POCHE BEACH ULTRAVIOLET LIGHT BACTERIA DISINFECTION PROJECT
Final Report

Submitted to the State Water Resources Control Board
Clean Beach Initiative Grant Program
in compliance with
CBI Agreement No. 06-130-550-2

Prepared by:
The County of Orange
OC Public Works
OC Watersheds

March 6, 2012

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FINAL REPORT

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SECTION 1.0 – INTRODUCTION

The Poche Beach Ultraviolet Light Bacteria Disinfection Project involves the construction and operation of an urban runoff treatment facility located at Poche Beach in south Orange County. The County of Orange has formally renamed the facility the "Poche Clean Beach Project" (Poche CBP) and the facility will be referred to as such throughout this report. The project was to a large extent funded by the Clean Beach Initiative (CBI) Grant Program, administrated by the State Water Resources Control Board (SWRCB). This Final Report is submitted in partial compliance with SWRCB Agreement No. 06-130-550-02 for project funding.

1.1 Project Objective

The Poche Clean Beach Project is intended to provide near term improvements in surfzone water quality and water contact recreational use at Poche Beach. The filtration and disinfection treatment facility is intended to provide significant reductions in bacteria loading from urban runoff which discharges to the beach, until long term bacteria source control and runoff reduction measures can be successfully implemented within the contributory watershed.

1.2 Project Location and Setting

The Poche CBP is situated in Dana Point at its local jurisdictional boundary with the City of San Clemente alongside the Prima Deshecha Canada Channel (County Flood Control District designation M01 Channel) at its terminus at Pacific Coast Highway and Poche Beach. Prima Deshecha Canada Channel drains a 4,450 acre primarily residential watershed including areas of San Clemente, San Juan Capistrano, and Dana Point. The channel originates near the Prima Deshecha landfill, and conveys flow through both open concrete channels and closed concrete box structures before discharging into the Pacific Ocean at Poche Beach. The channel receives year-round continual flow from both urban and storm surface runoff and some groundwater. The structured channel ends past the railroad bridge, where drainage then meanders through a beach pond whose form shifts in response to changes in upstream flows, ocean swell, and tidal action. Periodically the County must request approval by State natural resource agencies and the Army Corps of Engineers to modify the sand bar controlling pond backwater levels, in order to maintain safe public access to the beach via a walkway under the railroad bridge.

Figure 1. Project Location

Figure 2. Poche Clean Beach Project - Project Setting

1.3 Project Background and Timeline

Poche Beach is an approximate 200 foot County-owned beach located adjacent to the outlet of Prima Deshecha Canada Channel. Over the last several years, the beach has been subject to persistent exceedances of AB411 fecal indicator bacteria standards, with corresponding extended water quality advisory postings by the Orange County Health Care Agency. The AB411 standards were established for California recreational beaches as a result of California Assembly Bill 411, which requires public advisory postings when bacteria levels within the surfzone exceed standards. The public interest organization Heal the Bay has listed Poche Beach as one of California's 10 worst quality beaches over the last several years. Urban runoff from the channel and its contributory watershed discharges to the ocean at Poche Beach, and has been demonstrated to be a significant source of bacteria loading to the beach.

In 2002 the San Diego Regional Water Quality Control Board issued a Clean Water Act Section 13225 directive for the County of Orange and City of San Clemente to implement and evaluate performance of long term measures to improve the bacterial quality of runoff within the channel. In response to this directive, the County and City have collaborated in a number of ongoing watershed bacteria source control investigations and water quality improvement programs, including the Poche treatment facility.

In 2001, the county was awarded a $500,000 grant from the State Clean Beach Initiative program to install an urban runoff treatment facility at Poche Beach. However, with only partial funding and an inability to obtain a Coastal Development Permit for an above ground treatment system, the proposal was modified to construct and install an in-channel treatment system as a pilot project. The system consisted of an in-channel ultraviolent (UV) light disinfection system

installed in the channel in 2004 and operated through the April – October AB411 period before it was removed to avoid facility damage during the storm season. In-channel facility operation and performance proved to be ineffective, expensive, and infeasible for several reasons, many of which were related to its in-channel location. Findings of the pilot study reaffirmed the advisability of reverting to the above ground off channel facility design concept for construction of a permanent treatment facility.

In 2006 the County received a second grant from the State Clean Beach Initiative Program (Agreement No. 06-130-550-2) to construct the permanent off channel Poche treatment facility. Facility construction began in 2007 and was completed in March 2009. An extended period of treatment performance trials was finally completed in May 2010, and the Poche CBP began effective operations in July 2010 under construction contractor change order. The County issued a construction Notice of Completion and formally accepted the facility in December 2010.

1.4 Project Costs and Funding

The original bid for facility construction cost was $2.3 million, with the final construction cost being $2.4 million. Total project cost including design, construction inspection, regulatory permit compliance, and performance evaluation was approximately $3.0 million.

Table 1. Grant Funds Allocation and Construction Funding Sources

Disbursement of Grant Funding	
Items	**Grant Allotment**
County Personnel (grant administration, project design management, construction management)	$150,000
Professional/Consultant Services	$50,000
Facility Construction	$1,300,000
TOTAL	$1,500,000
Construction Funding Sources	
Organization	**Amount**
SWRCB	$1,300,000
County of Orange	$550,000
City of San Clemente	$550,000
TOTAL	$2,400,000
Additional Funds for Construction-Related Costs	
miocean	$250,000

The $1.5 million grant from the State Clean Beach Initiatives Program was fully applied to the project according to the allocation in Table 1. Other project construction financial sponsors

included the City of San Clemente, the County, and miocean, a local environmental public interest group; sponsorship amounts are identified in Table 1. State grant funds for construction were matched by over 100% from local sponsors. The miocean grant of $250,000 could be construed as having been leveraged by public agency project sponsorship commitments, in order to assist with overall project implementation costs.

The County estimates that operations and maintenance costs will be approximately $200,000 – 250,000 per year. The County and City of San Clemente have executed a long term agreement to share annual operations and maintenance costs. South Coast Water District presently operates the facility on the County's behalf.

1.5 Grant Agreement Deliverables

The County completed a number of product deliverables as conditions of the Clean Beach Initiative grant agreement. The deliverables and their corresponding submittal dates are presented below.

Table 2. Grant Agreement Deliverables and Submittal Dates

Work Item	Items for Review	Submittal Date
1.1	Quality Assurance Project Plan	June 2008
1.2	Monitoring Plan	June 2008
2.2	Board Approval to Advertise	February 2007
2.3	Design Contract Documents	March 2007
3.2	Photo Documentation	January 2010
3.3	Record Drawings of Plans	November 2011
4.1	Progress Summary	Annually in September
4.2	Draft Final Project Report	November 2011
4.3	Final Project Report	March 2012

SECTION 2 – FACILITY DESCRIPTION AND OPERATION

2.1 Facility Description

The Poche Clean Beach Project is an offline package treatment facility situated on railroad right-of-way alongside the upcoast side of Prima Deshecha (M01) Channel to treat dry weather runoff in the channel prior to its discharge to the beach. The treatment process involves initial gross solids screening, sand filtration to remove finer suspended solids and associated turbidity, then ultraviolet (UV) light disinfection to disable bacteria prior to its discharge back into the channel. The facility is capable of treating a maximum instantaneous flow of 800 gallons per minute (gpm) or 1.1. million gallons per day (MGD). The low elevation profile of the facility amid other roadway, drainage channel, and railroad infrastructure makes it relatively unobtrusive to the general public and beach users. Major components of the treatment facility are described as follows.

Channel Diversion Structure. An Obermeyer Hydro inflatable spillway gate constructed within the channel serves to divert dry weather flow into the treatment facility wet well/pump station adjacent to the channel. The hinged steel gate is anchored to the channel bottom and supported by inflatable bladders and restraining straps on the downstream side. Upstream flow is then diverted into the adjacent wet well/pump station through a bar screened sluice gate to restrict large and floatable trash and debris. During periods of storm flows or high backwater levels due to formation of the sand berm across the beach pond outlet, the bladders deflate and the spillway gate lowers to the channel floor to allow unrestricted conveyance of channel flood flow. Under lowered gate conditions the treatment facility either shuts off (with stormflow) or operates by withdrawing from, treating, and discharging water into the beach pond backwater.

Wet Well/Pump Station. Runoff diverted into the underground wet well passes through a filter screen to remove gross suspended solids before entering the clear well side of the well, which contains three 10-HP sump pumps. Depending upon whether the channel spillway gate is up or down, the pumps provide either intermittent cycled or continuous pressurized conveyance of runoff through the treatment facility up to a maximum flow rate of 800 gallons per minute (gpm). Normal operating outflow rate, however, generally varied between 210 – 800 gpm, depending upon channel inflow and sand filter backpressure conditions.

Sand Filters. Runoff is filtered through three high flow Neptune Benson 5.6 ft diameter tanks of sand media operated in parallel in order to remove fine suspended solids. Excessive backpressure is periodically relieved by backwashing accumulative contaminants on the filter surface to the sanitary sewer, where each filter tank is sequentially backwashed using filtered water from the other two tanks. A 10,000 gallon surcharge tank is also located on site in order to temporarily store and attenuate backwash flows into the sanitary sewer.

Ultraviolet Light (UV) Reactor. Filtered runoff is then routed through a Triogen 24 kilowatt medium pressure UV disinfection chamber. Bacterial exposure to UV light effectively alters its DNA and destroys its reproductive capability. Critical factors to UV bacterial inactivation efficiency are flow rate through the chamber, and the residual turbidity and absorbance characteristics of the influent.

Process Control System. A Symantec Process Logic Control system governs overall facility operation. The system communicates with separate control panels for channel diversion spillway gate, UV reactor, and sand filters, as well as information from several flow meters, water level indicators, turbidity meters, valves and other facility components for integrated operation of the system in both automated and manual mode based on operational set points within the system logic. It also provides a Human Machine Interface for ready access by operators for system operational status, history, and process adjustments.

Record Drawings. The as-built construction plans for the facility are presented in Appendix C. As the water treatment process components of facility construction were bid as a performance

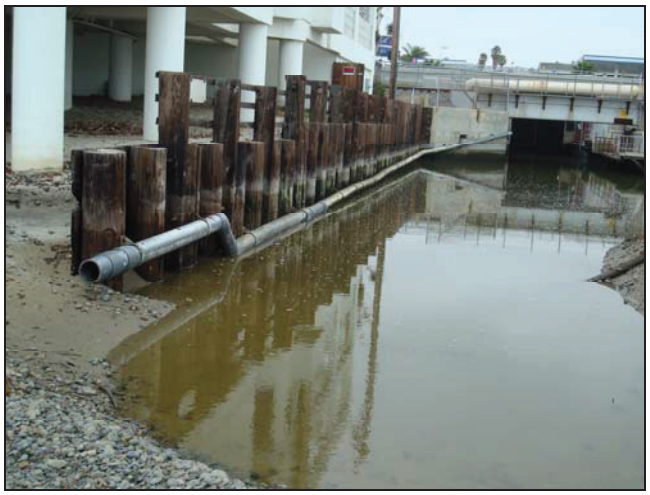
specification, specific treatment components and assemblies were furnished by the contractor. The as-built construction plans reflect the final treatment process schematic of facility design.

Operations Manual. As part of the construction contract, the contractor provided a three volume Operations & Maintenance Manual for facility operation. The manual provided specifications and operations and maintenance information on all functional facility components, as well as general facility operations procedures.

Project Signage. Permanent project signage was installed in conformance with conditions of the CBI grant agreement. The sign is displayed immediately adjacent to the facility, along Pacific Coast Highway, at the intersection of Camino Capistrano.

2.2. Treated Outflow Discharge Location

The original intent of project design was to discharge treated outflow directly to the surfzone and bypass the beach pond. This was to be accomplished via a rigid 8-inch diameter PVC discharge pipe constructed along the wooden bulkhead on the upcoast side of the beach pond and a flexible 50 foot long PVC pipe extending past the sand berm into the surfzone (Figure 3).



However, a condition of the project's Coastal Development Permit 05-06-093 required that 2010 treated outflow be discharged immediately downstream from the inflatable spillway gate and intake point (Figure 3). The Coastal Commission's intent was that the beach pond share in the water quality benefit of the high quality freshwater discharge from the treatment facility. However, the permit did identify an amendment process by which the discharge location could be reconsidered should initial receiving water quality data demonstrate that the treated water quality benefit was not being delivered to the surfzone.

Figure 3. Poche Clean Beach Project
Originally Proposed and Actual Treated Outflow Discharge Locations

The County accordingly plumbed the discharge pipe to discharge at the required location during the 2010 operations season (Figure 3). Water quality findings from 2010 operations (County of Orange, 2011) conclusively demonstrated that this discharge location was ineffective in improving surfzone quality. Based on these findings, the Coastal Commission approved the County proposal to conduct a demonstration trial of the original discharge proposal to bypass of the beach pond and discharge directly to the ocean during the 2011 operations season using the flexible pipe extension. However, the San Diego Regional Water Quality Control Board had concerns regarding this proposal; the County therefore modified the 2011 demonstration trial to discharge treated runoff at the end of the rigid pipe along the bulkhead (Figure 3).

