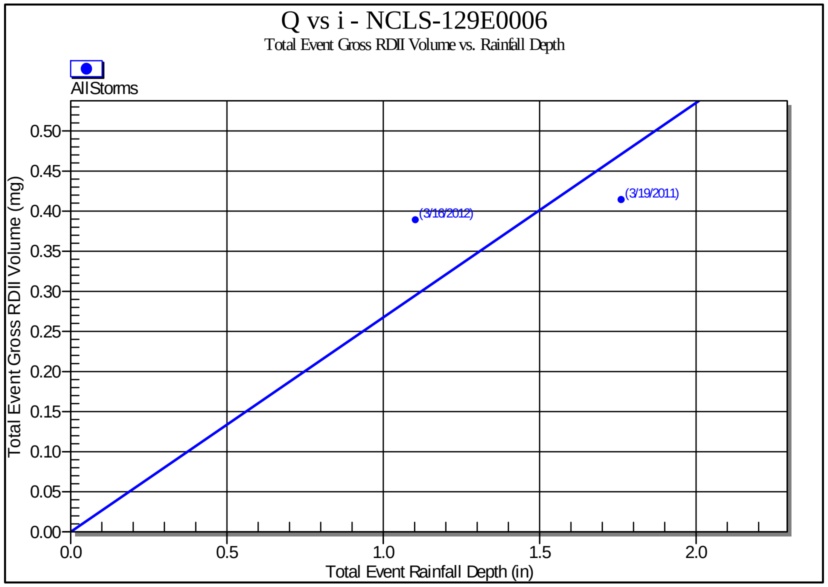

Storm Event - 12/18/2010
IRWD_07ENGCYN
Rainfall
Gross Q
Gross I/I
Weekdays
Weekends
Flow (MGD)
Rainfall (in)
Storms
17 Fri
18 Sat
19 Sun
20 Mon
21 Tue
22 Wed
23 Thu
24 Fri
25 Sat
26 Sun
27 Mon
28 Tue
Dec 2010
Date

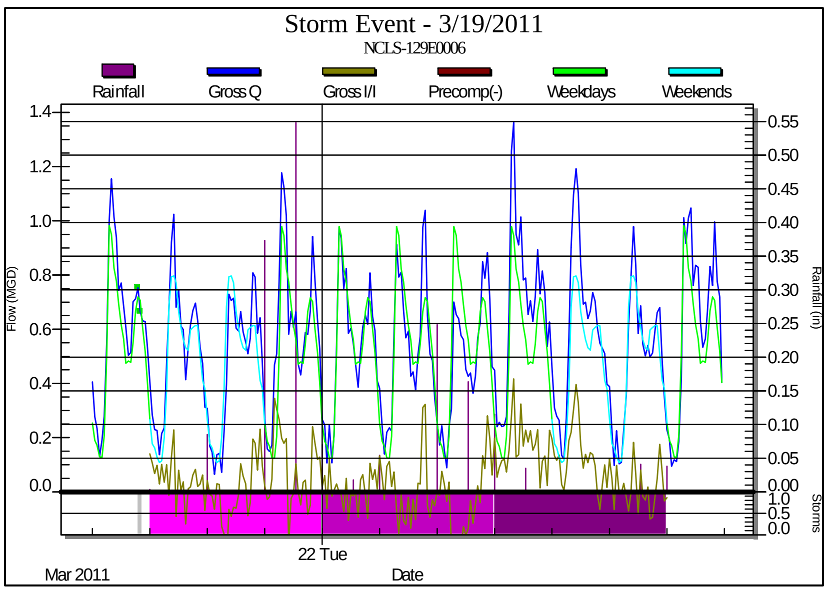

Storm Event - 3/19/2011
IRWD_07ENGCYN
Rainfall
Gross Q
Gross I/I
Precomp(-)
Weekdays
Weekends
Flow (MGD)
Rainfall (in)
Storms
18 Fri
19 Sat
20 Sun
21 Mon
22 Tue
23 Wed
24 Thu
25 Fri
26 Sat
27 Sun
28 Mon
29 Tue
Mar 2011
Date


