County Sanitation District No. 2
Los Angeles County
California

PRELIMINARY DESIGN REPORT FOR WHITTIER NARROWS WATER RECLAMATION PLANT U.V. DISINFECTION FACILITIES

SANITATION DISTRICTS OF LOS ANGELES COUNTY

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1. INTRODUCTION

This report presents the preliminary engineering for the design of the Whittier Narrows Water Reclamation Plant - U.V. Disinfection Facilities. After review and approval of the proposed concepts and facilities by Districts' staff, the report will serve as the basis for the detailed engineering and design of the project.

This project will modify the existing treatment facilities to provide an ultraviolet light disinfection process, largely replacing the current disinfection process that uses sodium hypochlorite for chlorination and sodium bisulfite for dechlorination. The UV treatment scheme will allow the plant to meet existing regulatory disinfection levels and reduce levels of disinfection byproducts, most notably nitrosodimethylamine (NDMA). Based on evaluations conducted to date and meeting with Districts' staff, a decision has been made to utilize an open channel system, incorporating low pressure, high output (LP/HO) UV lamps targeting disinfection, rather than NDMA destruction. The project will include the installation of open channel UV reactor trains and appurtenant electrical systems, modifications to the plant filter effluent/backwash hydraulics, modifications for effluent filter cleaning and modifications to the existing plant control system.

It should be noted that some hypochlorite addition would still be required with UV disinfection. In this multi-barrier scheme, UV irradiation will be the primary means of disinfection in achieving Title 22 compliance. A low dosage of hypochlorite (with a short contact time) will act as a secondary barrier that will keep virus titers to essentially a non-detect level. Without hypochlorite, adenovirus, a viral pathogen, is still detected in the effluent at UV disinfection dosages.

A project is currently under construction at the WNWRP that provides a Recycled Water Pump Station for irrigation reuse. This pump station will be connected to the chlorine contact tanks. After UV disinfection is implemented, the CCTs will be used for effluent storage and the CCT water levels will vary diurnally.

2. WHITTIER NARROW WATER RECLAMATION PLANT (WNWRP)

The WNWRP is a part of the Los Angeles County Sanitation Districts' (LACSD) Joint Outfall System (JOS). The WNWRP provides hydraulic relief of the downstream sewers leading to the JWPCP while also providing reclaimed water to the Central Basin.

Existing treatment at the WNWRP consists of primary sedimentation, NDN activated sludge biological treatment, secondary sedimentation, coagulation, inert dual media effluent filtration, followed by chlorination and dechlorination. Tertiary effluent is normally discharged to the Rio Hondo or San Gabriel River systems for reclamation and a small amount is reused at Norman's Nursery. Primary and waste activated solids are discharged back to the JO "B" Trunk Sewer for conveyance and eventual treatment at the JWPCP.

2.1 Facility Location.

The WNWRP is located at 301 N. Rosemead Blvd. in the city of South El Monte and east of the Los Angeles metropolitan area. It is near the intersection of the Pomona Freeway (60) and Rosemead Blvd. The WNWRP site is in an unincorporated area of Los Angeles County, southeast of the Whittier Narrows Dam Recreation Area and north of San Gabriel Boulevard, between the Rio Hondo channel on the west and Rosemead Boulevard on the east. The Whittier Narrows Dam Recreation Area is operated by the City of Los Angeles Department of Parks and Recreation. The WNWRP and the recreation area are located within the Whittier Narrow Flood Control Basin, which is owned by the U. S. Government and operated by the Army Corps of Engineers (Corps). The WNWRP site is leased to the Districts until 2020, at which time an extension of the lease is expected. This is primarily because the utilization of the land as a flood control basin effectively limits any new development that may compete for land use.

The site on which the WNWRP is located is designated as an "Open Space" land use in the Los Angeles County General Plan. The site and surrounding properties are zoned for Open Space or Agricultural. Of the total 27.15 acres dedicated to the WNWRP site, approximately 16 acres is currently leased from the Corps by Norman's Nursery. The lease to Norman's Nursery may be cancelled if the Districts require use of the land. Norman's Nursery was relocated to its present location when it was displaced by the construction of San Jose Creek WRP Stage III.

2.2 Permitted Capacity and Future Expansion.

The existing facility is a tertiary wastewater treatment facility with a current NPDES permitted design capacity of 15 MGD. Therefore, the 30-day average and daily maximum mass emission limits for the WNWRP are based on daily concentrations with an effluent flow of 15 mgd. The WNWRP was originally designed for 12 MGD, but the permit was later increased to 18 MGD and then subsequently lowered to 15 MGD. Upgrades to the plant over the last 10 years for the removal of ammonia using a nitrification/denitrification (NDN) process have limited the treatment capacity of the existing tankage to approximately 13 MGD. Due to limitations of the existing return sludge pumps and process air compressors, the WNWRP has been treating approximately 8 MGD over the past few years. Another project is in the preliminary design phase to address these limitations. However, because the plant is located in a floodplain, the Districts' management has decided that no more tankage is to be provided at the WNWRP site in the foreseeable future. Therefore, the NDN capacity of the plant will likely remain limited to 13 MGD. The ultimate treatment capacity of the site identified in the 1977 Facilities Plan and the 2010 JOS Master Facilities Plan is 80 mgd.

2.3 Water Reuse at the WNWRP.

The WNWRP was the first water reclamation plant built by the Districts and was completed in 1962. Currently, most of the reclaimed water produced at the WNWRP is used by the Water Replenishment District to recharge the Central Basin. This basin is recharged through the Rio Hondo and San Gabriel Coastal Spreading Grounds (Montebello Forebay) with reclaimed water from the SJCWRP, WNWRP and Pomona WRP. Both of these spreading grounds are operated by the Los Angeles County Department of Public Works. Existing conditions are such that virtually all the reclaimed water produced at the WNWRP is reused for groundwater recharge. Reclaimed water from the WNWRP is normally discharged to the Rio Hondo, which flows to the Rio Hondo Spreading Grounds for recharge. Occasionally, during rainstorm events, the reclaimed water for the WNWRP reaches the lined portion of the Rio Hondo, which flows to the lined portion of the Los Angeles River and eventually discharges to the ocean. The reclaimed water produced at the WNWRP can also be diverted to the San Gabriel River. Just south of the Whittier Narrows Dam, reclaimed water is diverted to spreading grounds via unlined reaches of the San Gabriel River. Another project, currently under construction, will enable the Title 22 effluent produced by the WNWRP to be pumped for reuse to the Whittier Narrows Dam Recreation Area, which is situated in the Main San Gabriel Basin. Because of NDMA issues, and those related to potable water well closures in the San Gabriel Valley due to groundwater contamination, reuse by irrigation in the San Gabriel Valley Basin is emerging as a preferred alternative over groundwater recharge of the Central Basin.

Currently, the Main San Gabriel Basin contains pockets of groundwater that have organic contaminant levels that exceed current drinking water standards. Efforts by other agencies have been undertaken to develop management and treatment schemes to reclaim these impacted water supplies in order to maintain their availability in the future. It has recently been discovered that the effluent from the WNWRP that is discharged to the Rio Hondo may be affecting the groundwater quality in the short reach of the Rio Hondo that is unlined and downstream of the plant. NDMA has been discovered in EPA monitoring wells that have been strategically placed to capture and treat the plumes of organic contamination migrating downgradient in the San Gabriel Basin.

The EPA has constructed several "Operable Units" to treat this organic contamination. The Whittier Narrows Operable Unit (WNOU) that is located near the WNWRP treats the groundwater in the area downgradient of the plant. However, NDMA would not be removed by the treatment provided by the WNOU, rendering that facility obsolete and the water unusable. The WNWRP UV Disinfection Facilities Project is expected to improve the water quality of the WNWRP effluent so that it does not adversely affect the groundwater in the vicinity of the wells that pump to the EPA's WNOU. The UV disinfection project is expected to reduce NDMA to levels that were typical before the nitrification/denitrification treatment process was implemented at the WNWRP. These levels have not adversely impacted groundwater quality in the past.

In the meantime, several steps have been taken to reduce effluent NDMA levels at the WRPs. For instance, the Operations group continues to optimize chemical usage. Use of polymers with minimal amine concentrations are being evaluated and may significantly reduce current NDMA levels. Also, for the JOS tertiary WRPs, the filter backwash, which contains high levels of NDMA, is captured and diverted back to the sewer for subsequent treatment at JWPCP. Even with these in-plant changes, levels of NDMA continue to be 1 to 2 orders of magnitude above the current DHS Notification Level (NL) of 10 ng/L. Operations has also implemented a discharge rotation program at the Whittier Narrows WRP in an effort to minimize impacts on EPA's extraction wells. In addition, the EPA is intermittently operating the extraction wells through a rotation program and is discharging the VOC-treated water to Legg Lakes under an agreement with the local Watermaster.

The WNWRP also currently provides water for direct reuse to Norman's Nursery. Additionally, the WNWRP is slated to provide water to the Upper San Gabriel Municipal Water District in the near future for direct reuse and irrigation at the Whittier Narrows Dam Recreation Area with the construction of a new recycled water pump station at the plant. **Refer to Part 4.1 of this report.**

2.4 <u>Existing Permits and Regulations.</u>

a. NPDES, Reuse and Groundwater Recharge

The treatment of wastewater is subject to various federal, state, and regional laws, rules, and regulations. The WNWRP operates within waste discharge requirements of NPDES Permit No. CA0053716 (Order No. R4-2002-0142). The permit is issued by the Los Angeles Regional Water Quality Control Board (RWQCB), and is scheduled for renewal every five years. The current NPDES permit will expire on July 10, 2007. The permit also requires the plant to meet various water quality objectives of the Water Quality Control Plan for the Los Angeles River Basin (Basin Plan). In addition, the plant is subject to the water reclamation (reuse) requirements of the Montebello Forebay Groundwater Recharge Permit, issued by the RWQCB. This groundwater permit pertains to the Rio Hondo and San Gabriel Coastal Spreading Grounds. According to the reuse permits, reclaimed water shall not contain trace constituents or other substances in concentrations that exceed the limits of the current California Department of Health Services Drinking Water Standards. Reclaimed water that is used to recharge groundwater, or that is discharged to a surface water body designated as a drinking water supply, must meet California drinking water standards for trace constituents, which are typically the same as the federal standards required by the Safe Drinking Water Act. The permitted disinfection requirement for reclaimed water produced at all of the Districts' WRPs, including the WNWRP, is such that the 7-day median number of total coliform cannot exceed 2.2/100 ml, and the total coliform count cannot exceed 23/100 ml in more than one sample in any 30-day period.

The permit requirements associated with chlorine residual deserve special mention. For the WNWRP, the total residual chlorine is limited to an instantaneous daily maximum of 0.1 mg/L, subject to the exclusions below. Excursions of up to 0.3 mg/L are allowable immediately following dechlorination provided that the total duration of such excursions do not exceed 15 minutes in any 24-hour period and the excursions are associated with changing of the chlorine tanks. Since chlorine tanks are not used at the WNWRP, it is not clear if any relief can be gained above the 0.1 mg/L residual [It is recommended that the reference to changing of chlorine tanks be dropped in future permits, consistent with the language in other WRP permits of the Districts]. Also, peaks in excess of 0.3 mg/L lasting less than one minute are not considered to be a violation of the chlorine residual requirement.

Note that the residual chlorine objective may be revised in the future. The SWRCB has released a draft document in April 2004 that included freshwater limits of 0.019 mg/L as a one-hour average and 0.011 mg/L as a 4-day average. Although this is a receiving water quality objective, the precedent is to apply these limits as "end of pipe" objectives.

Operators normally add an excess of bisulfite in order to meet the chlorine residual requirements. Bisulfite residual is not regulated, but reportedly can increase toxicity and theoretically consume dissolved oxygen and lower the pH.

b. NDMA Regulatory Issues

N-nitrosodimethylamine (NDMA) is a nitrosamine formed in many industrial and natural processes. It occurs in various foods and alcoholic beverages, is created from nitrates and nitrites in the human gut, and is also detected in cigarette smoke. The nitrosamines are considered as classic carcinogens. Given the low volatility and skin permeability of NDMA, neither inhalation nor dermal exposure routes are expected to contribute significant amounts of exposure relative to the oral route. However, NDMA contributions from food sources are probably a relevant fraction of total exposure.

NDMA has become more important in California because of its increasing detection in drinking water. It has been associated with the chloramine disinfection process. California DHS requested that OEHHA develop a PHG for NDMA, to support the development of a California MCL. There is no federal Maximum Contaminant Level (MCL) for NDMA, but there is a California Notification Level (formerly known as the Action Level) of 10 ng/L. This level has fluctuated over the years as more was discovered about NDMA as an emerging contaminant.

From the discussion above, it is clear that NDMA regulatory issues with regards to the WNWRP plant effluent really originate from drinking water regulations. Because of it being an emerging contaminant, it regulatory levels have change over time and there is some uncertainty about where they will end up or how vigorous they will be enforced. The current NDMA levels in effluent discharged by all seven of the tertiary WRPs are well below the California Toxics Rule criteria for the protection of the recreational beneficial use. It is doubtful that NDMA levels in reclaimed water pose a threat to underlying groundwater when used properly for irrigation purposes (e.g., not exceeding agronomic demand). However, when a Drinking Water Standard (DWS) for NDMA is established, it will be applicable to the tertiary WRPs via the Title 22 DWS narrative requirement currently contained in the reuse permits.

In the near future, it is expected that the current DHS Notification Level for NDMA of 10 ng/L will be adopted as a Maximum Contaminant Level (MCL) for the Drinking Water Standard (DWS). This future change to the DWS will certainly impact all seven of the tertiary WRPs that discharge to unlined river reaches where underlying groundwater could be impacted. It may also impact treated effluent used for water reuse activities since current reuse permits require compliance with DWS. Typically NDMA is detected in the WRP secondary effluent at less than 100 ng/L. This is above the current DHS Notification Level but well below the Response Level.

Notification levels are advisory levels and not enforceable standards. They are health-based advisory levels established by DHS for chemicals in drinking water that lack maximum contaminant levels (MCLs). Notification levels are established as precautionary measures for contaminants that may be considered candidates for establishment of a MCL, but have not yet undergone or completed the regulatory standard setting process.

The Response Level is set at chemical concentrations 10 to 100 times the Notification Level, depending on the toxicological endpoint (*i.e.*, non-cancer effects or cancer risk) of the chemical. The Response Level designates the point where DHS recommends that a drinking water system take the source out of service. For NDMA, the Response Level is 20 times the Notification Level, or 200 ng/L.

c. Other Permits and Environmental Documentation

1. Floodplain Management

Executive Order 11988, a federal requirement prepared in 1979, relates to floodplain management. It was promulgated to avoid long-term and short-term adverse impacts associated with occupation and modification of floodplains. Projects must be designed or actions performed to minimize the potential harm to the floodplain. Documentation is prepared and a notice is circulated explaining why the action is proposed to be located in the floodplain.

2. Storm Water

The WNWRP is also regulated by the General Permit Conditions for Industrial Activities for storm water discharges. A Storm Water Pollution Prevention Plan has been developed and is maintained for the site.

3. Storm Water Discharge for Construction Activities

The construction at the WNWRP will be subject to General Permit Conditions for Construction Activities for storm water discharges. A Storm Water Pollution Prevention Plan will be developed specifically for construction of the project.

4. National Fire Protection Act (NFPA)

The WNWRP UV Disinfection Facilities design will be in accordance with NFPA 820 guidelines and all applicable County of Los Angeles ordinances. Construction plans will require approval of the County of Los Angeles Fire Department. Because of its remote location, and the fact that it is not near a potable water or firewater supply, the WNWRP fits the NFPA description of a "Rural/Non-urban" area in which a fire prevention system does not require a pressurized hydrant system.

5. South Coast Air Quality Management District (SCAQMD)

The WNWRP UV Disinfection Facilities design will comply with all applicable rules and regulations of the South Coast Air Quality Management District (SCAQMD). A Permit to Construct and operate will be required from the SCAQMD for all equipment.

6. Additional Permit Requirements

Additional information on existing laws, rules, and regulations may be found in the Final Joint Outfall System 2010 Master Facilities Plan and EIR dated June 1995.

7. Environmental Documentation

There are no apparent negative environmental impacts that have been identified for the UV Disinfection Facilities project and therefore no mitigation measures are necessary.

3. NEED FOR UV DISINFECTION

3.1 NDN Operation.

Since 1996, the operation at the WNWRP has been a nitrification/denitrification (NDN) activated sludge process in which essentially all of the ammonia nitrogen (approx. 23 mg/L as N) and organic nitrogen (approx. 8 mg/L as N) in the bulk liquid flow is biologically removed. A change from the standard removal of carbonaceous BOD with limited nitrification was necessary to meet new effluent nitrogen standards, effective June 2003. More specifically, it was necessary to meet an effluent ammonia-nitrogen limit ranging from 1 to 2 mg/L, depending on temperature and pH, and also meet a combined nitrite/nitrate-nitrogen limit of 8 mg/L (as N) on a monthly average. In the NDN mode, organic nitrogen is converted to ammonia nitrogen and the process of nitrification converts ammonia-nitrogen to nitrite and then nitrate. The process of denitrification then converts nitrate to nitrogen gas, and the nitrogen is then removed from the aqueous system. Because the existing disinfection scheme at the WNWRP requires chloramine, a small amount of industrial aqueous ammonia (approx. 1-2 mg/L as nitrogen) is added to the secondary effluent prior to the addition of sodium hypochlorite. After injection and mixing of the sodium hypochlorite before the filters and following suitable chlorine contact time, dechlorination is accomplished by the addition of sodium bisulfite.

3.2 NDMA.

Recent data have shown that the upgrade to the NDN activated sludge process has led to increased levels of n-Nitrosodimethylamine (NDMA) in the effluent of the WNWRP and other CSDLAC facilities. Identification of NDMA or its precursors in the sewer, and the generation of NDMA in wastewater treatment processes, is complicated because of multiple formation and degradation pathways. However, it appears that disinfection by chloramination with monochloramine in the presence of NDMA precursors is the main reason for the increased NDMA levels in the NDN operation. The NDMA precursors are due in large part to the use of polymers at the plant to control foam and to improve secondary settling characteristics.

Chloramination, rather than free chlorination, has been typically used by the Districts because of the lower trihalomethane (THM) concentrations that result.

Since the NDMA issue affects a number of Districts' facilities that have switched to the NDN treatment mode, this has led to an agreement with the RWQCB to proceed with UV disinfection at the WNWRP. The San Jose Creek and Pomona WRPs also discharge to unlined reaches of the San Gabriel River and Rio Hondo and are similarly used in the Montebello Forebay for groundwater recharge. The installation of a UV system at the WNWRP has been mentioned in the recently approved Pomona WRP NPDES permit. The WNWRP will be used as a test plant to gather operational data before other plants are ever retrofitted with UV systems.

3.3 <u>Other Factors.</u>

Besides NDMA, a number of other regulatory concerns that are favorably impacted by the installation of a UV system at the WNWRP are listed below:

- Residual Chlorine. Exceedances should be reduced since normally chlorine will not be the primary disinfectant and can be added more cautiously. The full complement of chlorine residual will only be required occasionally when operating in standby hypochlorite mode.

- Ammonia. Exceedances will be reduced since ammonia will not be added back for chloramination purposes in the effluent going to the receiving water.

- Cyanide. Exceedances may be reduced by limiting the chlorination of the effluent. New cyanide limits are scheduled to go into effect in the years 2007-2009 at various plants (WNWRP - May 7, 2007).

- Mandatory Monetary Penalties (MMPs). Penalties associated with the above items will be reduced if the overall numbers of exceedances are minimized.

- 450 CT Requirement. Currently, the reclamation permit requires total virus inactivation in lieu of meeting the 450 CT requirement. It is expected that the 450 CT requirement may be enforced in the future. With UV disinfection, the 450 CT requirement will not be a concern.

- Sodium, Chloride and Sulfate. Effluent concentrations of these constituents will be lower, when lower amounts of sodium hypochlorite and sodium bisulfite are added.

Although the above concerns have been evident with the use of chlorine, and will be reduced by the use of UV, it should be noted that disinfection by chlorination has provided near perfect compliance in meeting coliform requirements and virus inactivation.

The use of free (and/or breakpoint) chlorination has also been explored by the Districts as both a temporary and long-term solution to disinfection problems. While considered to be an acceptable temporary alternative to chloramination in terms of NDMA, free chlorination may not be a good long-term alternative, since it raises the levels of THMs. It also does not address the 450 CT issue and also suffers from the fact that there is some bleed-through of ammonia at high flow rates. In this case, the free chlorination process would become a chloramination process unless additional chlorine is added to achieve breakpoint chlorination. Needless to say, this would be a more difficult process to control.

The Districts have recently conducted a UV disinfection pilot project at the WNWRP to test the disinfection efficacy of UV and the extent of NDMA destruction and disinfection byproduct formation. It was determined that irradiation of the effluent by ultraviolet (UV) light was a feasible and cost effective technology capable of achieving disinfection of wastewater, without additional generation of NDMA and other chlorination byproducts. The process also achieves measurable destruction of NDMA at disinfection dosages. The use of a UV Disinfection System at the WNWRP will restore NDMA concentrations to pre-NDN levels. This will protect the quality of local groundwater and will prevent the formation of other chlorinated disinfection byproducts, such as THMs.

The pilot testing at Whittier Narrows has shown that the DHS required UV dosage (100 mJ/cm2) is inadequate to inactivate adenovirus. Therefore, as mentioned previously, a small free chlorine dose with a short contact time will be required prior to effluent discharge. This practice is not expected to increase THMs or other DBPs significantly, although some residual exceedance problems may be experienced due to faulty analyzer operation.

4. RELATED PROJECTS

The following is a list of projects related to the WNWRP UV Disinfection Facilities, along with a brief description of each project.

4.1 San Gabriel Valley Direct Reuse Project – Phase IIB Recycled Water Pump Station.

a. Project Overview

This project involves the construction of a pump station and wetwell directly south of, and connected to, the existing chlorine contact tanks (CCTs) by two 30-inch pipelines. A 24-inch diameter discharge force main will be constructed on plant property to connect with the main portion of the reuse line that proceeds north from the plant. Most of the plant effluent at the WNWRP, which is currently directed to the Central Basin for groundwater recharge, will be pumped to the San Gabriel Basin as irrigation water supplying the Whittier Narrows Dam Recreation Area and golf course. Variable speed pumps are being provided at the pump station, along with a separate SCE power feed and appurtenant transformers and switchgear.

With the UV process, the WNWRP's CCTs will no longer be required to provide the contact time for disinfection, except in a standby disinfection mode, and will thus be available for diurnal storage of reuse water for San Gabriel Valley. By using the CCTs (hereinafter referred to as Effluent Storage/Chlorine Contact Tanks, ES/CCTs) for reuse storage, USGMWD avoids the construction of a large reservoir on Districts' property. The initial proposed reservoir volume was 2 MG and would have interfered with the future expansion of secondary clarifiers to the west.

After both contracts (UV Disinfection Facilities and Recycled Water Pump Station) are completed, the two ES/CCTs will be used for a combined reuse storage volume of approximately one million gallons, with the water level in both tanks varying diurnally. For the present condition of operating two aeration tanks, and assuming the plant will be operated to produce a relatively constant 9.4 MGD, the ES/CCT storage will provide the required steady reuse flow of 11.55 mgd during the nine hour scheduled reuse irrigation time (10 p.m. to 7 a.m.). Minor reuse demand may be expected during the day, after 7 a.m. Filter backwash will occur during the day when the water levels in the ES/CCTs have recovered to such a level that there is adequate storage volume for backwashing.

Future improvements to the WNWRP's return sludge pumping and process air compressors will allow more flow to be treated at the plant. This will allow the reuse goal to be more easily met and will reduce storage demands on the ES/CCTs. In addition, future facilities are to be added to the reuse system, which will reduce the demands on the ES/CCTs. A reuse pipeline for the SJCWRP will be tied into the reuse pipeline for the WNWRP. In addition, another 1 MG storage reservoir will be provided at the end of the system (in Arcadia). This second reservoir will likely be filled during the day by the SJCWRP and/or by the WNWRP after daily backwash requirements are satisfied.

The Districts will provide a chlorine residual for the reuse pipeline, with the chemical cost reimbursed by USGVMWD. This scheme may or may not include ammonia addition.

b. Plant Modifications

The following plant modifications are currently being made as part of the Recycled Water Pump Station Project:

1. Recycled Water Wetwell and Pumps

- Construction of a wetwell for the Recycled Water Pump Station, connected to the existing CCTs through two parallel 30-inch pipelines and butterfly isolation valves
- Installation of four reuse pumps, one surge tank and a 24-inch diameter reuse pipeline proceeding across the north boundary of the plant.

2. Process Water Systems

- Provision of weir in wetwell to prevent over-pumping and assure retention of firewater and washwater supply
- Change of the existing 16-inch foam spray/washwater/chemical dilution water suction line from the Dechlorination Channel to the reuse wetwell (for an uninterrupted supply of chlorinated, in-plant process water).

- Addition of an upstream leg and isolation valve in the above-mentioned 16-inch foam spray/washwater/chemical dilution water suction line to receive UV disinfected water (this line will be extended during the WNWRP UV Disinfection Facilities project)

- Provision of a 4-inch line and isolation valve to supply UV disinfected water to a proposed chemical dilution water pump (this line will be extended during the WNWRP UV Disinfection Facilities project)

- Extension of the draft hydrant piping to a lower level in the existing CCT (the water level in the ES/CCTs will rise and fall, but a minimum amount of water will be reserved for fire protection at all times)

- Extension of Norman's Nursery pump suction lines into the existing CCT's sump area and provision of a foot valve on each suction line to keep the pump primed (the water level in the ES/CCTs will rise and fall).

- Addition of a washwater connection to Norman's Nursery pump suction (to prime the pump, if necessary, since the water level in the ES/CCTs will rise and fall)

- Connection of the reuse discharge line to Norman's Nursery pump discharge line (allows the Norman's Nursery pump to be retired in the future, if desired)

- Provision of an emergency firewater connection on the discharge of the reuse pipeline (standby for the draft hydrant)

3. Electrical and Instrumentation

- Installation of separate electrical power feed, transformer, switchgear and power meter

- Installation of a PLC for stand alone control of the pump station

- Installation of conduit for communication between the PLC and plant DCS

- Installation of a transducer for the wetwell level indication

4.2 WNWRP Miscellaneous Plant Modifications.

This project involves the demolition of the existing airlift return sludge pumps and the construction of a proposed Return Sludge Pump Station for greater return capacity. It also involves the replacement of the existing process air compressors with larger and more efficient compressors. With the upgrade of the process air and return systems, the WNWRP plant is expected to once again operate with three aeration tanks instead of two, and at higher plant flows. This will put greater stress on the existing clarifiers and effluent filters, which in turn, may have a slight effect on the effluent UVT. The design UVT value assumed ultimately affects the number of UV lamps provided on the project.

4.3 Replacement of Existing Filter Effluent Pump Variable Speed Controls.

Although this is not a formal project, Operations is considering the replacement of the existing variable speed controls for the filter effluent pumps. The operation of these pumps has been suspect for the last year and the existing speed controls are a very old technology and obsolete, which means parts are very hard to obtain. Replacement with more modern VFCs and motors should increase the reliability of the entire facility and may possibly result in more even flows to the UV system, which would produce better disinfection and increase UV efficiency.

4.4 Replacement of Existing Power Feed and Transformer by SCE.

This project commenced in March 2005 and was required for maintenance reasons, as well as the increased capacity needed by the UV facilities. The electrical conductors, which were made of lead material, were replaced from the power pole to the transformer. The roof top transformer was also replaced. The automatic transfer switch was be updated for smoother transitions during power interruptions.

5. PLANT MODIFICATIONS

5.1 Project Overview.

a. Proposed Process Changes

- The normal disinfection practice of chloramination, now achieved by adding aqueous ammonia and sodium hypochlorite before the effluent filters (pre-chlorination), will be discontinued as the normal mode of disinfection and retained as a standby mode of operation.

- The effluent flow from the Filter Effluent Pumps will be metered and will receive a 0.5-1.5 mg/L dose of hypochlorite, at a point downstream of the effluent filters and upstream of the UV reactors, for adenovirus control.

- The effluent flow will be equally split among operating UV reactor trains and will receive a UV dose of 100-mJ/cm^2. After passing through the UV reactors, the treatment process will be considered complete and will be designated as "end of pipe". At this point, the plant effluent will be automatically sampled and grab samples will be taken for coliform.

- The UV effluent will be preferentially directed to the ES/CCTs for reuse storage and subsequently pumped by the Recycled Water Pump Station. Since free chlorination and storage of this effluent may lead to THMs, the provision for reuse water chloramination will be provided by having ammonia injection capability in the channels leading to the ES/CCTs. Hypochlorite will be added to the reuse flow as it enters the CCTs. Note that NDMA and THM formation in the irrigation reuse water will not be monitored since it is not regulated after "end of pipe".

- After the CCTs are filled, the plant effluent will automatically flow to the receiving water. Prior to leaving the plant, the flow will be monitored for chlorine residual and dechlorinated with sodium bisulfite if necessary.
- The effluent filters will be shock dosed with hypochlorite as necessary during the backwash operation to prevent filter growths.
- Backwashing will be provided by a dedicated backwash pump taking suction from ES/CCT No. 2 (west tank). The existing backwash system will be retained for standby backwashing capability.

b. General Discussion

A UV Disinfection System will be constructed and operated to act as the main mode in a multi-barrier disinfection scheme. For UV disinfection, the filter effluent flow will be equally split through parallel UV treatment trains fitted with multiple banks of lamps in series. The on/off operation of the UV trains and individual banks, including the variable power to the lamps, will be automatically controlled to achieve the appropriate UV dosage at DHS validated flowrates and transmissivity. Adenovirus will be inactivated by adding a low dose of sodium hypochlorite (0.5 –1.5 mg/L as chlorine) after effluent filtration and before the UV reactors. This low chlorine dose may or may not typically need dechlorination, depending on the dosage, the chlorine demand and the chemical addition point. The existing bisulfite system will remain operational in any case. The existing pre-chlorination and post-chlorination facilities using sodium hypochlorite will be retained as a standby system during peak storm flows and at other times when the UV reactors are either inadequate or unavailable for service.

The WNWRP effluent will be preferentially reused for irrigation via the Recycled Water Pump Station currently under construction, or discharged to the receiving water for reclamation purposes. The UV disinfected effluent that is not needed for irrigation reuse will be discharged via the effluent outfall piping to the Rio Hondo or San Gabriel River, where the reclaimed water is normally used for groundwater recharge and ultimately for indirect potable reuse. At the water purveyor's request, the irrigation reuse water will be chlorinated after UV disinfection to prevent growths in the distribution system. It will be stored in the ES/CCTs for subsequent pumping during nighttime hours.

A proposed backwash pump will use UV treated water for backwashing purposes and will take suction from an ES/CCT. Since the backwash water is taken downstream of the UV reactors, the UV system will not experience the large flow fluctuations associated with backwashing, as with the current operation. Although intuitively the use of UV disinfected water may seem inefficient, each backwash is only 0.1 million gallons. The waste of a small amount of UV treated water is acceptable in order to achieve a more stable disinfection process. This also prevents excessive startup and shutdown of the UV lamps, which can lead to premature aging and failure of the lamps.

Because the effluent filters will no longer be pre-chlorinated, all necessary piping and controls will be added so that a shock dose of hypochlorite can be added to the filters individually during the backwash cycle. Shock dosing will prevent biological growths from causing excessive headloss and filter blinding.

Since there is concern about NDMA formation from chloramination of precursors trapped in the filters, the filter waste backwash water will not be returned to the treatment process. This operational scheme is consistent with the current practice at all upstream WRPs to divert waste backwash flows to the sewer, per an agreement with the Los Angeles RWQCB. If a free chlorine residual were to be used for post-chlorination of the reuse water, the waste backwash could conceivably be recycled to the plant, since NDMA formation would be limited. However, since waste backwash recycling necessitates the use of a dedicated secondary clarifier, and the plant is clarifier limited, it is most likely that waste backwash will continue to be diverted to the sewer in order to free up the clarifier for secondary clarification and thereby increase the overall production of effluent.

Processes and facilities that will be modified and/or expanded include: chlorine contact tanks, filter backwash pumping and cleaning, chlorination, dechlorination and support facilities, such as in-plant process water systems and sampling systems.

c. System Operating Scheme

Figure No. 1 depicts an overall schematic of the proposed UV facilities and should be referenced for the discussion that follows. Refer also to **Part 5.3** of this report.

System operation will be as follows:

- Four(4) UV reactor trains will be fed from the existing CCT inlet channel (to be redesignated as the UV/CCT Inlet Channel. The channel sidewalls will be extended vertically to achieve the additional head requirement for UV treatment, while maximizing the capacity of the ES/CCTs for reuse storage.

- The UV reactor trains will be located in, and parallel to, the 2nd and 3rd passes of each existing CCT (relative to the exterior pass of each CCT as the 1st pass). The reactor trains will discharge to the UV Outlet Channel, a common channel perpendicular to the reactor trains. At low ES/CCT water levels, the channel will supply flow to individual Effluent Storage Channels, one for each ES/CCT. The flow in each channel will fill the corresponding ES/CCT from a position immediately downstream of the existing CCT inlet slide gate. The flow will be chlorinated before entering each ES/CCT. When the ES/CCTs are full, the water in the Effluent Storage and UV Outlet Channels will rise to an elevation where it overflows a weir leading to the Receiving Water Channels. The Receiving Water Channels will transfer flow into the existing Dechlorination Channel. The flow will then proceed over the existing final effluent weir and then to the Effluent Diversion Structure. Note that during the time that flow proceeds to the receiving water, gates in the Effluent Storage Channels will close to prevent diffusion of chlorine into the receiving water effluent.