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SECTION 3.0 – 2010 FACILITY PERFORMANCE EVALUATION

3.1 Water Quality Monitoring Objectives

The primary 2010 water quality monitoring objective was to determine the extent to which the Poche Clean Beach Project (Poche CBP) improved water quality at Poche Beach. The three specific objectives of the water quality monitoring program were to:

1) determine the bacterial outflow quality and treatment efficiency of the Poche CBP;
2) determine concentrations for cadmium, copper, and zinc for treated outflow; and
3) evaluate receiving water response of discharge of treated outflow to the beach pond and surfzone under the required 2010 discharge location. Determine the extent to which passage through the pond affects the quality of treated runoff delivered to the surfzone.

3.2 Water Quality Monitoring Program Overview

The water quality monitoring program was conducted in general conformance with the project Monitoring and Reporting Plan, as modified for conditions imposed by the Section 401c Water Quality Certification and Coastal Zone Development Permit for project construction. Samples were collected at six stations: 1) channel influent to Poche CBP; 2) treated outflow from Poche CBP; 3) the mid point of the beach pond between treated outflow discharge and the pond outlet to the beach; 4) the pond outlet to the beach; 5) the surfzone, 25 yards upcoast of the pond outlet; and 6) the surfzone, 25 yards downcoast of the pond outlet. Treated outflow discharge and sampling station locations are indicated on Figure 4.

Figure 4. Poche Clean Beach Project
2010 Treated Outflow Discharge and Water Quality Monitoring Locations

All six stations were sampled for total coliform, fecal coliform, and enterococcus fecal indicator bacteria, while the Poche CBP treated outflow was also sampled for total metals analysis of cadmium, copper, and zinc. Both fecal indicator bacteria and heavy metals were sampled on a schedule of decreasing frequency as the performance period progressed. No sampling was conducted during or within 72 hours after a measurable rain event within the Prima Deshecha Canada watershed. A summary overview of the monitoring program is presented in Table 1.

Table 3. 2010 Performance Evaluation Monitoring Overview

Parameters	Sample Type	Monitoring Locations	Frequency	Samples per Station
Total coliform, Fecal coliform Enterococcus	Grab	Poche CBP influent Poche CBP treated outflow Midpoint of beach pond Beach pond outlet Surfzone 25 yds upcoast of pond 25 yds downcoast of pond	3 times/ week for months 1-2, 2 times/week for months 3-6, then once/week thereafter	36-39
Total Metals: Cadmium Copper Zinc	Grab	Poche PCBP treated outflow	once/week for months 1 – 2, then once/month thereafter	10

3.3 Water Quality Monitoring Quality Assurance / Quality Control

The Poche CBP sample collection, analysis, and data management was conducted in general conformance with the project's Quality Assurance Project Plan (QAPP), as modified for construction permit conditions imposed by regulatory agencies. OC Watersheds conducts an extensive county-wide surface water sampling program, where field samples are transferred to the Orange County Health Care Agency – Environmental Health Laboratory for bacterial analyses and to selected private laboratories for other analyses. A program QA/QC protocol is thereby followed, where generic blind synthetic samples are prepared and submitted along with the collective field samples and project-specific QA/QC duplicate samples and trip blanks for each project. In this way, individual project data can be evaluated against QA/QC results from not only the subject project but for all OC Watersheds projects. Poche project data was successfully validated by both project specific as well as program QA/QC analytical results.

Project Specific QA/QC. The Poche CBP data base collected between August 4 and December 13, 2010 included 16 duplicate pairs for fecal indicator bacteria analyses and 3 duplicate pairs for trace metals. Fecal indicator bacteria duplicate samples were filled individually rather than a single sample collected and then split. As such, the analyses were as much a measure of bacteria variability within natural waters as a laboratory analytical precision metric. Duplicate absolute variability for all three indicator bacteria in logarithmic form averaged 9.1% and ranged between 0 – 63% in relative percent difference (RPD); 92% of bacterial duplicate analytical RPDs were within the acceptable control limit of +/- 20%. Duplicate variability for

the three metals samples ranged between 0-2% RPD for cadmium, 0-23% for copper, and 7-8% for zinc, all within the acceptable +/- 25% analytical control limit for metals. The results from the relatively low number of project metals duplicates was corroborated by results from the programmatic metals duplicate QA/QC data base.

Project –specific blind synthetic samples were submitted on two different 2 sampling dates for total and fecal bacterial levels. Measured results for both days were within the acceptable target limits referenced by the commercial provider. Finally, trip blanks were prepared and submitted for 23 days of bacteria sampling and 5 days of metals sampling. All trip blanks analyses were below reportable detection limits for the respective analyses.

Project-specific QA/QC results for duplicate sample pairs, blind synthetic samples and trip blank samples are presented in Appendix B.

Program QA/QC. The Poche project-specific QA/QC results were complemented by the OC Watersheds monitoring 2009-2010 program QA/QC results which were summarized and reported in January 2011. Performance of participating laboratories was based on approximately 800 blind synthetic, duplicate/split, equipment blank, and trip blank samples for fecal bacteria and trace metals submitted over the period July 2009 – June 2010. Analytical results for all 32 blind synthetic reference samples for fecal indicator bacteria were within acceptable testing control limits established by the commercial reference sample provider. Accuracy and precision of trace metal QA/QC analyses were very good, with over 95% of samples within acceptable QA/QC control limits.

3.4 2010 Facility Operations

Operational Period. The Poche CBP initiated formal operations on July 20, 2010 and generally operated through December 16, 2010, when extended heavy rainstorm activity resulted in operations being suspended for the rest of the calendar year. During the 24 week reporting period, the facility was generally operational for approximately 109 days, or 66% of the period. In addition to mid-December suspension of operations due to large storm activity, intermittent downtime also occurred between October 5 – November 16 due to a series of problems with the pumps and the UV disinfection unit. The facility generally continued to treat inflow during minor rainstorms experienced during October and November; however, no water quality sampling was performed during and 72 hours following storm events.

Operational Control. The facility was initially operated by the construction contractor under change order for the first 19 weeks of operation until a short term operations agreement was executed with South Coast Water District, the County's designated long term operator. South Coast Water District assumed operations on November 29, 2010 for the remaining three weeks of the 2010 operational year.

Diversion Spillway Gate Operational Constraint. An important constraint affecting facility operations was the dynamic condition of the sand berm across the channel outlet along the beach. The berm controlled the beach pond discharge to the surfzone, water surface elevation in the pond, and corresponding backwater elevation against the downstream side of the channel spillway diversion gate. When the berm was fully established along the high intertidal zone of the beach, pond backwater not only inundated the public beach access walkway under

the railroad bridge, but overtopped the spillway gate, constituting a potential concern regarding its structural stability when the upstream water level was pumped down.

The high pond backwater condition imposed a scenario whereby it was necessary to operate the Poche CBP with the spillway gate in lowered position. Instead of treating influent runoff and discharging treated flow downstream of the gate, the facility instead drew in water directly from and discharged treated water back into the beach pond. This resulted in continuous facility operation rather than intermittent cycled operation, and resulted in inefficient treatment of inflow, through hydraulic short circuiting and retreating of some inflow while allowing some channel inflow to bypass the facility untreated.

During the 2010 August – November operational period, OC Parks conducted 3 berm breaching activities to maintain public beach access. Onset of heavy rains and attendant stormflow in December 2010 resulted in considerable scouring of the berm, which alleviated the chronic backwater condition and dispelled the need for further modifications. However, despite these maintenance actions, the Poche CBP was still compelled to operate in the suboptimal spillway gate lowered position for approximately 54 percent of the performance period.

Runoff Volumes Treated. It was not possible to definitively quantify runoff volume treated during the 2010 performance period. The facility operated for over half the performance period with the spillway gate lowered, due to the high pond backwater created by the sand berm. During lowered gate operation, the facility continuously treated water from the beach pond commingled with influent runoff, not influent runoff by itself. There was no way to quantify the extent to which influent runoff was being treated more than once, since treated outflow is discharged not to the surfzone but back into the beach pond. A faulty flow meter readout display also contributed to the inability to consistently determine daily facility outflow rates.

However, an average daily treated volume during the 2010 performance period was estimated to be 0.75 million gallons per day (GPD). This was based on instantaneous flow rate readings for 21 individual days when the spillway gate was lowered, which ranged between 0.4 – 1.02 MGD and averaged 0.75 MGD. This estimate was corroborated by a 10 day period of raised gate operation in December when the faulty flowmeter could be read, which produced an average treated flow rate of 0.73 MGD. Improved accuracy and consistency of flow readings are expected in 2011 with replacement of the faulty flowmeter LED digitizer display.

Floatable Debris Maintenance. There was surprisingly little floatable trash and debris experienced under normal dry weather flow conditions during the 2010 operational period. Facility design had made provisions for a debris screen suspended across the channel just upstream of the intake point to the treatment facility, with the expectation that intercepted plastic and other floatable debris would need to be removed 2-3 times/week. The paucity of debris experienced in dry weather flow obviated the need for extensive removal efforts, and may be attributable to a responsible watershed community as well as effective trash/debris public awareness and source control programs implemented by the watershed cities.

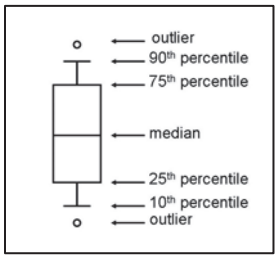
Health Care Agency Beach Quality Monitoring and Status. Poche Beach is one of numerous Orange County coastal locations where the surfzone is monitored weekly for bacterial quality. Should surfzone sampling exceed AB411 single sample standards for any of the three fecal

bacteria indicators, the Orange County Health Care Agency (OCHCA) will post public water quality advisories at the beach until the single sample or geomean exceedances abate.

During the July – December 2010 Poche CBP operational period, OCHCA sampling station S-15 at Poche Beach was characterized by extended exceedances of the enterococcus single sample or 5-sample geomean standards. Other than August 9-16, the beach was posted continuously from July 10 through December 2, when postings were removed. The transition to better winter surfzone quality (January – April) has been a consistent seasonal trend in recent years. The apparent factors collectively contributing to the December reduction in surfzone bacterial levels in 2010 are: 1) the onset of lower winter channel influent bacterial concentrations; 2) lower beach pond retention times due to a sustained open berm condition created by periodic storm flows and favorable surf and tide conditions; 3) a seasonal reduction of large numbers of shorebirds congregating at the beach pond outlet; and 4) operation of the Poche CBP.

3.5 2010 Facility Treatment Performance – Fecal Indicator Bacteria

Poche Clean Beach Project (Poche CPB) bacteria removal data during the 2010 performance period is presented in Figure 5 and summarized in Table 4, with complete individual data presented in Appendix A. In Figure 5, both AB411 single sample and geomean standards thresholds are expressed horizontally as dashed and solid lines, respectively, for comparative purposes. The facility provided average treatment efficiencies of 93-95 % for all three fecal indicator bacteria. Total coliform influent geomean was 5,289 CFU/100 ml, with a treated outflow geomean of 87 CFU/100 ml, well below the AB411 geomean standard value of 1,000 CFU/100 ml. Fecal coliform influent geomean was 867 CFU/100 ml and treated outflow geomean was 23 CFU/100 ml, well below the AB411 geomean standard value of 200 CFU/100 ml. Treatment performance was sufficient to consistently produce outflow total coliform and fecal coliform levels well below those values corresponding to AB 411 bacteria quality standards for marine surfzone receiving waters. Total coliform outflow levels exceeded the value corresponding to the AB411 single sample standard (10,000 CFU/100ml) only twice out of 39 samples and none of 35 rolling 5-sample geomeans exceeded the geomean standard value. Fecal coliform outflow levels exceeded the AB411 single sample standard value (400 CFU/100 ml) once in 39 samples, with no exceedances of the rolling 5-sample geomeans.



Average enterococcus treatment efficiency (94.37%) was comparable to those for total coliform and fecal coliform indicator bacteria. Inflow enterococcus geomean was 974 CFU/100 ml and treated ouflow geomean was 25 CFU/100 ml, below the AB411 geomean standard value of 35 CFU/100 ml. However, there was a greater incidence of individual and rolling 5-sample geomean treated outflow values exceeding values corresponding to AB411 enterococcus standards. Treated outflow enterococcus exceeded AB411 single sample standard value (104 CFU/100 ml) in 6 of 39 individual samples, and exceeded the AB411 geomean standard value (35 CFU/100 ml) in 20 out of the 35 rolling 5-sample geomeans.