Storm Event - 3/16/2012
IRWD_07ENGCYN
Rainfall
Gross Q
Gross I/I
Precomp(+)
Weekdays
Weekends
Flow (MGD)
Rainfall (in)
Storms
15 Thu
16 Fri
17 Sat
18 Sun
19 Mon
20 Tue
21 Wed
22 Thu
23 Fri
24 Sat
Mar 2012
Date

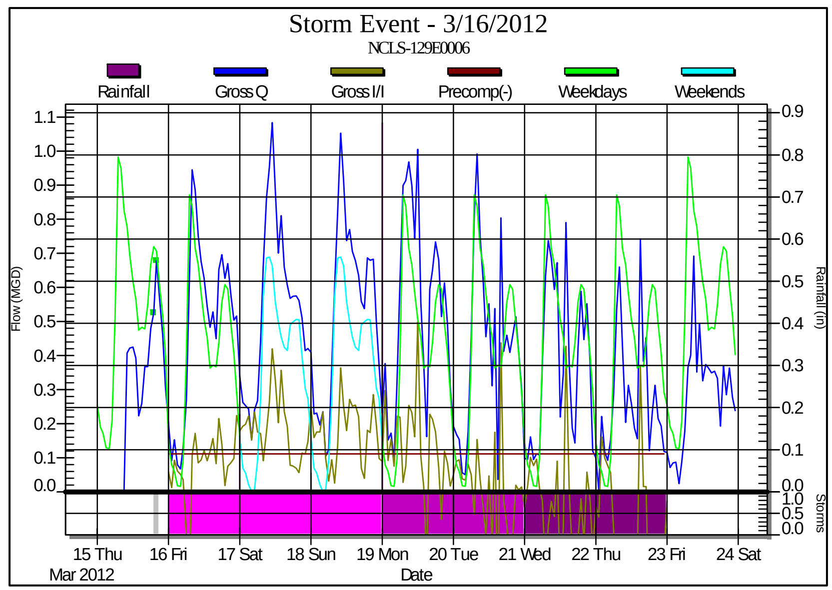

Pipe Flow
NCLS-129E0006
Rainfall
Qfinal(g)
Flow (MGD)
Rainfall (in)
1.5
1.0
0.5
0.0
Jan 2010
Apr
Jul
Oct
Jan 2011
Apr
Jul
Oct
Jan 2012
Apr
Date


Dry Weather Flow
NCLS-129E0006
Weekdays
Weekends
MGD
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
3
6
9
12
15
18
21
Hours


Q vs i - NCLS-129E0006
Total Event Gross RDII Volume vs. Rainfall Depth
All Storms
Total Event Gross RDII Volume (mg)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
(3/16/2012)
(3/19/2011)
0.0
0.5
1.0
1.5
2.0
Total Event Rainfall Depth (in)



Storm Event - 3/19/2011
NCLS-129E0006
Rainfall
Gross Q
Gross I/I
Precomp(-)
Weekdays
Weekends
Flow (MGD)
Rainfall (in)
Storms
22 Tue
Mar 2011
Date



Storm Event - 3/16/2012
NCLS-129E0006
Rainfall
Gross Q
Gross I/I
Precomp(-)
Weekdays
Weekends
Flow (MGD)
Rainfall (in)
Storms
15 Thu
16 Fri
17 Sat
18 Sun
19 Mon
20 Tue
21 Wed
22 Thu
23 Fri
24 Sat
Mar 2012
Date