- The UV reactor trains will each be provided with an inlet sluice gate that will either be fully open or closed, depending on whether the reactor train is on-line or off-line, respectively. Each reactor train will have three to five banks of lamps in series (to be determined from the system supplier proposals). The trains will be operated in parallel with equal flows. A differential pressure cell on each train will verify that an equal flow split is achieved. An automatic weir gate located on the effluent end will control the water level in the reactor trains. This control is essential to keep the water surface on the first bank from being too high and the water surface on the last bank from being too low. This control also ensures that all lamps are submerged if there is no flow to the reactor.

- The UV reactor trains will be supplied with an automatic drain valve into a header system that will allow partially disinfected water to be dumped to the plant sewer so that the UV reactor train can be serviced. This "off-spec" (inadequately disinfected) water will not be discharged as plant effluent. The piping arrangement will also allow an out of service reactor train to be filled from an operating reactor train prior to startup.

- The operational UV dosage will be controlled by the UV manufacturer's PLC and reported to the plant distributed control system. The operational does will be based on bioassayed validation studies of delivered UV dose. Operational dose is a function of flow/lamp, UVT, lamp power, as well as lamp aging and fouling. The individual banks in each train will be capable of being turned off, or turned down to approximately 50-60% power to lower the operational dose. Unnecessary starting and stopping of lamps or banks will be minimized as it shortens lamp life.

- The lamps will be provided with mechanical, and possibly chemical/mechanical, cleaning mechanisms to keep lamp sleeve fouling to a minimum. The sleeve cleaning cycle will be experimentally determined as it is site specific and depends on the chemical constituents of the water. Periodic manual cleaning, done by bank removal and soaking in an acid bath, will be necessary if a mechanical cleaning-only system is provided (Wedeco).

- In standby hypochlorite mode, the water level will rise in the ES/CCTs to the point that flow enters the Receiving Water Channels through an extended weir at the end of these channels. This flow must then be dechlorinated as it passes through the Dechlorination Channel before it flows to the receiving water.

5.2 UV Disinfection System.

1. General

Based on evaluations conducted to date and meetings with Districts' staff, a decision has been made to utilize an open channel system utilizing low pressure/high output (LP/HO) lamps.

Open channel systems are preferable to pressure vessel systems for wastewater applications because they facilitate inspection, cleaning and maintenance. Plans are to utilize four parallel UV reactor trains with inlet sluice gates and modulating outlet weirs. The trains would be built near deck level at the front end of four passes in the existing CCTs (Refer to Figure No. 1).

LP/HO lamps are the most efficient lamp technology for the production of a monochromatic output at a wavelength of 254 nm, which is close to the peak disinfection wavelength of 260 nm. Although a fewer number of medium pressure lamps could be used, these lamps produce polychromatic light over a broad band of wavelengths. This is less efficient on a power basis and leads to biological growths because of wavelengths in the visible spectrum. Medium pressure lamps also operate at higher temperatures, which promote greater lamp fouling. Low pressure/low output (LP/LO) lamps could also be used, but because their output is so low, approximately 4 times the number of LP/HO lamps would be necessary. Recently, there have been a number of UV facilities that have retrofitted their medium pressure or LP/LO systems to LP/HO systems. Some have abandoned their UV systems altogether. In lieu of California's past energy supply problems, the most reasonable and cost effective alternative is to use LP/HO lamps.

2. Comparison of Trojan and Wedeco UV Systems

Currently there are two leading manufacturers with multiple LPHO systems operating in North America. They are Trojan Technologies (Ontario, Canada) and Wedeco ITT (Charlotte, North Carolina). Both Trojan and Wedeco UV systems are open channel systems using horizontally mounted LPHO lamps. Both systems' lamp power can be automatically adjusted for variable flow and UVT conditions.

Wedeco has a slight power turndown advantage over Trojan, 50% vs. 60% respectively, and its turndown is linear whereas Trojan's is in stepped increments. Cool down is necessary to restart the lamps upon failure of each system. Guaranteed lamp life is approximately the same. Ballasts supply two lamps in each system. Wedeco's system can be configured to have module sizes of 2-20 lamps, in increments of two lamps, and the lamps of each module are aligned in two vertical columns. Trojan's modules can be configured with either 4, 6 or 8 lamps, with the 8-lamp module being preferable in larger facilities. The lamps of Trojan's modules are aligned in one vertical column.

One of the biggest differences is that Trojan's ballasts are mounted in the UV channel headspace for cooling purposes. These are typically NEMA 6P anodized aluminum enclosures that can withstand limited submergence. Wedeco's ballasts are located outside the channel in NEMA 4X 316 SS air-conditioned panels and or NEMA 12 panels located inside an air-conditioned building.

Another major difference is the automatic cleaning mechanisms. Wedeco has a mechanical-only wiper system and uses the NWRI default cleaning factor for sizing calculations. An acid bath chemical cleaning tank will be required for out of channel cleaning of Wedeco's UV lamp modules and banks. Trojan uses a combination chemical/mechanical wiper system, which results in an excellent fouling factor.

The following table compares some of the principal differences between the competitive systems:

Table 1.

General Comparison of Trojan and Wedeco UV Systems	Trojan UV 3000 Plus	Wedeco TAK55
Proposed Lamp Spacing	4-inch	4.7-inch
Lamp cleaning system	Chem/Mech	Mechanical
Power range	60-100%	50-100%
Power adjustment increments	3% steps	linear
Guaranteed lamp life at EOLL factor	9,000	8,760
Lamp input at full power	~ 250 watts	~310 watts
Fouling factor (FF)	0.95	0.80
End of lamp life factor (EOLL)	0.82	0.85
Combined lamp factor (FF x EOLL)	0.779	0.68
Lamp factor comparison (based on Wedeco lamp)	14.6 %	---

3. Reactor Validation Studies

All UV systems proposed for disinfection of water and wastewater in the State of California are to have a validation on file with DHS. Pertinent validations currently on file for Title 22 unrestricted reuse are as follows:

Table 2.

UV System	Lamp Spacing	Plant and Date	Location or Agency
Wedeco TAK55	120-mm (4.7-inch)	Dry Creek WRP, 2003	Roseville, CA
Trojan UV 3000 Plus	3.5-inch	Wild Horse Pass WRF, 2002	Wild Horse Pass, AZ
Trojan UV 3000 Plus	4.0-inch*	Whittier Narrows WRP, 2005	LACSD

*Note: the 4-inch validation has recently been accepted by the DHS (October 2005).

In the early stages of the Whittier Narrows project in late 2003/early 2004, plans were to have Districts' Research staff test both the Trojan and Wedeco UV systems on a pilot scale. A particular objective of the research was to determine the effectiveness of the systems in the inactivation of coliform at UV dosages of 100 mJ/cm^2 (the target dosage recommended by NWRI and DHS). Unfortunately, Wedeco did not have a UV pilot plant available for testing and so the research had to be limited to the Trojan system only. Fortunately, it was felt that the existing Wedeco validation could be utilized for the purposes of design, equipment procurement and operation.

At the time, the production version of the UV 3000 Plus System was only offered with LSI lamps at a 3.5-inch lamp spacing. After reviewing the associated validation report, the Districts discovered that the 3.5-inch lamp spacing did not optimize the system for the high transmittance water (72-80% UVT) typically produced at the Whittier Narrows plant. Specifically, the lamps were so close together that the system would dose considerably above the target of 100 mJ/cm^2 most of the time. Attempting to reduce dosage by increasing the flow/lamp was not possible because of headloss limitations associated with the close lamp spacing.

The pilot plant furnished by Trojan was capable of being configured with three different lamp spacings; 3-inch, 3.5-inch and 4-inch. After discussions with Trojan, a decision was made to validate the UV 3000 Plus pilot plant using LSI lamps at a 4-inch lamp spacing. Trojan agreed that this lamp spacing would allow the Districts to optimize performance and avoid overdosing and headloss problems.

Because the 4-inch UV 300 Plus system had not been validated previously, Trojan agreed to validate the system at their expense. To this end, they hired Carollo Engineers to conduct the validation tests at the Whittier Narrows plant, under the direction of Andy Salveson. The Districts had previously hired Carollo and Mr. Salveson as a consultant for the project. Although considerable time had been spent by Research and Design on the development of a test protocol that was to be the basis of the validation work, Trojan's decision to validate the system at their expense meant that Trojan and Carollo had the responsibility for the development and approval of the test protocol and validation.

The validation tests on the Trojan pilot plant were conducted during the summer of 2004 and were completed by the end of August. The Districts' Research Section conducted additional tests for coliform inactivation, cyanide and duplicate virus testing after the validation testing was completed. The validation data analysis, report writing and internal discussions at Trojan took many months after the validation tests were completed. The report was finally submitted to DHS in March of 2005. DHS provided comments to Trojan and Carollo in April 2005. Trojan and Carollo responded with a revised report in June 2005. That report was accepted by DHS in October, 2005.

Although DHS has recently accepted Trojan's system with 4-inch lamp spacing, is should be noted that the Districts took exception to Trojan's use of a linear regression to analyze the collimated beam bioassay data obtained during the research. A second analysis performed by the Districts used a non-linear regression (2nd order polynomial) to provide a better curve fit. Refer to Appendix D for a comparison of these methods. The Districts' method is more conservative at the UV dosages under consideration and will effectively be used to determine the minimum number of Trojan lamps required for this project.

It should also be noted that Trojan has recently completed testing at the WNWRP for the UV 3000 Plus System with a new lamp manufactured by Heraeus that is predicted to be 25-30% more efficient. It is the Districts' understanding that this test data will be submitted to DHS for approval in the near future. The new lamp will also need to have the factors for lamp life and fouling approved as well. Upon approval, the new lamps would be available for later use at the Whittier Narrows WRP. The new lamps, which currently are slightly shorter, will be able to replace the currently validated lamps either by the insertion of pin connectors or else be manufactured to the same dimensions of the currently validated LSI lamps.

4. UV System Supplier Selection Process

The UV equipment to be used on this project will be pre-selected based on an evaluation of proposals received from Trojan and Wedeco, the two manufacturers that have the experience and qualifications for this application. The proposals will be solicited by an RFP from the Districts. The proposals will be ranked on the basis of a 20-year life cycle cost, including both capital and maintenance expenses. The purchase agreement in the selected proposal will be offered by the System Supplier to the general contractor for the installation contract. Pre-selection of the UV System Supplier is necessary in order to finalize the design with regards to number of lamps, number of banks, channel dimensions, electrical requirements, appurtenant buildings and cleaning equipment, as these requirements can change from manufacturer to manufacturer. Pre-selection will expedite the overall procurement and construction process while also allowing the Districts to maintain tighter control over the procurement process.

5. Design Criteria

a) General

The UV Disinfection System Design Criteria is summarized in the following table:

Table 3.

Total Number of UV Reactor Trains	4
Peak Dry Weather UV Flow	21.0 MGD[1]
Peak Wet Weather UV Flow	24.2 MGD[2]
Typical Daily Low UVT	71%
Lowest Expected UVT	69%
Minimum UV Dosage Under Each of the Following Conditions: 21.0 MGD and 71% UVT with Standby[3] 24.2 MGD and 69% UVT without Standby[4]	100 mJ/cm^2

1. Corresponds to a peak sanitary effluent flow of 19.5 MGD with sidestreams.
2. Corresponds to a peak storm flow of 23.0 MGD with sidestreams.
3. With one UV train out of service
4. With all UV trains in service.

A discussion of applicable plant flows and UVT's follows.

b) Plant Flows

The WNWRP was the first water reclamation plant built by the Districts and was completed in 1962. It was originally designed for conventional activated sludge treatment (and nitrification) with an average plant capacity of 12 MGD (on an effluent basis), but was later re-rated for an average plant capacity of 15 MGD (with partial nitrification). Due to its relatively small size compared to other plants, and the flexibility of being able to bypass flow without problems, the WNWRP has been used extensively for full-scale research purposes.

During research and subsequent operation in an NDN mode with an MLE configuration (since 1996), it was apparent that the plant was no longer capable of treating an average plant flow of 15 MGD at the higher level of treatment required (incorporating both anoxic and aerobic zones within the same tank volume). Because an NDN system operates at higher MCRTs, oxygen demands and D.O. levels, the existing process air compressors and RAS pumps are undersized. Currently, the plant is being operated with only two of three aeration tanks on line and is treating an average plant flow of approximately 9 MGD.

After the RAS and air systems are upgraded, it is expected that the plant will be capable of treating an average plant flow of 13 MGD. In order to achieve an average plant capacity of 15 MGD, additional secondary clarifiers would be required. There are no plans to do this, since for the time being, Districts' management has decided not to build any more tankage in the Whittier Narrows floodplain. The UV system is being designed based on peak flows (which include any additional flows above the peak effluent flows), and will be capable of disinfecting the peak flows associated with operation at average plant flows of 15 MGD.

The following design flows are proposed for this project:

Table 4.

Plant Effluent Flows	Plant Effluent Design Flow (MGD)	UV System Design Flow (MGD)	UV System Design Flow (Ratio to Average UV System Flow)
Average Flow	13.0	13.5	1.00
Minimum Flow	6.0	6.0	0.44
Peak Sanitary Flow	19.5	21.0	1.56
Peak Storm Flow	23.0	24.2	1.79

Refer to Appendix A for histogram and probability plots of effluent flow data. The more current data shown for the period October 1, 1994 to September 30, 2005 is felt to be more applicable. It can be seen that during dry weather, the peak sanitary flow is less than 19.5 MGD over 99% of the time. Furthermore, during wet weather, the peak storm flow is less than 23 MGD approximately 99% of the time. These flows are the peak plant effluent flows shown in Table 4 above. Note that with all reactors in service at typical UVTs, the UV system will be capable of disinfecting the highest recorded storm flow of the past 20 years (25.8 MGD). Note that this historical peak storm flow is unlikely to be seen in the near future, since much of the JOB sewer flow has been diverted to SJC WRP Stages Two and Three via the construction of the SJC Interceptor.

The WNWRP is technically a scalping plant without solids handling, and as such, sludge and backwash recovery flows are returned to the sewer (ahead of the proposed UV system) for further processing at the JWPCP. Other flows that will not contribute to the plant effluent flow will have to be treated by the UV system. As a result, total amount of flow that will be treated by the UV system is greater than the plant effluent flow. A summary of the internal plant (sidestream) flows, prorated for an average plant effluent flow of 15 MGD, is shown in the following table:

Table 5.

Miscellaneous Plant Flows	Instantaneous Flow (gpm)	Flow Duration	Flow Destination	Instantaneous Flow Contribution to UV at Peak Sanitary Flow (gpm)
Primary Sludge	35	24 hrs/day	To sewer, before UV	0
Waste Act. Sludge	139	24 hrs/day	To sewer, before UV	0
Skimmings	278	24 hrs/day	To sewer, before UV	0
Washwater & CDW[1]	208	24 hrs/day	To UV	144
Norman's Nursery	236	12 hrs/day	To UV	236
Waste Backwash	6700	15 min/bw	To sewer, before UV	0
Filter Draindown[2]	694	30 min//bw	To UV	694
Total Additional Flow to UV[3]				1,074 Approx. 1.5 MGD

Notes: 1. Washwater and CDW (chemical dilution water) are assumed to be recycled at 60%.
2. Current filter draindown of 3 MGD over 10 minutes will be limited to 1.0 MGD over 30 minutes following implementation of UV disinfection.
3. In addition to the plant effluent flow.

The above flows have been added as appropriate to the plant effluent design flows to obtain the UV system design flows in Table 4. Note that it has been assumed that water for Norman's Nursery will not be required during a storm.

c) Plant UV Transmittance (UVT)

Based on an analysis of UVT data collected over the past year and presented in Appendix B of this report, the effluent from the WNWRP typically varies between 72% and 78% UVT on a diurnal basis. This inference can be made from data collected when there was confidence in the on-line UVT analyzer, i.e., when the analyzer results closely matched grab samples analyzed with spectroscopy. Occasionally the on-line UVT data dipped to 70%. Although rare, even lower UVTs were encountered at times, and may have been due to calibration issues with the on-line analyzer. Over the course of the year with the plant in operation, no grab samples were ever analyzed with UVTs lower than 69.0%. A reading of 68.0% was obtained on a UVT grab sample when the plant was off-line for a short time.

Since UV systems need to be designed conservatively, the proposed design UVT at peak sanitary flow will be 71%. A 69% design UVT will be used under peak storm flow conditions. The design UVTs selected should provide for conservatism in the event of:

- an occasional errant industrial discharge or temporary plant upset
- plant operational stress as higher average flows are treated at the plant
- on-line analyzer drift

It should be noted that UV systems do not have a lot of flexibility to ramp down. As a result, care should be taken not to make the design UVT too conservative, which can result in an overdose at lower flows and higher UVTs, as well as increased maintenance and capital costs.

6. UV Equipment Sizing

a) Number of Reactor Trains

As noted previously, four new UV reactor trains will be provided, each capable of treating 7.0 MGD of flow at 71% UVT. This will allow UV system flows of 21 MGD (peak sanitary flows of 19.5 MGD plus sidestreams) to be met with one reactor train out of service. Higher flows per train will be possible when the UVT is greater than 71%, although limited by the allowable reactor train headloss (essentially equal to half the lamp spacing with the lamps of the last bank half submerged). With the standby train in operation at typical UVTs, the UV system will be capable of disinfecting the highest recorded peak storm event. During normal operation, two UV reactors trains should be enough to treat an average plant effluent flow of 13 MGD, with typical UVT's above 70 %.

b) Number of Banks/Modules/Lamps

Each reactor train will be fitted with multiple banks of lamps, with each bank contributing to a measurable amount of headloss. A minimum of two banks is required per NWRI Guidelines. Anywhere from three to five banks will be provided per train, depending on the manufacturers system limitations. Note that system headloss is a particular concern.

From preliminary calculations based on the design conditions discussed previously, assuming four reactor trains, and after assessing headloss constraints, it appears that a four-bank system would be the best configuration for both manufacturers. The Trojan system would have 8 lamps per module and each bank would contain an 8 deep × 7 wide array of 56 lamps for a total of 896 lamps. Wedeco would have 18 lamps per module and each bank would contain a 9 deep × 8 wide array of 72 lamps for a total of 1152 lamps. Refer to Appendix C for preliminary UV equipment sizing determinations.

A summary of these results follows.

Table 6.

Sizing of Trojan and Wedeco UV Systems	Trojan UV 3000 Plus 4-inch	Wedeco TAK55 4.7-inch
Number of Banks	4	4
Bank Lamp Array	8 deep 7 wide	9 deep 8 wide
Total No. of Lamps at Plant Design Condition	896	1152
Required gpm/lamp/bank at Design Condition	86.8	67.5
Headloss for 4 banks at Design Flow	1.73 in	1.57 in
Total Connected Power	224 kW	357 kW
Turndown (2 Banks at Low Power Relative to 4 Banks at Full Power)	30%	25%
Nominal Channel Depth (Lamp Spacing x No. of Vertical Lamps)	32.0 in	42.6 in
Nominal Channel Width (i.d.)	28.0 in	37.4 in

7. Reliability and Redundancy

The NWRI Guidelines require that either a standby train or a standby bank on each train be provided. Otherwise, some sort of contingency plan must be provided for equipment failure. At the WNWRP, reliability and redundancy concerns are addressed by the following:

- A standby reactor train will be available during peak sanitary flow conditions at the design UVT.
- The sodium hypochlorite disinfection system will remain. It will serve as a standby system during peak storm events. This approach will be acceptable to water regulators since any DBPs produced by chlorination during this time will not enter the groundwater recharge operation. It is also possible that the chlorinated flow can be stored in the ES/CCTs if the tanks are not full at the time of the UV system failure.

- There are redundant (two) electrical power feeds that supply the plant.
- The UV system will not normally be operating under limiting conditions of flow or UVT. There will normally be additional banks or trains available.
- The plant influent flow can be varied over a wide range, since the plant is not an "end of the line" plant.
- Secondary effluent can directed to the sewer, except during some storm events.

8. DHS Approvals

a) Reactor Equipment Validation Reports

UV systems are validated to determine disinfection performance over a range of operating conditions (flows/lamp and UVTs). The validation tests are typically conducted in accordance with NWRI Guidelines and must be approved by DHS. The inactivation of a target organism (MS2) is quantified and related to collimated beam studies at known UV dosages. Comparisons of the reactor and the collimated beam inactivation are used to establish the delivered UV dose response of the reactor. The regression equation(s) that is developed in the equipment validation report must be approved by DHS. It is used for reactor sizing and to control the UV system at the target operational dose.

Design and operational allowances must be made for the lamp sleeve cleaning system and lamp age as well. Unless NWRI default factors are used, these issues must be validated and approved by the DHS. This testing generates the fouling factor (FF) and end of lamp life (EOLL - the relative intensity at the end of lamp life) factor, which are also used for reactor sizing and to control the UV system at the target operational dose.

b) Engineering Report

Prior to implementation of the UV disinfection system, an Engineering Report must be submitted to the DHS. An abbreviated report is acceptable if the proposed modifications solely involve the replacement of existing disinfection processes with UV disinfection as long as it provides an evaluation of how the new system will integrate with the new treatment process. Items that the Engineering Report should include are the following:

- The UV disinfection system design basis, including reactor train layout and dimensions
- The specific type of equipment being provided with the equipment validation report appended.
- Monitoring and control description, including the method to determine the operational UV dose
- Water levels, water level control device and velocity ranges

- Sampling information
- UV system reliability features
- Contingency plans for lamp breakage, power interruptions, activation of standby equipment and failure of the upstream treatment processes or UV system.
- Operator training program and O&M plans

The Districts are responsible for filing an engineering report with the DHS and the RWQCB for any material change or proposed change in character, location, or volume of the reclaimed water or its use. This is per Section 13522.5 of the California Water Code and Section 60323 of the California Wastewater Reclamation Criteria. Additionally, the reclaiming agency is responsible for ensuring that all users of reclaimed water comply with the specification and requirements for such use.

c) Field Commissioning Report

Per the NWRI Guidelines, after the UV facilities are complete, a field commissioning report is required to be submitted to, and approved by, DHS. The report summarizes the results of field acceptance testing demonstrating the satisfactory performance of the system.

9. Future UV Facility Expansion

The proposed UV facilities have been laid out with expansion in mind. There is space for additional UV trains to be located between the proposed trains if expansion of an open channel system is required. This could be a consideration if the plant flow is increased or, to a lesser extent, if disinfection or DBP requirements become more stringent in the future.

A more difficult challenge would be posed if the Notification Level (10 ng/L - formerly called the Action Level) of NDMA ever becomes an end of pipe limit. At this point, NDMA destruction would certainly control the design, as NDMA destruction requires many times the power necessary for disinfection. In this case, the open channel systems currently on the market would be inadequate and pressure vessel reactors would certainly be necessary. In addition, it is questionable whether LP/HO lamps would be able to deliver the high UV intensities required in an acceptable footprint. For this reason, the provision of medium pressure lamps in closed vessels might be necessary. Finally, because of the higher headloss associated with the closed vessel reactors, the filter effluent pumps would have to be changed out to pumps capable of pumping higher head. These units could conceivably pump the effluent through the closed vessels and then through the open channel system, if the latter system has any useful life or benefit remaining.

10. Crane Options

Cranes will be provided per manufacturer's recommendations to allow either a module or entire bank to be removed from the channel. Bridge, jib or davit cranes could be provided. The crane capacity will depend on the number of lamps in one module or the number of modules in one bank. For instance, each Trojan module weighs approximately 110 lbs. If seven modules are installed in a bank, the resulting weight is approximately 950 lbs (includes the bank frame). A half-ton crane should be sufficient for this type of load. Smaller davit cranes could be provided if only modules are to be removed. Space will also have to be allotted in the design for a module and/or bank holder on top of the deck.

5.3 Effluent Conveyance System.

The following section briefly describes how the effluent will be metered and conveyed with the UV Disinfection Facilities Project.

a. Effluent Filters

Filter drain down will be limited to 1 MGD to prevent the UV reactors from seeing large flow fluctuations. Currently, filter draindown occurs rapidly and adds about 3 MGD to the effluent flow. This is equivalent to the filter draining approximately 6 ft, or about 11,500 gallons over the course of 5.5 minutes.

b. Filter Effluent/Backwash Pump Station

The existing filter effluent/backwash pumps will remain in service. After UV disinfection is implemented, the existing pumps will normally be dedicated for effluent pumping only, however, they will provide backup for filter effluent backwashing in the case where the proposed backwash pump is inoperable. The existing filter effluent/backwash pumps may see a slightly increased head because of modifications due to construction of the UV facilities.

c. Metering of Flow to UV

The existing magmeter on the discharge line of the filter effluent pumps, which is not operational at this time, will be replaced. Accurate flow measurement to the UV reactors is necessary to calculate the operational UV dosage. In order to produce a full pipe for metering purposes, either the pipeline downstream of the meter will be restricted, or it will be modified to contain a short vertical section. Alternatively, the flowmeter can be replaced with a magmeter that is able to measure a pipe flowing partially full.

d. UV/CCT Inlet Channel

The UV reactors will be fed from the existing CCT inlet channel (to be redesignated as the UV/CCT Inlet Channel). This inlet channel will have its sidewalls extended vertically for free board and to achieve the additional head requirement for the UV treatment, while maximizing the capacity of the ES/CCTs for reuse storage.

e. UV Reactors

Each reactor train will be fitted with automatic inlet gates (full open/close). The UV reactors can tolerate headloss that is approximately half the lamp spacing from the first bank of lamps to the last bank of lamps. The water level in each reactor will be controlled by an ultrasonic level sensor, so that the lamps in the last bank are at least half submerged for cooling purposes. Level control will be performed by a modulating weir gate (downward opening), which is located at the end of the reactor train. Some head will be lost as flow proceeds over the gate and then freefalls afterwards. The upper limit of the weir gate will be set so that the ballasts of the Trojan system will not be submerged under any condition. A differential pressure (DP) cell monitoring the change in water level from the inlet to outlet of each reactor train will provide flow split characterizations. One DP cell could be provided for each reactor train, or one DP cell could be manifolded to all reactor trains so that flow splits can be more reliably compared. A drain line connection on the effluent end of the UV reactor to the plant sewer will be provided for maintenance purposes.

f. UV Outlet Channel and Effluent Storage Channels

The effluent of the UV reactor trains will fall into the UV Outlet Channel that will direct the effluent to the Receiving Water Channels via the Outlet Channel weir, or to one of the two Effluent Storage Channels for reuse storage via the ES/CCTs. As long as storage volume is available, the UV reactor effluent will not develop the necessary head to overflow the UV Outlet Channel weir and the effluent will preferentially flow to storage in the ES/CCTs. Prior to entering the ES/CCT, hypochlorite (and possibly ammonia) will be added to the effluent to provide the chlorine residual in the reuse distribution system. Mixers and/or mixing tabs will be provided in the Effluent Storage Channels as necessary. Once the ES/CCTs are full, the slide gates in the Effluent Storage Channels will close to prevent the diffusion of chlorine to the water in the UV Outlet Channel.

g. UV Receiving Water Channels/Ultimate Disposal

Once the ES/CCTs are full, the water surface in the Effluent Storage Channels will rise until water overflows the UV Outlet Channel weir. The water will then flow into separate Receiving Water Channels to the existing Dechlorination Channel and then to the pipeline leading to the Effluent Diversion Structure and outfall system.

h. Effluent Storage/Chlorine Contact Tanks (ES/CCTs)

Refer to Part 4.1 of this report.

i. Recycled Water Pump Station.

Refer to Part 4.1 of this report.

j. Norman's Nursery Reuse Pump

The existing reuse pump is a Districts-supplied pump that delivers Title 22 disinfected tertiary effluent to Norman's Nursery, which is located on sub-leased property adjacent to the WNWRP.

The pump takes suction from the end of either or both CCTs, depending on the operational position of the valves immediately south of the dechlorination channel. The suction lines are located approximately 18 inches above ground level and extend through the dechlorination channel into the CCTs. Normally, if both CCTs are in service, both valves are open.

Operation of the Norman's Nursery pump is on an as-needed basis. During dry weather conditions, the nursery plants are watered every other day for approximately 10 hours. An employee from Norman's Nursery enters the WNWRP through an opening in the fence between the adjacent properties and turns the reuse pump on without plant operator involvement. When the watering is finished, Nursery personnel typically turn the pump off.

A meter on the pump discharge line records the total amount of water used for billing purposes. The Norman's Nursery flow is added to other effluent flows to total the WNWRP effluent flow. The reuse flowmeter, and the rights to sell the reuse water, are owned by the San Gabriel Valley Water Company; the same water retailer that will sell the reuse water from the proposed project constructed by USGVMWD (the local water wholesaler) to the Whittier Narrows Dam Recreation Area.

Table 7. Existing Norman's Nursery Reuse Pump

Reuse Water System	Number	Capacity Each	TDH	Horsepower	Total Additive Capacity
Norman's Nursery Pump	1	250 gpm	260 ft	30 HP	250 gpm

5.4 Sodium Hypochlorite/Sodium Bisulfite System.

a. Existing System

Existing disinfection at the WNWRP is accomplished by chloramination, using sodium hypochlorite as the source of chlorine. The sodium hypochlorite is delivered as a 12.5% Cl2 solution and stored in two elevated storage tanks. Two different modes exist for the chlorine addition, pre-chlorination and post-chlorination. Pre-chlorination, where chlorine addition occurs upstream of the effluent filters is preferred to post-chlorination, where it occurs downstream of the effluent filters. In addition to disinfection, pre-chlorination reduces the biological growths and the associated increased headloss that tend to produce filter blinding. In the pre-chlorination mode, the hypochlorite flow is injected and mechanically mixed into the secondary effluent in the chemical preconditioning tank, where alum is also added. Immediately upstream of the preconditioning tank, a small amount of ammonia is added and blended into the secondary effluent. This is done in order to form chloramines (instead of having a free chlorine residual) upon addition of hypochlorite. This is necessary because practically all ammonia is removed in the existing nitrification/denitrification activated sludge process at the WNWRP. Free chlorine enhances the formation of trihalomethanes, which are unwanted and regulated disinfection byproducts.

Following chlorination and gravity filtration, flow is pumped by the filter effluent pumps into the two existing chlorine contact tanks. The effluent flow then passes through the existing common Dechlorination Channel, where it is dechlorinated with an excess of sodium bisulfite. Dechlorination is necessary so that residual chlorine, which is harmful to aquatic life, does not reach the receiving waters. The plant effluent is then discharged via pipeline to the effluent diversion structure where the flow can be directed to the Rio Hondo or San Gabriel River. In addition, a small portion of the plant effluent is pumped directly from the CCTs without dechlorination to Norman's Nursery, which is located to the north and east of the plant.

The existing disinfection facilities include an aqueous ammonia storage tank, sodium hypochlorite storage tanks, pre-chlorination mixers, post-chlorination mixer, chlorine contact tanks, sodium bisulfite storage tanks and associated metering systems to adequately dose and control chemical flows. Design criteria associated with the existing disinfection facilities are listed in **Table 8**.

Table 8. Existing Chlorination/Dechlorination System Design Criteria

CHLORINE CONTACT TANKS	
No. of Tanks	2
No. of Passes per Tank	5
Length of Tank	131.00 ft
Inside Width of Tank	42.25 ft
Average Water Depth	15.74 ft
Volume of Two Tanks	1,303,000 gal
Contact Time at Avg. Plant Flow (15 MGD)	125 min
Contact time at Peak Sanitary Flow (20 MGD)	94 min
Contact time at Peak Storm Flow (25 MGD)	75 min
Drain Pump	180 gpm @ 25 ft TDH, 3 HP
SODIUM HYPOCHLORITE TANKS	
No. of Tanks	2
Capacity per Tank	15,250 gal
Usable Volume per Tank	14,000 gal
Tank Dimensions	14 ft diameter, 13.25 ft height
Type of Feed	Gravity
Solution Strength	12.5% as Cl2
SODIUM BISULFITE TANKS	
No. of Tanks	2
Capacity per Tank	8,000 gal
Usable Volume per Tank	7,200 gal
Tank Dimensions	11 ft diameter, 11.25 ft height
Type of Feed	Gravity
Solution Strength	25%
AMMONIA TANK	
No. of Tanks	1
Capacity per Tank	6500 gal
Usable Volume per Tank	5500 gal
Tank Dimensions	10 ft diameter, 11.0 ft height
Solution Strength	19.5%
Type of Feed	Pumped
Feed Pump	Variable Speed Peristaltic, 0.0 to 0.1 gpm

a. Proposed System

1. Disinfection of Adenovirus

For a discussion of the epidemiological concerns associated with adenovirus, refer to Appendix E.

a) Dosage Requirement

The Districts cannot typically achieve the 450 CT requirement (the product of the chlorine residual in mg/L and contact time in minutes = 450 mg/L-min) and the 90-minute modal contact time at reuse facilities. In lieu of meeting these requirements, the Districts have historically performed virus testing on a monthly basis for the past 20 years to show that viruses are not present in the effluent. To date, after numerous samples disinfected by chlorination, there have only been 2 positive virus tests. Although implementation of a UV system should make the CT requirements moot issues, the virus testing is written in the recharge permit and therefore will be necessary for some time after the implementation of UV. In order to achieve non-detectable virus levels, a multi-barrier disinfection approach will be implemented. In addition to the UV irradiation, the effluent will be chlorinated at a low dose of approximately 0.5 to 1.5 mg/L as chlorine. At these low levels, there will be insufficient contact time to produce DBPs. The utilization of chlorine as a disinfectant inherently poses a risk of occasional residual exceedances, especially due to equipment and instrumentation malfunction. This risk will still exist at the low chlorine dosage necessary for adenovirus inactivation, but the risk should be smaller since UV will be the primary disinfectant. However, it may be advisable to operate with a low dose of bisulfite constantly being fed into the system (setup to dechlorinate approximately half the dose of chlorine applied), when it is sensed that the ES/CCTs are full and flow proceeds to the receiving water.

b) Contact and Detention Time

It is also necessary to achieve a minimum contact time of the chlorine with the effluent. Although the modal contact time (MCT) is probably the most applicable parameter when it comes to contact time, the hydraulic detention time (HDT) can be used as a measure of the upper limit of the MCT. At a chlorine dosage of 0.5 to 1.5 mg/L, it is estimated that an HRT of approximately 5 minutes would be needed to guarantee complete inactivation of adenovirus. Since the volume of the channels and the UV reactor trains is relatively fixed (except that the total volume of the reactor trains is a function of the number of reactors on-line) chlorine dosage concentrations will have to be maintained by the DCS to keep the mathematical product of chlorine dosage concentration and contact time in an acceptable range. If the product is too high, the DBPs may increase; if it is too low, adenovirus may not be sufficiently inactivated.