Figure 5. Poche Clean Beach Project
Fecal Indicator Bacteria for Inflow and Treated Outflow
August – December 2010

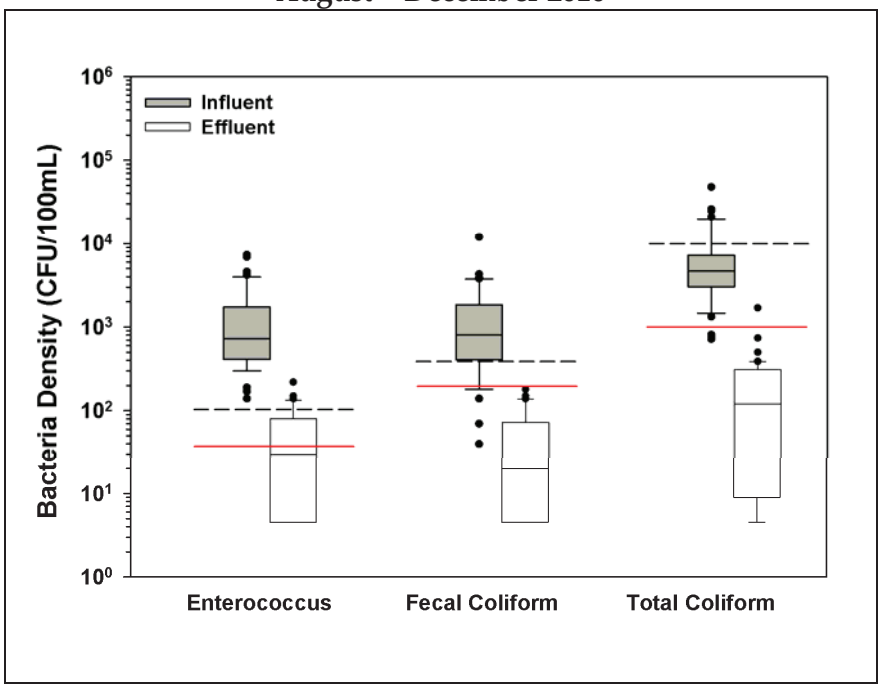


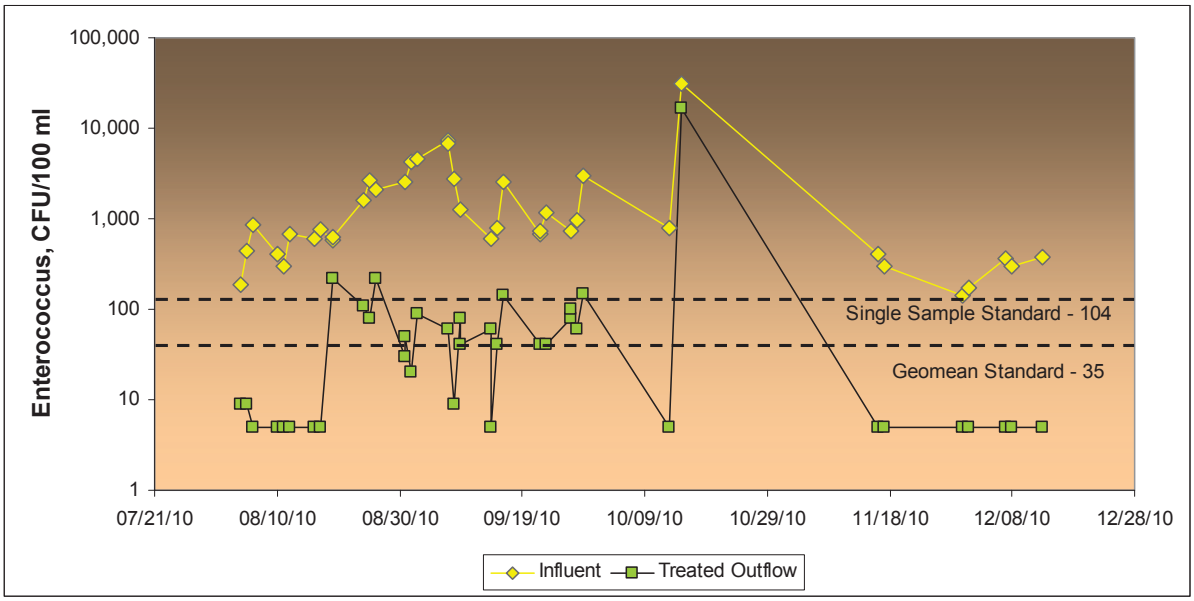
Table 4. Poche Clean Beach Project
Fecal Indicator Bacteria Removal Performance Summary
August – December 2010

Fecal Indicator Bacteria	Influent		Outflow				
	N	Geomean	N	Geomean	Average Removal Efficiency, %	No. exceeding AB411 values	
						Single sample	5-sample geomean
Total coliform	39	5,289	39	87	94.35%	2 / 39	0 / 35
Fecal coliform	39	867	39	23	93.22%	1 / 39	0 / 35
Enterococcus	38	974	39	25	94.37%	6 / 39	20 / 35

In summary, overall Poche CBP 2010 bacterial treatment performance was reasonably acceptable but needs to be improved for enterococcus, given Poche Beach's history of chronic exceedance of AB411 enterococcus standards in the surfzone. It is important to understand that the construction contractor was operating the facility during the first 5 months (July – November) of the 2010 performance period, as a necessary interim period prior to assumption of long term operations by South Coast Water District (SCWD) in December 2010. As the construction contractor was working under the direct supervision of OC Inspection during this interim period, OC Watersheds had limited opportunity for direct contact with the contractor, with a significant lag period in water quality data sharing to help the contractor respond to

what appeared to be inconsistent performance results (Figure 6). Once SCWD assumed operations on November 29, 2010, OC Watersheds was able to work directly with the operator for much better coordination in performance data sharing, interpretation, and operational modification response. It is expected that this working relationship will result in improved treatment consistency and effectiveness in 2011. It is likely coincidental given a seasonal reduction in enterococcus influent levels, but is nonetheless promising that all five outflow enterococcus samples collected after SCWD assumed operations (Figure 6) were below detectible levels (<9 CFU/100ml).

Figure 6. Poche Clean Beach Project
Inflow and Treated Outflow Enterococcus Levels
August – December 2010



3.6 2010 Facility Treatment Performance – Treated Outflow Metals

Poche CBP treated outflow was sampled 10 times over the 2010 performance period for total metal analyses of cadmium, copper, and zinc, in accordance with the conditions of the project's Section 401c Certification. Individual analytical results are presented in Figure 7 and Appendix A, and are summarized in Table 5. Despite the total metal analytical procedure, the results are a practical estimation of the dissolved metals fraction, as the treated outflow samples were subjected to sand filtration of particulate solids prior to sampling. Generally, copper and zinc concentrations were relatively low, with low to moderate variability, and did not exceed water quality standards. Cadmium concentrations in treated outflow also demonstrated low to moderate variability, and generally ranged between 4 – 7 ug/l, with elevated concentrations in both cadmium and zinc for samples collected in late 2010 (Figure 7). Cadmium analyses frequently exceeded the California Toxics Rule freshwater chronic standard and consistently exceeded the Ocean Plan daily maximum standard (Table 5). Standards comparisons were based on indirect estimations of sample matrix hardness as $CaCO_3$, from measured total dissolved solids concentrations and the univariate regression relationship between the two parameters ($R^2 = 0.846$, $p<0.001$).

Figure 7. Poche Clean Beach Project
2010 Treated Outflow Total Metals

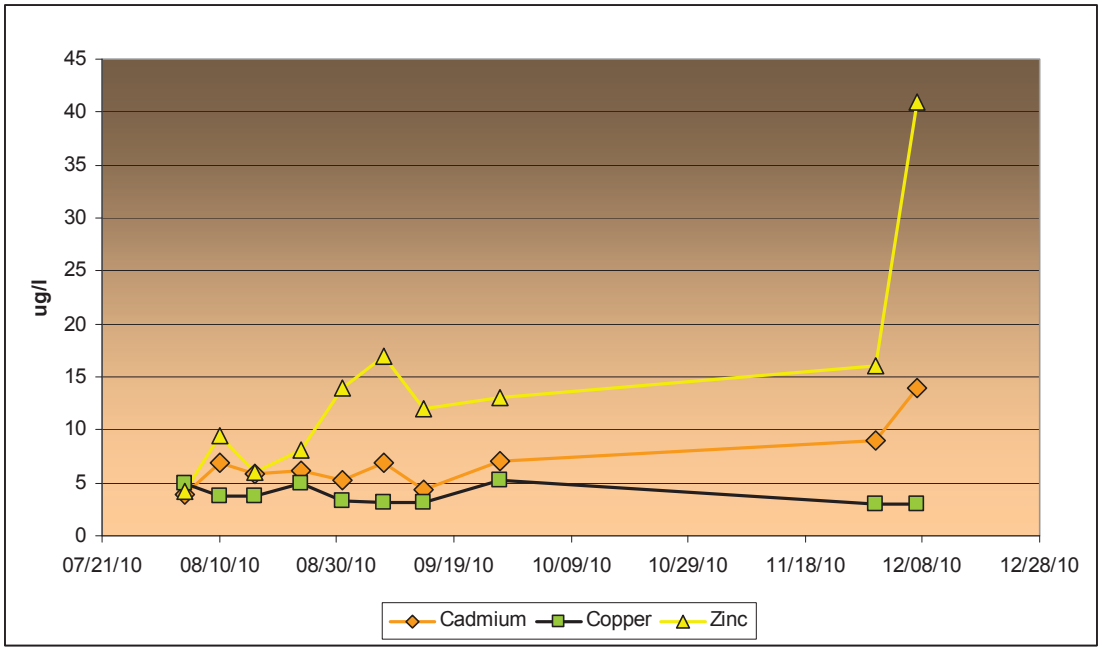


Table 5. Poche Clean Beach Project
2010 Treated Outflow Total Metals Characterization

	Cadmium	Copper	Zinc
Number of Samples	10	10	10
Mean, ug/l	7.0	3.8	14.1
Minimum, ug/l	3.9	3.0	4.2
Maximum, ug/l	14.0	5.3	41
CTR Chronic Standard, ug/l	6.25	29.3	382.4
% of Sample Exceedance	50%	0%	0%
Ocean Plan Daily Max, ug/l	4	12	80
% of Sample Exceedance	90%	0%	0%

Limited historical investigative studies upstream in the Prima Deshecha Canada Channel watershed were very suggestive that high cadmium concentrations present in dry weather flow are attributable to its natural leaching from marine sedimentary soils indigenous to the watershed. Further investigations are in progress to better characterize this phenomenon in south Orange County watersheds. As mentioned, outflow sample concentrations underwent

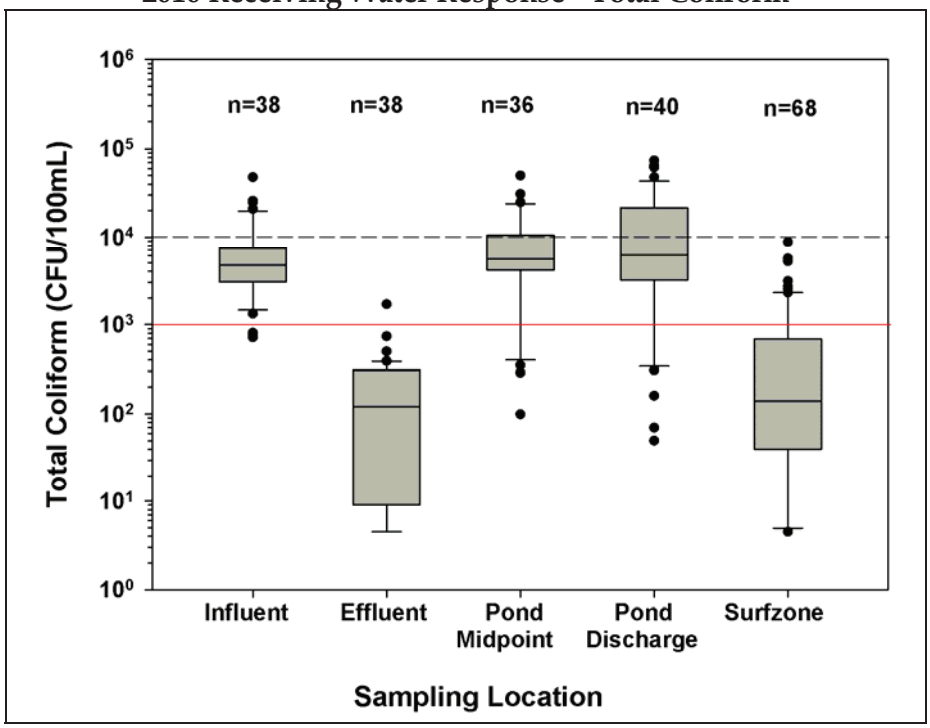
sand filtration, and likely reflect a benefit in particulate metals removal passing through the treatment facility. However, Poche CBP influent samples were not taken concurrently with outflow samples, so it is unknown what the absolute total cadmium concentrations were in ambient dry weather runoff, or the extent to which cadmium loads in such runoff were removed by the treatment facility.

3.7 2010 Receiving Water Quality Response – Fecal Indicator Bacteria

The 2010 downstream receiving water quality response to the discharge of Poche CBP treated outflow is presented in Figures 8 - 10 for total coliform, fecal coliform, and enterococcus, and summarized in Table 6. Stationing is presented in figures from left to right in conformance with flow passage, while both AB411 single sample and geomean standards thresholds are expressed horizontally as dashed and solid lines, respectively. Complete individual bacteria data for all stations is presented in Appendix A.

Figures for all indicator bacteria clearly demonstrate that the potential water quality benefit of Poche CBP treated outflow was dissipated within the beach pond before reaching the surfzone. Pond bacteria concentrations were generally 1 – 2 orders of magnitude higher than the treated outflow, and tended to increase in passage through the pond. Indeed, bacteria concentrations in the pond were generally higher than untreated channel influent (raised gate condition) for all three indicator bacteria.