APPENDIX L

2012 SSMP Audit Findings and Recommendations Summary

Finding Type	Linkage to WDR	SSMP Audit Finding	Auditor Recommended Correction Action	Corrective Action Status
Non-compliance	D.13 (ii)(a) Organization	The SSMP does not include the name(s) of the responsible or authorized representatives, as defined in the SSS WDR.	Update the SSMP to include this information. The District may want to consider providing the required information as an attachment to the SSMP to simply future SSMP updates.	Addressed in SSMP update.
Non-compliance	D.13 (ii)(b) Organization	The SSMP does not include names and telephone numbers for management, administrative, and maintenance positions responsible for implementing specific measures in the SSMP.	Update the SSMP to include this information. The District may want to consider providing the required information as an attachment to the SSMP to simply future SSMP updates.	Addressed in SSMP update.
Non-compliance	D.13 (ii)(b) Organization	The SSMP does not include a narrative explanation of the lines (	Add the required information to the text of the SSMP. This information could be provided in a table, including an indication of which position is responsible for which aspects of the SSMP.	Addressed in SSMP update.
Non-compliance	D.13 (ii)(c) Organization	The description of the chain of communication for reporting SSOs is incomplete.	Update the SSMP to include a description of the chain of communication. Any chain of communication included in the Organization section of the SSMP should be consistent with the Overflow Emergency Response Plan (OERP). The District may want to consider simply referencing the updated OERP to meet this requirement.	Addressed in SSMP update.
Non-compliance	D.13 (iii) Legal Authority	The SSMP does not demonstrate IRWD's legal authorities relating to: - Ensuring access for maintenance, inspection, or repairs for portions of the lateral owned or maintained by the Public Agency; - Enforcing any violation of its sewer ordinances	Update the SSMP to include references to the appropriate documents creating legal authorities for these items.	Addressed in SSMP update.
Non-compliance	D.13 (iv)(c) O&M Program - Rehabilitation and Replacement Plan	The SSMP does not include a rehabilitation and replacement plan identifying: - Short-term and long-term rehabilitation actions to address deficiencies; - A description of regular visual and TV inspections of manholes and sewer pipes; - A system for ranking the condition of sewer pipes and scheduling rehabilitation; - A capital improvement plan and schedule for developing funds	Update the SSMP to include a rehabilitation and replacement plan section addressing WDR requirements. The District may want to consider including the following items in the rehabilitation and replacement plan: - Estimating the lifecycle of collection system assets and developing a long-term projection for system renewal. - A description of the amount of reserve funding the District is putting aside for future repair and replacement.	Addressed in SSMP update.
Non-compliance	D.13 (iv)(e) O&M Program	Equipment: The SSMP does not include an inventory of equipment and replacement parts or a discussion of why this is not necessary.	Add the required information as an attachment to the SSMP or add a discussion of why this is not necessary.	Addressed in SSMP update.
Non-compliance	D.13 (vi) Overflow Emergency Response Plan (OERP)	Current overflow emergency response procedures are not well documented.	Prepare an updated Overflow Emergency Response Plan, making sure to include the required elements listed in the SSS WDR.	Addressed in SSMP update.
Non-compliance	D.13 (x) SSMP Program Audits	The SSMP indicates SSMP audits were to be performed every two years starting in 2005. The WDR requires SSMP audits every two years from certification of completion of the SSMP. IRWD certified in CIWQS that the SSMP was completed on 9/30/2005. SSMP audits should have been performed in 2007, 2009, and 2011.	Update the SSMP audit section to include a schedule for performing future SSMP audits and perform audits as scheduled. The next audit should be performed in the first quarter of 2014 and should review SSMP effectiveness for Calendar Years 2012 and 2013.	Addressed in SSMP update.
Non-compliance	D.13 (xi) Communication Program	IRWD has not defined a means to communicate with the public on a regular basis on the performance of the SSMP.	Define a means to communicate with the public on a regular basis on the performance of the SSMP and update the SSMP to include a description of how IRWD intends to accomplish this.	Addressed in SSMP update.
Minor Non-conforman	D.13 (iv)(b) O&M Program - Preventive Maintenance	The SSMP indicates that the sewer system is cleaned once annually. The District is on schedule to complete sewer cleaning of the entire system on an 18-month cycle.	Although the District is technically not meeting the stated goal for sewer cleaning in the SSMP, the goal is well above industry standard for system-wide sewer cleaning. It is recommended that the District update the SSMP to include a more achievable goal and based on the preventive maintenance needs of the sewer system.	Addressed in SSMP update.
Major non-conforman	D.13 (vii) FOG Control Program - Sufficient Staff to Enforce	The District does not have sufficient resources available to perform enforcement for all of the FOG violations identified by the FOG inspection contractor.	Perform a workload analysis of FOG enforcement work activities to determine the additional labor required to enforce FOG violations in a timely manner.	Addressed in SSMP update.