The actual detention time that can be assigned to the UV reactors will ultimately depend on the selected UV manufacturer and ultimately, the volume of the UV reactors. At the peak sanitary flow plus sidestreams of 21 MGD, the filter effluent flume and Filter Effluent Pump Station wetwell contribute 0.22 and 2.76 minutes of detention time, respectively. The wetwell suffers from hydraulic problems (it more closely resembles a continuously stirred tank reactor, or CSTR, rather than a plug flow reactor). The ES/CCT Inlet Channel that feeds the UV reactor will provide an additional 1.25 minutes of contact time assuming that 40% of the channel volume is available (this percentage is a function of the channel hydraulics and the particular UV reactor trains that are in service). At the design flow of 21 MGD, approximately 0.56 minutes of detention time will be experienced in the three UV reactor trains. This estimate is approximate and is based on a four bank per train system, after accounting for the volume of the sleeves and mounting brackets. By adding up all these contributions, a detention time of 4.8 minutes is obtained at 21 MGD. Note that there will be some contact time in the effluent channels after the UV system, prior to dechlorination. Contact time determinations are presented in Appendix E.

Another option would be to chlorinate at the existing pre-chlorination point. While this scheme would provide enough contact time, it is probably not advisable to add chlorine ahead of the effluent filters on a long-term basis due to DBP formation. This option would almost certainly ensure that there would be no residual remaining at the point of dechlorination. Another option would be to reserve some of the volume of the contact tank for adenovirus inactivation, but unfortunately this is at the expense of valuable reservoir storage.

c) Proposed Additional Controls

In the future, the Districts may want to consider installing oxidation/reduction potential (ORP) probes to better control low-level disinfection. Although chlorine dosage can be approximated with good metering, the strength of hypochlorite is not constant and fluctuations in ammonia may cause the disinfection system to switch back and forth between free chlorination and chloramination, thus affecting the disinfection of adenovirus. According to White's Handbook of Chlorination, ORP is a measure of disinfection regardless of chlorine species. ORP control may be the best method to control at low chlorine dosages, while also reducing the amount of chemical used and the quantity of DBPs formed.

2. Standby Disinfection for the UV System

The existing ability to add sodium hypochlorite as a primary means of disinfection will be retained to serve as a backup or standby system when the UV system is down. Hypochlorite addition will also be used when the UV system capacity is exceeded in a storm event (typically with one or more UV channels out of service) or when the UVT of the effluent falls to a value outside the validated range of the UV equipment.

3. Chlorine Residual for the Irrigation Reuse Distribution System

a) General

After applying a low chlorine dosage to all of the plant effluent for adenovirus disinfection, and following disinfection of all the plant effluent with UV, the effluent directed to irrigation reuse will be chlorinated with hypochlorite to provide a residual in the effluent storage/reuse distribution system. Chlorine residual is desirable to prevent biological growth in the distribution system. If these growths are not prevented, there could be odors associated with the reuse water, increased frictional resistance in the reuse pipeline (leading to higher power requirements) and plugging of irrigation nozzles. Injection of hypochlorite also helps to keep the ES/CCTs free of biological growths, which can harbor coliform bacteria and also contribute to problems with bacterial regrowth. It is necessary to keep the ES/CCTs relatively coliform free, since the ES/CCTs will be used for contact time when the WNWRP is in standby chlorination mode.

Although providing a chlorine residual for the irrigation reuse water after UV disinfection at first seems counterintuitive, it should be noted that the Districts' treatment process will be considered complete and designated "end of pipe" immediately after the UV process. The UV effluent will be sampled for monitoring and reporting purposes to determine compliance with all permits (reuse, reclamation and receiving water). Downstream of the sampling point, the effluent will be discharged either to receiving waters for possible groundwater recharge or diverted to reuse storage in the ES/CCTs after chlorination. This scheme is acceptable from a regulatory perspective.

The reuse chlorine residual being provided by the Districts is really a service that the Districts are performing for, and at the expense of, USGVMWD. This arrangement allows the Districts to recoup some of the capital costs associated with the chlorination facilities, which must be kept fully operational as standby for the UV system. The Districts will also benefit in that a portion of the chlorinated water will be used for plant washwater purposes (not billed to USGVMWD).

b) Free Chlorine Versus Chloramination

The reuse purveyor has requested that a free chlorine residual be provided. After considering the environmental impacts, the Districts have decided to provide an option for chloramination as well. Since the reuse water may initially be stored in the ES/CCTs approximately 12-14 hours, a free chlorine residual may result in elevated THMs to the first reuse customer. In order to discourage THM formation, aqueous ammonia will be added (approximately 2 mg/L) to produce a chloramine residual. Although chloramination can be expected to result in NDMA formation, NDMA will be less of a concern for irrigation water than THMs, since NDMA is primarily an ingestion hazard, while THMs can also be an inhalation hazard. The chloramine will also result in a longer lasting and more stable residual than the free chlorine. Furthermore, since the amine portion of the chloramine reverts back to ammonia when the chlorine dissipates, the water will actually have a small fertilizer value for plants. Capability for ammonia addition will be provided in the Effluent Storage Channels going to the ES/CCTs and blended with mixers or mixing tabs.

Because of the uncertainty of continued ammonia addition in the future, it is not recommended at this time to upgrade the existing aqueous ammonia storage tank at the WNWRP to the standards of other recently constructed ammonia facilities at other WRPs. This means the existing fiberglass tank, which is vented to the atmosphere and provided with PVC piping, will not be changed to pressurized (unvented) carbon steel vessels and piping.

c) Proposed Chlorine Mixers

Sodium hypochlorite will be injected in the Effluent Storage Channels before the UV disinfected water drops into the ES/CCTs. It is anticipated that some mechanical flash mixing may be necessary during certain operating conditions. When the ES/CCT water levels are low, mixing of the hypochlorite should occur as a result of the turbulence associated with the drop from the channel above. However, when the ES/CCTs are relatively full, the hydraulic mixing associated with the drop is expected to disappear. Because of this, a 10-15 HP chemical flash mixer will be provided in each Effluent Storage Channel and will be operated automatically when the water in the ES/CCTs reaches a certain level.

4. Filter Growth Control

Hypochlorite piping and solenoid controls will be provided for each filter so that the filter can be chlorinated during the air scour portion of the backwash cycle. With the implementation of UV disinfection, pre-chlorination (the addition of chlorine before the effluent filters) will be discontinued. In order to prevent biological growths from blinding the filters and creating headloss problems and excessive backwashing, the filters will need to be shocked dosed with hypochlorite solution on an intermittent basis (approximately once or twice per week). This would probably be most effective during the air purge of the backwash cycle. At this point in the cycle, the filter has been drained so that the water surface over the bed is at its lowest point. This will reduce the hypochlorite requirement. The dosage requirement is expected to be around 50 ppm as Cl_2. The air scour should provide good mixing so that all the media is contacted. It may also be beneficial to increase the scour part of the cycle to increase the contact time. Since chlorination of organics is known to increase DBP's, this water will be wasted to the sewer, via the backwash recovery wetwell and pump station, for ultimate treatment at the JWPCP.

5.5 <u>Effluent Filter Backwash System</u>.

a. Existing System

The existing filter effluent pumps provide the filter backwash capability at the WNWRP. These pumps are always operated to maintain a set point level in the pump station wetwell. Approximately 13 mgd is needed for a backwash. If the plant flow is 13 MGD or above, the backwash portion of the effluent flow is directed to the filter being backwashed. If the plant flow is less than 13 mgd, additional "make-up (recirculation)" water is pulled from the CCTs, via the CCT Inlet Channel. This make-up water flows by gravity through a manually operated sluice gate in the side of the pump station wetwell. This water is then pumped with the rest of the backwash water to the filter being cleaned.

In addition to the local, on-off backwash valve for each filter, the system depends on two automatically positioned valves as follows. At the onset of a backwash, in the discharge pipeline from the pump station, a distribution valve goes to a set position to increase the system pressure. This is necessary to develop the head necessary for backwashing. A backwash pipeline to the filters originates from the pump station discharge pipeline upstream of the distribution valve. The master backwash valve in the backwash pipeline modulates to deliver the required flow to the filter being cleaned.

b. Proposed System

During normal operation, the three existing filter effluent/backwash pumps will be used for effluent pumping only. A dedicated backwash pump will utilize water that has been UV disinfected and stored in the ES/CCTs. Utilizing water taken downstream of the UV reactors will prevent the reactors from seeing large flow fluctuations. By using a stored water source, it will be possible to backwash at required flowrates at lower plant flows. Since the water entering the ES/CCTs will be chlorinated, and because hypochlorite will be added to the filters during the backwash cycle, waste backwash water will not be recovered (recycled to the plant) but instead will be wasted to the sewer (an approximate average of 0.3 MGD if individual filter backwashing is performed every 48 hours). This is consistent with the Districts' promise to the RWQCB that backwash at the WRPs will not be recycled, since it was discovered that backwash contains large amounts of NDMA.

The following are backwash pump design options:

- Provide a dedicated backwash pump inside CCT No. 2
- Provide a dedicated canned backwash pump inside CCT No. 2 (west)
- Provide a dedicated canned backwash pump on west side of CCT No. 2
- Install a backwash line off of the Recycled Water Pump Station discharge line and provide pressure reduction
- Provide a dedicated canned backwash pump at the empty pump bay at the Filter Effluent Pump Station with suction line connected to the CCT No. 2.

Other options for the pump were considered, but are considered to be less desirable. These options included putting the new backwash pump at the Recycled Water Pump Station, as well as remotely locating the pump but taking suction from the Recycled Water Pump Station through a pipeline.

The preferred alternative for the proposed backwash pump is to provide a dedicated pump inside CCT No. 2. The discharge piping will be hung on the west side of the CCT, along the top of the filter effluent pump discharge manifold, and then connected and valved to the existing backwash piping. A dedicated standby pump will not be provided. Instead, the existing filter effluent/backwash system will be used as standby in case the dedicated backwash pump is not available. Operation of the aforementioned recirculation valve into the filter effluent wetwell will no longer be required.

Table 9. Proposed Backwash Pump Design Criteria

Water System	Number	Capacity	TDH	Horsepower
Backwash (BW)	1	10,250 gpm	25 ft	100 HP

The actual head requirement for the backwash pump will be verified by field-testing the system curve for the backwash piping and media expansion. In addition, since the level of the ES/CCTs will vary due to reuse storage and utilization, it may be beneficial to provide a VFC on this pump to handle the varying head requirement.

5.6 In-Plant Process Water System.

a. Existing Systems

There are four existing process water systems at the WNWRP that utilize plant effluent for various in-plant needs. These are the foam spray, washwater, chemical dilution water and firewater systems.

1. Foam Spray

The existing foam spray system has been out of service for many years and currently is not functional. It formerly supplied water for aeration tank foam control. Prior to NDN operation, the WNWRP was operated in a different activated sludge mode with aeration of the return sludge at the beginning of the aeration tanks. Because complete nitrification was not necessary, foam in the aeration tanks was eventually controlled by reducing the MCRT (thinning the mixed liquor). When the mode of operation changed to NDN, the increased MCRT associated with this process once again led to foam problems. This time the foam problem was controlled by continuous cationic polymer addition into the return sludge. This was opposed to the former operation where polymer addition was implemented occasionally during high SVI episodes. Because cationic polymer is manufactured from NDMA precursors, and chloramination of precursors were linked to NDMA formation during disinfection, the WNWRP was operated without polymer for a length of time. After going two months without cationic polymer addition the foam reappeared, and polymer addition was reinstituted, albeit at a reduced amount. Currently, there are no plans to make the existing foam spray pumps operational.

2. Washwater System

The existing washwater system supplies water for hose bibs, polymer make-up and secondary clarifier water sprays. Washwater is also used for plant irrigation during early morning hours, when operators are not typically using the system for other purposes.

3. Chemical Dilution Water System

The chemical dilution water (CDW) pumps are not currently operated as a separate system, as there is very little need for chemical dilution and considerably more need for washwater pressure. One CDW pump is currently run in parallel with one washwater pump, and both pump into the CDW and washwater discharge headers. CDW needs at the plant have diminished since dry polymer, gaseous chlorine and sulfur dioxide have been replaced with other chemicals. Currently sodium hypochlorite is gravity fed at full strength into the secondary effluent for chlorination. Alum is trickled into the secondary effluent at full strength before filtration to meet RWQCB requirements for coagulation. The only current chemical dilution water need is for polymer make-up and polymer carrying water. The polymer make-up need is estimated to be 20 gpm for 15 minutes every 12 hours. The polymer carrying water is approximately 7-10 gpm and added on a continuous basis.

4. Firewater

The existing firewater system consists of a single draft hydrant connected to Chlorine Contact Tank No. 2 (west tank). It was designed so that a fire truck (pumper) could hook up to the hydrant and pump the tertiary effluent to fight a fire. Since the existing system operates with the contact tanks running full, having enough water available to fight a fire has never been an issue.

In summary, in-plant process water systems at the WNWRP are not generally utilized at the capacities for which they were designed.

The following design criteria applies to the existing in-plant process water systems:

Table 10.

Process Water System	Number of Pumps	Capacity Each	TDH	Horsepower (each pump)	Total Additive Pump Capacity
Foam Spray (FS)	2	450 gpm	50 ft	7.5 HP	900 gpm
Washwater (WW)	1	100 gpm	230 ft	15 HP	780 gpm
	2	190 gpm	213 ft	25 HP	
	1	300 gpm	240 ft	30 HP	
Chemical Dilution Water (CDW)	2	400 gpm	260 ft	40 HP	800 gpm
Firewater*	0	-	-	-	-

*Note that the firewater system is composed of a single draft hydrant with pumping supplied by the Fire Department

b. Proposed Systems

1. Foam Spray, Washwater and Chemical Dilution Water

As part of the Recycled Water Pump Station project, the existing FS/WW/CDW suction line connection into the Dechlorination Channel is being modified. The line will now connect to the Recycled Water Pump Station wetwell, which will become the normal supply. A connection will also be made to the UV Outlet Channel, where this connection will be used to prime the washwater pumps in the case where the ES/CCTs are drawn down too far and there is a loss of prime. Continuous operation of the washwater pumps is necessary since washwater is used for cooling of the process air compressors. In the future, the Miscellaneous Plant Modifications project will provide new process air compressors that will most likely be air-cooled, negating the need for continuous washwater flow.

2. Firewater

The existing firewater supply connection in the west CCT will be augmented by a new connection off of the discharge line from the Recycled Water Pump Station. The ES/CCT drawdown by the Recycled Water Pump Station will be limited by the firewater design criteria to supply 1250 gpm for 2 hours (150,000 gal) along with 300 gpm of washwater for 3 hours (54,000) for a total reserved storage volume of 204,000 gal. It should be noted that this is a conservative allowance based on firewater requirements for pressurized systems. The WNWRP has one draft hydrant (unpressurized) and actually has lower firewater requirements due to the rural area in which it is located.

3. Polymer Make-Up and Dilution Water

UV disinfected (unchlorinated) water will be provided for polymer make-up and dilution. Chlorinated water will be used during the hypochlorite mode of operation. A new suction line will be provided to a proposed low capacity, chemical dilution pump in the blower building. The discharge of this pump will be connected to the existing CDW piping leading to the polymer facilities. Chlorinated water will be used occasionally as a back-up, through the existing CDW connection to the existing washwater and existing CDW pump discharge piping.

5.7 Sampling System.

a. Existing System

The existing final effluent sampling consists of an automatic 24-hour composite sample for routine analyses taken from the exit end of the Dechlorination Channel and a daily grab sample for coliform taken from the effluent end of one CCT. The composite sample is pumped and the grab sample is taken with a grab pole. The laboratory prefers the use of peristaltic pumps when samples have to be pumped.

Chlorine residual is measured after the flow leaves the CCTs and then again after the dechlorination process.

b. Proposed System

One of the challenges of the proposed UV flow scheme is that there will not be a channel or structure that combines all the effluent at all times after UV treatment. After UV irradiation, water will be directed to either the Receiving Water Channels or the ES/CCTs for storage of reuse water. To demonstrate that the WNWRP has produced acceptable water meeting the reuse, recharge and receiving water permits, a single 24-hour composite sample for routine analyses will be collected automatically from the outlets of all operating UV reactor trains. Samples from each operating train will flow through hydraulically similar lines to a sample trough containing a peristaltic pump. The pump will be controlled to provide a flow weighted composite sample. Each train sample line will be provided with a solenoid valve that will be open whenever the reactor train is on-line. The sample trough will be provided with an overflow to the ES/CCTs or plant sewer.

Since the effluent flow will receive a small chlorine dose for adenovirus control upstream of the UV reactor, the chlorine residual will be monitored just downstream of the existing CCTs, as with the current operation. Once the water in the ES/CCTs reaches a high level, the bisulfite system shall meter an overdose of bisulfite based on the flow measured at the diversion structure and assuming an operator-adjustable setting for chlorine residual. If the operator-adjustable setting is ever exceeded, as evidenced by the reading from the existing chlorine residual analyzer prior to dechlorination, then the bisulfite overdose shall be based on the reading from the analyzer instead. Theoretically, there should not be a measurable chlorine residual from the UV reactors, due to the small amount of chlorine that will be applied. As before, the final effluent going to the receiving water will be monitored for chlorine residual by an existing analyzer to make sure that there is no chlorine residual being discharged.

A grab sample for coliform will be taken once per day from one or more operating UV reactors.

When the hypochlorite system is utilized in standby mode, the existing sampling system will be utilized. Sampling system switchovers may require some manual intervention by the operator.

5.8 Electrical System.

a. Existing Plant Electrical Power Supply

The WNWRP is supplied electrical power by a dual power feed system. There are two Southern California Edison (SCE) Substations (Mesa and Brookline) that can feed the plant. An automatic transfer switch transfers the plant connection from one power supply to the other if the on-line connection experiences a failure. Additionally, there are two emergency standby power generators provided at the plant. A 110-volt generator supplies power to the Control Room and a 440-volt generator supplies power to operate the JO "B" Gate when there is a total loss of power from the grid (SCE).

b. Recycled Water Pump Station Power Feed

The Recycled Water Pump Station, currently being constructed for the USGVMWD, will be supplied by a separate feed coming from one of the two existing Edison power feeds. It will not be connected to any of the plant switchboards and will have its own meter for billing purposes. The pump station will not be powered by the dual power feed system, since the Districts pay extra for this uninterrupted supply. The reuse pumps will be operated mainly at night. As a result, the annual 8-hour shutdown for Edison maintenance, which occurs during the daytime hours, should not be a problem. Since the WNWRP is protected by the dual power feed system, it is possible that the Recycled Water Pump Station might not be operational due to a failure at its power supply, while the rest of the plant is operating normally. If this occurs, flow will continue to be stored in the ES/CCTs until they are full and then flow will be discharged to the receiving water.

c. Electrical Power Requirement

Trojan 3000 Plus LPHO lamps use 250 watts per lamp. Assuming 896 lamps are required for the design flow and UVT, the total power required is 0.22 MW. Wedeco's LPHO lamps use 310 watts per lamp. Assuming 1152 lamps are required for the design flow and UVT, the total power required is 0.36 MW. These loads can be accommodated by the plant's current electrical system. Additional power of about 0.11 MW will be required to operate the proposed backwash pump. The proposed chlorine mixers will also require a small amount of additional power.

d. Miscellaneous Electrical and Instrumentation

As a minimum, the following electrical/instrumentation work items will be required:

- Switchboard for UV system
- UV reactor software programming, indication and controls
- Electrical connection for proposed backwash pump
- Proposed backwash pump software programming, indication and controls
- Software programming, indication and controls for shock dosing of filters during backwashing
- Power for possible air conditioned enclosure to house Wedeco's ballasts and controls
- Integration of water level indications with flow and level controls. Addition of interlocks
- Filter effluent flowmeter
- Power and control for miscellaneous sampling modifications
- Additional lighting as required
- Controls for adenovirus chlorination

e. Power Failure Scenarios

1. Total Plant Power Failure

Because of the existing dual source of power from SCE, a total plant power failure is less likely to occur. If this should ever occur, however, any system in the plant requiring pumped flow or utilizing electrical energy (influent, effluent, RAS, mixed liquor recirculation, backwash and water system pumps along with process air compressors) will cease to operate. Under these conditions, the plant is out of service and no flow will enter or leave the plant. Power for the UV system is not necessary at this point since the flow that was being pumped into the WNWRP will continue down the JO "B" sewer to the JWPCP. The JO "B" gate downstream of the plant, powered by the standby generator, will be opened fully to better bypass flow around the WNWRP. Once power is restored and the UV lamps are allowed to warm up, flow can be UV disinfected and routed to reuse storage or discharged to the receiving water. Water that may be trapped in the UV system and inadequately disinfected can be diverted to the plant sewer before startup of the UV system.

2. Localized Power Failure

An in-plant single point power loss could be experienced by the UV system. Because of protections built into the overall disinfection scheme, a decision has been made not to provide a dedicated standby source of power for this event. Instead, interlocks will stop the filter effluent pumps and the UV reactor train inlet valves will close. Existing operation of the plant is such that although the influent pumps continue to pump with the filter effluent pumps off, the secondary effluent flow will eventually back up ahead of the filters and overflow to the JO"B" sewer.

If a localized power outage to the UV system is experienced, and it is imperative that the plant be operated to reduce the hydraulic load on the sewer downstream, operators can switch to the standby disinfection mode (sodium hypochlorite addition, preferably post-chlorination at first, to minimize the gap in disinfection). If inadequately disinfected effluent is contained in the ES/CCTs, and does not exit the plant to the receiving water or through the Recycled Water Pump Station, calcium hypochlorite pellets can be added and the plant flow bypassed to enable chlorine contact time before discharge.

6. PROJECT COST

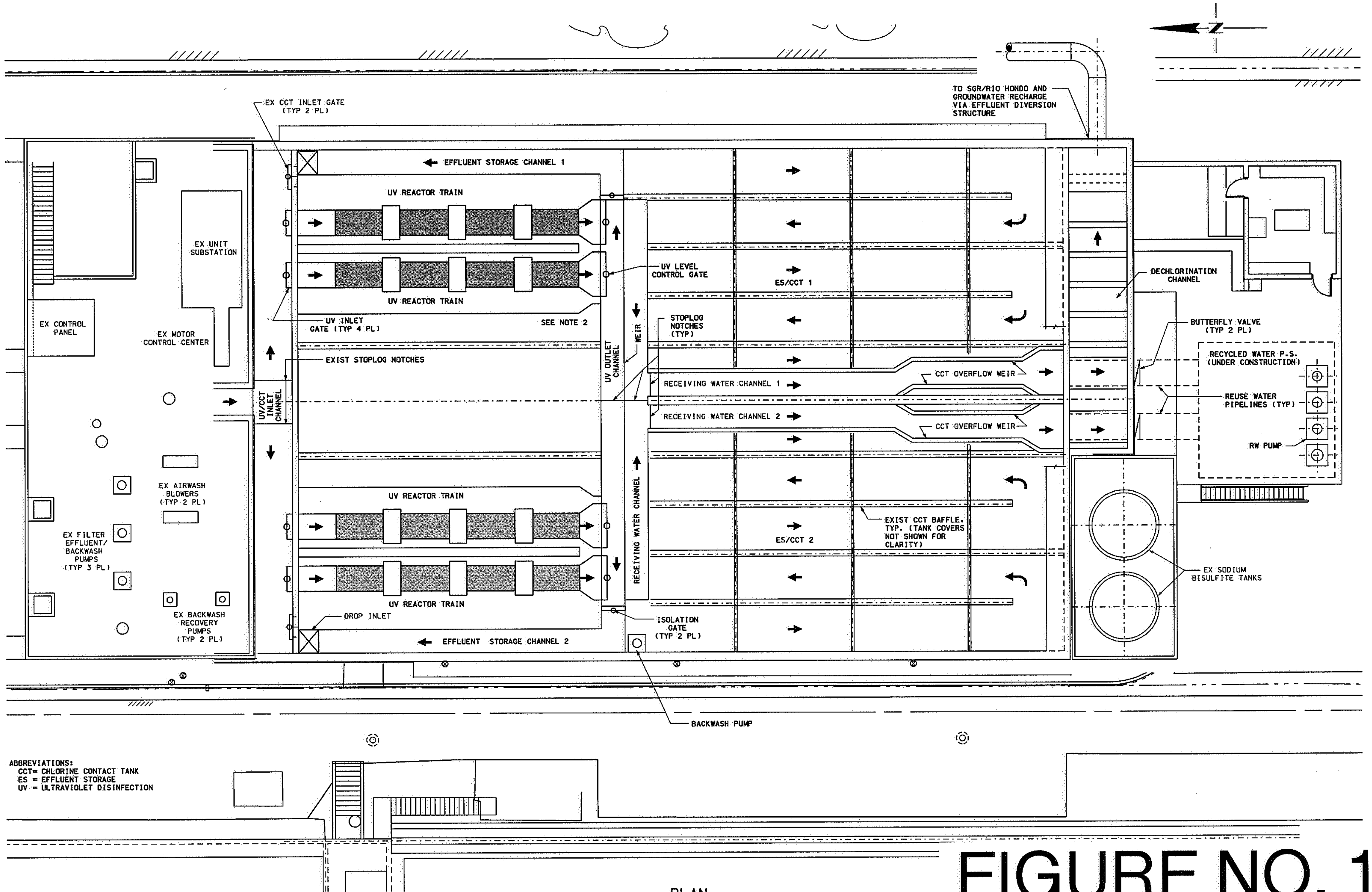
Costs for this project include procurement of the UV equipment, modification of the CCT structures for the UV channels and conveyance, provision of a dedicated backwash pump, provision of chemical mixers, provision of a small chemical dilution water pump and appurtenant electrical equipment and controls.

This project may receive grant funding as a result of Proposition 50. The Districts are in the first step of a multi-step grant application process in which a 50% matching grant has been requested. Since the Proposition 50 grants are watershed based, a number of potential projects have been lumped together for review and rating purposes. One stipulation that may be unattractive is that legal remedies may be limited if money is received from the State. This may make the acceptance of grant money less attractive, if it prevents exercising the Districts' right to litigate NDMA regulatory issues in the future.

Costs associated with this project are listed in the following table:

Table 11. Cost Estimate for the WNWRP — UV Disinfection Facilities Project

Budget Category	Districts Share	State Grant Share	Total
Direct Project Administration Costs	$5 K	$5 K	$10 K
Planning, Design, Engineering and Environmental Documentation	$200 K	$200 K	$400 K
Construction and Implementation	$2,600 K	$2,600 K	$5,200 K
Environmental Compliance, Mitigation and Enhancement	$10 K	$10 K	$20 K
Construction Administration	$200K	$200K	$400K
Construction and Implementation Contingency	$260 K	$260 K	$520 K
Total	$3.275 M	$3.275 M	$6.55 M



ABBREVIATIONS:
CCT= CHLORINE CONTACT TANK
ES = EFFLUENT STORAGE
UV = ULTRAVIOLET DISINFECTION

PLAN
SCALE: 1/8"=1'-0

NOTES:
1. ALL GATES ARE TO BE AUTOMATED.
2. ES/CCT'S CONTINUE UNDER UV TRAINS.

FIGURE NO. 1

WARNING ⊢ 1" ⊣ IF THIS LINE IS NOT 1" LONG, THEN DWG IS NOT TO SCALE.

COUNTY SANITATION DISTRICT NO. 2
OF LOS ANGELES COUNTY, CALIFORNIA

DESIGNED	MAY, 2005
DRAWN	MAY, 2005
CHECKED	MAY, 2005
REVIEWED	MAY, 2005

WHITTIER NARROWS WATER RECLAMATION PLANT
U. V. DISINFECTION FACILITIES

SCHEMATIC OF PROPOSED FACILITIES

SCALE:
SHEET NO.
DWG. NO. JO-g-1141

REVISIONS | NO. | DATE | INITIALS
REFERENCE DWG. NO./JOB NO. | FIELD BOOK NO.