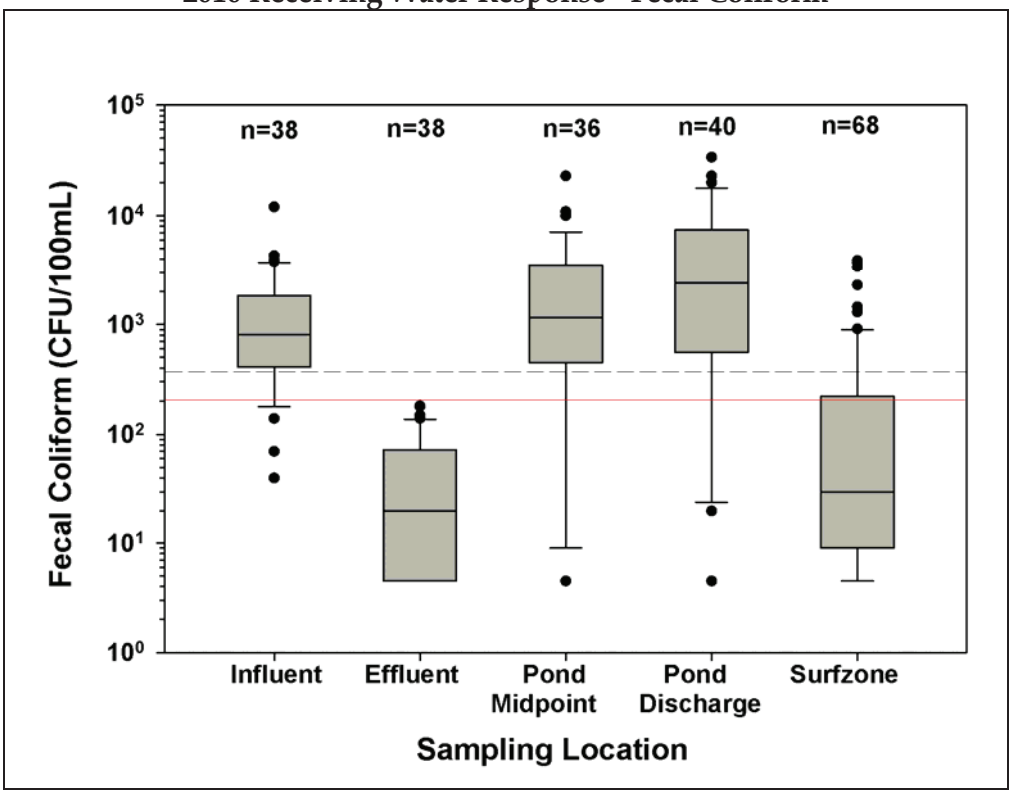
Figure 8. Poche Clean Beach Project
2010 Receiving Water Response - Total Coliform



Surfzone samples indicated a comparable and opposite counter effect, where the surfzone consistently demonstrated a dispersive capability to lower pond outflow bacteria concentrations by 1-2 orders of magnitude for all three indicators within 25 yards of the outflow. This

dispersive capability was sufficient to result in consistently acceptable surfzone total coliform concentrations, as corroborated by the absence of OCHCA AB411 exceedances of this parameter during the performance period (Figure 8). Surfzone dispersive capability was also generally effective in maintaining acceptable fecal coliform conditions, although several surfzone samples exceeded the AB411 single sample standard of 400 CFU/100ml, which is apparent in Figure 9. This was also corroborated by intermittent exceedances reported by OCHCA sampling in late August through early October.

Figure 9. Poche Clean Beach Project
2010 Receiving Water Response - Fecal Coliform

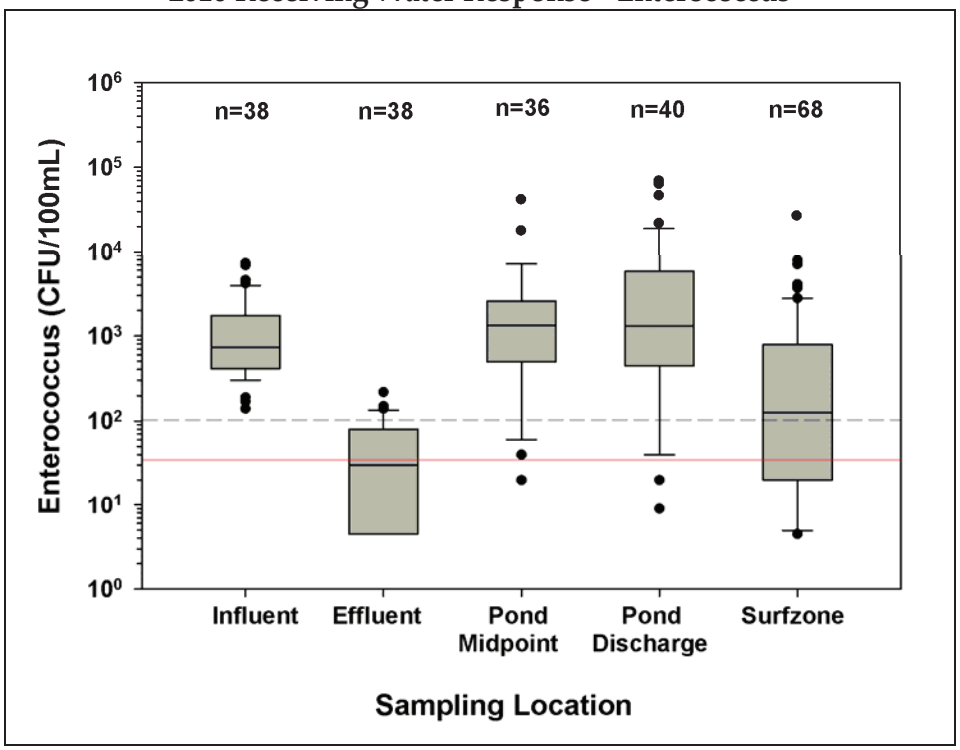


However, surfzone dispersive capability was not able to offset the high enterococcus concentrations within the pond to the extent of maintaining acceptable low levels within the surfzone (Figure 10). Enterococcus constituted the primary basis for the extended OCHCA water quality advisory postings of the beach between August – November 2010. It is reasonable to conjecture from monitoring data that, had Poche CBP treated outflow been discharged directly to the surfzone, the dispersive effect of surfzone mixing would have been sufficient to consistently maintain acceptable AB411 enterococcus levels within the immediate vicinity of the treated outflow discharge.

The total operational fecal indicator bacteria data base for the stations is summarized in Table 6 for total operations, as well as breakouts for gate raised and gate lowered operating scenarios. Geomean data clearly demonstrates that the decline in receiving water quality in passage through the beach pond was comparable under either operating mode. Raised gate operations

mode reflected slightly lower total coliform and fecal coliform geomeans and slightly higher enterococcus geomeans that the lowered gate operations mode.

Figure 10. Poche Clean Beach Project
2010 Receiving Water Response - Enterococcus



The gate lowered operating mode is believed to be more inefficient and costly than gate raised mode. The gate lowered mode operated 24 hours per day, with correspondingly higher pumping hours and electricity usage than the gate raised mode. Gate lowered operations is likely characterized by substantial hydraulic short circuiting at the intake/discharge point resulting in the recycling of treated water, while allowing some fraction of channel runoff to bypass the treatment facility entirely. However, the comparable pond quality under the gate raised operations mode indicates that some other bacteria source may have been contributing to and sustaining higher bacteria levels within the pond.

There were no special investigations conducted of other sources of indicator bacteria within the beach pond. However, for much of August and September, considerable numbers of shorebirds congregated daily at the beach pond and its outlet to the surfzone. It is speculated that the Poche location is a rest area from shorebird feeding incursions to the nearby Prima Deshecha landfill. Daily bird counts during this period averaged 287 per day and ranged from 30 to as many as 1,120 birds per count. It is possible that the shorebirds were contributing to the higher elevated bacteria concentrations within the pond and along the surfzone.

Shorebird populations dispersed in October; however, there is a paucity of concurrent water quality data in October and November for comparative purposes due to rain activity, facility operational problems, and a planned transition to a less frequent sampling schedule. The data correlation between bird populations and pond bacteria concentrations was reasonably strong

(r=0.62), but reduced pond bacteria in November – December could also have been affected by other observed factors such as lower winter bacteria levels in channel influent and the onset of winter storm events which resulted in sustained breaching of the sand berm and lowered hydraulic residence time with the pond.

Table 6. Summary of 2010 Receiving Water Response - Fecal Indicator Bacteria

	Fecal Indicator Bacteria Geomeans, CFU/100 ml				
	PCBP Influent n=38	PCBP Outflow n=38	Pond Midpoint n=36	Pond Discharge n=40	Surfzone (upcoast & downcoast) n=72
Total Coliform					
Total Operations	4916	69	4973	5508	155
Gate Raised	5100	74	4800	5200	--
Gate Lowered	4000	76	5400	6100	--
Fecal Coliform					
Total Operations	817	20	840	1283	51
Gate Raised	800	21	760	1100	--
Gate Lowered	730	18	840	1600	--
Enterococcus					
Total Operations	882	21	1091	1371	127
Gate Raised	970	26	1100	1400	--
Gate Lowered	610	16	950	1200	--

There is also compelling evidence that pond sediments and beach sands can be a significant source of enterococcus in both freshwater and ocean beach environments and contribute to surfzone bacteria along the California coastline. Recent research efforts have demonstrated that enterococcus bacteria have the ability to successfully propagate outside of a host organism in sediments and fine beach sands (Moriarty et al, 2008; Yamahara et al, 2007; Lee et al, 2006).

3.8 2010 Performance Evaluation Summary Findings

During the 2010 operational period, the Poche Clean Beach Project (Poche CBP) was in operation approximately 66% of the time. Average daily treated flow rates were determined to be approximately 0.75 million gallons per day (MGD). The facility operated with the diversion spillway gate in the raised position approximately 45% of the time, with 55% of the time in the lowered gate position.

Poche CBP bacterial treatment efficiencies averaged between 93-95% for all three indicator bacteria. Treated outflow concentrations for total coliform and fecal coliform were consistently below values corresponding to AB411 surfzone single sample and 5-sample geomean standards. However, despite an average 94% treatment efficiency, treated outflow enterococcus concentrations still exceeded the value corresponding to the AB411 single sample standard of 104 CFU/100 ml in 15% of samples and exceeded the value corresponding to the AB411 geomean standard of 35 CFU/100 ml in 57% of the rolling 5-sample geomeans. While performance results were reasonably acceptable, it is expected that treatment efficiencies will improve in 2011 with the facility being professionally operated by South Coast Water District.

Receiving water quality response data clearly demonstrated that the considerable water quality benefit produced by Poche CBP treatment of urban runoff was unable to be delivered to the surfzone in 2010. The project's Coastal Zone Development permit required that treated outflow be discharged immediately downstream of the spillway gate, in part to improve the quality of the beach pond prior to its discharge to the surfzone. Instead, the passage of treated outflow through the pond resulted in a 1-2 order of magnitude increase in concentrations of all three indicator bacteria, returning outflow bacteria to pre-treatment levels. Despite an offsetting 1-2 order of magnitude reduction in enterococcus concentrations due to the dispersive capability of the surfzone at the pond outlet, resultant enterococcus concentrations in the surfzone were still sufficiently high to consistently exceed the AB411 geomean standard from late August to mid November 2010. Water quality data is suggestive that, had treated outflow bypassed the pond and been discharged directly to the surfzone, the near shore dispersive capability exerted on the treated outflow would have been sufficient to maintain consistently acceptable AB411 bacterial quality in the immediate vicinity of the treated outflow discharge to the surfzone.

The trend of increasing bacteria concentrations with passage through the beach pond was observed in both raised gate as well as lowered gate operations modes, which suggested that there were additional sources of fecal indicator bacteria within the pond. Likely additional sources included: 1) feces from large numbers of shorebirds which congregated along the pond and its outlet during the performance period; and 2) the natural regrowth of enterococcus within pond sediments.

Based on 2010 performance results, it seemed evident that the County should meet the following objectives in 2011 to improve water quality at Poche Beach: 1) improve the level and consistency of facility treatment performance; and 2) acquire resource agency approval to bypass the beach pond and discharge treated runoff directly to the surfzone.

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SECTION 4.0 – 2011 FACILITY PERFORMANCE EVALUATION

4.1 Pre-Operation 2011 Preparatory Activities

From mid-January to mid-May 2011, the Poche Clean Beach Project (Poche CBP) operated on an intermittent one day per week basis in order to complete a number of facility repairs and maintain the facility in operational condition. These repairs extended into the early summer. There was no need to operate the facility for water quality purposes, as surfzone quality did not exceed AB411 standards during this period. In May and June, water treatment operations were modified to accommodate City structural reconditioning of the Pacific Coast Highway bridge supports adjacent to and within the channel box culvert.

A project water quality report on 2010 performance monitoring was submitted to the San Diego Regional Water Quality Control Board (Regional Board) and California Coastal Commission on March 1, 2011 as a condition of facility construction permits. Data clearly demonstrated that the water quality benefit of treated runoff was unable to be delivered to the surfzone due to its passage through the beach pond, and affirmed the need to relocate the facility discharge in order to achieve a surfzone water quality benefit.

In April 2011, the County submitted a Coastal Development Permit amendment application to request a three month demonstration trial during the summer of 2011 to test the water quality benefit of relocation of the Poche CBP discharge to bypass the scour pond and discharge directly to the surfzone. Discharge was to be accomplished using the existing rigid discharge pipe along the bulkhead and a 50-foot extension of flexible pipe beyond the sand berm retaining the beach pond. The Coastal Commission approved the request, issuing the amendment on May 27, 2011.

However, the Regional Board expressed concerns with permitting even a temporary demonstration trial of direct ocean discharge, on the basis that: 1) the County had not yet demonstrated the facility's ability to consistently meet AB411 bacteria standards; and 2) cadmium concentrations in treated outflow exceeded Ocean Plan standards. For the purposes of facilitating 2011 operations, the County therefore withdrew its application and submitted a revised proposal for a demonstration trial of a discharge at the end of the rigid pipe along the wooden bulkhead. Under this proposal, treated outflow would continue to discharge into the beach pond, albeit closer to its outlet to the ocean. The location would be expected to result in less residence time for recontamination within the pond than the 2010 discharge location, and improve the quality of pond outflow to the surfzone. The end of bulkhead discharge location had already been approved by the Regional Board in the original Section 401 certification.