Finding Type	Linkage to WDR	SSMP Audit Finding	Auditor Recommended Correction Action	Corrective Action Status
Minor Non-conforman	D.13 viii (a-d) - System Evaluation and Capacity Assurance Plan	District's current SSMP was completed prior to publication of the 2006 Master Plan, and does not describe in adequate detail the system evaluation that was performed or the capital improvement projects that resulted. The SSMP does not describe the SAMP process for new development and how it is coordinated with the Master Plan.	Update the SSMP to include a more thorough description of the District's 2006 Master Plan, including the development of specific planning criteria and the improvement projects performed following field validation. Also document the Master Plan projects that were found to be unnecessary and why. The updated SSMP should also include a description of the District's SAMP process and how it is coordinated with the Master Plan.	Addressed in SSMP update.
Minor Non-conforman	D.13 viii (a-d) - System Evaluation and Capacity Assurance Plan	The District's current planning criteria for flow generation factors are based on water demand and flow monitoring studies performed in 2003-2005. Given the declining flows experienced by wastewater agencies since that time, the factors may have changed significantly.	Update the flow generation factors used for capacity planning through a combination of water demand analysis and targeted flow monitoring. Use the new flow generation factors in the Master Plan update which is planned to be initiated within the next two years.	Future
Minor Non-conforman	D.13 viii (b) – System Evaluation and Capacity Assurance Plan	The current planning criteria account for I/I by using conservative d/D ratios. While this method appears to be adequate based on the lack of observed wet weather overflows, it is possible that some areas of the system experience I/I sufficient to limit the capacity available for future upstream development	In conjunction with an update of the Master Plan, consider a targeted wet weather flow monitoring program to identify areas in which I/I may be problematic. Highest priority for wet weather flow monitoring should be given to older sewers which are suspected of having high I/I, and which also have the potential for receiving additional flows from future upstream development. Areas of high I/I that are already built-out and do not have a history of backups or overflows are of less concern, unless they contribute significant amounts of I/I to downstream sewers which will serve future development. In the near term, utilize existing high level sensors in suspected high-I/I areas to determine if sewers are surcharging during rainfall events. Use this information to help design the wet weather flow monitoring program.	Performed preliminary I/I Study.
Recommendation	D.13 (i) Goal	Existing SSMP text does not match the goal as defined in the SSS WDR.	Update stated goal to match the language provided in the SSS WDR.	Addressed in SSMP update.
Recommendation	D.13 (iv)(a) Operations and Maintenance Program	The District does not have access to mapping for stormwater conveyance facilities throughout the entire service area. The District does have access to support from the County of Orange, in the form of staff and equipment, during an SSO event and County staff do have access to all available stormwater conveyance mapping data as well as have historical knowledge of the location of stormwater conveyance assets.	Continue to work with the County of Orange to gain access to stormwater conveyance mapping information as it becomes available. Make this information available to Collection System Operations field crews.	Future
Recommendation	D.13 (iv)(b) O&M Program - Preventive Maintenance	The District's current system-wide cleaning strategy to clean the system once every 18 months is potentially more than is needed. Although an aggressive sewer cleaning strategy is one of the factors contributing to the low SSO rates the District is achieving, it may be possible to achieve the same results with a condition-based sewer cleaning approach which determines sewer cleaning frequency based on the cleaning needs individual pipelines.	Some pipelines in the sewer system could be cleaned on a significantly reduced schedule with little to no risk of having a sewer overflow. The District may want to consider using feedback from sewer cleaning crews to identify pipelines and areas which may not require such an aggressive system-wide cleaning schedule and begin to increase periods between cleanings in these locations. If the District employs a condition-based sewer cleaning approach an additional opportunity will be to re-invest sewer cleaning resources to performing additional CCTV inspection. This could be accomplished over a multi-year period with a phased transition of a crew from cleaning to CCTV. The additional CCTV inspection capability could be focused on inspection in lieu of cleaning, validation of preventive maintenance schedules, and additional system-wide inspection for condition assessment.	Future
Recommendation	D.13 (iv)(b) O&M Program - Preventive Maintenance	The District currently utilizes a paper-based system and MS Access database to schedule and track sewer preventive maintenance activities. The District is in the process of selecting an asset management system and implementing new processes to support collection system asset management.	Include in the new asset management system business processes to collect code-based feedback from sewer cleaning crews indicating the type and severity of material found during cleaning activities. Implement a process to analyze this data to continually optimize sewer cleaning frequencies with the goal of focusing cleaning on locations prone to maintenance issues or with a high risk associated with system failure.	Plan to address discussed in SSMP update.