12/7/2005 2:06:27 PM rrocola
R:\WN\JOG1141\m\114pmpstapln.dgn

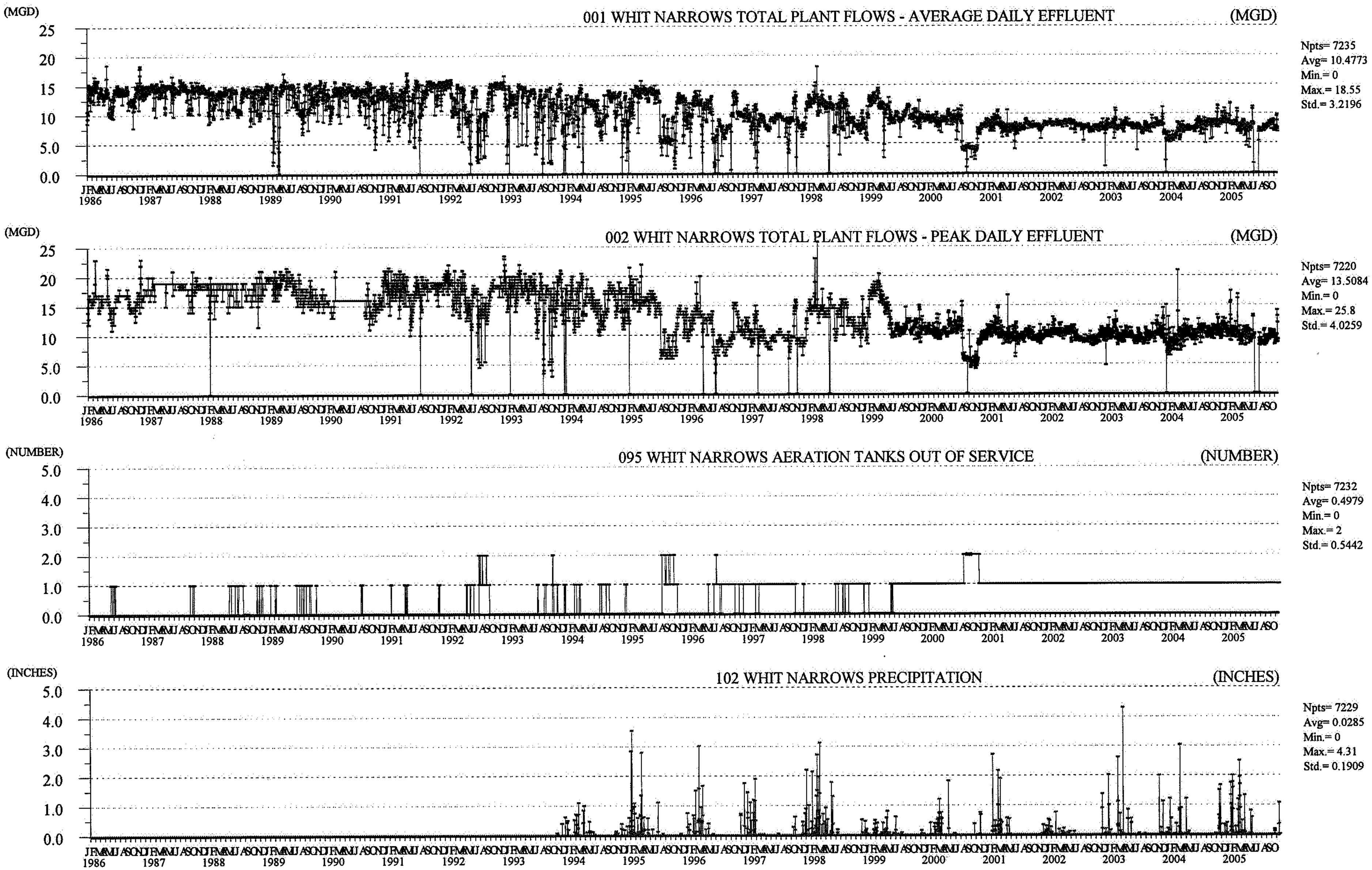
Appendix A

WNWRP Historical Wastewater Characteristics

WNWRP Historical Wastewater Characteristics					
Characteristic	Units	1 yr. Daily Avg. (2004)	5 yr. Daily Avg. (2000-2004)	5 yr. Daily Min. (2000-2004)	5 yr. Daily Max. (2000-2004)
Avg. Effluent Flow	MGD	7.8	7.8	0	11.4
Peak Effluent Flow	MGD	10.2	9.9	0	20.9
Raw TSS	mg/L	243.7	283.5	115.0	556.0
PE TSS	mg/L	103.5	99.8	58.0	176.0
SE TSS	mg/L	4.8	4.5	< 1.0	64.0
FE TSS	mg/L	1.1	1.1	< 1.0	3.0
Raw BOD5	mg/L	219.3	247.9	120.0	633.0
PE BOD5	mg/L	153.5	158.9	101.0	275.0
FE BOD5	mg/L	3.1	2.5	< 1.0	10
BOD Removal	%	98.6	99.0	98	99
Raw TCOD	mg/L	482.7	541.3	243.0	986.0
PE TCOD	mg/L	331.7	314.8	135.0	503.0
SE TCOD	mg/L	26.8	25.7	12.0	74.0
FE TCOD	mg/L	22.8	21.8	9.0	42.0
FE Soluble COD	mg/L	21.0	20.0	7.0	41.0
TCOD Removal	%	95.4	96.0	84.5	97.7
PE NH3-N	mg/L	24.4	24.1	14.0	33.6
SE NH3-N	mg/L	1.1	1.2	< 0.1	8.3
FE NH3-N	mg/L	0.8	0.9	< 0.1	3.1
FE NO2- N & NO3-N	mg/L	6.1	5.6	3.1	7.8
FE Org-N	mg/L	1.7	1.7	< 0.1	4.8
FE Tot N-N	mg/L	8.6	8.5	5.5	12.3
Raw pH	pH	7.6	7.6	6.6	9.4
FE pH	pH	7.5	7.3	6.7	7.7
Temperature	oF	76	76	66	84
FE Turbidity	NTU	1.04	0.96	0.4	2.2
FE Turb. - Daily Max	NTU	1.09	1.03	0.1	3.1
Precipitation	in/yr*	19.1*	14.8*	7.8*	4.3 in/day

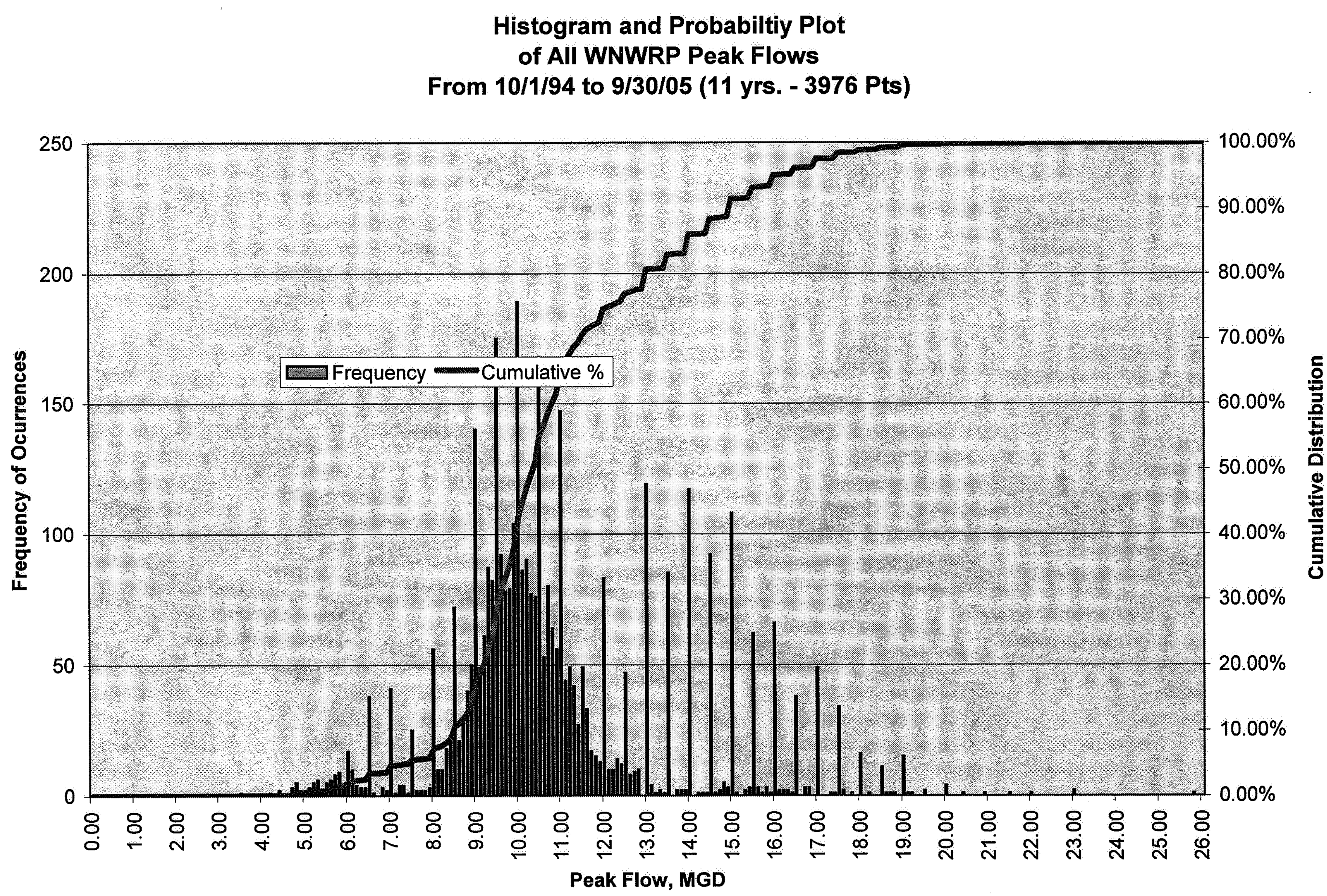
* Yearly average, minimum and maximum, respectively. Daily maximum precipitation was 4.3 inches

WHITTIER NARROWS WRP
(JAN 1, 1986) - (OCT 22, 2005)
7235 Days

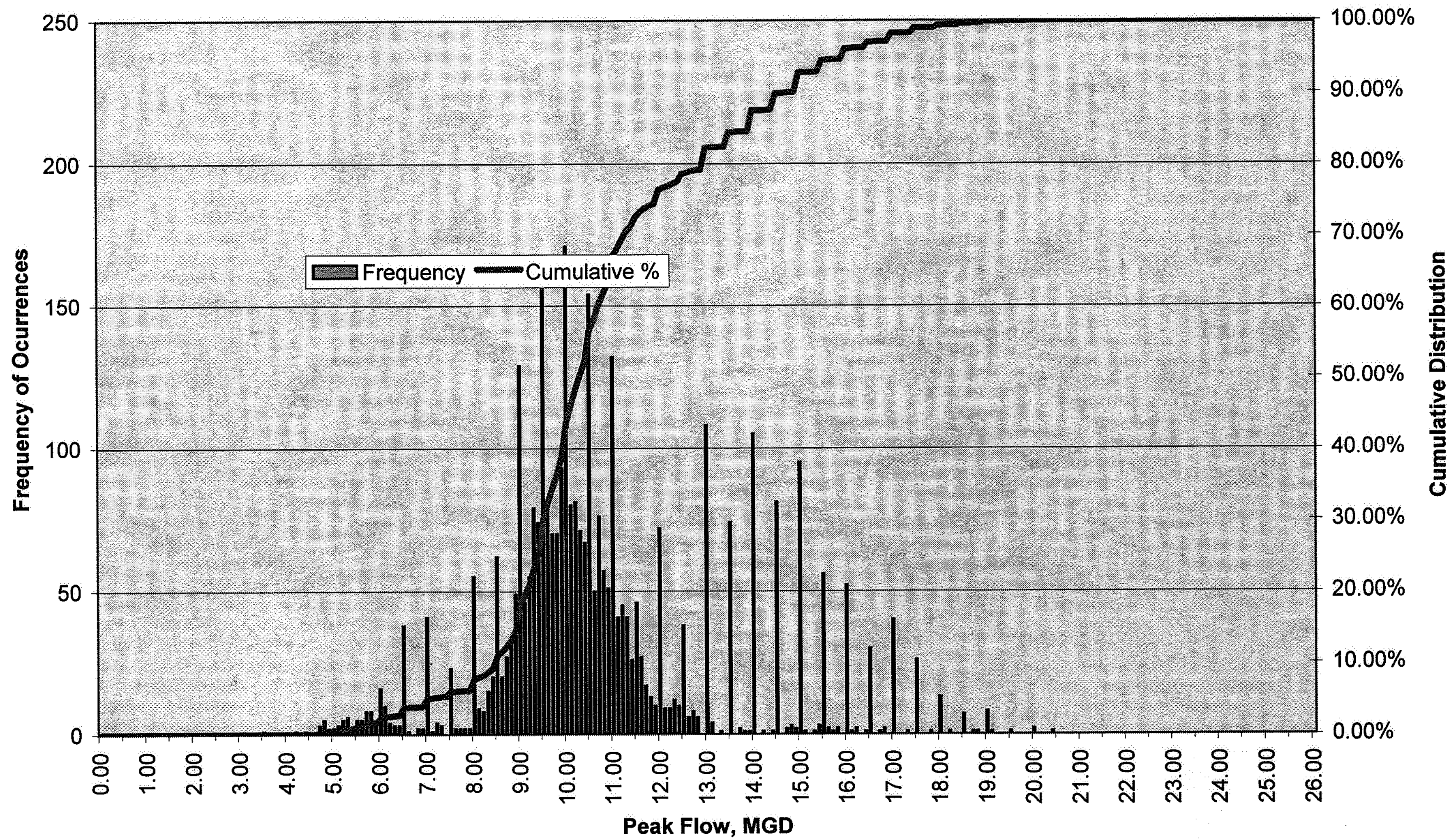


1- Custom

Run Date = 10/23/2005 20:02
Plot Date 10-27-2005 11:35:24

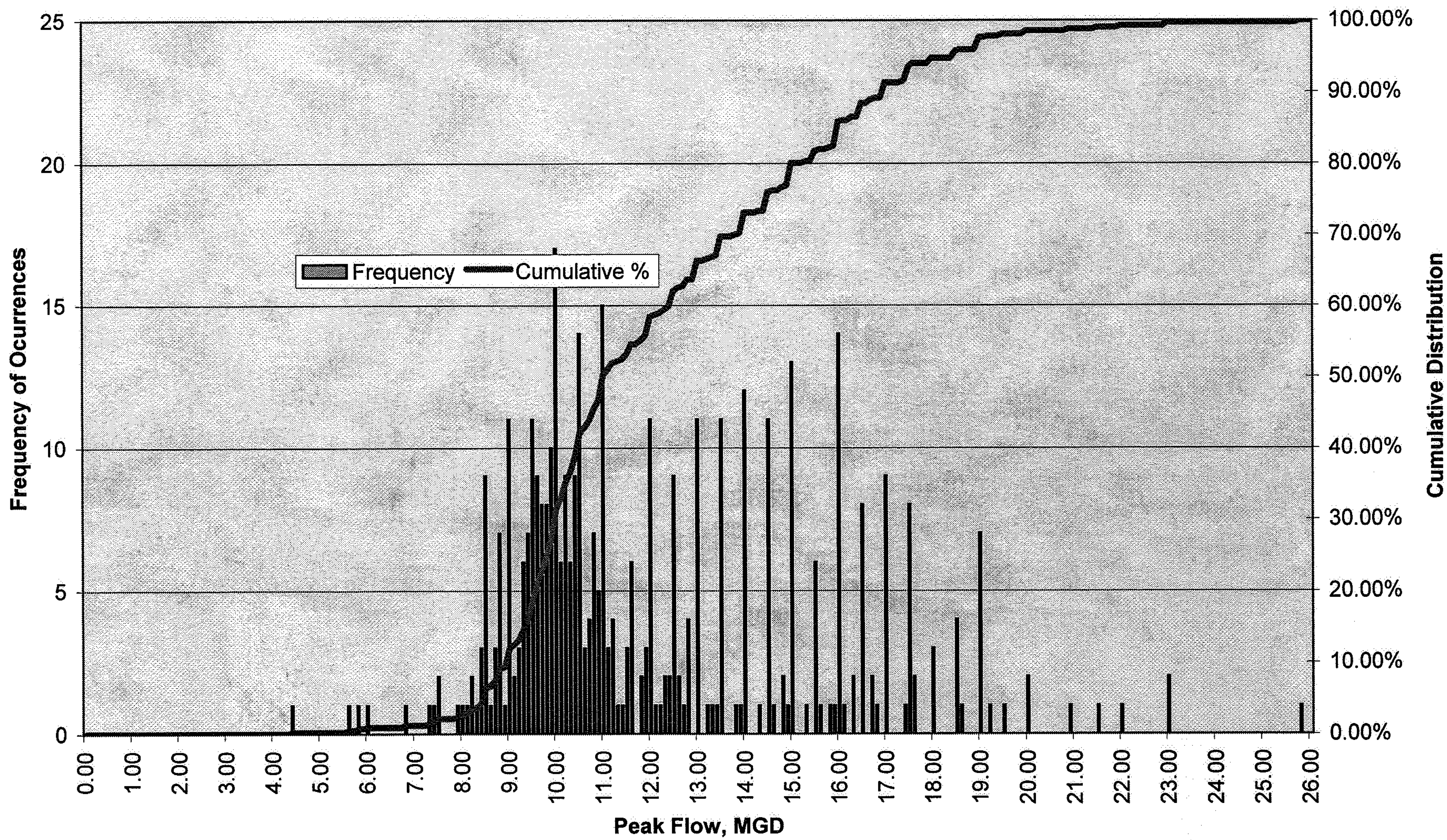

Histogram and Probabiltiy Plot
of All WNWRP Peak Flows
From 10/1/94 to 9/30/05 (11 yrs. - 3976 Pts)
250
200
150
100
50
0
Frequency of Ocurrences
Frequency
Cumulative %
100.00%
90.00%
80.00%
70.00%
60.00%
50.00%
40.00%
30.00%
20.00%
10.00%
0.00%
Cumulative Distribution
0.00
1.00
2.00
3.00
4.00
5.00
6.00
7.00
8.00
9.00
10.00
11.00
12.00
13.00
14.00
15.00
16.00
17.00
18.00
19.00
20.00
21.00
22.00
23.00
24.00
25.00
26.00
Peak Flow, MGD

Histogram and Probabiltiy Plot of WNWRP Peak Dry Flows From 10/1/94 to 9/30/05 (11 yrs - 3545 Pts)



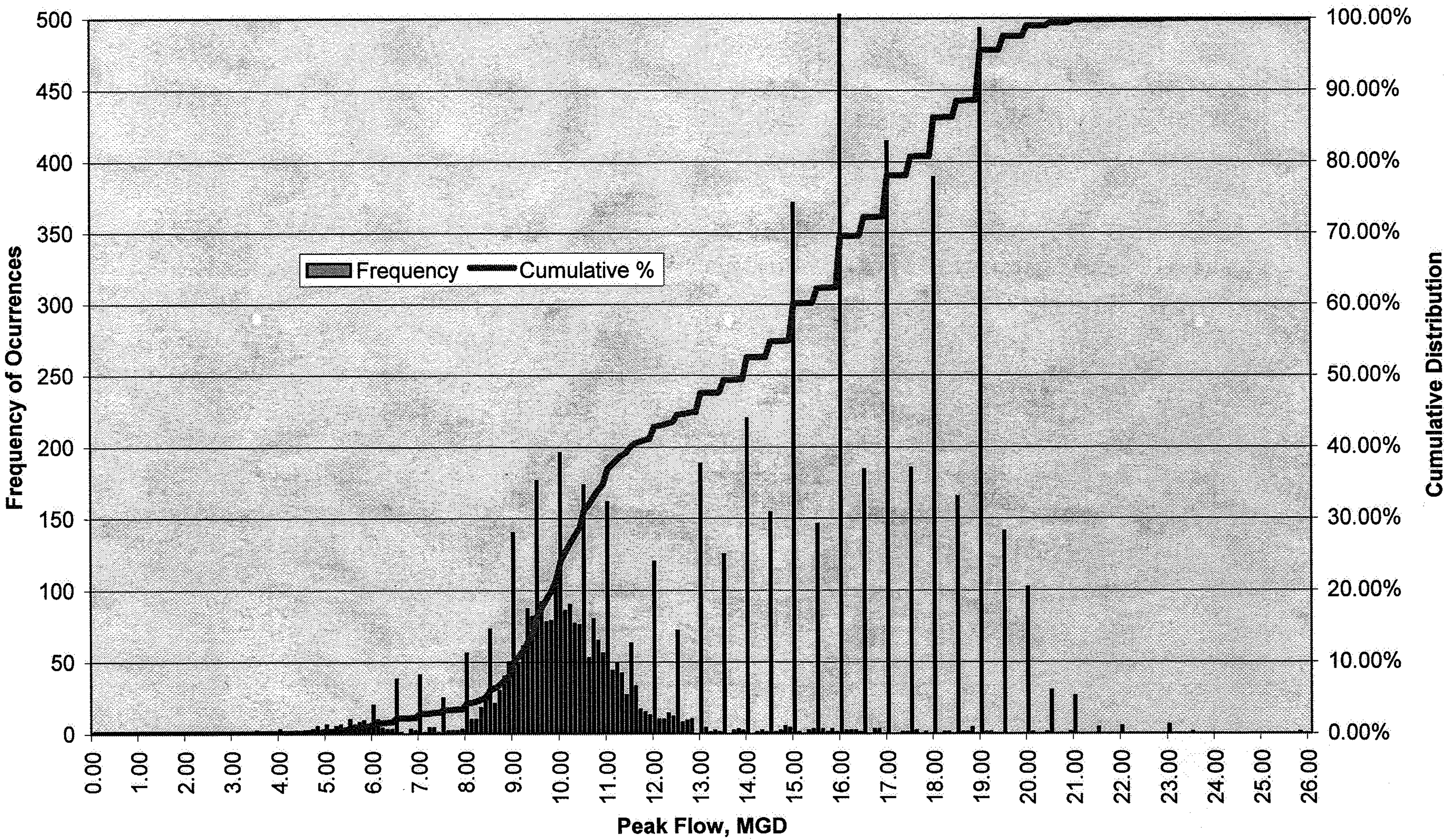
WN Peak Flow Data Analysis2.xls / Peak Dry (2)

Histogram and Probabiltiy Plot of WNWRP Wet Weather Peak Flows From 10/1/94 to 9/30/05 (11 yrs - 416 Pts)



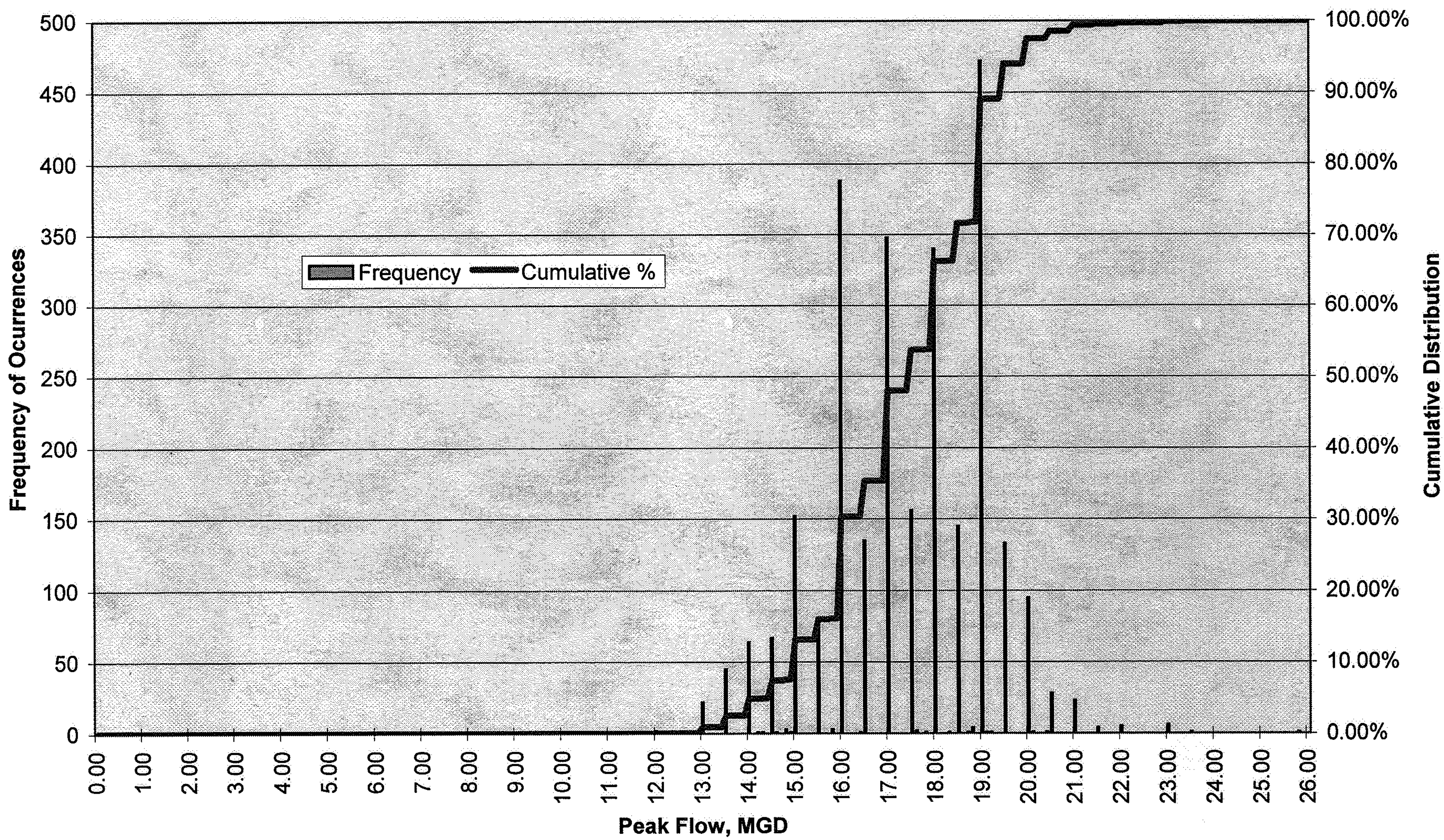
WN Peak Flow Data Analysis2.xls / Peak Wet

Histogram and Probabiltiy Plot of All WNWRP Peak Flows From 1/1/86 to 10/15/05 (19.75 yrs - 7148 Pts)



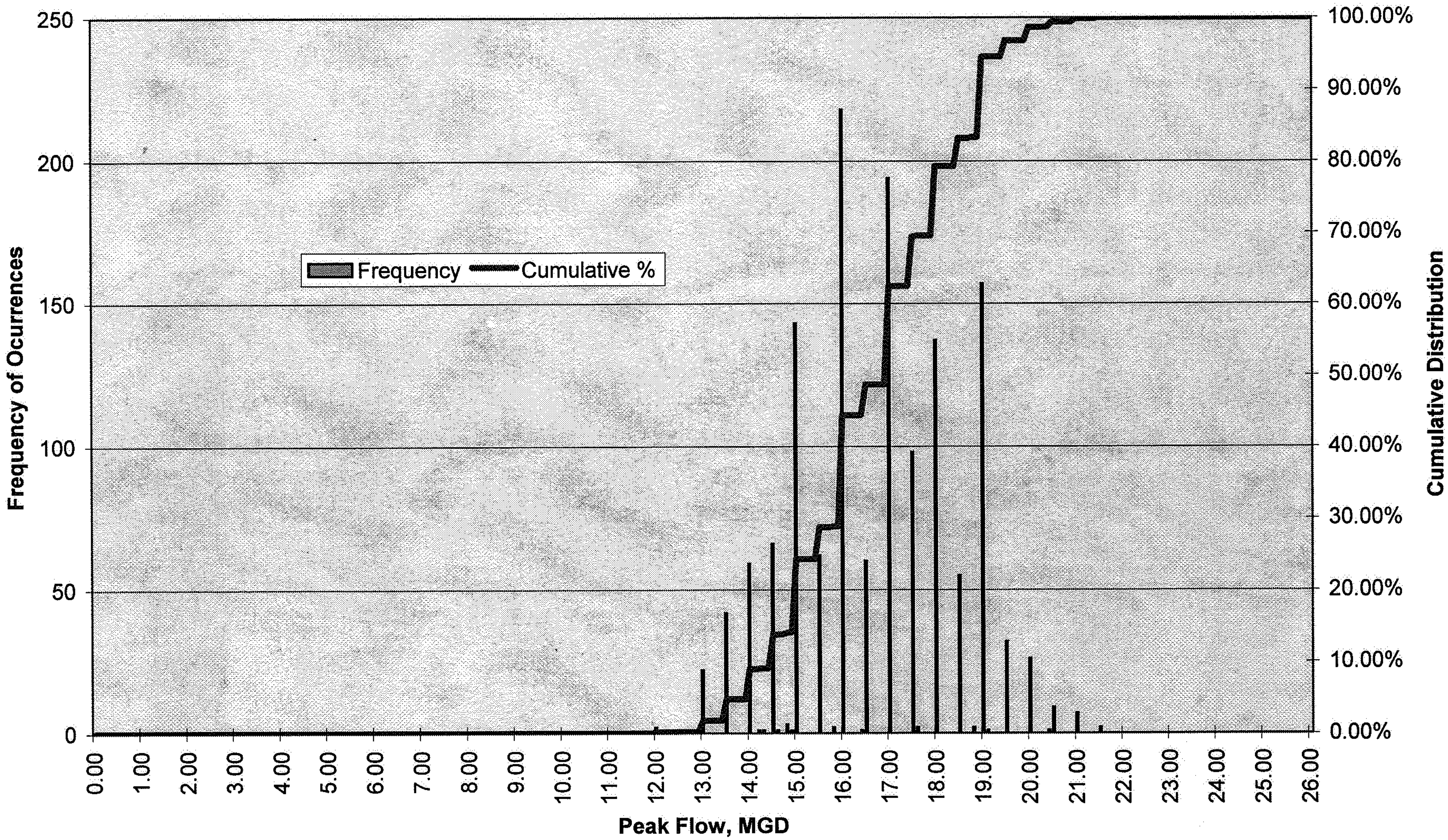
WN Peak Flow Data Analysis2.xls / All Peaks

Histogram and Probabiltiy Plot
of WNWRP Peak Flows with Average Flows > 12 MGD
From 1/1/86 to 10/15/05 (19.75 yrs - 2736 Pts)



WN Peak Flow Data Analysis2.xls / >12 MGD

Histogram and Probabiltiy Plot of WNWRP Peak Flows with Average Flows > 12 and <14 MGD From 1/1/86 to 10/15/05 (19.75 yrs - 1408 Pts)



WN Peak Flow Data Analysis2.xls / >12 <14 MGD

Appendix B — WNWRP Filter Effluent UVT Data

General

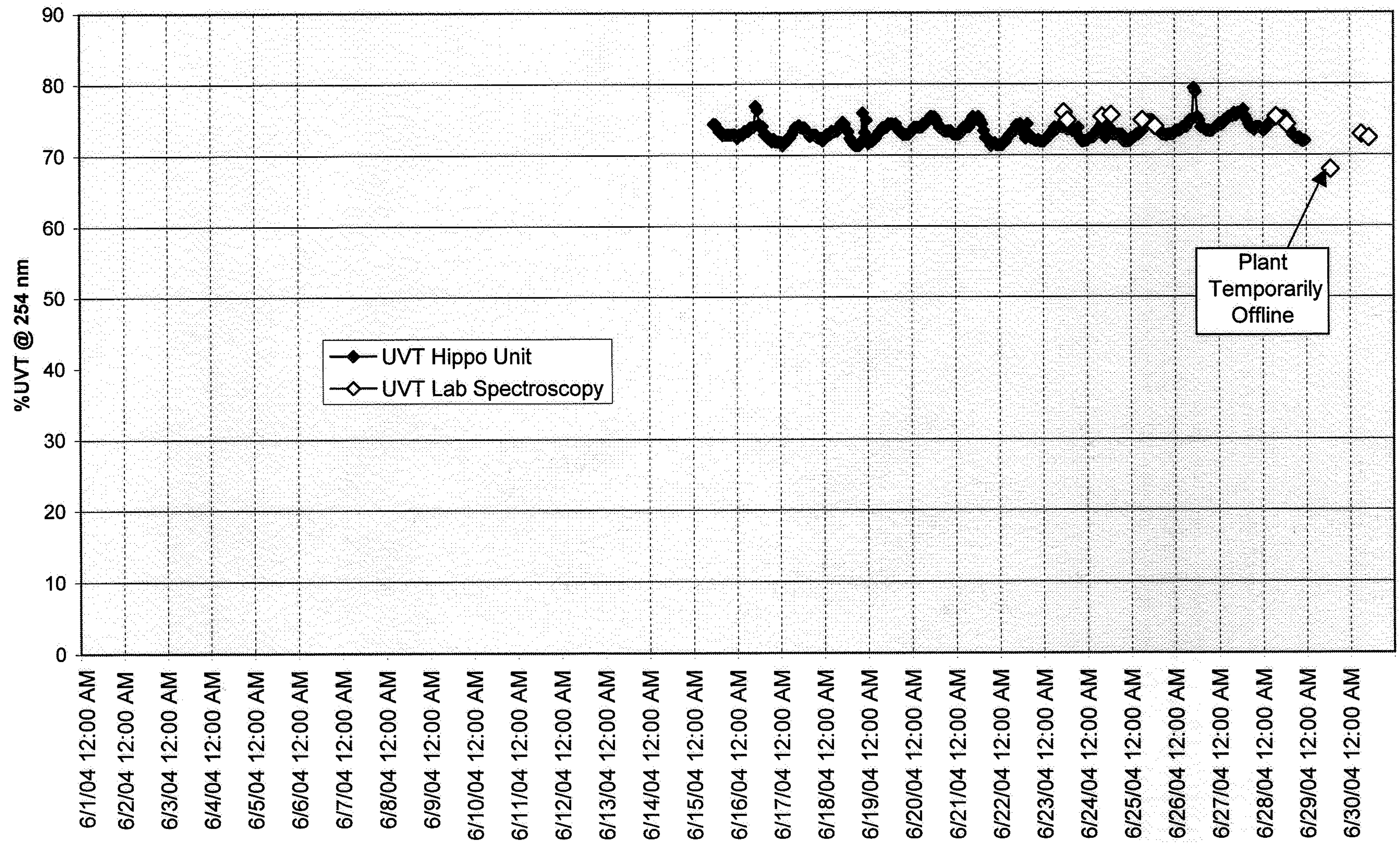
The data contained in Appendix B is mainly derived from Wedeco's On-Line UVT Analyzer (Hippo Unit). Since the number of sample points generated by the unit were too numerous to easily plot, an Excel macro was written to "grab" the UVT on the hour. Limited grab samples were also taken and brought to the Whittier Narrows WRP Laboratory for analysis by spectrophotometry. Most of the time, the two methods of analyses gave similar results, which lent confidence in the Hippo Unit's results. However, it is clear from the data for October and November 2004 and January 2005 that this was not always the case. During these months, the Hippo Unit often provided lower UVTs than the grab samples.

Note that the Hippo Unit had to be sent back to the factory on separate occasions for extended periods. The first time was for lamp replacement. The other times were due to calibration issues. Eventually Wedeco instructed the Research Section on how to field-calibrate the unit. This procedure worked for a while until the range of the adjustment screw proved inadequate. Subsequently, the Districts have lost confidence in the Hippo Unit. The Districts are currently in the process of evaluating other on-line analyzers, but to date, no units have proven to be satisfactory.

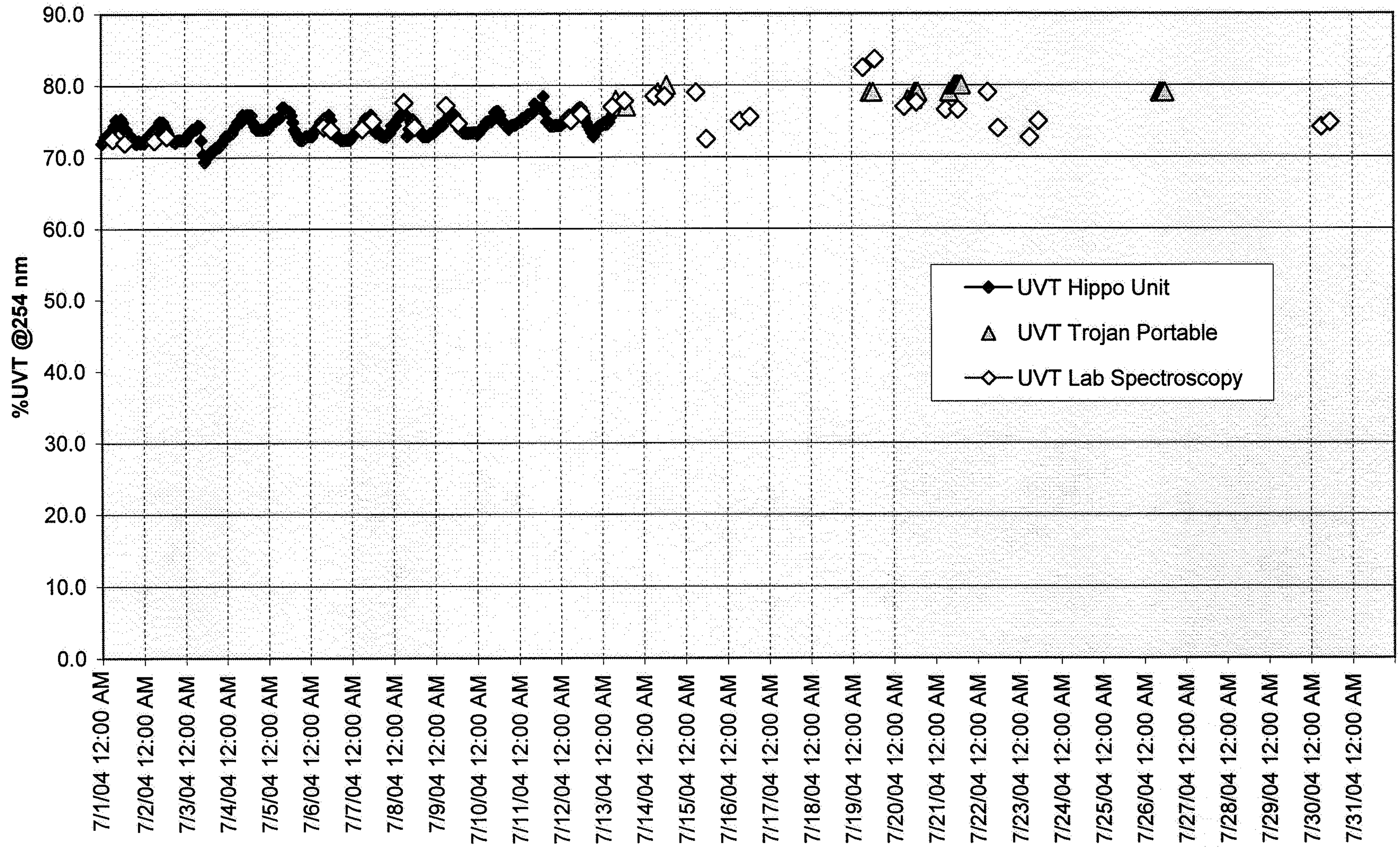
In the latter stages of evaluating the Hippo Unit, there was some discussion about whether the UVT was dropping dramatically during the evening/morning hours when the WNWRP was unmanned. After the Hippo Unit was decommissioned, special sampling was instituted with an ISCO sampler to take hourly grabs. At this point in time, the UVT data from the ISCO grab samples do not support the major swings in UVT results that were sometimes observed with the Hippo Unit. This probably means that the erratic results from the Hippo Unit were equipment or sampling related.