A modified Section 401 certification was issued by the Regional Board on July 22, 2011. Repair of the rigid discharge pipe, which had been damaged during a winter storm, had been held in abeyance by regulatory agencies pending approval of a new discharge location. The pipe repair was completed in late July, whereupon facility operation initiated using the new discharge location. The process of regulatory approval of the new discharge location and pipe repair resulted in the deferral of the 2011 operational performance period from June through August to the period August through October, 2011.

4.2 Water Quality Monitoring Objectives

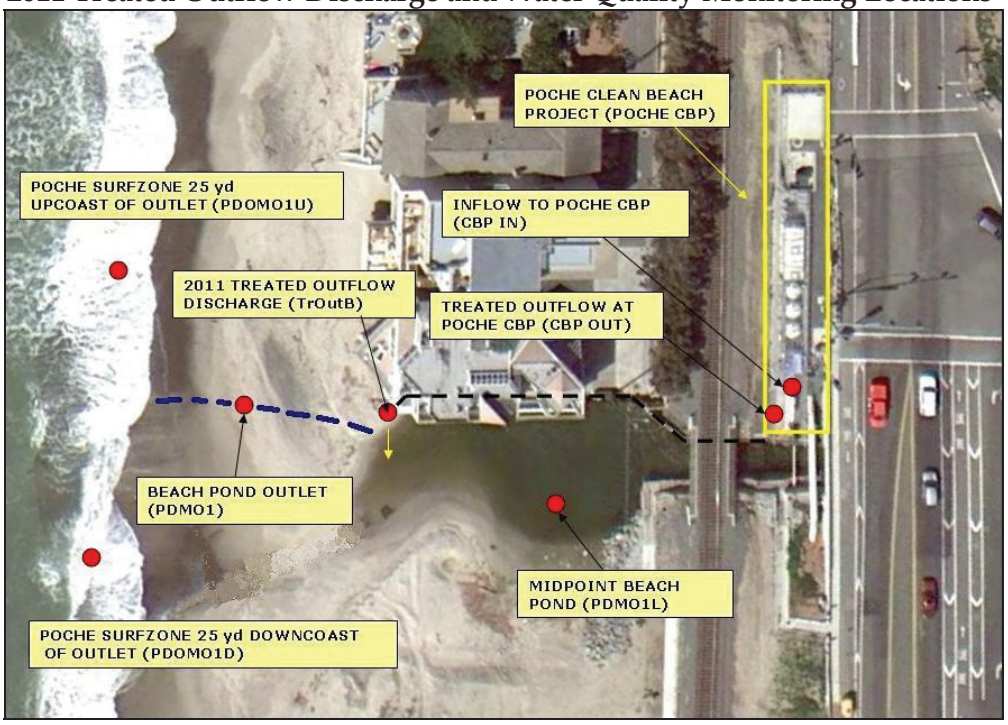
The objectives of the 2011 monitoring program were the following:

1) determine Poche CBP bacteria treatment efficiency and treated outflow bacterial quality;
2) determine the extent to which treated outflow was subject to bacterial recontamination by conveyance through the rigid discharge pipe along the bulkhead;
3) determine the extent to which the new discharge location improved bacterial quality of beach pond outflow to the surfzone;
4) determine the extent to which the new discharge location improved surfzone water quality within the surfzone; and
5) determine the extent to which surfzone quality is dependent on beach pond outflow quality versus shorebird numbers congregating along the intervening intertidal zone.

4.3 Water Quality Monitoring Program Overview

The water quality monitoring program for 2011 initiated on August 9 and ended on October 27. Samples were collected at seven stations: 1) channel influent to Poche CBP; 2) treated outflow at the Poche CBP; 3) treated outflow at the pipe discharge location; 4) mid point within the beach pond; 5) midway point of the pond outlet to the surfzone; 6) the surfzone, 25 yards upcoast of the pond outlet; and 7) the surfzone, 25 yards downcoast of the pond outlet. Treated outflow discharge and sampling station locations are indicated on Figure 11. It should be noted that the pond outlet location is transient in nature. Figure 4 is a representation of the location of the pond outlet during the 2011 performance season, immediately oceanside of the treated outflow discharge location along the bulkhead.

Figure 11. Poche Clean Beach Project
2011 Treated Outflow Discharge and Water Quality Monitoring Locations



All seven stations were sampled for total coliform, fecal coliform, and enterococcus indicator bacteria, while the Poche CBP treated outflow was also sampled for total metals analysis of cadmium, copper, and zinc. Fecal indicator bacteria sampling was generally conducted on a twice per week frequency, dependent upon the operational status of the facility. No sampling was conducted during or within 72 hours of a measurable rain event within the Prima Deshecha Canada watershed. A summary overview of the monitoring program is presented in Table 7.

Table 7. 2011 Performance Evaluation Monitoring Overview

Parameters	Sample Type	Monitoring Locations	Sampling Frequency	Samples per Station
Total coliform, Fecal coliform Enterococcus	Grab	All seven locations	2/week	19 - 22
Cadmium, Copper, Zinc	Grab	Poche CBP treated outflow	monthly	3
Turbidity	Grab	Mid-Beach Pond, Pond Outlet	weekly	14

Shorebird populations at the beach were also quantified for the 24 hour period preceding sampling visits. Shorebird counts were performed retroactively from digital records of a remote camera installed at the beach by OC Parks. Counts were conducted into the winter months when surfzone bacteria concentrations historically recede, in order to discern whether a significant correlation exists between shorebird numbers and surfzone bacteria concentrations.

4.4 Water Quality Monitoring Quality Assurance / Quality Control

Poche CBP sample collection, analysis, and data management was conducted in general conformance with the project's Quality Assurance Project Plan (QAPP), as modified for construction permit conditions imposed by regulatory agencies. OC Watersheds conducts an extensive county-wide surface water sampling program, where field samples are transferred to the Orange County Health Care Agency Environmental Health Laboratory for bacterial analyses and to private laboratories for other analyses. A QA/QC protocol is followed, where generic blind synthetic samples are prepared and submitted along with collective field samples as well as project-specific QA/QC duplicate samples and trip blanks. In this way, individual project data can be evaluated against QA/QC results from not only the subject project but for all OC Watersheds projects. Poche project data analytical integrity was successfully validated by both limited project specific samples as well as the larger program QA/QC analytical results.

Project Specific QA/QC. The Poche CBP data base collected between August 18 and October 27, 2011 included 6 duplicate pairs for fecal indicator bacteria analyses. Bacteria duplicate samples were collected individually rather than a single sample collected and then split. As such, analyses were both a measure of bacteria variability in natural waters as well as a laboratory analytical precision metric. Duplicate absolute variability for all three indicator bacteria in logarithmic form averaged 7.1% and ranged between 0 – 68% in relative percent difference (RPD); 90% of bacterial duplicate RPDs were within the acceptable control limit of

+/- 20%. One project-specific trip blank sample was prepared for bacteria analyses, which were below detectable limits. Project trip blank validation was supported by a considerable program trip blank data base, results of which are described in the program QA/QC section.

Given that only three samples for trace metals were collected, no project-specific duplicate sampling was performed. Again, performance relied on the substantial program duplicate data base for trace metals which characterized laboratory precision. These results are presented in the program QA/QC section.

Project-specific QA/QC results for duplicate sample pairs and trip blank samples are presented in Appendix B.

Program QA/QC. The OC Watersheds monitoring QA/QC program results were last compiled and reported in November 2011. Performance characterization of participating laboratories was based on approximately 1,070 blind synthetic, duplicate/split, equipment blank, and trip blank samples for fecal bacteria and trace metals submitted over the period July 2010 – June 2011. Analytical results for 92% (77 of 84) of blind synthetic reference sample analyses for fecal indicator bacteria were within acceptable testing control limits established by the commercial reference sample provider. Precision of duplicate analyses for indicator bacteria was generally very `good; total coliform demonstrated the most consistent recoveries, with slightly greater scatter for fecal coliform and enterococcus. Analyses were below detectable limits in 99% and 96% of indicator bacteria trip blank and equipment blank samples, respectively. Accuracy and precision of trace metal QA/QC analyses were very good, with over 97% of samples within acceptable QA/QC control limits. The 2010-11 program QA/AC results relevant to Poche sampling parameters are presented in Appendix B.

4.5 2011 Facility Operations

Operational Period. Poche CBP 2011 operations initiated on July 29, 2010 and ended on October 31, 2011, the date imposed by the Coastal Commission for terminating demonstration trial operation using the discharge location at the end of the rigid pipe. The facility was generally operational for approximately 75 days, or 82% of the performance period, where down time was attributable to shutdown for either rain events or facility repairs.

Runoff Volumes Treated. During the operational period, the Poche CBP treated a total of 43.5 million gallons (MG), for an average daily flow rate of 0.58 million gallons per day (MGD).

Operational Control. The Poche CBP was capably operated and maintained by South Coast Water District (SCWD), with the County executing a 5 year operations agreement with SCWD in June 2011. However, the construction contractor maintained an important element of operational responsibility through a materials and workmanship construction warranty. Extended facility operation periods under less than fully effective mechanical conditions in 2011 were not attributable to SCWD inattention, but instead to the construction warranty process, which required formal notification of the construction contractor to return to the site to resolve significant facility component and workmanship issues. Several operational issues failed to be resolved during the 2011 performance period.

Diversion Spillway Gate. During the 2011 performance period, the Poche CBP operated with the channel diversion gate in effective raised position for an estimated 65% of the time, an increase from 46% in 2010. The gate was actually in raised position a greater period of time, but was ineffective during extended periods in August when process control adjustments resulted in channel runoff bypassing the Poche CBP and overflowing the gate into the beach pond. The raised gate position is the more effective operating mode than the lowered gate position in terms of water quality treatment and energy cost-effectiveness. The improvement in effective raised gate operations in 2011 could have been attributable to a combination of lower channel inflow rates, lower beach pond backwater levels, and better operational control by SCWD.

Operational and Treatment Constraints. Three major operational factors constrained facility treatment performance and receiving water response during the evaluation period. Performance data collected during the entire month of August was compromised by conditions related to iterative adjustments of facility process control functions in response to increased facility back pressure due to initiating use of the longer discharge line. This resulted in extended periods of full recycle of treated outflow back to the wet well, no discharge out the treated outflow pipe, some channel inflow to be repeatedly treated, and some channel inflow bypassing the facility and flowing to the beach pond untreated.

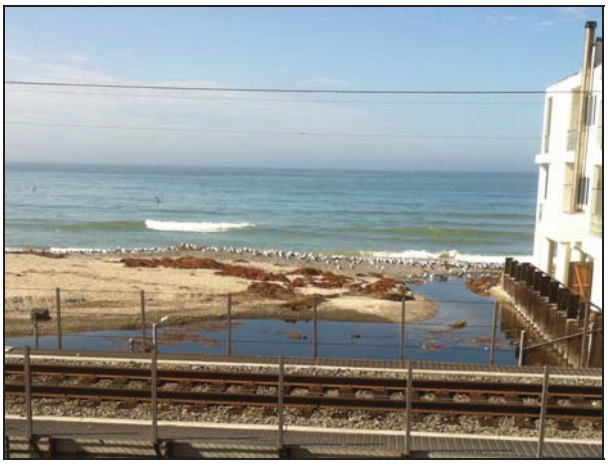
Disinfection performance during the remaining two months was constrained by a ballast failure in the UV disinfection chamber, which resulted in only 3 of the 4 UV lamp systems being functional during this entire period. Despite the critical nature of the ballast to disinfection performance, the contractor was unable to procure and replace the component before treatment operations ceased on October 31, 2011. The inability to operate all 4 UV lamps surely resulted in less than optimal bacteria removal efficiency during the entire performance period.

Finally, pump and pump sequencer malfunction issues resulted in sustained periods of single pump (rather than double pump) operation in August and October, which may have resulted in periods when some channel flow bypassed the treatment facility.

Beach Pond Outlet Location During Performance Period. Beach pond configuration and location of its outlet to the ocean is dynamic in nature, as it shifts in response to changes in channel flows, ocean swell, tidal action, sand berm development, and any mechanical modifications to the sand berm for pond level management. Pond outlet location relative to the treated outflow discharge is believed to be an important determinant of the extent to which treated outflow might be discharged to the beach pond and yet still be able to improve bacterial quality within the surfzone. An optimal pond outlet location would encourage treated outflow discharge to hydraulically short-circuit the pond and be conveyed to the surfzone with minimal mixing, residence time and opportunity for recontamination within the pond.

While the Regional Board requires that treated runoff not be discharged directly to the ocean, the pond outlet during the 2011 performance period nevertheless developed in the best location possible for limiting treated outflow residence time within the pond. Following sand berm maintenance for pipe repair in July 2011, the pond outlet established immediately downstream of the treated outflow discharge pipe at the end of the wooden bulkhead, and remained in this location for the duration of the performance period (see images below). This pond outlet

orientation would be expected to result in the minimal commingling of treated runoff within the pond before its outflow to the surfzone.