Finding Type	Linkage to WDR	SSMP Audit Finding	Auditor Recommended Correction Action	Corrective Action Status
Recommendation	D.13 (iv)(c) O&M Program - Rehabilitation and Replacement Program	The District currently uses a combination of Tabware software and paper work orders to track and communicate collection system repair, rehabilitation, and replacement needs. Currently the District does not have a streamlined process for mapping deficiencies recommended for repair, rehabilitation, or replacement. Mapping of these deficiencies would enable Engineering to group projects addressing deficiencies geographically.	Include a means for tracking collection system asset repair, rehabilitation, and replacement needs and activities in the implementation of the asset management system currently being planned. Include a means to map system deficiencies and locations recommended for repair, rehabilitation, or replacement to support Engineering in defining projects to address system deficiencies.	Future
Recommendation	D.13 (iv)(c) O&M Program - Rehabilitation and Replacement Program	The District does not have an approach to assess the condition of all force mains within the collection system.	The District should consider performing a risk assessment of force main assets and developing an approach to managing risk associated with force main assets including an analysis of probable failure modes, contingency plans in the event of failure, and approaches to assess condition issues linked to probable failure modes.	Future
Recommendation	D.13 (vii)(a) FOG Control Program	Several opportunities were identified during the audit for additional public outreach regarding FOG control. Current public outreach activities include brochures sent to residential customers with bills during the holiday season as well as information provided on IRWD's website. Multi-family residences have specifically been identified as a potentially significant source of FOG.	Arrange for regular communication between the FOG Program Manager and the Public Outreach Coordinator regarding: - Development and implementation of a multifamily outreach campaign. - Ongoing public outreach efforts.	Future
Recommendation	D.13 viii (a-d) - System Evaluation and Capacity Assurance Plan	The District uses the InfoSewer hydraulic modeling software, which is not a fully-dynamic program. InfoSewer is adequate for analyzing and sizing simple sewer systems with gradual flow variations that operate primarily in a non-surcharge mode.	Evaluate whether converting to a fully-dynamic model would provide sufficient benefits to planning and operational analyses to offset the additional cost and re-training of staff. This evaluation could be done in conjunction with the update of the Master Plan. A fully-dynamic model (e.g., InfoSWMM) can more accurately represent the hydraulics within a sewer system that includes diversion structures that can split flow in two directions at normal or high levels, and that may experience backups due to planned or unplanned constrictions, pump operations, or temporary diversions.	Future
Recommendation	D.13 (xi) Communication Program	IRWD did not provided a means for the public to provide input into development and implementation of the original SSMP. IRWD has the opportunity to provide a means for the public to provide input during the next SSMP update.	Provide a means for the public to provide input into the next revision of the SSMP and future implementation activities.	Addressed in SSMP update.