Based on an analysis of all results obtained to date, the lowest (most conservative) expected effluent UVT would be 69% with a normal low diurnal UVT of 72%. The 10^{th} percentile of acceptable Hippo data was calculated to be 71.3%.

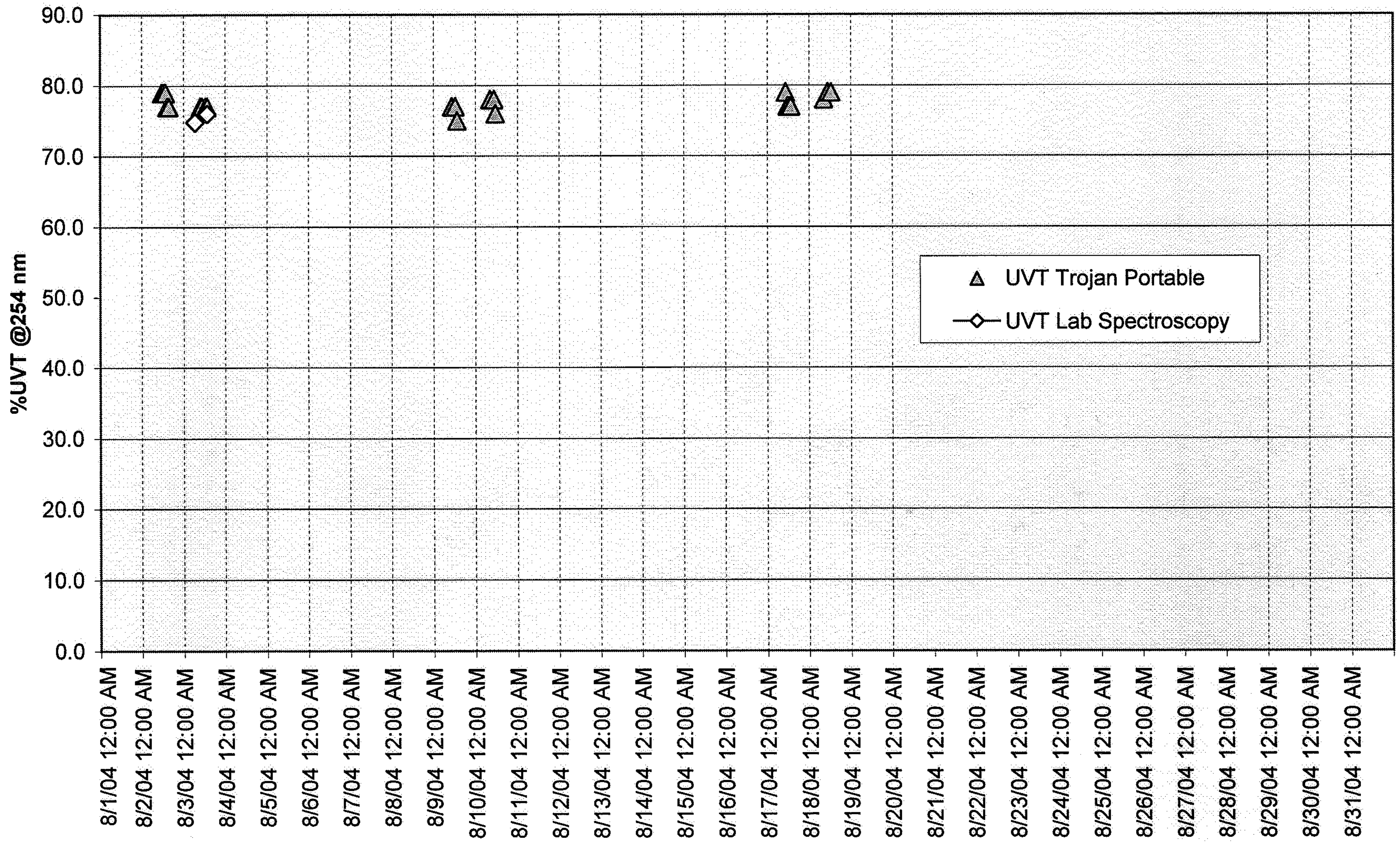
Wedeco On-Line (Hippo) Analyzer UVT Data Taken on the Hour with Laboratory Grabs June 2004

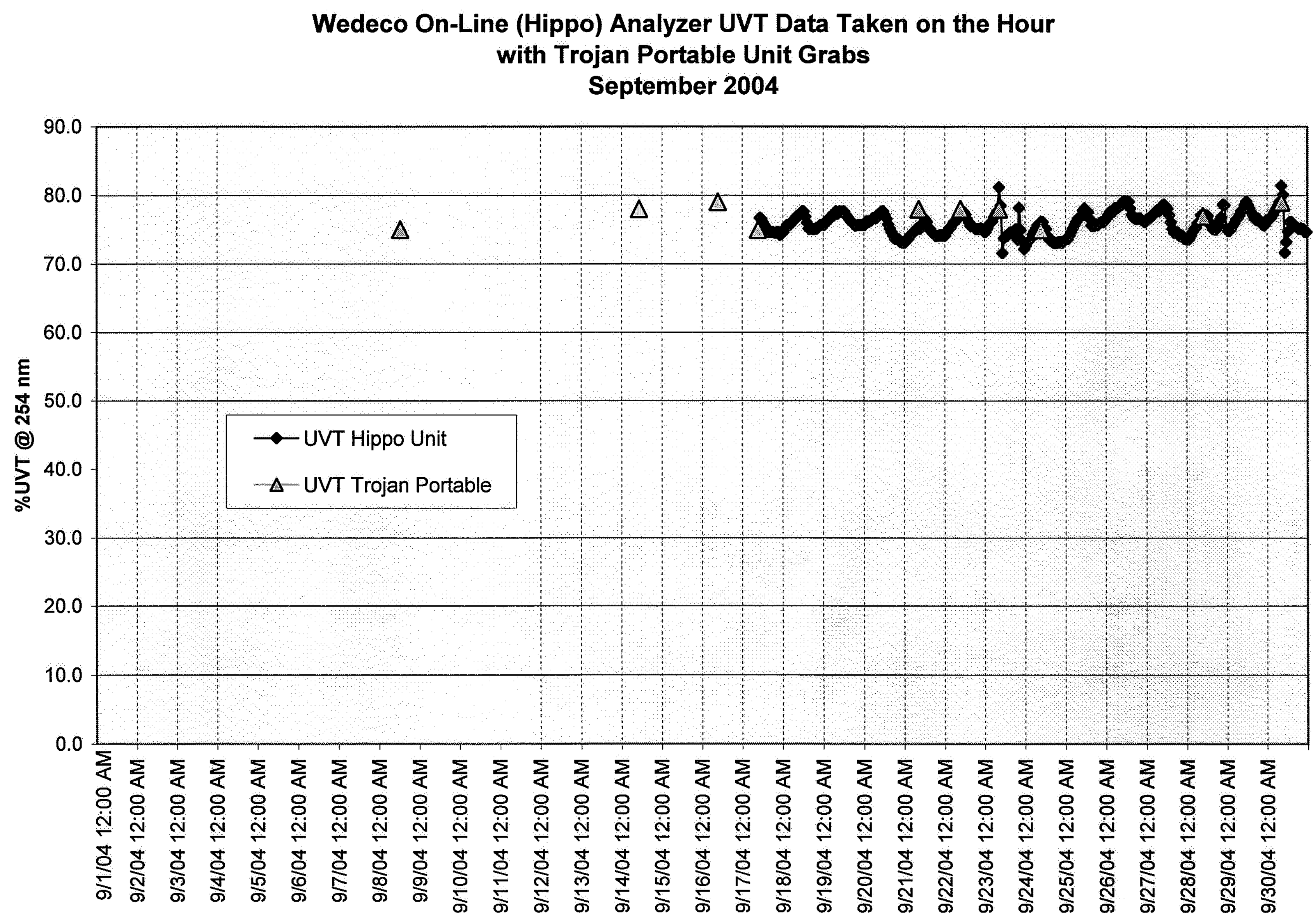


Wedeco On-Line (Hippo) Analyzer UVT Data Taken on the Hour with Trojan Portable Unit and Laboratory Grabs July 2004

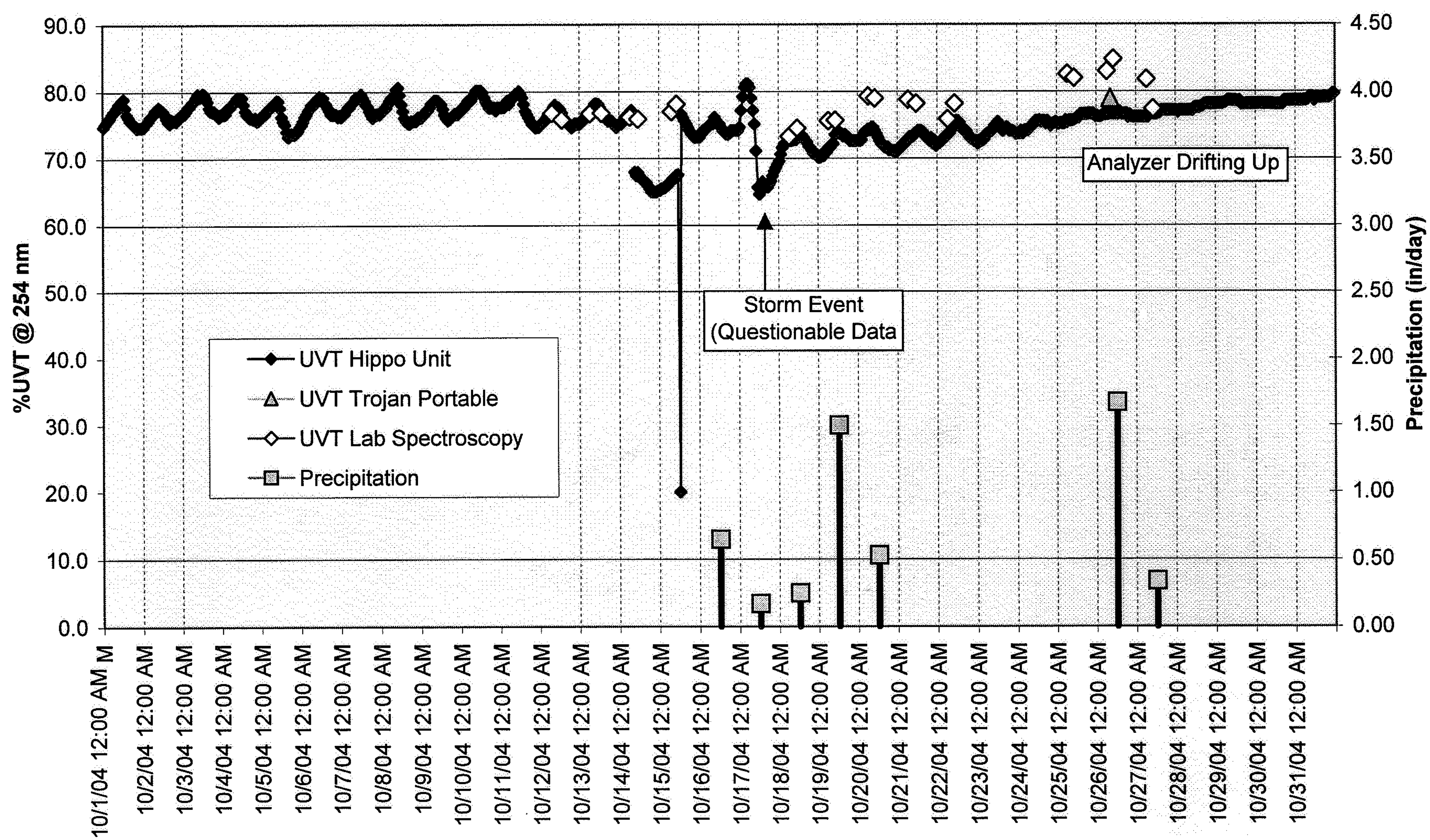


Trojan Portable Unit and Laboratory Grabs
August 2004

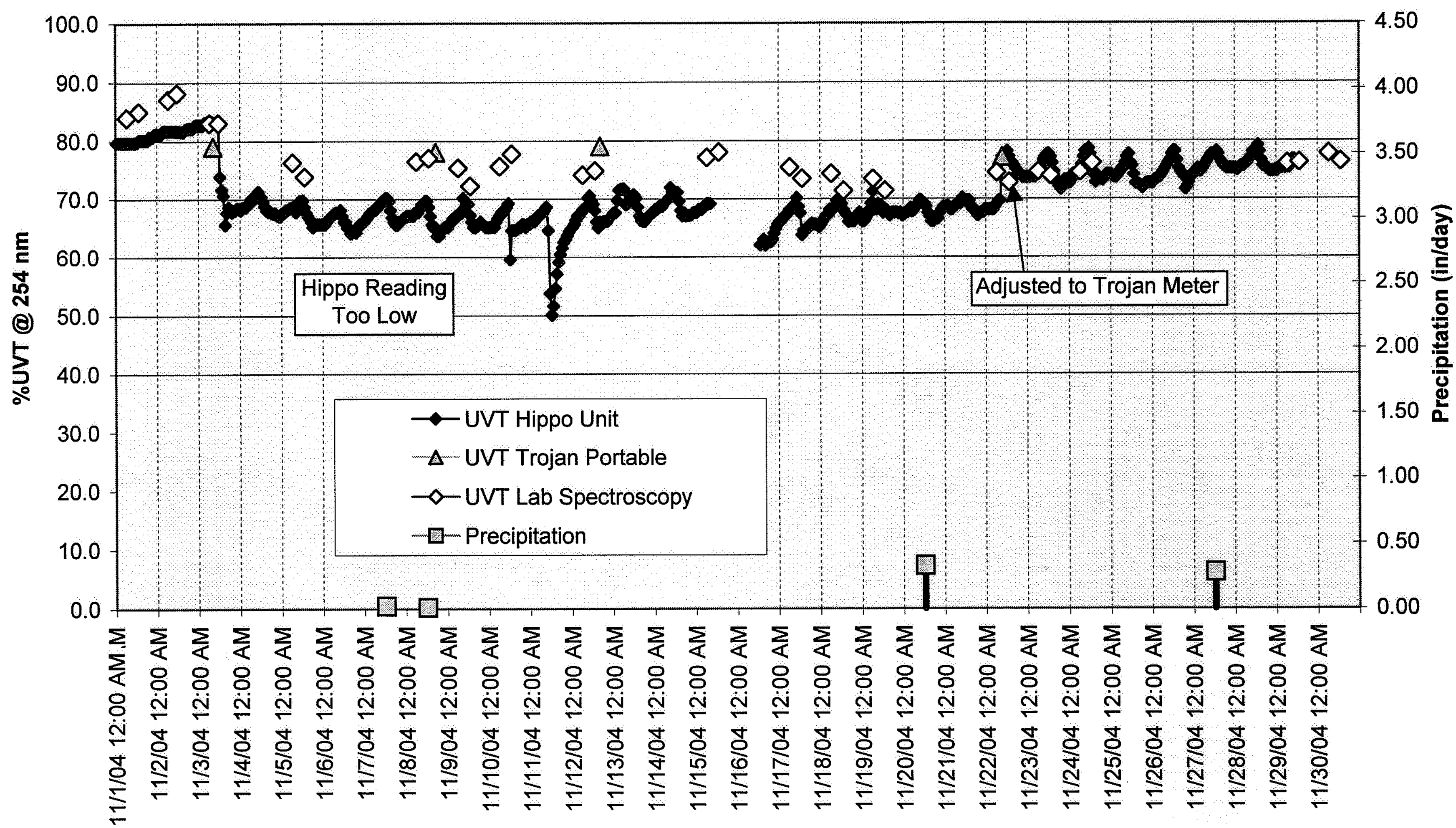



Wedeco On-Line (Hippo) Analyzer UVT Data Taken on the Hour
with Trojan Portable Unit Grabs
September 2004
%UVT @ 254 nm
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
UVT Hippo Unit
UVT Trojan Portable
9/1/04 12:00 AM
9/2/04 12:00 AM
9/3/04 12:00 AM
9/4/04 12:00 AM
9/5/04 12:00 AM
9/6/04 12:00 AM
9/7/04 12:00 AM
9/8/04 12:00 AM
9/9/04 12:00 AM
9/10/04 12:00 AM
9/11/04 12:00 AM
9/12/04 12:00 AM
9/13/04 12:00 AM
9/14/04 12:00 AM
9/15/04 12:00 AM
9/16/04 12:00 AM
9/17/04 12:00 AM
9/18/04 12:00 AM
9/19/04 12:00 AM
9/20/04 12:00 AM
9/21/04 12:00 AM
9/22/04 12:00 AM
9/23/04 12:00 AM
9/24/04 12:00 AM
9/25/04 12:00 AM
9/26/04 12:00 AM
9/27/04 12:00 AM
9/28/04 12:00 AM
9/29/04 12:00 AM
9/30/04 12:00 AM

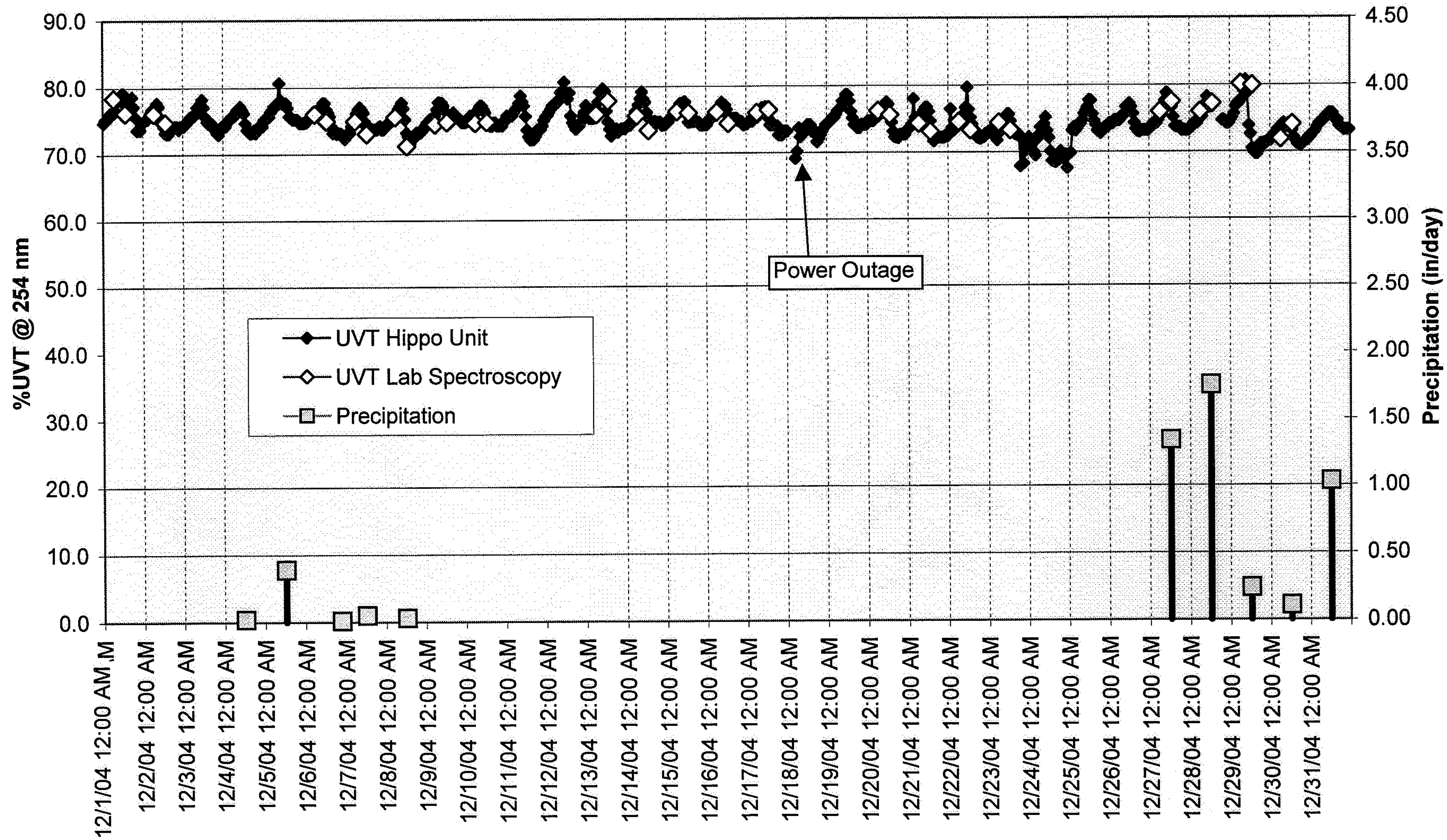
Wedeco On-Line (Hippo) Analyzer UVT Data Taken on the Hour with Trojan Portable Unit and Laboratory Grabs October 2004



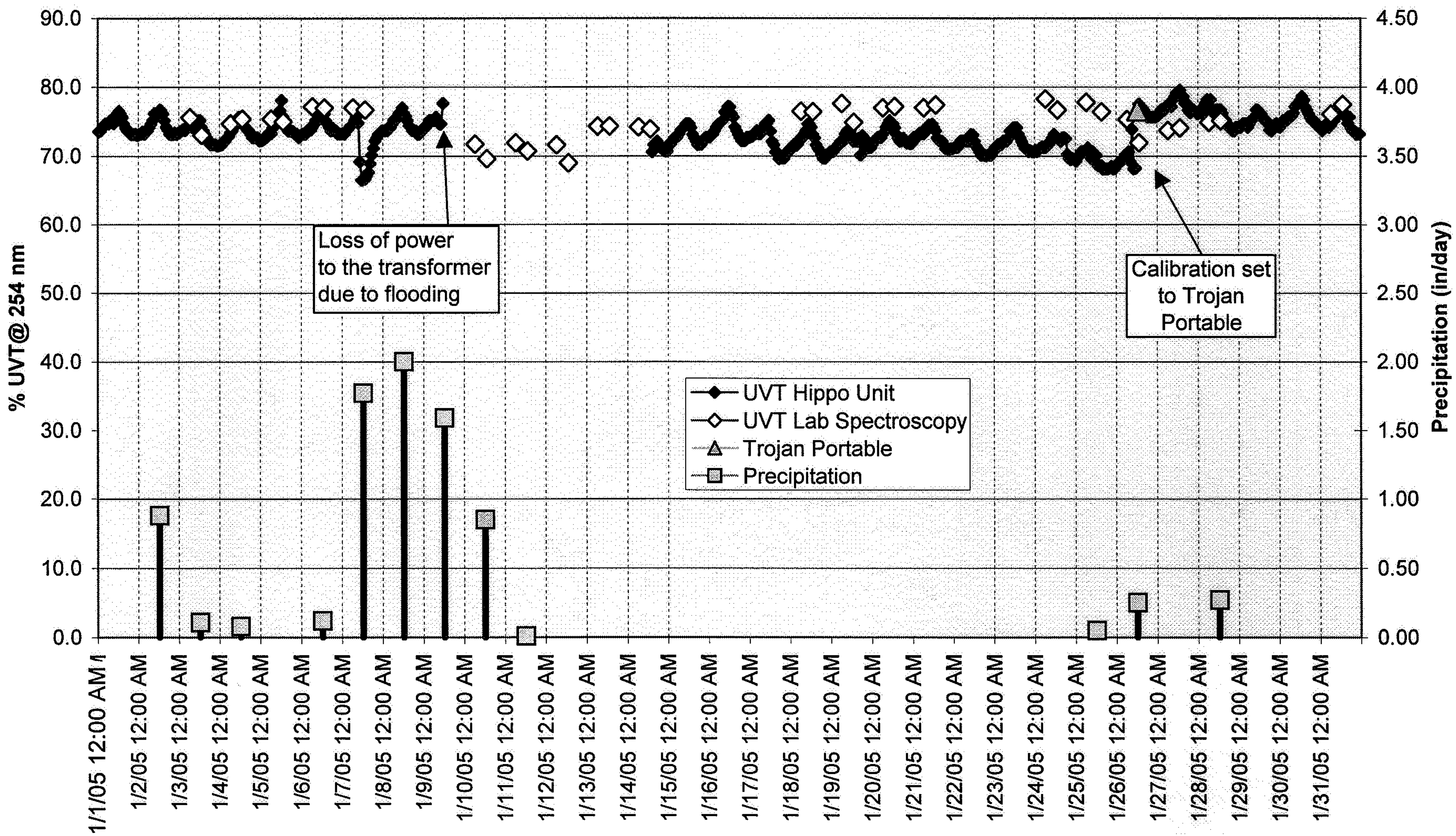
Wedeco On-Line (Hippo) Analyzer UVT Data Taken on the Hour with Trojan Portable Unit and Laboratory Grabs November 2004



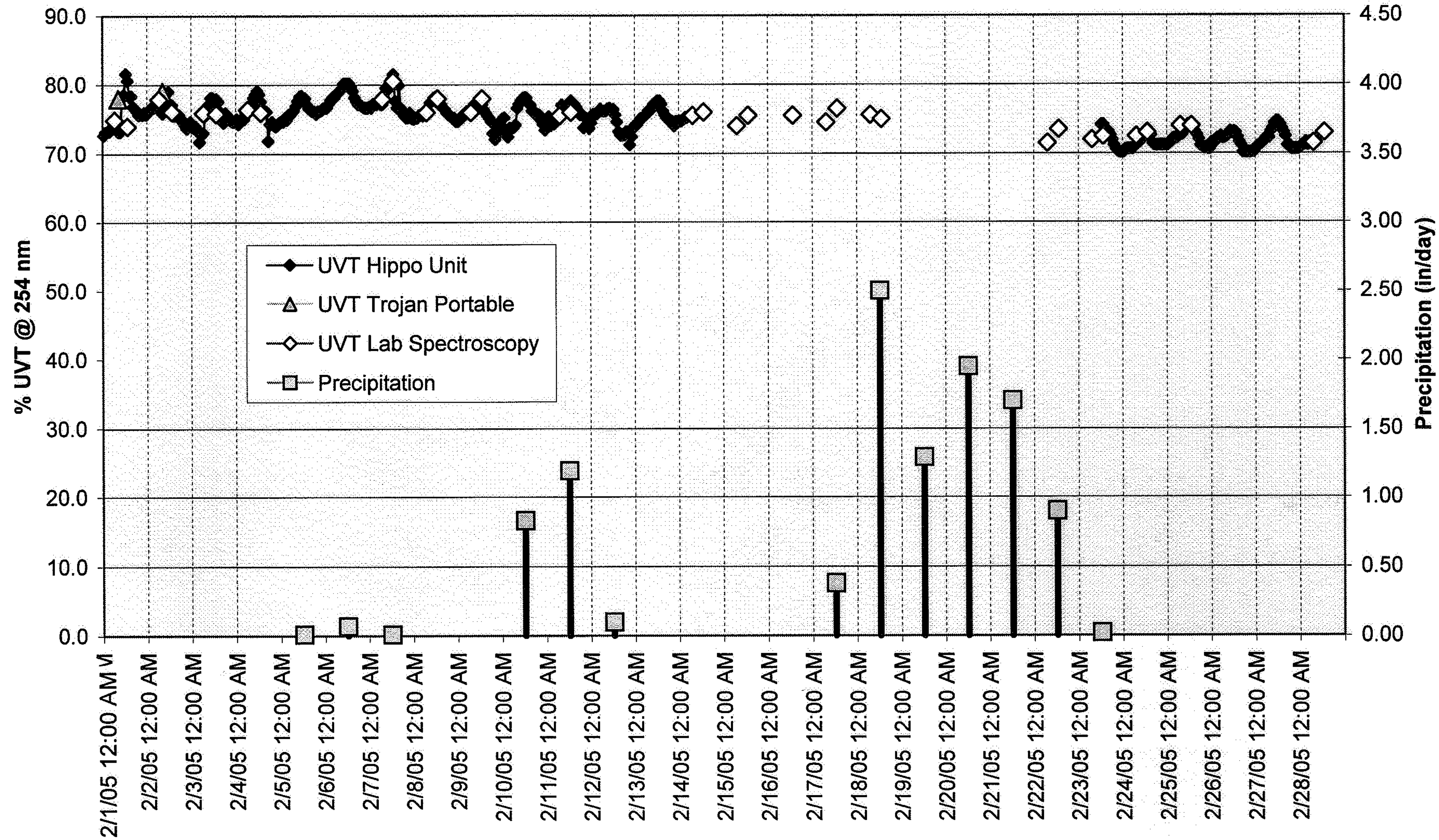
Wedeco On-Line (Hippo) Analyzer UVT Data Taken on the Hour with Laboratory Grabs December 2004



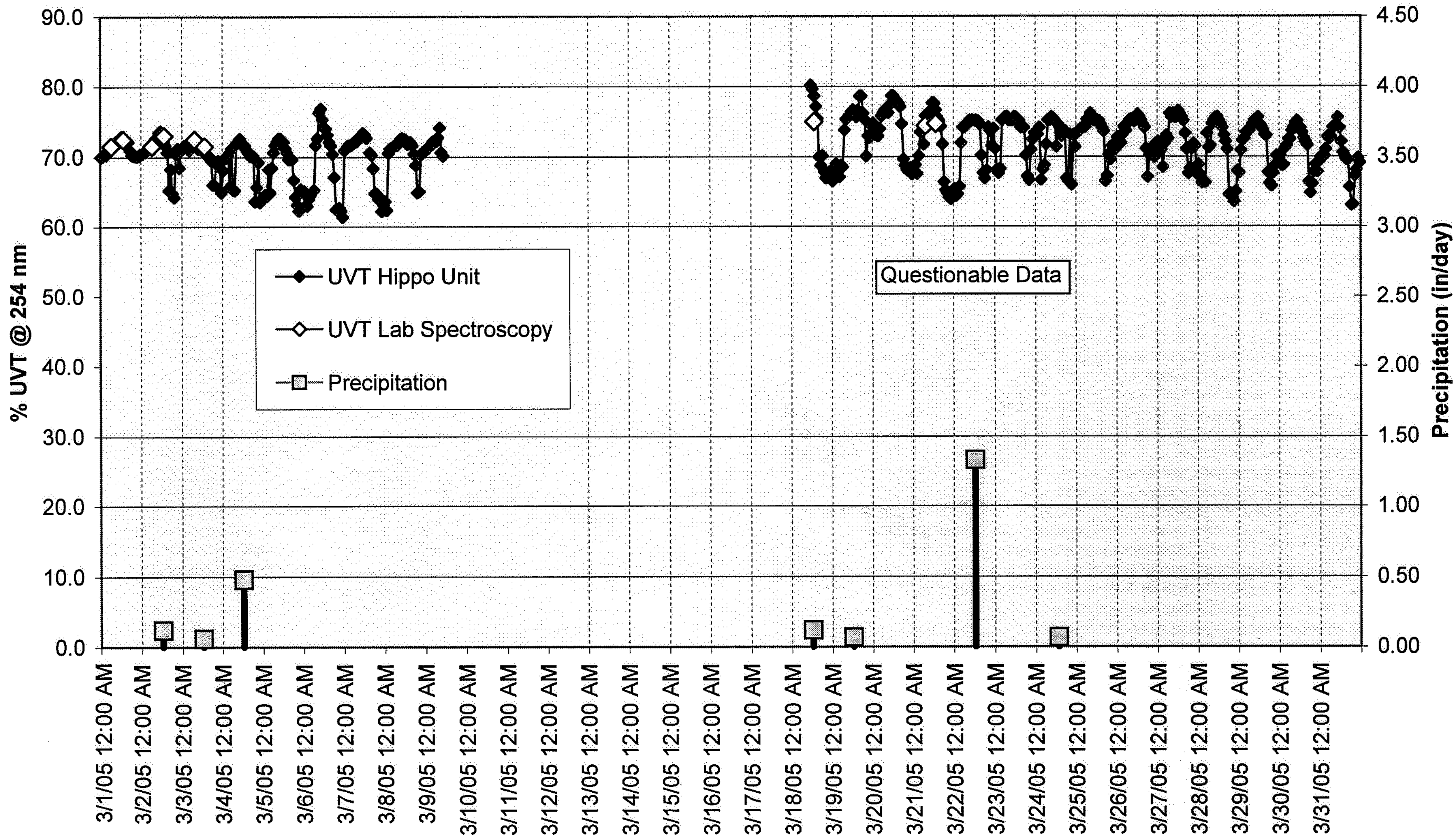
Wedeco On-Line (Hippo) Analyzer UVT Data Taken on the Hour with Trojan Portable Unit and Laboratory Grabs January 2005