September 6, 2011

October 11, 2011

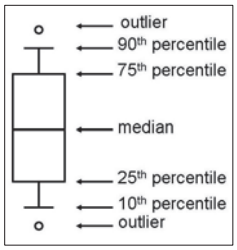
Shorebird Presence During Performance Period. Shorebird presence at Poche Beach during the performance period was quantified through review of still images from a camera installed at the beach by OC Parks in July 2011. Shorebird populations were predominantly seagulls; shorebird presence varied between 0 to 720 birds per count and averaged 169 birds per count throughout the performance period. The shorebirds tended to congregate in the immediate vicinity of the pond outlet along the exposed intertidal area of the beach. It is speculated that the Poche location is a drinking and rest area from shorebird feeding incursions to the nearby Prima Deshecha landfill. Shorebird presence continued past the end of the performance period extending into January 2012, albeit at slightly lower numbers (average 104 birds per count). The beach camera imagery provided a powerful new tool by which to effectively characterize shorebird presence at the beach.

Health Care Agency Beach Quality Monitoring and Status. Poche Beach is one of numerous Orange County coastal locations where the surfzone is monitored weekly for bacterial quality. Should surfzone sampling exceed AB411 single sample standards for any of the three fecal bacteria indicators, the Orange County Health Care Agency (OCHCA) will post public water quality advisories at the beach until the single sample or geomean exceedances abate.

OCHCA sampling station S-15 at Poche Beach is situated approximately 100 yards upcoast from the Poche outlet. During the August – October 2011 Poche CBP operational period, S-15 was characterized by extended exceedances of the enterococcus single sample or 5-sample geomean standards. The beach was posted continuously throughout the performance period. Surfzone exceedances and postings continued into January 2012, with the exception of the week of January 6 – 13, when heavy surf likely contributed to a reduction in bacteria levels and a lifting of the posting. The transition to acceptable winter/spring dry weather surfzone quality (January – April) has been a consistent seasonal trend in recent years. However, the persistent high bacteria levels during the 2011-12 wet season may be attributable to the absence of sustained large storm activity to date.

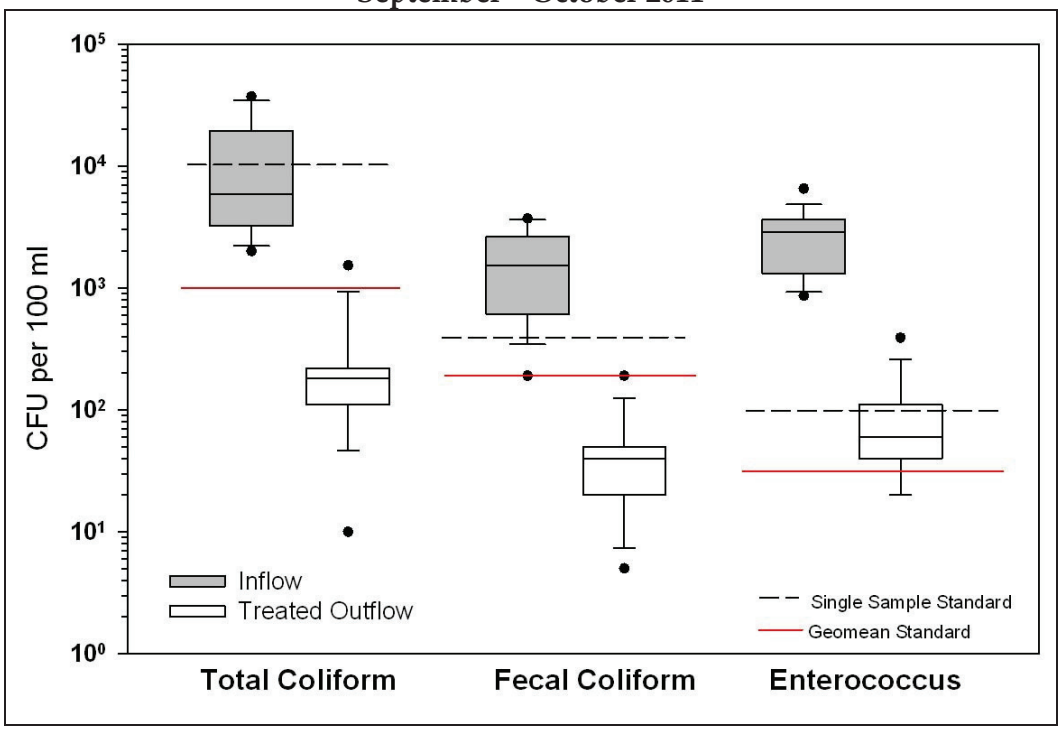
4.6 2011 Facility Performance – Fecal Indicator Bacteria

Evaluation of Poche Clean Beach Project (Poche CBP) bacteria treatment performance was based on a comparison of influent and treated outflow samples within the Poche CBP for all three fecal indicator bacteria, with consideration of both absolute concentrations as well as relative treatment efficiency. Influent and treated outflow bacteria data during the 2012 period is presented in Figure 12 and summarized in Table 8, with individual data presented in Appendix A. In Figure 12, AB411 single sample and geomean standards thresholds are expressed in the figure as horizontal dashed and red solid lines, respectively, for comparative purposes. Given the late startup date for operations and the compromised performance data in August, only 15 representative influent and treated outflow sample pairs were collected to characterize treatment performance.



Poche CBP provided average treatment efficiencies of approximately 97% for all three fecal indicator bacteria. This was relatively impressive, given that only 3 of the 4 UV disinfection lamp systems were functional during the entire operations period. While this level of treatment was sufficient to provide acceptable treated outflow concentrations for total coliform and fecal coliform, it did not achieve acceptable treated outflow concentrations for enterococcus. Enterococcus is the most important metric of facility performance, in that water quality advisory postings at Poche are predominantly based on enterococcus standards exceedance.

Figure 12. Poche Clean Beach Project
Fecal Indicator Bacteria for Inflow and Treated Outflow
September – October 2011



The influent total coliform geomean was 5,341 CFU/100 ml, with a treated outflow geomean of 126 CFU/100 ml, well below the AB411 geomean standard value of 1,000 CFU/100 ml. The influent fecal coliform geomean was 1,253 CFU/100 ml and treated outflow geomean was 31 CFU/100 ml, well below the AB411 geomean standard value of 200 CFU/100 ml. Treatment performance was sufficient to consistently produce outflow total coliform and fecal coliform levels well below the values corresponding to AB 411 bacteria quality standards for marine surfzone receiving waters. Treated outflow resulted in no exceedances of AB411 single sample standards for either total coliform (10,000 CFU/100ml) or fecal coliform (400 CFU/100 ml) out of 15 samples. None of 11 rolling 5-sample geomeans exceeded geomean standard values for either total coliform or fecal coliform (Table 8).

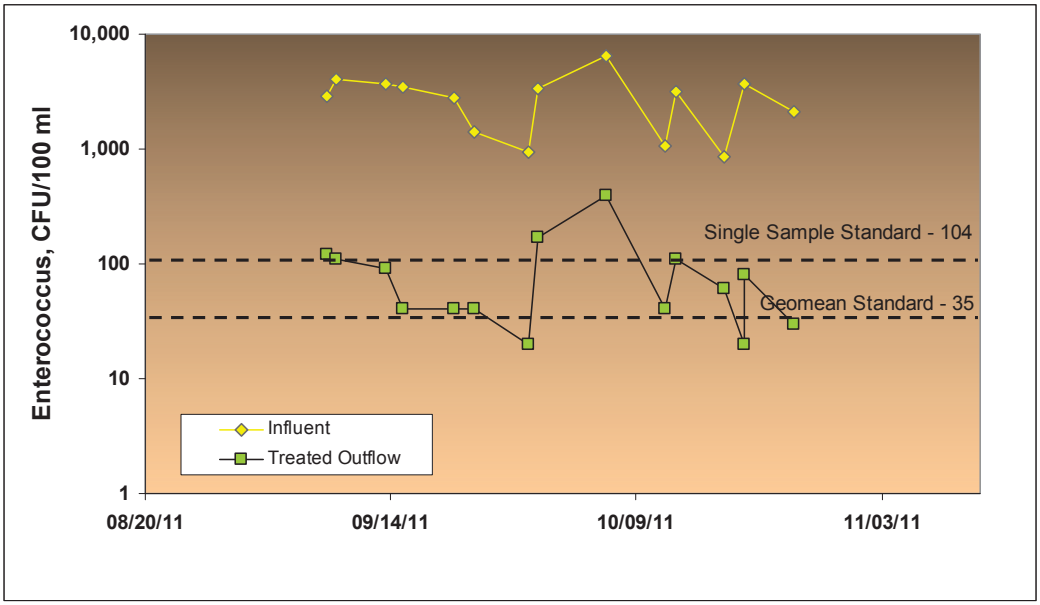
Inflow enterococcus geomean was 2,335 CFU/100 ml and treated outflow geomean was 68 CFU/100 ml, well above the AB411 geomean standard value of 35 CFU/100 ml. Treated outflow enterococcus exceeded the value corresponding to the AB411 single sample standard (104 CFU/100 ml) in 5 of 15 individual samples, and exceeded the value corresponding to the AB411 geomean standard in all 11 rolling 5-sample geomeans (Table 8).

Table 8. Poche Clean Beach Project
Fecal Indicator Bacteria Removal Performance
September – October 2011

Fecal Indicator Bacteria	Influent		Treated Outflow				
	N	Geomean	N	Geomean	Average Removal Efficiency, %	No. exceeding AB411 values	
						Single sample	5-sample geomean
Total coliform	15	7,132	15	164	97.26%	0/15	0/11
Fecal coliform	15	1,253	15	31	96.65%	0/15	0/11
Enterococcus	15	2,335	15	64	96.82%	5/15	11/11

While enterococcus removal fell short of performance expectations, operational circumstances were nevertheless suggestive that performance will be improved in 2012. A comparison of enterococcus analyses for individual influent and treated outflow sample pairs (Figure 13) demonstrated a consistency in operational enterococcus removal efficiency.

Figure 13. Poche Clean Beach Project
Enterococcus Levels, Influent and Treated Outflow
September – October 2011



Performance results for 2011 are compared with 2010 results in Table 9. While 2011 treated outflow enterococcus (geomean 68 CFU/100 ml) was higher than that produced in 2010 (geomean 25 CFU/100 ml), this was attributable to 2011 influent concentrations (2,335 CFU/100 ml) being much higher than 2010 levels (974 CFU/100 ml). The 2011 Poche CBP average enterococcus removal efficiency (96.82%) was actually greater than that produced in 2010 (94.37%), despite that the Poche CBP was operated for the entire 2011 performance season with only 3 of 4 UV disinfection lamp systems functional. These results suggest that SCWD provided superior facility operation and maintenance in 2011 relative to construction contractor facility operation in 2010, and that 2011 performance would have achieved even higher removal efficiency had all four UV lamps been functional. It is believed that future Poche CBP operations will meet bacteria removal expectations (> 99%) once the construction warranty period expires in 2012 and facility operational integrity is no longer dependent upon timely construction contractor response to warranty claims.

Table 9. Poche Clean Beach Project
Fecal Indicator Bacteria Removal Performance, 2011 vs. 2010

Fecal Indicator Bacteria	2011*				2010**			
	N	Influent, Geomean	Treated Outflow, Geomean	Average Removal Efficiency	N	Influent, Geomean	Treated Outflow, Geomean	Average Removal Efficiency
Total coliform	15	7,132	164	97.26%	39	5289	87	94.35%
Fecal coliform	15	1,253	31	96.65%	39	867	23	93.22%
Enterococcus	15	2,335	64	96.82%	39	974	25	94.37%

* operated with only 3 of 4 UV lamps functional ** all 4 UV lamps functional

4.7 2011 Facility Performance – Treated Outflow Metals

Poche CBP treated outflow was sampled 3 times for total metal analyses of cadmium, copper, and zinc, in accordance with the conditions of the project's Section 401c Certification. Individual analytical results are presented in Appendix A, and summarized in Table 10. The total metal analytical results are a practical estimation of the dissolved metals fraction, as the treated outflow samples were subjected to sand filtration of particulate solids prior to sampling.

Table 10. Poche Clean Beach Project
2011 Treated Outflow Metals Characterization

	Cadmium	Copper	Zinc
Number of Samples	3	3	3
Mean, ug/l	4.8	2.7	10.8
Minimum, ug/l	3.4	2.0	4.5
Maximum, ug/l	5.7	3.2	16.0
CTR Chronic Standard, ug/l	6.25	29.3	382.4
Sample No. Exceeding Standards	0/3	0/3	0/3
Ocean Plan Daily Maximum, ug/l	4.0	12	80
Sample No. Exceeding Standards	2/3	0/3	0/3

Copper and zinc concentrations were relatively low, with low to moderate variability, and did not exceed California Toxics Rule or Ocean Plan water quality standards. Cadmium concentrations in treated outflow also demonstrated low to moderate variability, ranging between 3.4 – 5.7 ug/l. Cadmium analyses did not exceed the California Toxics Rule freshwater chronic standard, but did exceed the Ocean Plan daily maximum standard in 2 of 3 samples. Standards comparisons were based on indirect estimations of sample matrix hardness as CaCO3, from measured total dissolved solids concentrations and the univariate regression relationship between the two parameters ($R^2 = 0.846$, $p<0.001$).