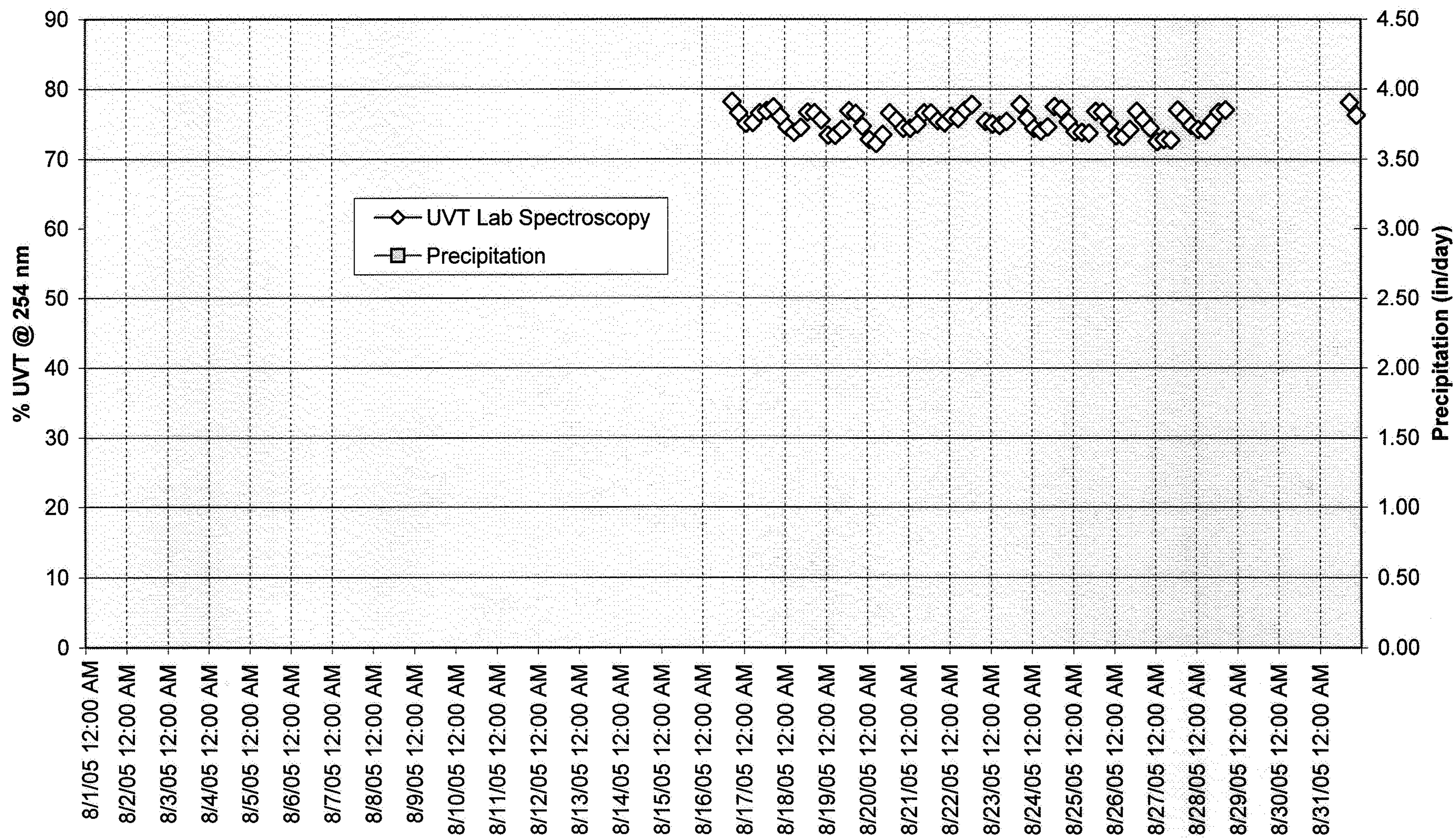
Wedeco On-Line (Hippo) Analyzer UVT Data Taken on the Hour with Trojan Portable Unit and Laboratory Grabs February 2005



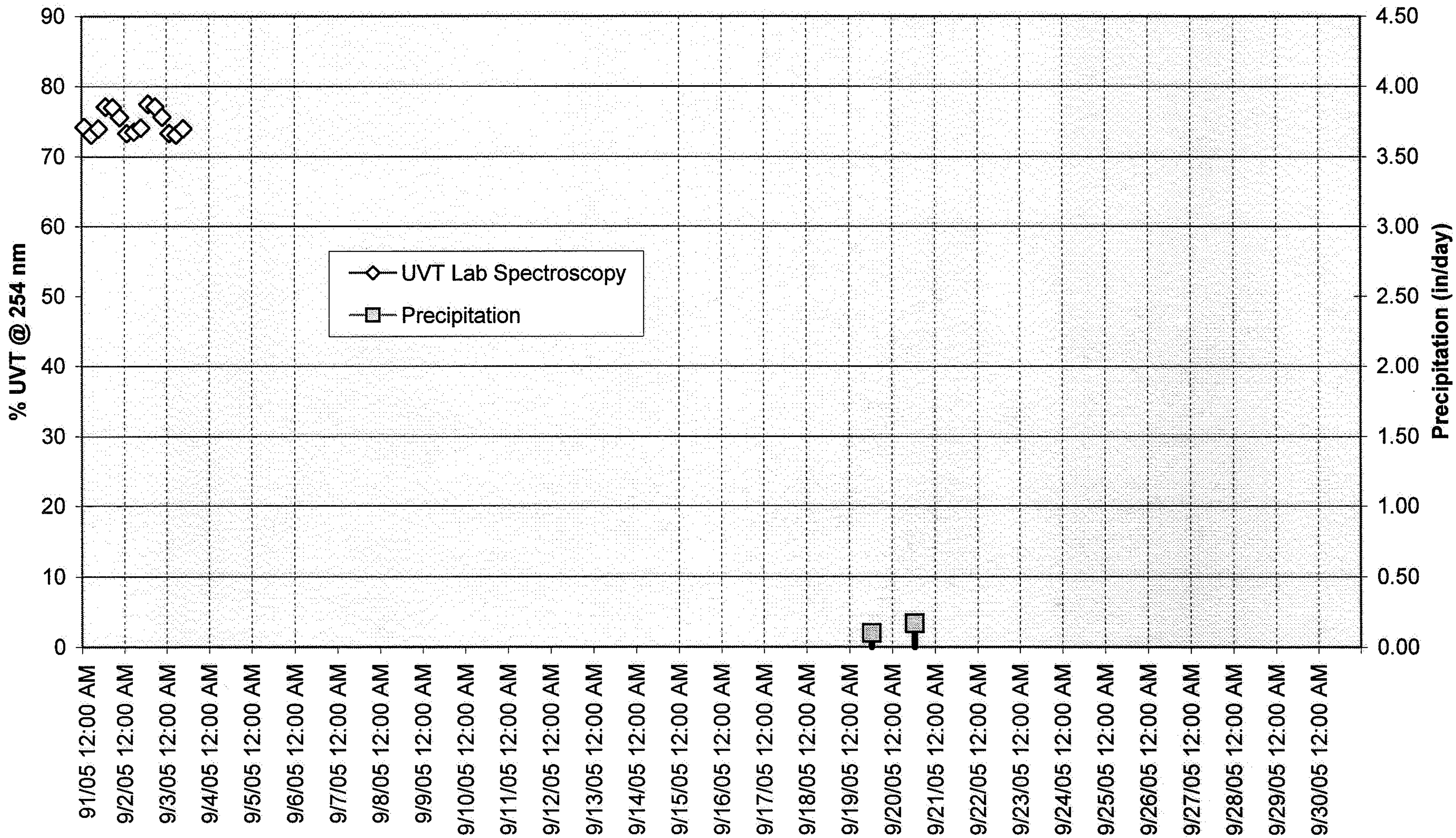
Wedeco On-Line (Hippo) UVT Analyzer Data Taken on the Hour with Laboratory Grabs March 2005



UVT Data
Laboratory Grabs
August 2005



UVT Data
Laboratory Grabs
September 2005



Appendix C

Preliminary Equipment Sizing Determinations

Appendix C — Preliminary Equipment Sizing Determinations

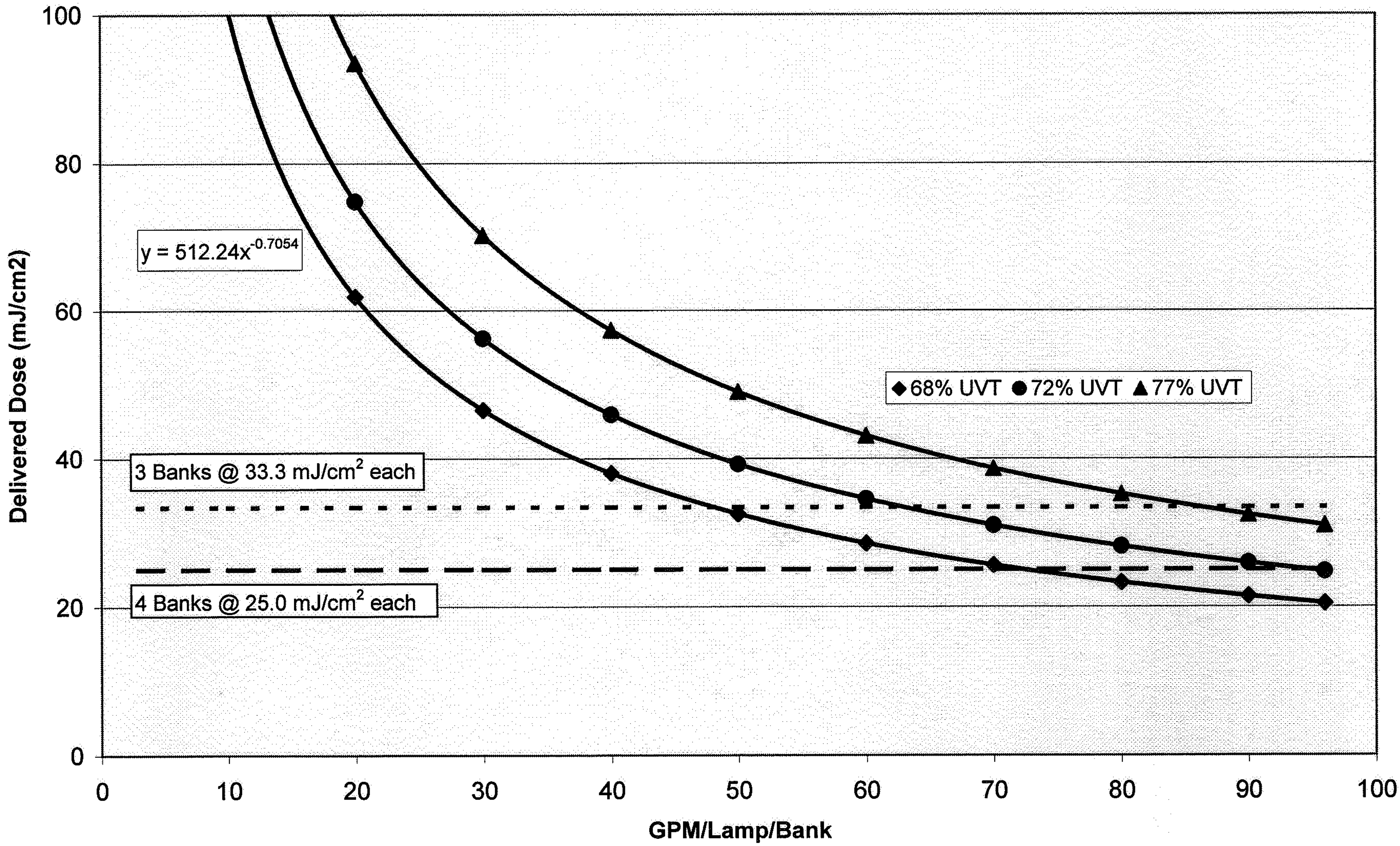
Equipment sizing is based on the DHS-approved validation studies. The target UV dosage required depends on the upstream treatment, and for media filtered wastewater is 100 mJ/cm^2. For this project, two design points have been identified. One is for the plant effluent peak wet weather flow plus sidestreams (24.2 MGD) at the worst-case UVT (69%). The other is the plant effluent peak sanitary flow plus sidestreams (21 MGD) at the typical low UVT (71%). It was determined that the peak sanitary design criteria condition was the controlling design condition for both manufacturers.

For each manufacturer, the respective regression equations and the appropriate fouling and lamp life factors were applied and utilized to determine the number of lamps required with different numbers of UV banks. The lamps per bank were rounded up to a whole number of lamps per module. For either manufacturer, headloss constraints were checked to see if they were acceptable.

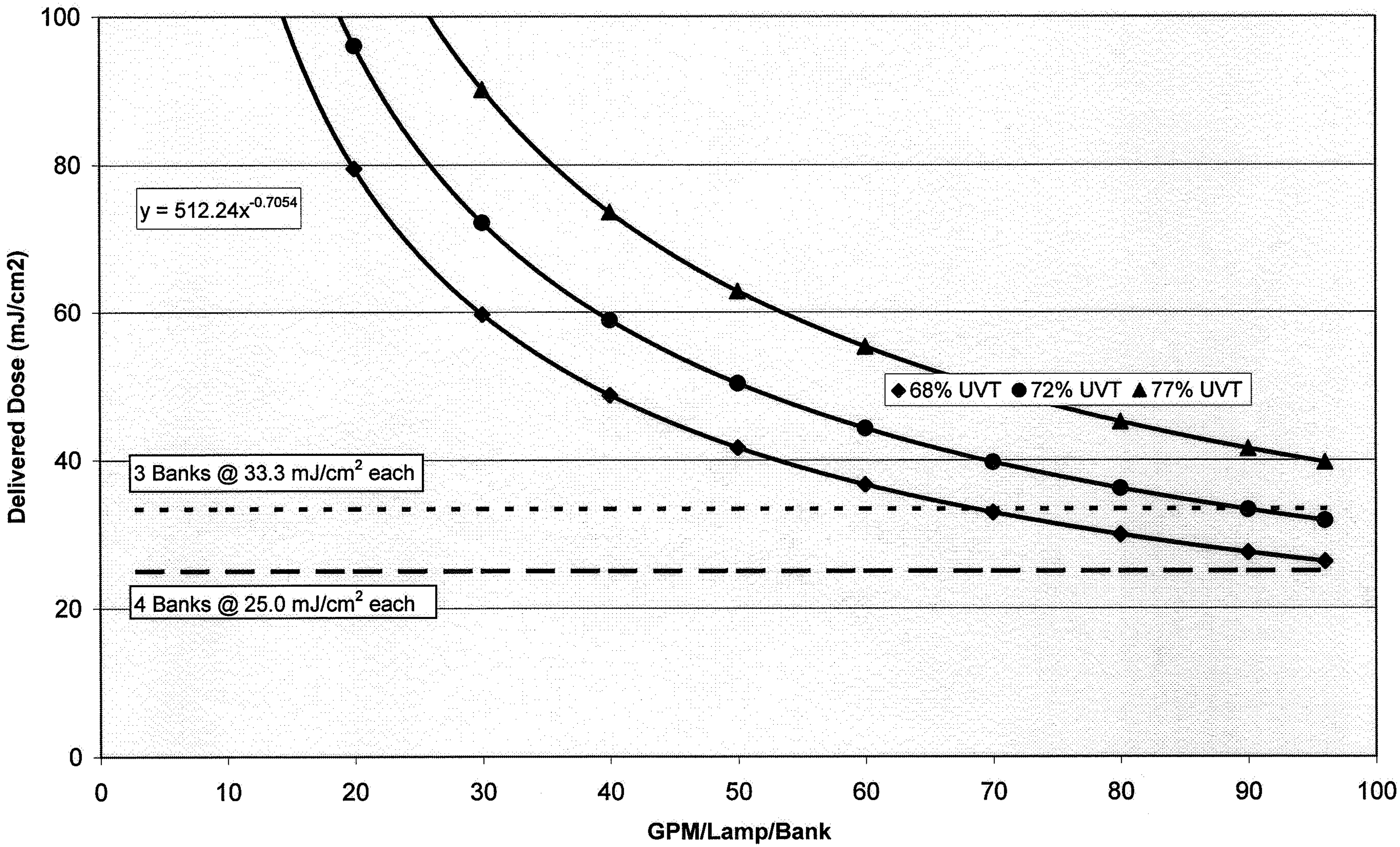
In the case of Wedeco, which can have modules with a different numbers of lamps, an iterative procedure was used to find a workable solution. Wedeco's module size can be altered to provide a more favorable lamp count or module count, which can affect power requirements and the life cycle cost evaluation. For the Wedeco example presented in this appendix, a reasonable configuration was assumed that gave a low lamp count (but not necessarily the lowest), along with the fewest number of modules.

Note that since the Districts have not yet received proposals from Trojan and Wedeco, the equipment sizing determinations herein are preliminary in nature. Within limits, either manufacturer may choose to provide a slightly different system configuration.

Trojan 3000 Plus UV System with a 4-inch Lamp Spacing
Design Delivered Dose at 60% Power and Operational UVTs
LACSD Equation with 0.95 Fouling and 0.82 EOLL Factors



Trojan 3000 Plus UV System with a 4-inch Lamp Spacing
Design Delivered Dose at 100% Power and Operational UVTs
LACSD Equation without Factors



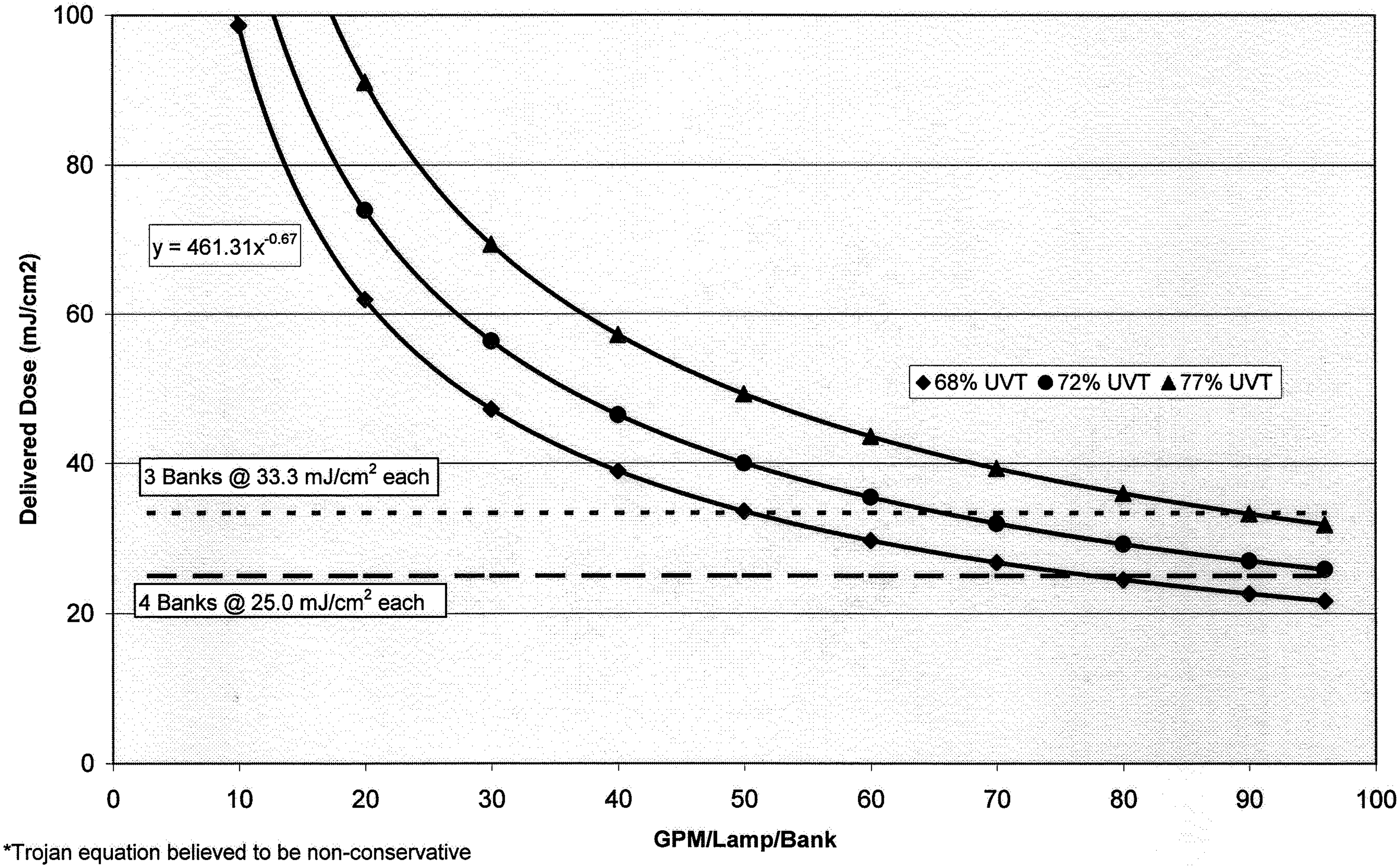
Whittier Narrows WRP - UV Disinfection
Trojan UV Systems - 4 inch
Modeled From LACSD's Eqn
Design Point 2 - 22.5 MGD @ 70% UVT

Note - Inputs Are Designated By Bold Type
Target Dose = a*(Flow^b)*(UVY^c)*(Power^d)
Flow = 10^ (((Log Dose)-(Log a) - (c*Log UVT) - (d Log Power))/b)

	% Full Power	Decimal % Reduced Power	Weighted Reduced Power	Total Weighted Reduced	Total Possible Power	System Turndown Relative to Full Power	
Bank 1	100	0.60	60				
Bank 2	100	0.60	60	120	200	0.60	2 Banks
Bank 3	100	0.00	0	120	300	0.40	3 Banks
Bank 4	100	0.00	0	120	400	0.30	4 Banks

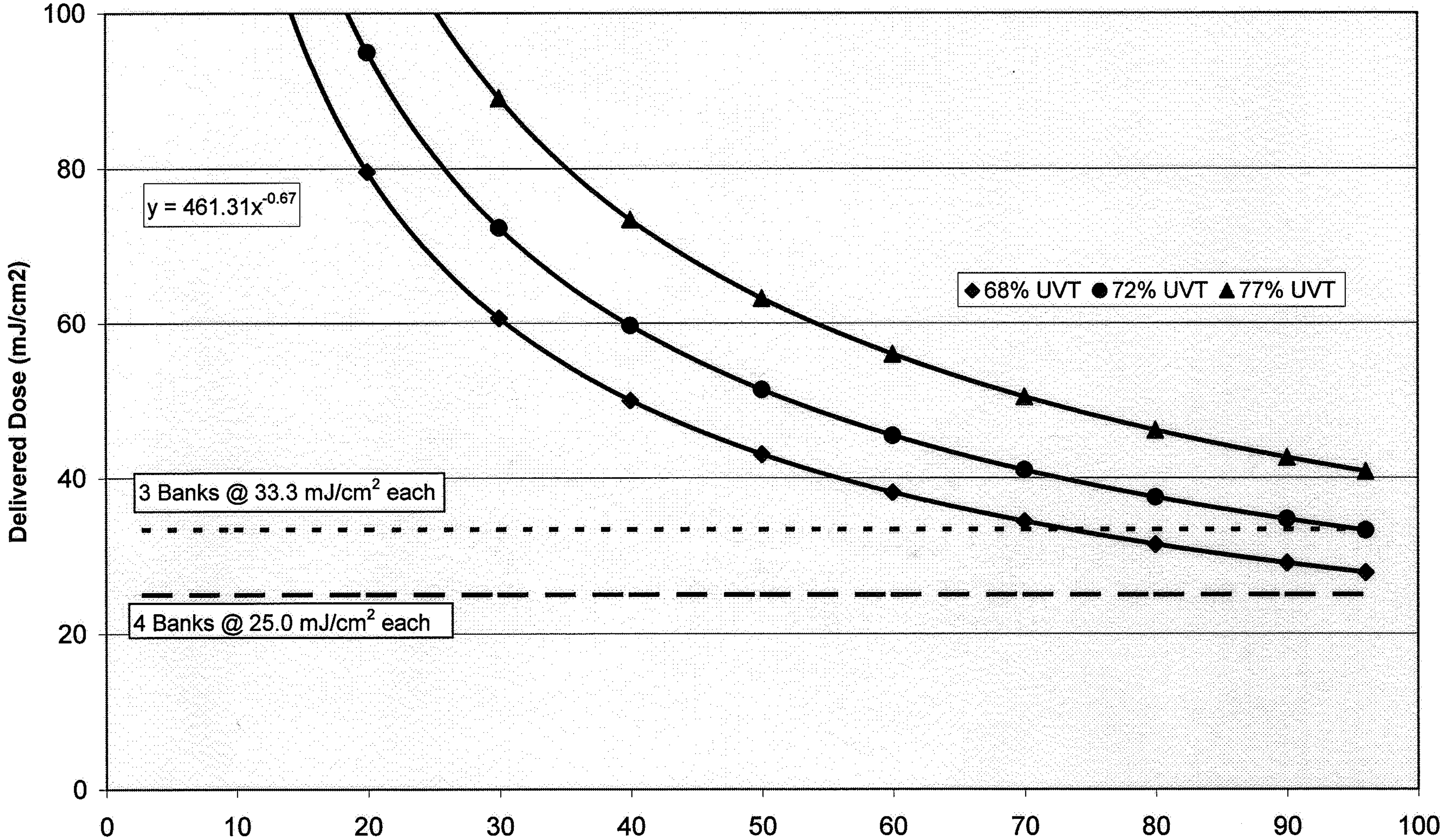
Lamp Spacing (inches)	4.00	4.00	4.00	
Plant Maximum Flow (MGD)	21.00	21.00	21.00	Based on Peak Storm Flow
No. of Operating Trains	3.00	3.00	3.00	Based on Max Day Peak Sanitary Flow. 3 Trains for 19.5 mgd
Max. Flow per Train (MGD)	7.00	7.00	7.00	Has to be below validated flow and not cause excessive headloss
No. Prop Operating Banks/Train	3.00	4.00	5.00	Headloss a big factor with more trains
Proposed Delivered Dose (mj/cm^2)	100.00	100.00	100.00	For Tertiary Filtered Effluent
Target Dose Per Bank (mj/cm^2)	33.33	25.00	20.00	Calc
Fouling Factor	0.9500	0.9500	0.9500	Validated Factor
End of Lamp Life Factor	0.8200	0.8200	0.8200	Valdiated Factor. Latest factor 9000 or 12000 hrs
Combined Lamp Factors	0.7790	0.7790	0.7790	Calc to derate the delivered dosage for higher target dosage
Target Dose per Bank after Factors	42.79	32.09	25.67	Calc based on lamp factors
Log Target Dose/Bank	1.63	1.51	1.41	Calc for simpler cell equations
Factor a	1.747E-05	1.747E-05	1.747E-05	Real factor a based on Trojan's given a'=log a
Log Factor a	-4.7576	-4.7576	-4.7576	Called a in Trojan Validation but really equals to log of Factor a
Flow Factor b	-0.7054	-0.7054	-0.7054	From Trojan Validation
UVT Factor c	3.3140	3.3140	3.3140	From Trojan Validation
Design UVT (%)	71.00	71.00	71.00	Input - Makes a big difference in number of lamps
Log Design UVT	1.851	1.851	1.851	Calc for simpler cell equations
Power Factor d	0.7513	0.7513	0.7513	From Trojan Validation
Power	100.00	100.00	100.00	Power for Design Condition
Log Power	2.000	2.000	2.000	Calc for simpler cell equations
Calc Flow/lamp/bank with factors	58.92	88.58	121.55	
Check of Eqn	42.79	32.09	25.67	Should match target dose/bank above
Headloss Limiting or Max Flow	96.00	92.90	83.80	Manual Input - Max Validated Flow = 96 gpm/l/b
Max Calc or Allowable Flow/Lamp/Bank	58.92	88.58	83.80	If statement concerning max flow/l/b or headloss limiting flow
Max Flow per Train (gpm)	4,861	4,861	4,861	Straightforward calculation
No. Lamps/Bank Needed for Max Flow	82.51	54.88	58.01	Straightforward calculation
Max. No. of Lamps/Bank after Scale-up	320.00	320.00	320.00	Based on scale-up of 10 times pilot
Lamps/Bank< Max L/Bank ?	Yes	Yes	Yes	Check to see if within allowable scale-up
Validated Low Velocity (fps)	0.058	0.058	0.058	Similar to gpm/lamp. Area of lamps not subtracted
Validated High Velocity (fps)	1.924	1.924	1.924	Similar to gpm/lamp. Area of lamps not subtracted
Maximum Water Depth (inches)	32.00	32.00	32.00	Based on lamp spacing
No. of Lamps Per Module	8.00	8.00	8.00	Trojan's standard module
No. of Modules/Bank	10.31	6.86	7.25	Straightforward calculation
No. of Modules/Bank (Round-Up)	11.00	7.00	8.00	Round-up
Actual Max Flow/Lamp/Bank (gpm)	55.24	86.81	75.95	Calculation based on rounded number
Max Q/L/B < Max Q/L ?	Yes	Yes	Yes	Should always be OK because of rounding up
Channel Width (inches)	44.00	28.00	32.00	Based on number of modules
Nominal Flow Area (sq. ft)	9.78	6.22	7.11	Straightforward calculation
Maximum Proposed Velocity (fps)	1.11	1.74	1.52	Straightforward calculation
Act. Vmax > Validated Vmax?	Yes	Yes	Yes	Check if within validated range
Headloss at Actual Max Flow (in/bank)	0.15	0.43	0.32	Need to have safety factor or shift up per graph
Total Headloss for all banks	0.45	1.73	1.61	Includes spare banks if any
Acceptable Headloss for 4" spacing	2.00	2.00	2.00	Half of lamp spacing
Acceptable Level at Last Bank (inches)	Yes	Yes	Yes	Check if acceptable submergence
Number of Lamps per Bank	88.00	56.00	64.00	
Number of Operating Lamps/Train	264.00	224.00	320.00	Straightforward calculation
No. of Spare Banks	**0.00**	**0.00**	**0.00**	Input - choose spare bank or train
No. Lamps in Spare Banks	0.00	0.00	0.00	Straightforward calculation
Total Number of Lamps per Train	264.00	224.00	320.00	Straightforward calculation
No. of Spare Trains	1.00	1.00	1.00	Input - choose spare bank or train
No. Lamps in Spare Trains	264.00	224.00	320.00	Straightforward calculation
Total No. of Spare Lamps	264.00	224.00	320.00	Straightforward calculation
Total Number of Lamps in UV System	1056.00	896.00	1280.00	Straightforward calculation
gpm/operating lamp/bank	55.24	86.81	75.95	From above
overall gpm/total system lamps	13.81	16.28	11.39	Want to select option with the highest value
Equivalent No. of roundup lamps %	6.7%	2.0%	10.3%	Can be viewed as extra capacity
Equivalent No. of roundup lamps	70.3	18.4	132.2	Can be viewed as extra capacity

Trojan 3000 Plus UV System with a 4-inch Lamp Spacing
Design Delivered Dose at 100% Power and Operational UVTs
Trojan Equation with 0.95 Fouling and 0.82 EOLL Factors*



*Trojan equation believed to be non-conservative

Trojan 3000 Plus UV System with a 4-inch Lamp Spacing
Design Delivered Dose at 100% Power and Operational UVTs
Trojan Equation without Factors*



*Trojan equation believed to be non-conservative

Whittier Narrows WRP - UV Disinfection
Trojan UV Systems - 4 inch
Modeled From Trojan's WNWRP Validation Eqn

Note - Inputs Are Designated By Bold Type

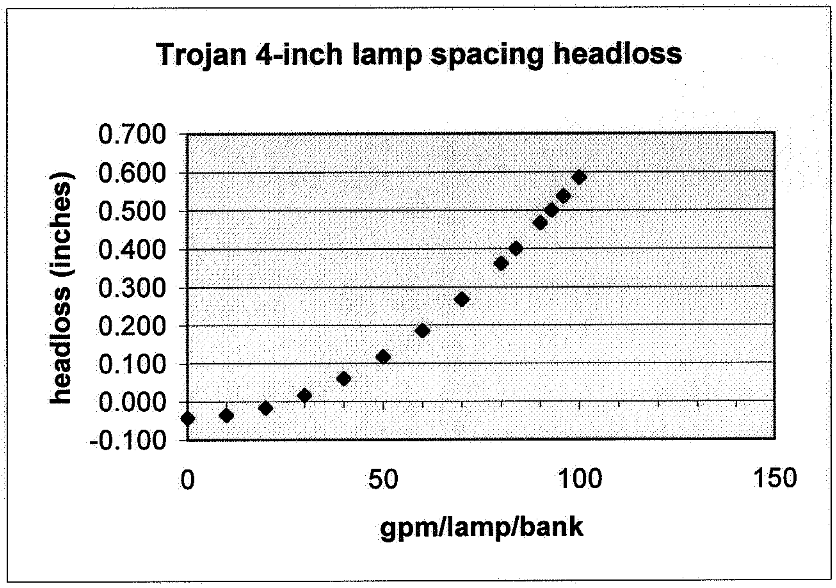
Target Dose = a*(Flow^b)*(UVY^c)*(Power^d)
Flow = 10^ (((Log Dose)-(Log a) - (c*Log UVT) - (d Log Power))/b)

Lamp Spacing (inches)	4.00	4.00	4.00	
Plant Maximum Flow (MGD)	**21.00**	**21.00**	**21.00**	Based on Peak Storm Flow
No. of Operating Trains	**3.00**	**3.00**	**3.00**	Based on Max Day Peak Sanitary Flow. 3 Trains for 19.5 mgd
Max. Flow per Train (MGD)	7.00	7.00	7.00	Has to be below validated flow and not cause excessive headloss
No. Prop Operating Banks/Train	3.00	4.00	5.00	Headloss a big factor with more trains
Proposed Delivered Dose (mj/cm^2)	**104.794**	**104.794**	**104.794**	For Tertiary Filtered Effluent
Target Dose Per Bank (mj/cm^2)	34.93	26.20	20.96	Calc
Fouling Factor	0.9500	0.9500	0.9500	Validated Factor
End of Lamp Life Factor	0.8200	0.8200	0.8200	Valdiated Factor. Latest factor 9000 or 12000 hrs
Combined Lamp Factors	0.7790	0.7790	0.7790	Calc to derate the delivered dosage for higher target dosage
Target Dose per Bank after Factors	44.84	33.63	26.90	Calc based on lamp factors
Log Target Dose/Bank	1.65	1.53	1.43	Calc for simpler cell equations
Factor a	5.129E-05	5.129E-05	5.129E-05	Real factor a based on Trojan's given a'=log a
Log Factor a	**-4.290**	**-4.290**	**-4.290**	Called a in Trojan Validation but really equals to log of Factor a
Flow Factor b	**-0.670**	**-0.670**	**-0.670**	From Trojan Validation
UVT Factor c	**3.090**	**3.090**	**3.090**	From Trojan Validation
Design UVT (%)	**71.00**	**71.00**	**71.00**	Input - Makes a big difference in number of lamps
Log Design UVT	1.851	1.851	1.851	Calc for simpler cell equations
Power Factor d	**0.700**	**0.700**	**0.700**	From Trojan Validation
Power	**100.00**	**100.00**	**100.00**	Power for Design Condition
Log Power	2.000	2.000	2.000	Calc for simpler cell equations
Calc Flow/lamp/bank with factors	57.45	88.2562	123.14	
Check of Eqn	44.84	33.63	26.90	Should match target dose/bank above
Headloss Limiting or Max Flow	**96.00**	**93.80**	84.60	Manual Input - Max Validated Flow = 96 gpm/l/b
Max Calc or Allowable Flow/Lamp/Bank	57.45	88.26	84.60	If statement concerning max flow/l/b or headloss limiting flow
Max Flow per Train (gpm)	4,861	4,861	4,861	Straightforward calculation
No. Lamps/Bank Needed for Max Flow	84.62	55.08	57.46	Straightforward calculation
Max. No. of Lamps/Bank after Scale-up	**320.00**	**320.00**	**320.00**	Based on scale-up of 10 times pilot
Lamps/Bank< Max L/Bank ?	Yes	Yes	Yes	Check to see if within allowable scale-up
Validated Low Velocity (fps)	0.058	0.058	0.058	Similar to gpm/lamp. Area of lamps not subtracted
Validated High Velocity (fps)	1.924	1.924	1.924	Similar to gpm/lamp. Area of lamps not subtracted
Maximum Water Depth (inches)	32.00	32.00	32.00	Based on lamp spacing
No. of Lamps Per Module	8.00	8.00	8.00	Trojan's standard module
No. of Modules/Bank	10.58	6.88	7.18	Straightforward calculation
No. of Modules/Bank (Round-Up)	11.00	7.00	8.00	Round-up
Actual Max Flow/Lamp/Bank (gpm)	55.24	86.81	75.95	Calculation based on rounded number
Max Q/L/B < Max Q/L ?	Yes	Yes	Yes	Should always be OK because of rounding up
Channel Width (inches)	44.00	28.00	32.00	Based on number of modules
Nominal Flow Area (sq. ft)	9.78	6.22	7.11	Straightforward calculation
Maximum Proposed Velocity (fps)	1.11	1.74	1.52	Straightforward calculation
Act. Vmax > Validated Vmax?	Yes	Yes	Yes	Check if within validated range
Headloss at Actual Max Flow (in/bank)	0.15	0.43	0.32	Need to have safety factor or shift up per graph
Total Headloss for all banks	0.61	2.16	1.93	Includes spare banks if any
Acceptable Headloss for 4" spacing	2.00	2.00	2.00	Half of lamp spacing
Acceptable Level at Last Bank (inches)	Yes	No	Yes	Check if acceptable submergence
Number of Lamps per Bank	88.00	56.00	64.00	
Number of Operating Lamps/Train	264.00	224.00	320.00	Straightforward calculation
No. of Spare Banks	**1.00**	**1.00**	**1.00**	Input - choose spare bank or train
No. Lamps in Spare Banks	88.00	56.00	64.00	Straightforward calculation
Total Number of Lamps per Train	**352.00**	**280.00**	**384.00**	Straightforward calculation
No. of Spare Trains	**0.00**	**0.00**	**0.00**	Input - choose spare bank or train
No. Lamps in Spare Trains	0.00	0.00	0.00	Straightforward calculation
Total No. of Spare Lamps	88.00	56.00	64.00	Straightforward calculation
Total Number of Lamps in UV System	1056.00	840.00	1152.00	Straightforward calculation
gpm/operating lamp/bank	55.24	86.81	75.95	
overall gpm/operating lamp	18.41	21.70	15.19	
overall gpm/total system lamps	13.81	17.36	12.66	

Headloss Calculations for Trojan 4-inch Spacing

Headloss per bank, in = (6.16 x 10-5)Q2 + (1.28 x 10-4)Q - (4.34 x 10-2)
Where: Q = flow divided by number of lamps in a single bank (gpm per lamp per bank)

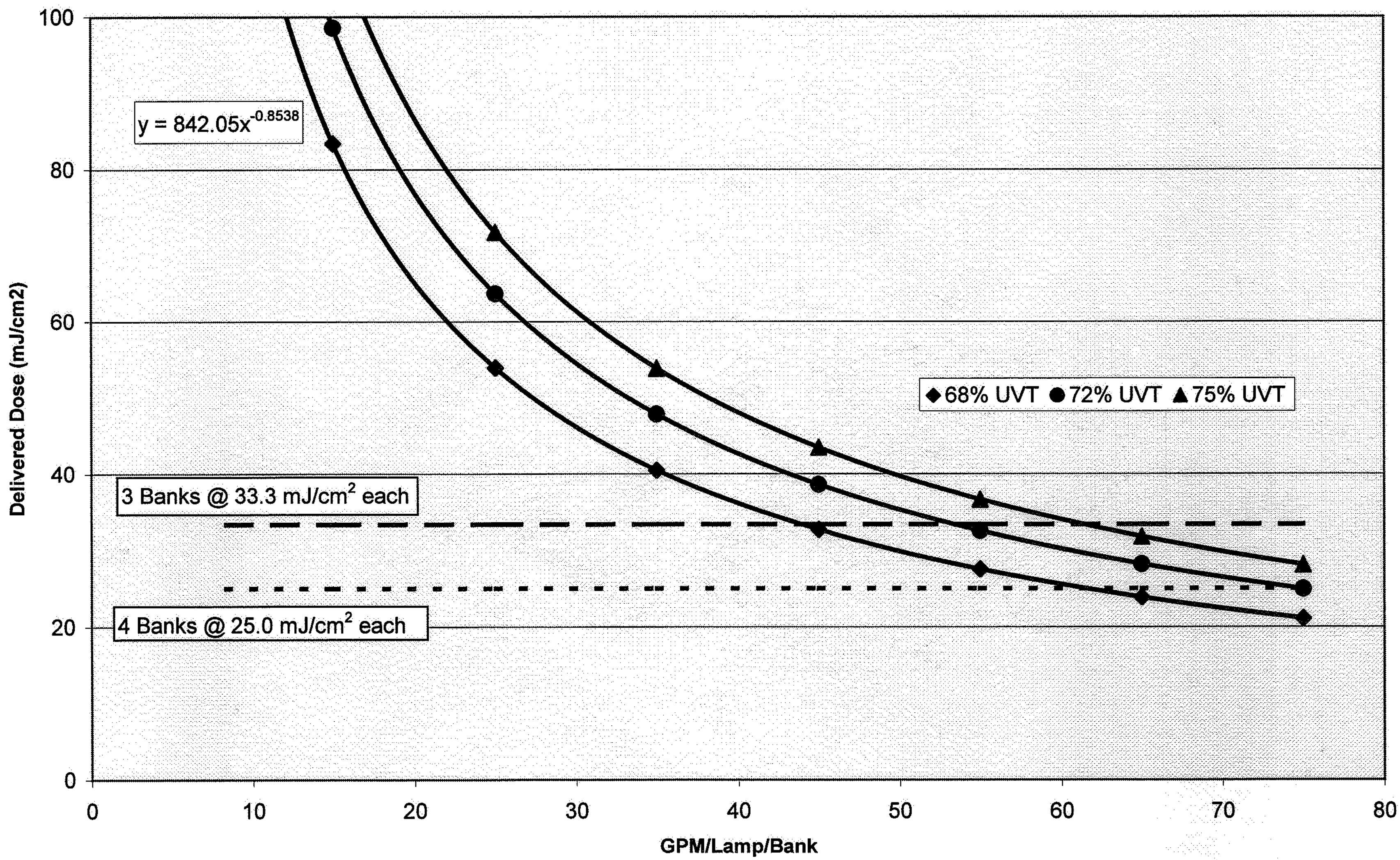
Flow gpm/l/b	Headloss/bank in
0.0	-0.043
10.0	-0.036
20.0	-0.016
30.0	0.016
40.0	0.060
50.0	0.117
60.0	0.186
70.0	0.267
80.0	0.361
83.8	0.400
90.0	0.467
92.9	0.500
96.0	0.537
100.0	0.585
106.4	0.667
110.0	0.716
117.7	0.824
120.0	0.859
130.0	1.014
129.1	1.000
140.0	1.182
150.0	1.362
160.0	1.554

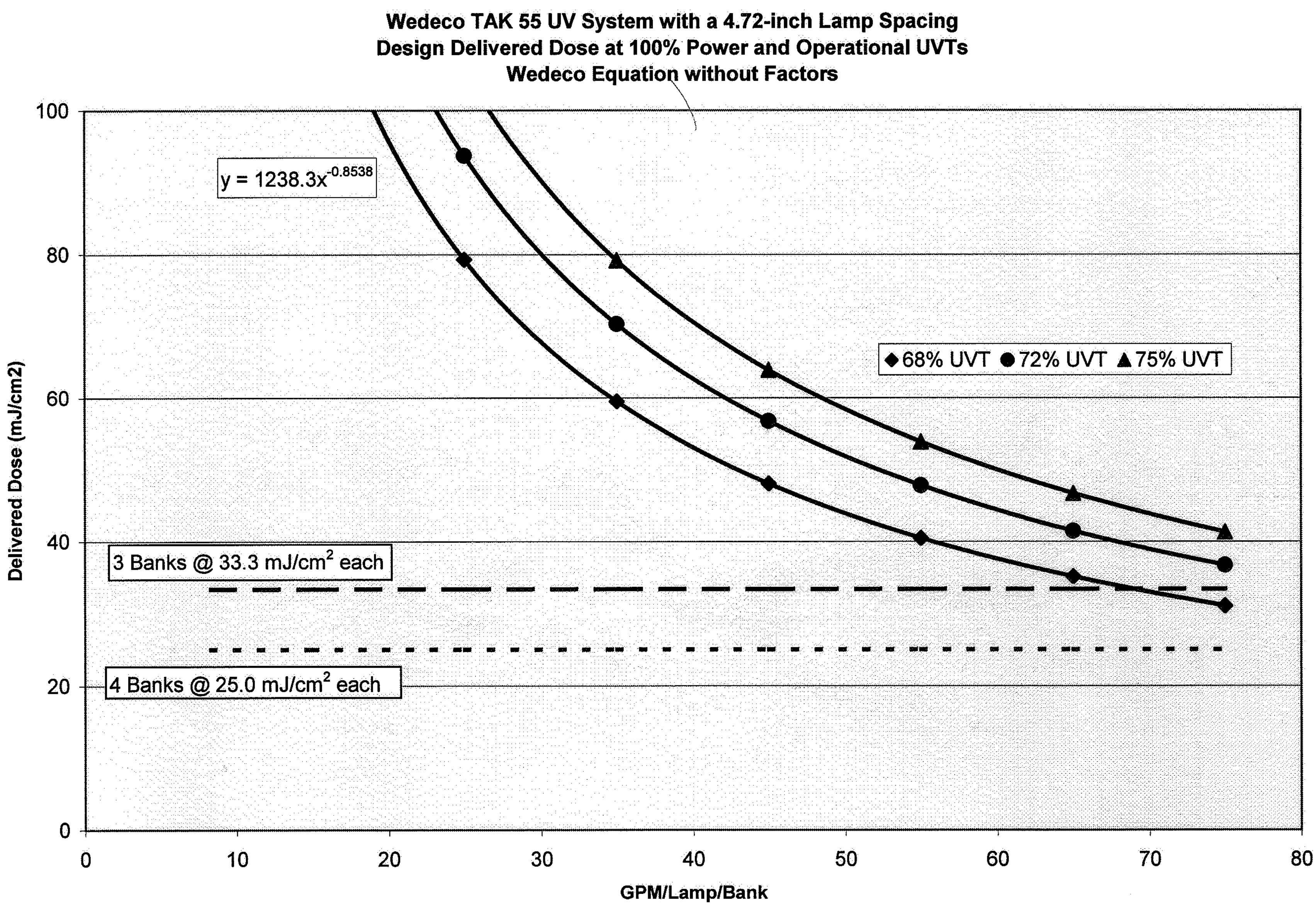


Total No. of Banks	Headloss Limiting Flows for 2" headloss		
	per Bank	Total HL	gpm/l/b
3 Banks	0.667	2.00	106.35
4 Banks	0.500	2.00	92.90
5 Banks	0.400	2.00	83.80

Note: 4 and 5 bank systems are headloss limited, while 3 bank systems are limited by maximum validated flow of 96 gpm/l/b

Wedeco TAK 55 UV System with a 4.72-inch Lamp Spacing
Design Delivered Dose at 100% Power and 68% UVT
Wedeco Equation with 0.80 Fouling and 0.85 EOLL Factors





Wedeco Design / Unfactored Graph Chart 1

WNWRP - UV Disinfection Facilities
Wedeco TAK 55
Modeled From Roseville Validation Eqn

Note - Inputs Are Designated By Bold Type

Target Dose = a*(Flow^b)*(UVY^c)*(Power^d)
Flow = 10^ (((Log Dose)-(Log a) - (c*Log UVT) - (d Log Power))/b)

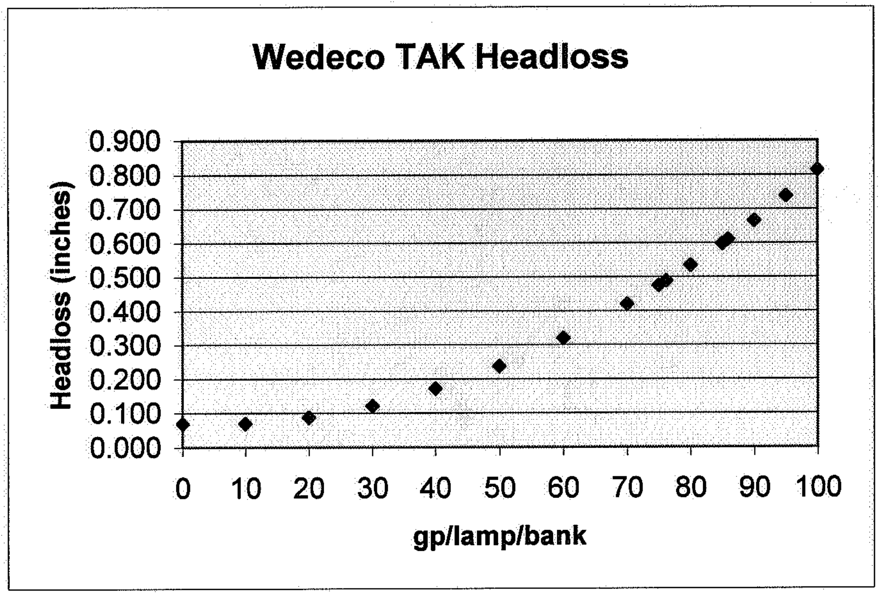
	% Full Power	Decimal % Reduced Power	Weighted Reduced Power	Total Weighted Reduced	Total Possible Power	Turndown Relative to Full Power	
Bank 1	100	0.50	50				
Bank 2	100	0.50	50	100	200	0.50	2 Banks
Bank 3	100	0.00	0	100	300	0.33	3 Banks
Bank 4	100	0.00	0	100	400	0.25	4 Banks
Bank 5	100	0.00	0	100	500	0.20	5 Banks

Lamp Spacing (mm)	120.00	120.00	120.00	Nominal spacing between lamps (not walls or bottom)
Lamp Spacing (inches)	4.72	4.72	4.72	Nominal spacing between lamps (not walls or bottom)
Plant Maximum Flow (MGD)	**21.00**	**21.00**	**21.00**	Based on Peak Storm Flow
No. of Operating Trains	**3.00**	**3.00**	**3.00**	Based on Max Day Peak Sanitary Flow. 3 Trains for 19.5 mgd
Max. Flow per Train (MGD)	7.00	7.00	7.00	Has to be below validated flow and not cause excessive headloss
No. Prop Operating Banks/Train	**3.00**	**4.00**	**5.00**	Headloss a big factor with more trains
Proposed Delivered Dose (mj/cm^2)	**137.80**	**100.00**	**100.00**	For Tertiary Filtered Effluent
Target Dose Per Bank (mj/cm^2)	45.93	25.00	20.00	Calc
Fouling Factor	0.8000	0.8000	0.8000	Validated Factor
End of Lamp Life Factor	0.8500	0.8500	0.8500	Valdated Factor for 8760 hrs
Combined Lamp Factors	0.6800	0.6800	0.6800	Calc to derate the delivered dosage for higher target dosage
Target Dose per Bank after Factors	67.55	36.76	29.41	Calc based on lamp factors
Log Target Dose/Bank	1.83	1.57	1.47	Calc for simpler cell equations
Factor a	0.0055616	0.0055616	0.0055616	Real factor a based on Trojan's given a'=log a
Log Factor a	**-2.2548**	**-2.2548**	**-2.2548**	Called a in Trojan Validation but really equals to log of Factor a
Flow Factor b	**-0.8538**	**-0.8538**	**-0.8538**	From Trojan Validation
UVT Factor c	**2.9182**	**2.9182**	**2.9182**	From Trojan Validation
Design UVT (%)	**71.00**	**71.00**	**71.00**	Input - Makes a big difference in number of lamps
Log Design UVT	1.851	1.851	1.851	Calc for simpler cell equations
Power Factor d	**0.0000**	**0.0000**	**0.0000**	Power not vaired in Wedeco validation
Power	**100.00**	**100.00**	**100.00**	Power for Design Condition
Log Power	2.000	2.000	2.000	Calc for simpler cell equations
Calc Flow/lamp/bank with factors	34.96	71.29	92.58	Real basis of comparison before rounding occurs
Check of Eqn	67.55	36.76	29.41	Should match target dose/bank above
Headloss Limiting or Max Valid Flow	**75.00**	**75.00**	**75.00**	Manual Input - Max Validated Flow = 75 gpm/l/b See Sheet Wed HL
Max Calc or Allowable Flow/Lamp/Bank	34.96	71.29	75.00	If statement concerning max flow/l/b or headloss limiting flow
Max Flow per Train (gpm)	4,861	4,861	4,861	Straightforward calculation
No. Lamps/Bank Needed for Max Flow	139.04	68.19	64.81	Straightforward calculation
Rounded No. Lamps/Bank for Max Flow	140.00	69.00	65.00	Straightforward calculation
Max. No. of Lamps/Bank after Scale-up	**120.00**	**120.00**	**120.00**	Based on scale-up of 10 times pilot
Lamps/Bank< Max L/Bank	No	Yes	Yes	Check to see if within allowable scale-up
Validated Low Velocity (fps)	0.130	0.130	0.130	Similar to gpm/lamp. Area of lamps not subtracted
Validated High Velocity (fps)	1.130	1.130	1.130	Similar to gpm/lamp. Area of lamps not subtracted
No. of Lamps Per Module	18.00	18.00	18.00	Trojan's standard module
Maximum Water Depth (mm)	1082.0	1082.0	1082.0	From validation
Maximum Water Depth (inches)	42.6	42.6	42.6	Based on lamp spacing
No. of Modules/Bank	7.78	3.83	3.61	Straightforward calculation
No. of Modules/Bank (Round-Up)	8.00	4.00	4.00	Round-up
Actual Max Flow/Lamp/Bank (gpm)	33.76	67.52	67.52	Calculation based on rounded number
Max Q/L/B < Max Q/L	Yes	Yes	Yes	Should always be OK because of rounding up
No of Lamp Columns	16.00	8.00	8.00	2 lamp columns per module
Channel Width (inches)	75.2	37.4	37.4	Based on number of modules
Nominal Flow Area (sq. ft)	22.23	11.06	11.06	Straightforward calculation
Maximum Proposed Velocity (fps)	0.49	0.98	0.98	Straightforward calculation
Act. Vmax > Validated Vmax?	Yes	Yes	Yes	Check if within validated range
Headloss at Actual Max Flow (in/bank)	0.14	0.39	0.39	May need to have safety factor
Total Headloss for all banks	0.41	1.57	1.97	Includes spare banks if any
Acceptable Headloss for Wedeco spacing	2.44	2.44	2.44	Half of lamp spacing
Acceptable Level at Last Bank (inches)	Yes	Yes	Yes	Check if acceptable submergence
Number of Lamps per Bank	144.00	72.00	72.00	
Number of Operating Lamps/Train	432.00	288.00	360.00	Straightforward calculation
No. of Spare Banks	**0.00**	**0.00**	**0.00**	Input - choose spare bank or train
No. Lamps in Spare Banks	0.00	0.00	0.00	Straightforward calculation
Total Number of Lamps per Train	**432.00**	**288.00**	**360.00**	Straightforward calculation
No. of Spare Trains	**1.00**	**1.00**	**1.00**	Input - choose spare bank or train
No. Lamps in Spare Trains	432.00	288.00	360.00	Straightforward calculation
Total No. of Spare Lamps	432.00	288.00	360.00	Straightforward calculation
Total Number of Lamps in UV System	**1728.00**	**1152.00**	**1440.00**	Straightforward calculation
gpm/operating lamp/bank	33.76	67.52	67.52	From above
overall gpm/total system lamps	8.44	12.66	10.13	Want this to be the highest
Equivalent No. of roundup lamps %	3.6%	5.6%	11.1%	Can be viewed as extra capacity
Equivalent No. of roundup lamps	61.6	64.4	159.6	Can be viewed as extra capacity

Headloss for TAK Wedeco 4.72 inch (120 mm) Spacing

Wedeco Headloss per bank=((8.13*10^-5)*(Q^2))-((6.82*10^-4)*Q)+(0.0685)

Flow gpm/l/b	Headloss in
0.0	0.069
10.00	0.070
20.00	0.087
30.00	0.121
40.00	0.171
50.00	0.238
60.00	0.320
70.00	0.419
75.00	0.475
76.15	0.488
80.00	0.534
85.00	0.598
85.90	0.610
90.00	0.666
95.00	0.737
100.00	0.813



Acceptable Headloss = 2+(120mm/2)=62 mm	
mm	in
62	2.44

Total No. of Banks	Headloss Limiting Flows for 2.44" Headloss		
	per Bank	Total HL	gpm/l/b
3 Banks	0.813	2.44	100.00
4 Banks	0.610	2.44	85.90
5 Banks	0.488	2.44	76.15

Notes: 3, 4 and 5 bank systems are limited by maximum validated flow range of 75 gpm/l/b.
5 bank systems are not headloss limited, but are very close to being headloss limited depending on safety factor

Appendix D

Trojan UV3000 Plus System Validation at the WNWRP
Comparison of Data Analysis Methods

Appendix D — Trojan UV 3000 Plus System Validation at the WNWRP Comparison of Data Analysis Methods

The Trojan/Carollo validation testing at the WNWRP was conducted with the UV 3000 Plus System using LSI lamps at a 4-inch spacing.

During the review of the Trojan/Carollo validation report, the Districts disagreed with the approach used to analyze the data from the individual collimated beam test runs. Trojan/Carollo's approach was to use a linear regression to analyze log inactivation data collected at UV dosages of 0 mJ/sq cm and above. While linear regressions have historically been used to analyze collimated beam data in the past, these analyses have typically been done at dosages considerably above 0 mJ/sq cm, where the inactivation curve is more linear. The NWRI Guidelines offer no guidance on the type of regression analysis to be used, but they do state unequivocally that no collimated beam data shall be analyzed at dosages below 20 mJ/sq cm. While the Districts do not necessarily disagree with Trojan/Carollo's inclusion of the 0 dosage point in the collimated beam analyses (and in fact, DHS is planning to allow this as well), the use of a linear regression in this case is inappropriate since it does not fit the data well. Delivered UV dosages determined in this manner are non-conservative at low to mid dosage levels. More accurate dosage determinations are obtained from collimated beam data that has been analyzed with a second order polynomial curve fit.

The dosage equation presented in Trojan's final validation report (June 22, 2005) for the UV3000 Plus System with 4-inch lamp spacing is:

$$\text{Log Dose} = -4.29 - (0.67 \times \text{Log Flow}) + (3.09 \times \text{Log UVT}) + (0.70 \times \text{Log Power Setting})$$

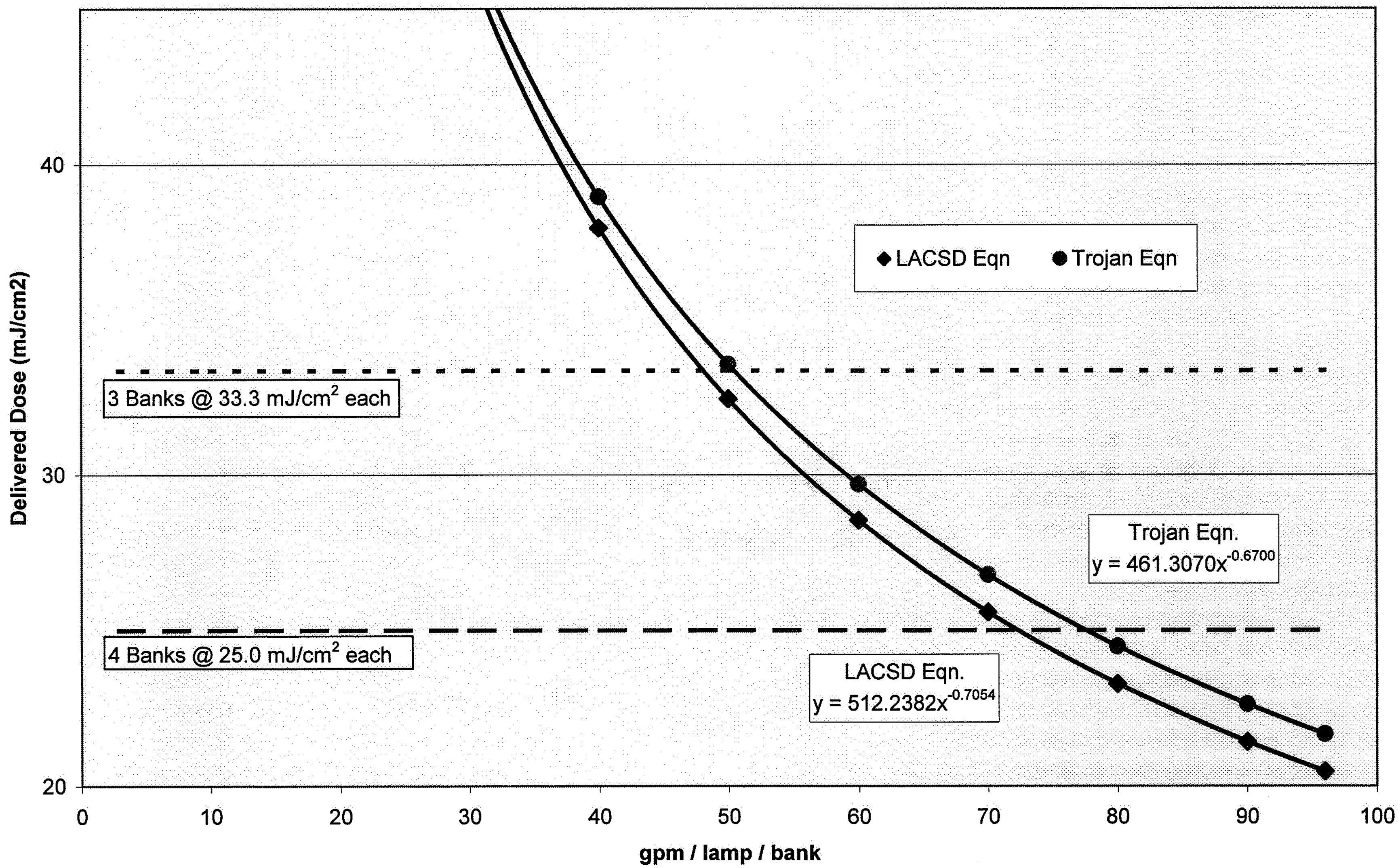
The above equation was developed by analyzing the collimated beam bioassay data with a linear regression, including the zero points.

If the collimated beam data for the Whittier Narrows project, including the zero dosage points, is analyzed instead with a second order polynomial regression, the resulting dose delivery equation for the system is:

$$\text{Log Dose} = -4.7576 - (0.7054 \times \text{Log Flow}) + (3.3140 \times \text{Log UVT}) + (0.7513 \times \text{Log Power Setting})$$

This version of the equation provides more conservative dosage results than the validation version of the equation proposed by Trojan/Carollo above. Because of the discrepancy in calculated dosages, the Districts' equipment procurement specifications will ask Trojan to provide a dose by their validated equation (based on linear collimated beam regression analyses) that will result in the same number of U.V. lamps as a dose of 100 mJ/sq cm determined from the more accurate equation developed from non-linear collimated beam regression analyses. To be equivalent to a true dosage of 100 mJ/sq cm, the specified dosage will be a function of other specified operating conditions as well. It appears at this time that the specified dosage will end up being approximately 105 mJ/sq cm as determined by the validated equation. If Trojan is selected and once the full-scale plant is built, the WNWRP will be operated at a dosage of 100 mJ/sq cm as determined by the more accurate, non-linear version of the equation.

Trojan UV 3000 Plus System with LSI Lamps at a 4-inch Spacing
Design Delivered Dose at 100% Power and 68% UVT
LACSD and Trojan Equations with 0.95 Fouling and 0.82 EOLL Factors



Appendix E

Adenovirus Epidemiological Concerns

Appendix E — Adenovirus Epidemiological Concerns

The NWRI Guidelines have been written with a target 5-log removal of poliovirus, which is defined as "essentially virus-free water". Since this degree of inactivation for a filtered wastewater typically occurs at a UV dose of 50 mJ/cm^2, and the mandatory delivered dose is 100 mJ/cm^2, a safety factor of 2 has been applied. This delivered dosage concept is based on pilot testing with MS2 phage as the indicator organism. Although adenovirus is less susceptible to UV inactivation than MS2 and poliovirus, a dosage of 100 mJ/cm^2 should result in an adenovirus inactivation of approximately two to three logs. Since adenovirus has been reported in the WNWRP secondary effluent from 1.5 pfu/L to 100 pfu/L, adenovirus may or may not be detected in a UV disinfected final effluent dosed at 100 mJ/cm^2, depending upon filtered effluent adenovirus titers.

The Safe Drinking Water Act (SDWA) regulates drinking water supplies throughout the nation. The purpose of the act is to protect the public health by creating multiple barriers against water pollution, which include filtration, disinfection and protection of source water. The EPA also sets national drinking water standards for biological and chemical contaminants. It publishes unenforceable maximum contaminant level goals and enforceable regulations that specify the maximum contaminant levels (MCLs) goals or treatment technique that has been shown to reduce contaminant(s) to an acceptable level. The EPA National Primary Drinking Water Standards specify that enteric viruses must be removed or inactivated by 4 logs (99.99%) from surface water, or groundwater under the influence of surface water, by filtration and disinfection or by a combination thereof.

Enteric adenoviruses are included on the EPA Drinking Water Contaminant List that was published in 1998. This list is put together for contaminants that are suspected of being a public health concern, but cannot be acted upon, or effectively regulated, because of inadequate information. Since enteric adenoviruses have greater environmental stability than other enteric viruses, and with their ubiquitous presence in sewage and surface waters, they are likely contaminants in public water supplies. Although outbreaks of disease due to enteric adenovirus are rare, it was one of the causative agents associated with a waterborne outbreak in Finland. According to the AWWA, to date there have been no positively identified waterborne outbreaks of adenovirus in the U.S. However, the etiologic agent is never identified in over half of the waterborne outbreaks of disease. Viruses may cause these outbreaks and the prevalence of adenoviruses leads one to believe they may be implicated.

Adenoviruses are transmitted via the fecal oral route and inhalation of aerosols. They are found throughout the world in polluted waters, drinking water sources, groundwater and even treated drinking water. They are detected at higher levels than enteroviruses in polluted waters and have higher resistance to environmental conditions. Of the 51 serotypes of adenovirus, 17 are pathogenic to humans. Adenovirus are reported to cause 2-7% of all lower respiratory tract illnesses in children in U.S and Great Britain, causing 200,000 children to be hospitalized. Non-enteric adenovirus has been associated with outbreaks of pharyngoconjunctivitus from swimming activities. Accidental fecal releases in swimming pools operated without sufficient chlorine residual have resulted in disease outbreaks. Boarding schools and military training facilities have also been affected by adenovirus outbreaks, and even deaths. These outbreaks are mainly respiratory in nature and not waterborne. Some adenoviruses (AD40, AD41) are important causes of acute gastroenteritis, especially in children less than 4 years old. The gastroenteritis caused by AD40 and AD 41 is common in infants, neonatal care units and day care centers. Most children have immunity for at least one type of adenovirus by age 10. Adenovirus infections can be caused by a low number of viral particles and once infected, the host will shed these in high numbers for long periods. September is the peak month for adenovirus infection.