Table 11. Poche Clean Beach Project
Treated Outflow Metals, 2011 vs. 2010

	2011				2010			
	N	Mean	Minimum	Maximum	N	Mean	Minimum	Maximum
		ug/l				ug/l		
Cadmium	3	4.8	3.4	5.7	10	7.0	3.9	14
Copper	3	2.7	2.0	3.2	10	3.8	3.0	5.3
Zinc	3	10.8	4.5	16.0	10	14.1	4.2	41

Treated outflow metals concentrations in 2011 generally coincided with those sampled in 2010, although 2011 mean and maximum values were lower than 2010 values for all three metals (Table 11). As in 2010, Poche CBP influent samples were not taken concurrently with outflow samples, so it is unknown what the absolute total cadmium concentrations were in ambient dry weather runoff, or the extent to which cadmium loads in such runoff were removed by the treatment facility.

4.8 Treated Outflow Discharge Pipe Sampling

In addition to treated outflow samples collected within the Poche CBP facility, sampling was also conducted at the end of the treated outflow discharge pipe throughout the performance period. End-of-pipe data was intended to represent treated outflow quality actually discharged to the beach pond in the receiving water quality response evaluation. However, extended high water levels in the beach pond resulted in extended periods of partially or fully submerged discharge pipe outlet conditions, where 14 of 17 samples were compromised by commingling with beach pond water. Given the insufficient number of representative samples from the discharge pipe, pipe discharge samples were excluded from the evaluation, and treated outflow samples at the Poche CBP were used for the receiving water response evaluation.

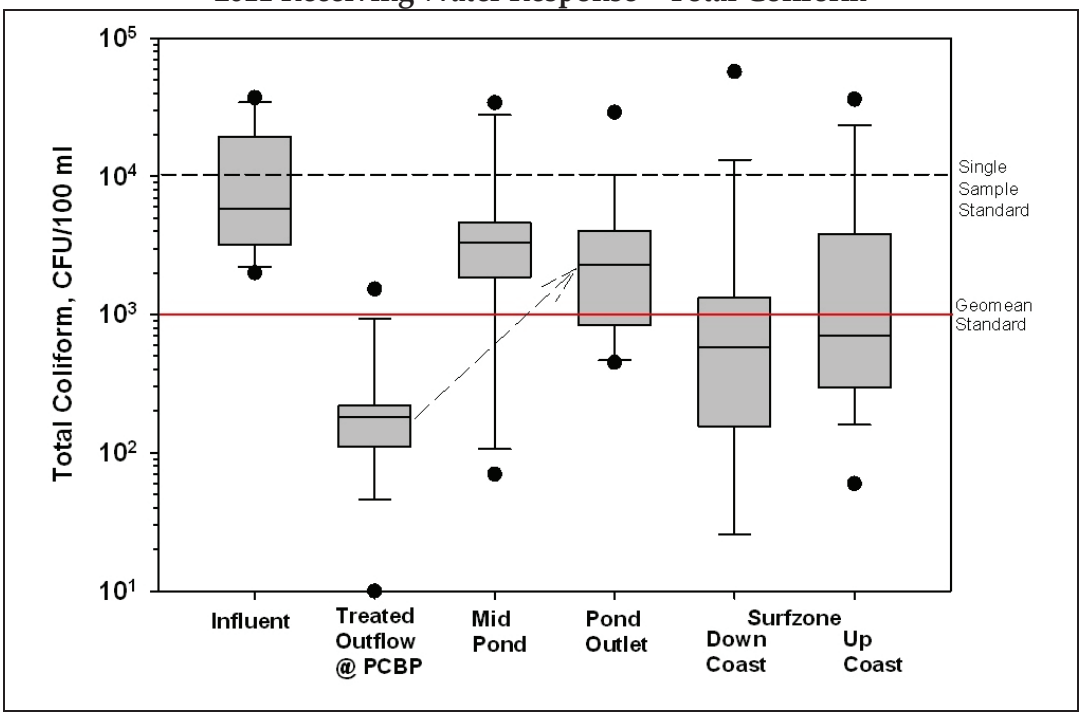
Treated outflow quality at the pipe discharge was also intended to be compared with treated outflow sampled within the Poche CBP, in order to determine the extent to which treated outflow might be recontaminated in passage through the 175-foot discharge pipe. This was of interest, as the discharge pipe breakage in January 2011 and subsequent extended submergence of the inactive pipe likely allowed considerable opportunity for bacteria contamination and propagation. While the insufficient number of representative pipe discharge samples prevented a definitive statistical determination, the small remaining sample set reflected minimal differences between the two sampling locations. The use of treated outflow samples within the Poche CBP was therefore considered to be a reasonable representation of treated outflow quality at its discharge to the beach pond.

4.9 2011 Receiving Water Quality Response – Fecal Indicator Bacteria

Receiving water quality response under the 2011 Poche CBP treatment performance and discharge relocation was evaluated through comparison of bacteria quality data at six sampling locations, as well as comparison with similar performance data in 2010. Special attention was directed to the following comparisons and relationships: 1) treated outflow quality with pond outlet quality; 2) mid-pond with pond outlet quality; 3) 2011 pond outlet quality with 2010 pond outlet quality; and 4) pond outlet quality with surfzone quality.

The 2011 receiving water quality response to the discharge of Poche CBP treated outflow is presented in Figures 14 - 16 for the three indicator bacteria, and summarized in Table 12. Stationing is presented in figures from left to right in general conformance with flow passage, where the broken arrows indicate that the location of treated outflow discharge is situated downstream of the mid-pond and upstream of the pond outlet stations. AB411 single sample and geomean standards thresholds are expressed horizontally as dashed and red solid lines, respectively. Complete individual bacteria data for all stations is presented in Appendix A.

Figure 14. Poche Clean Beach Project
2011 Receiving Water Response – Total Coliform



Figures for all indicator bacteria demonstrate that much of the water quality benefit of Poche CBP treated outflow was unable to be delivered to the surfzone. Pond outflow concentrations were an order of magnitude greater than that of treated outflow for all indicator bacteria, despite the presumed relatively short residence time of treated outflow within the pond. Total coliform and fecal coliform concentrations in treated outflow (geomeans 164 CFU/100 ml and 31 CFU/100 ml, respectively) were predominantly below values corresponding to AB411 geomeans; however, pond outflow samples (2,118 CFU/100 ml and 459 CFU/100 ml, respectively) generally exceeded AB411 geomean values.

Treated outflow enterococcus levels (geomean 64 CFU/100 ml) consistently exceeded the value corresponding to the AB411 geomean (35 CFU/100 ml), but further increased by over an order of magnitude in pond outflow (geomean 939 CFU/100 ml). Pond outlet concentrations, however, were lower than mid-pond concentrations for all three indicator bacteria.

Figure 15. Poche Clean Beach Project
2011 Receiving Water Quality Response – Fecal Coliform

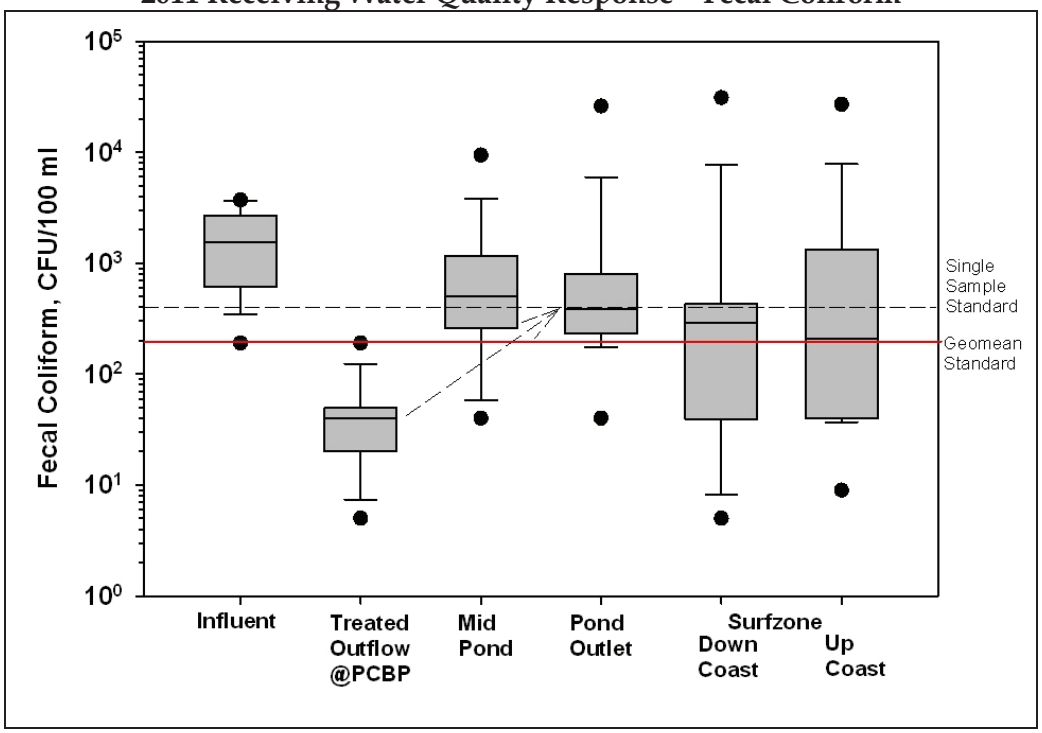
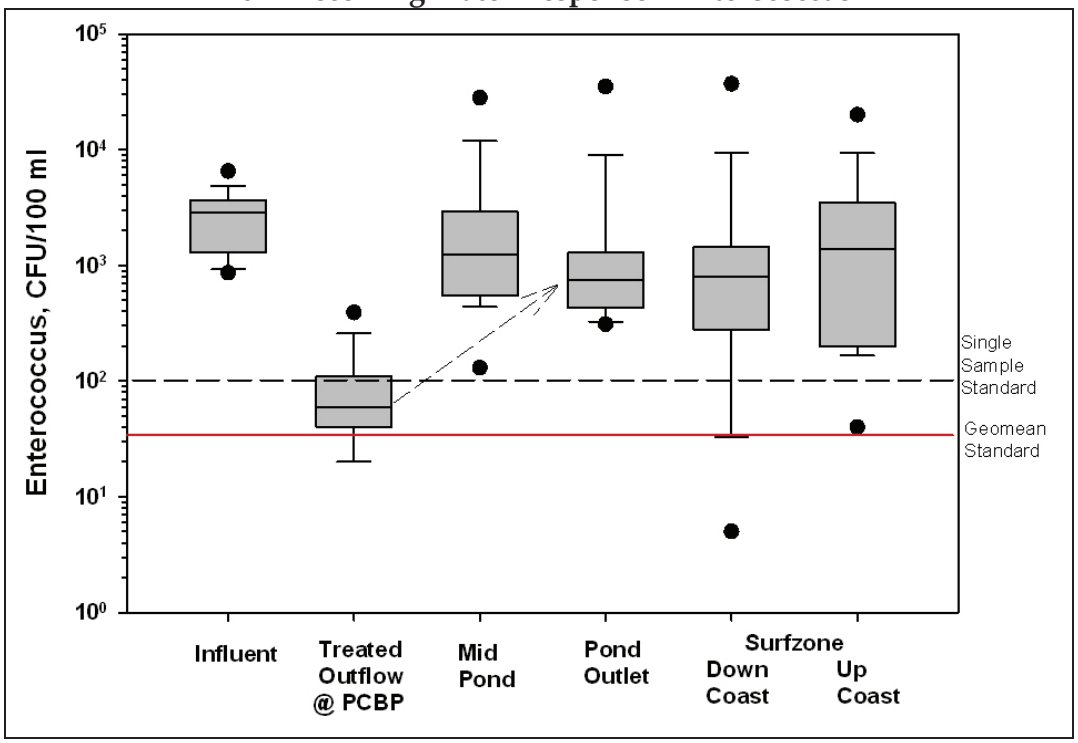


Figure 16. Poche Clean Beach Project
2011 Receiving Water Response – Enterococcus



Surfzone samples (25 yards upcoast and downcoast of the pond outlet) either frequently or consistently exceeded AB411 standards for all three indicator bacteria. The transition from pond outlet to collective surfzone samples provided relatively little dispersive effect compared to 2010. Surfzone total coliform and fecal coliform levels reflected averaged reductions of 67% and 57% respectively from pond outflow concentrations. Average surfzone enterococcus concentrations reflected only a 20% reduction relative to pond outflow.

Furthermore, comparison of pond outflow with separate data sets for upcoast and downcoast surfzone stations demonstrated that pond outflow primarily influenced upcoast water quality. Correlations between pond outflow and upcoast surfzone samples were strong for all indicator bacteria (0.53 total coliform, 0.97 fecal coliform, 0.89 enterococcus). Conversely, little or no correlation existed between pond outflow and the downcoast surfzone (0.03 total coliform, -0.03 fecal coliform, -0.002 enterococcus). Correlations suggest the presence of consistent southerly currents and/or swells acting at Poche in the upcoast direction during the performance period.