Recent drinking water rules promulgated by the EPA attempt to find a reasonable balance between protection against microbial pathogens (specifically Cryptosporidium and Giardia) and disinfection byproducts THMs and HAAs). These rules are the Long Term 2 Enhanced Surface Water Treatment Rule and the Stage 2 Disinfectants/ Disinfection Byproducts Rule, and they are expected to be finalized in 2005. Although UV disinfection does a very good job of reducing DBPs and inactivating Cryptosporidium, researchers have repeatedly shown that adenoviruses are more resistant to UV. This is probably due to the fact that adenoviruses have double stranded DNA (which may allow them to repair DNA damage) and a relatively high guanosine and cytosine content as compared to other viruses. A reported dose of 203-226 MJ//cm2 is required for a 4-log inactivation of serotypes AD 40 and AD 41.

It seems therefore, that if the Districts want to continue to produce a "virus-free" effluent, some sort of multi-barrier scheme of chlorination and UV disinfection would be the most effective. Drinking water plants are mandated to achieve a 4-log virus removal or inactivation, not necessarily for their disinfection scheme, but for their entire treatment process. However, since there may not be 4 logs of virus in the source water, this level of inactivation essentially becomes not-detect. However, a virus-free effluent should not to be confused with 4-log removal, which could theoretically allow some residual viruses. Additionally, some viruses are not easily cultured and may be missed depending upon the techniques used to quantify results. Although PCR techniques can have positive virus samples of approximately three times the positive samples for cell cultures, some of these viral particles can be non-viable.

Arizona Standards

The following is an excerpt from Wastewater Microbiology (Bitton,1994)

> Water reuse in Arizona is employed at 180 plants treating approximately 200 MGD. The state has established a compliance program for monitoring viruses, Giardia, and fecal coliforms in reused wastewater. Arizona is the only state in the United States that has adopted standards for enteric viruses. The standards specify that virus levels should not exceed 1 PFU/40 L for reclaimed water used for spray-irrigation of food eaten raw or for unrestricted-access water sports. For irrigated landscape area and golf courses with full access to the public, the virus level should not exceed 125 PFU/40 L. With regards to Giardia, none should be detected in 49 L of water. Virus monitoring for activated sludge plants and oxidation pond effluents showed that 60% of the samples met the compliance standard of 1 PFU/ 40 L. Furthermore, 97% of sand filtered activated sludge effluents met

the virus standard and two thirds met the Giardia standards.

To put the Districts' objective of "no (detectable) viruses in the effluent" in perspective with requirements in Arizona, the Districts' virus sampling volume of 300 gallons (1,136 L) is about 30 times the 40 L volume being sampled in Arizona. In addition, it could be argued that any numerical limit that specifies a level of detection, even if the requirement specifies a limit less than a certain level (like 1 PFU/40 L), is infinitely less restrictive than a standard of no viruses at all.

Since the Districts could not meet the 450 CT requirement at some of their facilities, they have entered into an agreement with the Regional Board to do monthly virus testing of effluent from their facilities. Results have historically been non-detectable for all but two samples over the course of 20 years. Recent testing has shown low levels of adenovirus present in UV disinfected pilot studies where the dose was 94 and 97 mJ/cm^2 and they were absent at 123 mJ/cm^2. Later tests showed no adenovirus for UV dosages of 94, 93 and 87 mJ/cm^2 with chorine dosages of 0.5, 1.0, and 1.5 mg/L, respectively. Since adenovirus is very susceptible to chlorine even at low contact times, the Districts propose to apply a low chlorine dosage to filter effluent after the filters so that viruses will not be detected in the effluent. Although this disinfection philosophy may not have a large impact on adenovirus disease transmission and is in excess of NWRI guidelines, and although non-detect does not necessarily mean there are no virus present, the Districts have determined that a double barrier approach will help perception issues and protect the groundwater reclamation interests in the Rio Hondo and San Gabriel River Spreading Basins.

The following tables show what detention times can be expected a the Whittier Narrows WRP with the low chlorine dosage for adenovirus. A contact time of 5 minutes will be targeted for the UV Disinfection Facilities design, and will be comprised of the effluent detention time in the Filter Effluent Pump wetwell, the UV/CCT Inlet Channel, the UV reactor trains and the Receiving Water Channels that precede dechlorination. At an effluent flow of 21 MGD and using half of the CCT inlet channel capacity, the cumulative detention time is approximately 4.8 minutes.

Calculation of Adenovirus Chlorine Detention Time at the WNWRP

	Water Surface Elevation (ft)	Floor Elevation (ft)	Depth (ft)	Length (ft)	Width (ft)	Volume (cu ft)	Volume (gal)	Effluent Flow (MGD)	Effluent Flow (gpm)	Detention Time (min)
Filter	200.00	190.25	9.75	32.00	17.25	5,382	40,257	6.00	4,167	9.66
Effluent								9.00	6,250	6.44
Wetwell								13.00	9,028	4.46
								19.00	13,194	3.05
								21.00	14,583	2.76
								28.00	19,444	2.07
Filter			3.00	20.00	7.00	420	3,142	6.00	4,167	0.75
Effluent								9.00	6,250	0.50
Flume								13.00	9,028	0.35
								19.00	13,194	0.24
								21.00	14,583	0.22
								28.00	19,444	0.16
40% of	215.60	203.75	11.85	86.00	6.00	2,446	18,295	6.00	4,167	4.39
CCT Inlet Channel								9.00	6,250	2.93
								13.00	9,028	2.03
								19.00	13,194	1.39
								21.00	14,583	1.25
								28.00	19,444	0.94

UV Reactor		**Trains I/S**	**Depth (ft)**	**Width (ft)**	**Length (ft)**	**Volume (cu ft)**	**Volume (gal)**	**Assumed Flow/lamp MGD**	**Assumed Flow (gpm)**	**Detention Time (min)**
(Based on Trojan Pilot with fourth bank. Bracket treated like one extra lamp per module)		3	2.67	2.33	63.00	1,174	8,784	6.00	4,167	1.98
3 trains in service								9.00	6,250	1.32
	Lamps (no)	**Sleeve Diameter (in)**	**Sleeve Area (sq ft)**	**Sleeve Length (ft)**	**Equivalent Sleeve No**	**Sleeve Volume (cu ft)**	**Sleeve Volume (gal)**	13.00	9,028	0.91
								19.00	13,194	0.62
								21.00	14,583	0.56
	672	1.40	0.0107	9.17	756	74.05	554	24.20	16,806	0.49
								28.00	19,444	0.42
		Net Volume Accounting for Sleeves and Brackets					**(gal)** 8,230	Total DT at 21 MGD		4.79

Possible Contact Time in Preconditioning Tank

	L ft	W ft	H ft	cu ft	Convert gal/cu ft	Volume gal	Convert gpm/MGD	MGD	gpm	Detention Time (min)
	60.00	14.50	10.33	8987.1	7.48	67224	694.4	6.00	4,166	16.1
								9.00	6,250	10.8
								13.00	9,027	7.4
								19.00	13,194	5.1
								21.00	14,582	4.6
								28.00	19,443	3.5

Possible Contact Time in CCT Pass
Note: Overall length of one pass is 131.0 ft

Contact time min	Flow mgd	gpm	Volume Required gal	Volume Required cu ft	Length of Required CCT Pass 15 ft deep by 8.5 ft wide
5.00	6.00	4,167	20,833	2,785	21.8
	9.00	6,250	31,250	4,178	32.8
	13.00	9,028	45,139	6,035	47.3
	19.00	13,194	65,972	8,820	69.2
	21.00	14,583	72,916	9,748	76.5
	28.00	19,444	97,222	12,998	101.9

Appendix F

UV Disinfection Capacity vs. UVT

Appendix F – UV Disinfection Capacity vs. UVT

General

It is interesting to see how UV disinfection capacity varies with UVT. The worst-case condition controlling the design of the UV system for the WNWRP occurs at peak sanitary flow (with sidestreams) with a typical low UVT and one reactor out of service. Thus, three reactor trains operating at a 100% power setting will have to treat a total of 21 MGD at 71% UVT. After determining the rounded number of lamps required for each system, disinfection capacities were determined as a function of UVT. The results show that at the design UVT of 71%, the rounded four bank Trojan and Wedeco systems will actually be able to treat flows of 28.6 and 29.6 MGD, respectively. The disinfection capacities of each system increase until headloss becomes limiting. This point is reached with the Trojan system at a flow of 30.0 MGD, which can treat a UVT of 71.7% or above. The limiting headloss condition for the Wedeco system is reached at 31.1 MGD, which can treat a UVT of 72.1% or above. The following table shows the variable disinfection capacities of individual reactor trains and the total system, as a function of UVT, for both Trojan and Wedeco.

Disinfection Capacities of Four Train and Four Bank UV Systems as a Function of UVT

% UVT	Trojan		Wedeco	
	Reactor Train Capacity (MGD)	Total System Capacity (MGD)	Reactor Train Capacity (MGD)	Total System Capacity (MGD)
65.00	4.72	18.87	5.47	21.86
67.00	5.44	21.76	6.06	24.25
69.00	6.25	24.98	6.70	26.81
70.00	6.68	26.73	7.04	28.17
71.00 Design Condition (without roundup)	7.00	28.00	7.00	28.00
71.00	7.14	28.57	7.39	29.57
71.72 Trojan Maximum	7.49	29.96	---	---
72.00	---	---	7.75	31.01
72.07 Wedeco Maximum	---	---	7.78	31.10

Note: This analysis was conducted at a lamp power of 100% and a dosage of 100 mJ/cm^2. All conditions are after lamp roundup, except for the design condition. The Trojan analysis is based on LACSD's equation. Note that a 1% change in the operating UVT from 70 to 71% results in an increase of treatment capacity by 5-7%.

Appendix G

Preliminary Construction Sequence

Appendix G – Preliminary Construction Sequence

The construction sequence will be predicated on the fact that at least one of the two CCTs will have to remain in service for the plant to produce effluent for reuse.

Phase I Construction in the West CCT

During Phase I of the construction project, CCT No. 2 (west) will be removed from service, drained and cleaned. CCT No. 1 (east) will remain in service and continue to provide chlorine contact time. Construction of two UV reactor trains, Effluent Storage Channel 2, the western half of the UV Outlet Channel and Receiving Water Channel, and Receiving Water Channel 2, will take place at this time. The westernmost UV drain connections will be constructed and tied into the plant sewer. The backwash pump (if available at that time) will be installed in the west CCT. Since the plant's existing fire protection will be out of service, which is solely supplied by the draft hydrant in CCT No. 2 (west), it is imperative that the Recycled Water Pump Station remains in operation. During this time, the pressurized firewater connection on the Recycled Water Pump Station discharge line will assume this function.

Phase II Construction in the East CCT

During Phase II of the construction project, CCT No. 1 (east) will be removed from service, drained and cleaned. The west CCT will remain in service and continue to provide chlorine contact time. Construction of two UV reactor trains, Effluent Storage Channel 1, the eastern half of the UV Outlet Channel and Receiving Water Channel, and Receiving Water Channel 1, will take place at this time. The chemical dilution water line will also be installed in the east CCT. It will be connected to the UV Outlet Channel to provide unchlorinated water for polymer make-up and carrying water. The easternmost UV drain connections will be constructed.

Anticipated Plant Shutdowns

When construction of the UV reactor trains has been completed, a plant shutdown(s) will be required to cut the openings for the UV reactor trains and to install the inlet gates. Tie-in of electrical power to the UV system and backwash recovery pump may require a short-term plant shutdown.

Appendix H

System Operation

Appendix H – System Operation

Operation of the Recycled Water Pump Station and CCTs Prior to Completion of the UV Disinfection Facilities

After the Recycled Water Pump Station work is completed, the WNWRP is expected to operate at a 9.4 MGD effluent flow with two or three aeration tanks on line. During this time, the plant will be providing disinfected tertiary effluent (filtered and chlorinated secondary effluent) that meets Title 22 standards as irrigation water to the Upper San Gabriel Municipal Water District. Due to funding requirements on the Recycled Water Pump Station contract, partial pumping of reuse water was originally required by September 30, 2005. Although this funding deadline has been relaxed somewhat, the plant will need to provide water to the pump station by January 2006 during startup activities. Because chlorine disinfection will still be used at this time, the CCTs will be needed to provide contact time. Therefore, the Recycled Water Pump Station will be operated without lowering the water level in the CCTs so that a nominal contact time can be maintained.

During this time, the plant effluent that does not get pumped by the Recycled Water Pump Station will be discharged to the receiving water and will require dechlorination. Level indication may need to be provided upstream of the CCT weir to ensure that enough sodium bisulfite is added for dechlorination as there is a delay in the receiving water flow measurement that is registered downstream at the effluent metering structure. During this time, it would be desirable to set the reuse pumping schedule to match flow availability and to minimize cycling of the Dechlorination System. The CCTs will only be operated as storage tanks with fluctuating water levels after the proposed UV system is operational.

Operation of the UV System with a Low UVT During times when the plant UVT is lower than the design UVT (but greater than the validated UVT limit of 55% UVT), more UV equipment will automatically be brought on line and the power ramped up to treat the plant flow. As long as the UV system can deliver 100 mJ/cm^2 with operational parameters within the system's validated range, plant flow will not have to be restricted. If this cannot be achieved, the plant flow will have to be reduced in order satisfy the required dosage.

During periods of low UVT (<70%), Operations staff will obtain a manual grab sample to determine if there is a real UVT problem or if it is just an on-line analyzer problem. If indeed the problem is real, in many cases, the operational response will be to reduce the plant influent flow and to consider diverting the secondary effluent flow to the sewer.

Operation of the UV System with a High UVT If a high UVT is encountered, the number of lamps that are on-line will be reduced, or the power of the UV system will be ramped down, in order to maintain the dose of 100 mJ/cm2. As long as this can be done with operational parameters within the system's validated range, the system should not overdose. Note that allowable system headloss may be a limitation here. **Refer also to Appendix F.**

Operational Conditions to be Avoided

During operation of the UV system, the following conditions should be avoided:

- Flow per lamp per bank outside of the validated range
- UVT's outside of the validated range
- Major lamp alarm conditions (adjacent or multiple lamp failures)
- Inadequate operational dose
- UV lamps providing inadequate irradiation because of warm-up, power quality problems, power interruption or power failure
- Lamps operating beyond their cleaning regimen guidelines or lamp age

Emergency Conditions

The following emergency conditions will be resolved automatically by the control system as follows:

1. **INADEQUATE UV DOSE** (after the system has ramped up to maximum lamp power and added all available banks and trains).
   a. Control will be transferred to the standby UVT analyzer.
   b. If the above proves inadequate, the Hypochlorite System will be activated and the UV System will be shut down.

2. **HIGH UV/CCT INLET CHANNEL WATER LEVEL**:
   a. An additional UV reactor train or trains will be activated, as long as the resulting operating conditions are within the validated range of the UV System.
   b. If the above proves inadequate, the Hypochlorite System will be activated and the UV System will be shut down.
   c. If the above proves inadequate, the Filter Effluent Pumps will be shut down manually, either locally or remotely.

3. **HIGH WATER LEVEL IN THE CCT:**
   a. An overflow weir will prevent this condition.

4. **LOW WATER LEVEL IN THE CCT:**
   a. The Recycled Water Pump Station Pumps will be stopped.

5. **FAILED PLANT EFFLUENT FLOW SIGNAL:**

   a. The Hypochlorite System will be activated and the UV System will be shut down

Notes:

- Automatic switchovers from the UV mode to the Hypochlorite mode will employ post-chlorination without ammonia addition. For a short transition time period, both systems will be operational. During operation in the Hypochlorite mode, the Recycled Water Pump Station will have to maintain high water levels in the ES/CCT's to maintain the required contact time.
- After an automatic switchover from the UV mode to the Hypochlorite mode, the existing effluent sampling system will have to be utilized. This existing system will remain operational at all times, even when in UV mode, to be ready in the event of an automatic switchover.
- Automatic switchovers from the Hypochlorite mode to the UV mode should never be required.

Chapter 1 Environmental Checklist Form

1. **Project Title:** Whittier Narrows Water Reclamation Plant Ultraviolet (UV) Disinfection Facilities

2. **Lead Agency Name and Address:** County Sanitation Districts of Los Angeles County

2. **Contact Person and Phone Number:** Name. Steven W. Highter
Address 1955 Workman Mill Rd, Whittier 90601
Phone (562) 699-7411 x 2711

4. **Project Location:** Unincorporated Los Angeles County.

5. **Project Sponsor's Name:** County Sanitation District of Los Angeles County

6. **General Plan Designation:** Government Miscellaneous

7. **Zoning:** Commercial Recreation

8. **Description of Project:** The proposed project involves upgrading the existing Whittier Narrows Water Reclamation Plant with UV disinfection facilities to achieve reduction in levels of N-Nitrosodimethylamine (NDMA) and allow continued use of recycled water for groundwater recharge in the Montebello Forebay. The UV disinfection facilities would replace the sodium hypochlorite disinfection facilities currently used, although the proposed project will employ a dual barrier disinfection process using a low dosage of free chlorine followed by normal UV disinfection. The proposed project will include the installation of open channel UV reactor trains and appurtenant electrical systems, modifications to the plant hydraulics, effluent filtration, and plant control systems.

9. **Surrounding Land Uses and Setting.** Open Space and Recreational Land

10. **Other public agencies whose approval is required (e.g., permits, financing approval, or participation agreement.)**

    U.S. Army Corps of Engineers and LA County Department of Public Works
    California Department of Health Services
    Los Angeles County Department of Health Services
    Regional Water Quality Control Board, Los Angeles Region

Environmental Factors Potentially Affected

The key environmental factors checked below would be potentially affected by the Project. However, as described in the checklist below, the Project would not cause significant impacts in any of these areas and would have beneficial impacts.

☐ Aesthetics	☐ Agriculture Resources	☐ Air Quality
☐ Biological Resources	☐ Cultural Resources	☐ Geology / Soils
☐ Hazards & Hazardous Materials	☒ Hydrology / Water Quality	☐ Land Use / Planning
☐ Mineral Resources	☐ Noise	☐ Population / Housing
☐ Public Services	☐ Recreation	☐ Transportation / Traffic
☐ Utilities / Service Systems	☐ Mandatory Findings of Significance	

1.1 Aesthetics

Would the Project:	*Potentially Significant Impact*	*Less Than Significant With Mitigation Incorporation*	*Less Than Significant Impact*	*No Impact*
a) Have a substantial adverse effect on a scenic vista?	☐	☐	☐	☒
b) Substantially damage scenic resources, including, but not limited to, trees, rock outcroppings, and historic buildings within a state scenic highway?	☐	☐	☐	☒
c) Substantially degrade the existing visual character or quality of the site and its surroundings?	☐	☐	☒	☐
d) Create a new source of substantial light or glare which would adversely affect day or nighttime views in the area?	☐	☐	☐	☒

1.2 Agriculture Resources

Would the Project:	*Potentially Significant Impact*	*Less Than Significant With Mitigation Incorporation*	*Less Than Significant Impact*	*No Impact*
a) Convert Prime Farmland, Unique Farmland, or Farmland of Statewide Importance (Farmland), as shown on the maps prepared pursuant to the Farmland Mapping and Monitoring Program of the California Resources Agency, to non-agricultural use?	☐	☐	☐	☒
b) Conflict with existing zoning for agricultural use, or a Williamson Act contract?	☐	☐	☐	☒
c) Involve other changes in the existing environment which, due to their location or nature, could result in conversion of Farmland, to non-agricultural use?	☐	☐	☐	☒

1.3 Air Quality

Would the Project:	*Potentially Significant Impact*	*Less Than Significant With Mitigation Incorporation*	*Less Than Significant Impact*	*No Impact*
a) Conflict with or obstruct implementation of the applicable air quality plan?	☐	☐	☐	☒
b) Violate any air quality standard or contribute substantially to an existing or projected air quality violation?	☐	☐	☐	☒
c) Result in a cumulatively considerable net increase of any criteria pollutant for which the Project region is non-attainment under an applicable federal or state ambient air quality standard (including releasing emissions which exceed quantitative thresholds for ozone precursors)?	☐	☐	☒	☐
d) Expose sensitive receptors to substantial pollutant concentrations?	☐	☐	☐	☒
e) Create objectionable odors affecting a substantial number of people?	☐	☐	☐	☒

1.4 Biological Resources

Would the Project:	*Potentially Significant Impact*	*Less Than Significant With Mitigation Incorporation*	*Less Than Significant Impact*	*No Impact*
a) Have a substantial adverse effect, either directly or through habitat modifications, on any species identified as a candidate, sensitive, or special-status species in local or regional plans, policies, or regulations, or by the California Department of Fish and Game or U.S. Fish and Wildlife Service?	☐	☐	☐	☒
b) Have a substantial adverse effect on any riparian habitat or other sensitive natural community identified in local or regional				

	Potentially Significant Impact	Less Than Significant With Mitigation Incorporation	Less Than Significant Impact	No Impact
plans, policies, regulations or by the California Department of Fish and Game or U.S. Fish and Wildlife Service?	☐	☐	☐	☒
c) Have a substantial adverse effect on federally protected wetlands as defined by Section 404 of the Clean Water Act (including, but not limited to, marsh, vernal pool, coastal, etc.) through direct removal, filling, hydrological interruption, or other means?	☐	☐	☒	☐
d) Interfere substantially with the movement of any native resident or migratory fish or wildlife corridors, or impede the use of native wildlife nursery sites?	☐	☐	☐	☒
e) Conflict with any local policies or ordinances protecting biological resources, such as a tree preservation policy or ordinance?	☐	☐	☐	☒
f) Conflict with the provisions of an adopted Habitat Conservation Plan (HCP), Natural Conservation Community Plan (NCCP), or other approved local, regional, or state HCP?	☐	☐	☐	☒

1.5 Cultural Resources

Would the Project:	*Potentially Significant Impact*	*Less Than Significant With Mitigation Incorporation*	*Less Than Significant Impact*	*No Impact*
a) Cause a substantial adverse change in the significance of a historical resource as defined in §15064.5?	☐	☐	☐	☒
b) Cause a substantial adverse change in the significance of a unique archaeological resource pursuant to §15064.5?	☐	☐	☐	☒
c) Directly or indirectly destroy a unique paleontological resource or site or unique geologic feature?	☐	☐	☐	☒
d) Disturb any human remains, including those interred outside of formal cemeteries?	☐	☐	☐	☒

1.6 Geology and Soils

Would the Project:	*Potentially Significant Impact*	*Less Than Significant With Mitigation Incorporation*	*Less Than Significant Impact*	*No Impact*
a) Expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving:				
i) Rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area or based on other substantial evidence of a known fault? Refer to Division of Mines and Geology Special Publication 42.	☐	☐	☐	☒
ii) Strong seismic ground shaking?	☐	☐	☐	☒
iii) Seismic-related ground failure, including liquefaction?	☐	☐	☐	☒
iv) Landslides?	☐	☐	☐	☒
b) Result in substantial soil erosion or the loss of topsoil?	☐	☐	☐	☒
c) Be located on geologic unit or soil that is unstable, or that would become unstable as a result of the Project, and potentially result in on-or off-site landslide, lateral spreading, subsidence, liquefaction, or collapse?	☐	☐	☒	☐
d) Be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1994), creating substantial risks to life or property?	☐	☐	☒	☐
e) Have soils incapable of adequately supporting the use of septic tanks or alternative wastewater disposal systems where sewers are not available for the disposal of wastewater?	☐	☐	☐	☒

1.7 Hazards and Hazardous Materials

Would the Project:	*Potentially Significant Impact*	*Less Than Significant With Mitigation Incorporation*	*Less Than Significant Impact*	*No Impact*
a) Create a significant hazard to the public or the environment through the routine transport, use, or disposal of hazardous materials?	☐	☐	☐	☒
b) Create a significant hazard to the public or the environment through reasonably foreseeable upset and accident conditions involving the release of hazardous materials into the environment?	☐	☐	☐	☒
c) Emit hazardous emissions or handle hazardous or acutely hazardous materials, substances, or waste within one-quarter mile of an existing or proposed school?	☐	☐	☐	☒
d) Be located on a site which is included on a list of hazardous materials sites compiled pursuant to Government Code Section 65962.5 and, as a result, would it create a significant hazard to the public or the environment?	☐	☐	☐	☒
e) For a project located within an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport, would the project result in a safety hazard for people residing or working in the project area?	☐	☐	☐	☒
f) For a project within the vicinity of a private airstrip, would the project result in a safety hazard for people residing or working in the Project area?	☐	☐	☐	☒
g) Impair implementation of or physically interfere with an adopted emergency response plan or emergency evacuation plan?	☐	☐	☐	☒
h) Expose people or structures to a significant risk of loss, injury or death involving wildland fires, including where wildlands are adjacent to				

urbanized areas or where residences are intermixed with wildlands?	☐	☐	☐	☒

1.8 Hydrology and Water Quality

Would the Project:	*Potentially Significant Impact*	*Less Than Significant With Mitigation Incorporation*	*Less Than Significant Impact*	*No Impact*
a) Violate any water quality standards or waste discharge requirements?	☐	☐	☐	☒
b) Substantially deplete groundwater supplies or interfere substantially with groundwater recharge such that there would be a net deficit in aquifer volume or a lowering of the local groundwater table level (e.g., the production rate of pre-existing nearby wells would drop to a level which would not support existing land uses or planned uses for which permits have been granted)?	☐	☐	☐	☒
c) Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, in a manner which would result in substantial erosion of siltation on- or off-site?	☐	☐	☐	☒
d) Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, or substantially increase the rate or amount of surface runoff in a manner which would result in flooding on- or off-site?	☐	☐	☐	☒
e) Create or contribute runoff water which would exceed the capacity of existing or planned storm water drainage systems or provide substantial additional sources of polluted runoff?	☐	☐	☐	☒
f) Otherwise substantially degrade water quality? (erosion potential)	☐	☐	☐	☒

	Potentially Significant Impact	Less Than Significant With Mitigation Incorporation	Less Than Significant Impact	No Impact
g) Place housing within a 100-year flood hazard area as mapped on a federal Flood Hazard Boundary or Flood Insurance Rate Map or other flood hazard delineation map?	☐	☐	☐	☒
h) Place within a 100-year flood hazard area structures which would impede or redirect flood flows?	☐	☐	☒	☐
i) Expose people or structures to a significant risk of loss, injury or death involving flooding, including flooding as a result of the failure of a levee or dam?	☐	☐	☐	☒
j) Inundation of seiche, tsunami, or mudflow?	☐	☐	☐	☒

1.9 Land Use and Planning

Would the Project:	*Potentially Significant Impact*	*Less Than Significant With Mitigation Incorporation*	*Less Than Significant Impact*	*No Impact*
a) Physically divide an established community?	☐	☐	☐	☒
b) Conflict with any applicable land use plan, policy, or regulation of an agency with jurisdiction over the Project (including, but not limited to the general plan, specific plan, local coastal program, or zoning ordinance) adopted for the purpose of avoiding or mitigating an environmental effect?	☐	☐	☐	☒
c) Conflict with any applicable HCP or NCCP?	☐	☐	☐	☒

1.10 Mineral Resources

Would the Project:	*Potentially Significant Impact*	*Less Than Significant With Mitigation Incorporation*	*Less Than Significant Impact*	*No Impact*
a) Result in the loss of availability of a known mineral resource that would be of value to the region and the residents of the state?	☐	☐	☐	☒

	Potentially Significant Impact	Less Than Significant With Mitigation Incorporation	Less Than Significant Impact	No Impact
b) Result in the loss of availability of a locally-important mineral resource recovery site delineated on a local general plan, specific plan or other land use plan?	☐	☐	☐	☒

1.11 Noise

Would the Project result in:	*Potentially Significant Impact*	*Less Than Significant With Mitigation Incorporation*	*Less Than Significant Impact*	*No Impact*
a) Exposure of persons to or generation of noise levels in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies?	☐	☐	☒	☐
b) Exposure of persons to or generation of excessive groundborne vibration or groundborne noise levels?	☐	☐	☒	☐
c) A substantial permanent increase in ambient noise levels in the Project vicinity above levels existing without the Project?	☐	☐	☐	☒
d) A substantial temporary or periodic increase in ambient noise levels in the Project vicinity above levels existing without the Project?	☐	☐	☐	☒
e) For a project located within an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport, would the Project expose people residing or working in the project area to excessive noise levels?	☐	☐	☐	☒
f) For a project within the vicinity of a private airstrip, would the Project expose people residing or working in the Project area to excessive noise levels?	☐	☐	☐	☒

1.12 Population and Housing

	Potentially Significant Impact	*Less Than Significant With Mitigation Incorporation*	*Less Than Significant Impact*	*No Impact*

Would the Project:	Potentially Significant Impact	Less Than Significant With Mitigation Incorporation	Less Than Significant Impact	No Impact
a) Induce substantial population growth in an area, either directly (for example, by proposing new homes and businesses) or indirectly (for example, through extension of roads or other infrastructure)?	☐	☐	☐	☒
b) Displace substantial numbers of existing housing, necessitating the construction of replacement housing elsewhere?	☐	☐	☐	☒
c) Displace substantial numbers of people necessitating the construction of replacement housing elsewhere?	☐	☐	☐	☒

1.13 Public Services

Would the Project:	*Potentially Significant Impact*	*Less Than Significant With Mitigation Incorporation*	*Less Than Significant Impact*	*No Impact*
a) Would the Project result in substantial adverse physical impacts associated with the provision of new or physically altered governmental facilities, need for new or physically altered governmental facilities, the construction of which could cause significant environmental impacts, in order to maintain acceptable service ratios, response times, or other performance objectives for any of the public services:				
Fire protection?	☐	☐	☐	☒
Police protection?	☐	☐	☐	☒
Schools?	☐	☐	☐	☒
Parks?	☐	☐	☐	☒
Other public facilities?	☐	☐	☐	☒

1.14 Recreation

Would the Project:	*Potentially Significant Impact*	*Less Than Significant With Mitigation Incorporation*	*Less Than Significant Impact*	*No Impact*

a) Would the Project increase the use of existing neighborhood and regional parks or other recreational facilities such that substantial physical deterioration of the facility would occur or be accelerated?	☐	☐	☐	☒
b) Does the Project include recreational facilities or require the construction or expansion of recreational facilities which might have an adverse physical effect on the environment?	☐	☐	☐	☒

1.15 Transportation/Traffic

Would the Project:	*Potentially Significant Impact*	*Less Than Significant With Mitigation Incorporation*	*Less Than Significant Impact*	*No Impact*
a) Cause an increase in traffic, which is substantial in relation to the existing traffic load and capacity of the street system (i.e., result in a substantial increase in either the number of vehicle trips, the volume-to-capacity ratio on roads, or congestion at intersections)?	☐	☐	☒	☐
b) Exceed, either individually or cumulatively, a level of service standard established by the county congestion management agency for designated roads or highways?	☐	☐	☐	☒
c) Result in a change in air traffic patterns, including either an increase in traffic levels or a change in location that results in substantial safety risks?	☐	☐	☐	☒
d) Substantially increase hazards due to a design feature (e.g., sharp curves or dangerous intersections) or incompatible uses (e.g., farm equipment)?	☐	☐	☐	☒
e) Result in inadequate emergency access?	☐	☐	☒	☐
f) Result in inadequate parking capacity?	☐	☐	☒	☐

	Potentially Significant Impact	Less Than Significant With Mitigation Incorporation	Less Than Significant Impact	No Impact
g) Conflict with adopted policies, plans, or programs supporting alternative transportation (e.g., bus turnouts, bicycle racks)?	☐	☐	☐	☒

1.16 Utilities and Service Systems

	Potentially Significant Impact	*Less Than Significant With Mitigation Incorporation*	*Less Than Significant Impact*	*No Impact*
Would the Project:				
a) Exceed wastewater treatment requirements of the applicable Regional Water Quality Control Board?	☐	☐	☐	☒
b) Require or result in the construction of new water or wastewater treatment facilities or expansion of existing facilities, the construction of which could cause significant environmental effects?	☐	☐	☐	☒
c) Require or result in the construction of new storm water drainage facilities or expansion of existing facilities, the construction of which could cause significant environmental effects?	☐	☐	☐	☒
d) Have sufficient water supplies available to serve the Project from existing entitlements and resources, or are new or expanded entitlements needed?	☐	☐	☐	☒
e) Result in a determination by the wastewater treatment provider which serves or may serve the Project that it has adequate capacity to serve the Project's projected demand in addition to the provider's existing commitments?	☐	☐	☐	☒
f) Be served by a landfill with sufficient permitted capacity to accommodate the Project's solid waste disposal needs?	☐	☐	☐	☒
g) Comply with federal, state, and local statutes and regulations related to solid waste?	☐	☐	☐	☒

1.17 Mandatory Findings of Significance

	Potentially Significant Impact	*Less Than Significant With Mitigation Incorporation*	*Less Than Significant Impact*	*No Impact*
a) Does the Project have the potential to degrade the quality of the environment, substantially reduce the habitat of a fish or wildlife species, cause a fish or wildlife population to drop below self-sustaining levels, threaten to eliminate a plant or animal community, reduce the number or restrict the range of a rare or endangered plant or animal or eliminate important examples of the major periods of California history or prehistory?	☐	☐	☐	☒
b) Does the Project have impacts that are individually limited, but cumulative considerable? ("Cumulative considerable" means that the incremental effects of a project are considerable when viewed in connection with the effects of past projects, the effects of other current projects, and the effects of probable future projects)?	☐	☐	☐	☒
c) Does the Project have environmental effects which will cause substantial adverse effects on human beings, either directly or indirectly?	☐	☐	☐	☒