Table 12. Summary of 2011 Receiving Water Response - Fecal Indicator Bacteria

	Fecal Indicator Bacteria Geomeans, CFU/100 ml						
	PCBP Inflow n=15	Treated Outflow n=15	Mid-pond n=18	Pond Outlet n=17	Surfzone n=35	Surfzone	
						Down Coast	Up Coast
Total coli	7,132	164	2,296	2,118	711	477	1,037
Fecal coli	1,253	31	546	459	200	146	270
Enterococcus	2,335	64	1,468	939	756	555	1,011

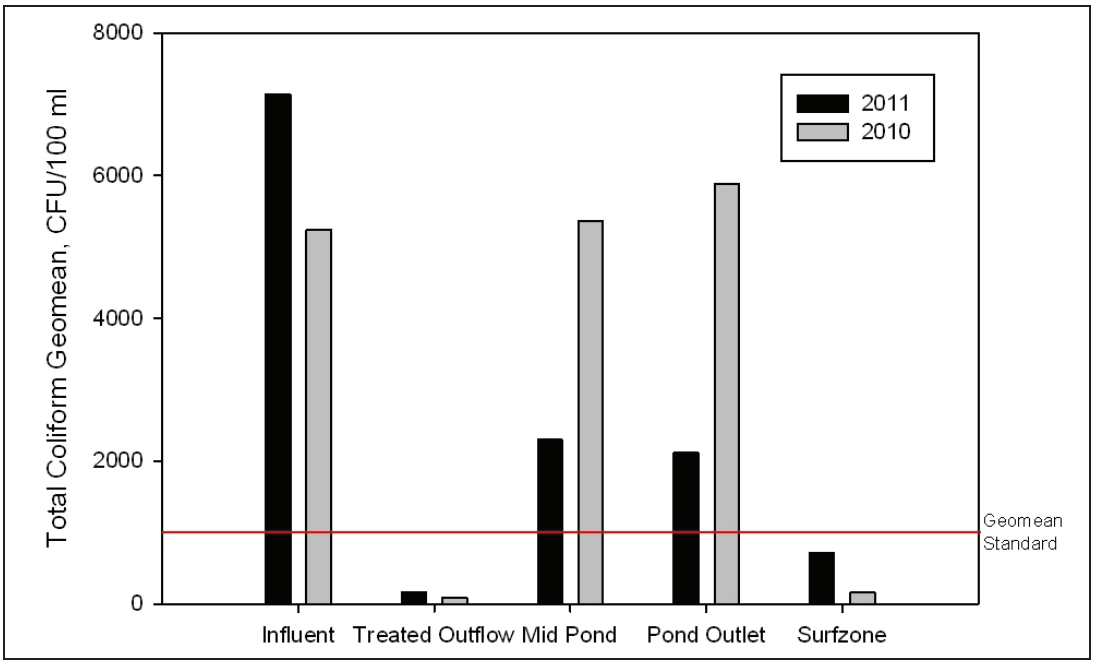
Therefore, if pond outflow quality is compared only to upcoast surfzone data, dispersive effects within the surfzone were even lower. Based on data set geomeans, upcoast surfzone total coliform and fecal coliform would reflect 51% and 41% reductions, respectively, when compared to pond outflow, and upcoast surfzone enterococcus was actually 8% higher than pond outflow levels. This would be compared to approximately 90% dispersive reductions observed at surfzone stations in 2010.

Given that no correlation was observed between pond outlet and the downcoast surfzone, the enterococcus exceedances at the downcoast station (geomean 555 CFU/100 ml, Table 12) suggest the presence of another proximal bacteria source downcoast of the pond outlet.

4.10 Comparison to 2010 Receiving Water Quality Response

Additional insight into receiving water response can be derived from comparison of 2011 data with 2010 response data. Station geomeans for 2011 and 2010 for all three indicator bacteria are presented in Figures 17 - 19 and summarized in Table 13. While comparative relationships were generally applicable to all indicator bacteria, relationships are primarily discussed with respect to enterococcus, given that it is the metric of most water quality concern at Poche Beach.

Figure 17. Poche Clean Beach Project
Total Coliform Receiving Water Response
2011 vs. 2010



Pond outlet bacteria quality improved substantially in 2011 relative to 2010 for all indicator bacteria, despite much higher 2011 channel influent concentrations and slightly higher treated outflow concentrations. The 2011 pond outlet geomean for enterococcus (939 CFU/100 ml) was much lower than the 2010 pond outlet geomean (1,468 CFU/100 ml - Figure 19). Alternatively expressed, indicator bacteria geomeans increased by 13 – 15 times from treated outflow to pond outflow in 2011, compared to 59 – 71 times in 2010. While the 2011 number of samples was smaller than the 2010 data set, data nevertheless indicated that relocation of the treated runoff discharge from immediately downstream of the Poche CBP to the oceanward end of the beach pond was effective in reducing bacteria levels in the pond outlet.

Notwithstanding improvements in water quality from relocation of the treated runoff discharge site into the pond, pond outlet concentrations were still unacceptably high. Despite the optimal pond configuration and orientation of the outlet relative to the treated outflow discharge pipe observed in 2011, there was still sufficient commingling of treated outflow within the pond for outlet geomeans to exceed values corresponding to AB411 geomean standards for all indicator bacteria. While understanding that bacteria is a non-conservative water quality parameter, a measure of the extent of effective pond bypass was nevertheless approximated through mass balance calculations using coincident pond, treated outflow, and pond outlet sample concentrations for all three bacteria indicators. The estimated percent of treated outflow in pond outflow (i.e. an expression of effective pond bypass) varied between 30 to 87% over the operations period, and averaged 61%. This indicated that there was still substantial commingling with, recontamination by, and outflow of pond water.

Figure 18. Poche Clean Beach Project
Fecal Coliform Receiving Water Response, 2011 vs. 2010

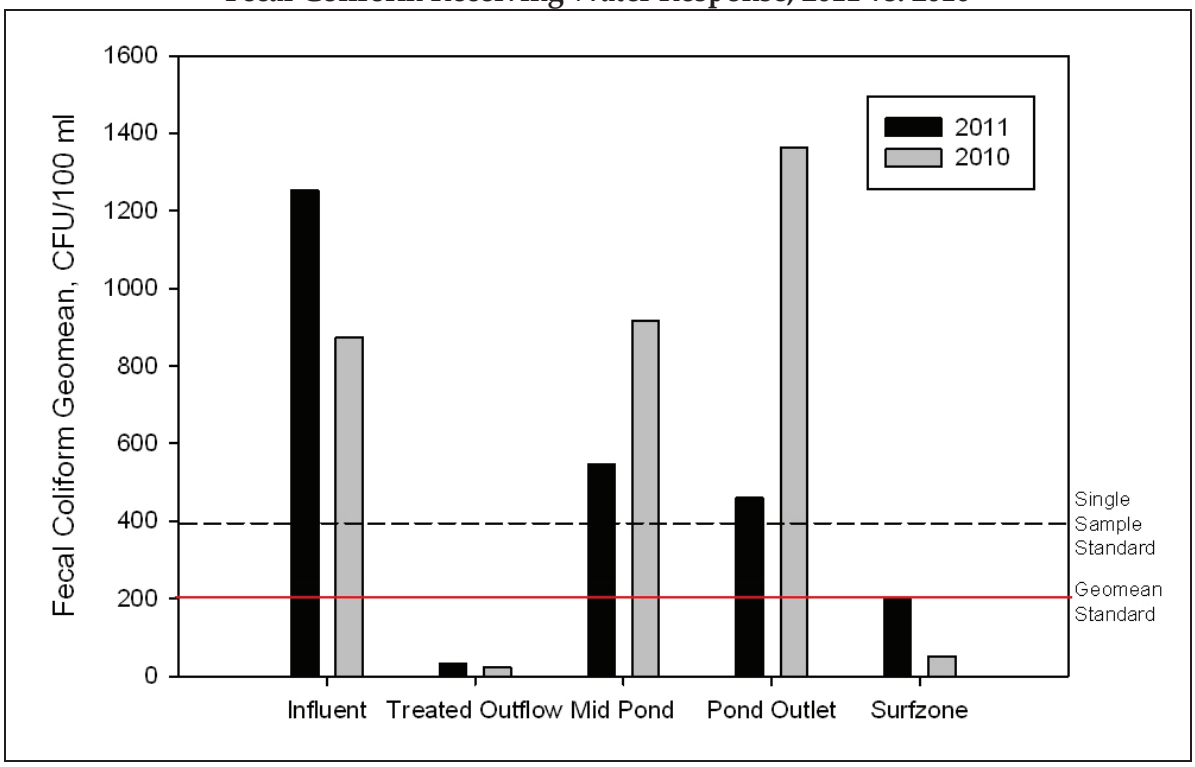
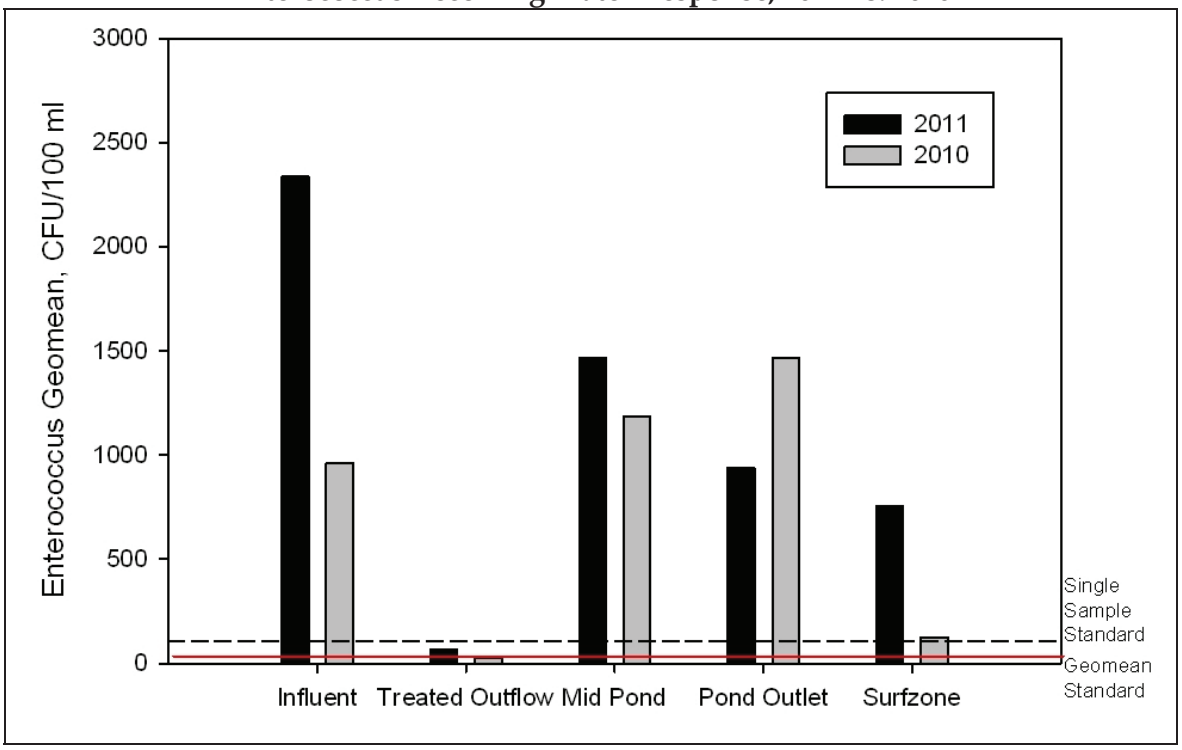


Figure 19. Poche Clean Beach Project
Enterococcus Receiving Water Response, 2011 vs. 2010



Despite substantially lower bacteria levels in 2011 pond outlet samples relative to 2010, bacteria levels in 2011 surfzone samples collected 25 yards upcoast and downcoast from the outlet were higher than in 2010. This resulted in a substantially limited surfzone dispersive effect observed in 2011 relative to 2010, especially for enterococcus. A 1 – 2 order of magnitude (91 - 97%) reduction was observed in 2010 from the pond outflow to surfzone samples for all bacteria geomeans. In comparison, in 2011 there was only a 20 - 67% reduction in geomeans observed, with enterococcus demonstrating the 20% reduction.

The 2010 performance evaluation indicated that, had treated outflow bypassed the pond and been discharged directly to the surfzone, the near shore dispersive capability exerted on the treated outflow would have been sufficient to lower enterococcus concentrations to consistently meet AB411 standards in the immediate vicinity of a treated outflow discharge to the surfzone. In 2011, slightly higher treated outflow enterococcus concentrations and much lower dispersive capability within the surfzone indicated that, had a direct ocean discharge of treated outflow been practiced, enterococcus concentrations might still have exceeded AB411 standards in the immediate vicinity of a treated outflow discharge to the ocean.

Table 13. 2011 vs. 2010 Receiving Water Response Comparison
Fecal Indicator Bacteria

Sampling Location	Total Coliform Geomean CFU/100 ml		Fecal Coliform Geomean CFU/100 ml		Enterococcus Geomean CFU/100 ml	
	2011	2010	2011	2010	2011	2010
PCBP Influent	7,132	5,236	1,253	874	2,335	964
Treated outflow	164	83	31	23	64	25
Mid-pond	2,296	5,364	546	915	1,468	1,183
Pond Outlet	2,118	5,875	459	1,362	939	1,468
Surfzone	711	157	200	52	756	126

The reason that the dispersive effect within the surfzone stations observed in 2010 did not recur in 2011 remains determined. Extensive shorebird numbers which converge along the exposed intertidal of the beach are likely independent contributors to surfzone bacteria concentrations at both the upcoast as well as downcoast surfzone stations. Correlations were performed between 2011 enterococcus data sets for pond outlet and surfzone stations and bird counts over a 24 hour period before sample collection. The comparisons produced modest correlations between birds vs. pond outlet (R=0.41) and birds vs. upcoast surfzone (R=0.43), with much weaker correlation between birds vs. downcoast surfzone (R= 0.13). Multiple regression analysis of data sets identified both the beach pond outlet and shorebirds as statistically significant determinant variables which influence surfzone bacteria quality. However, there is no basis for assuming that 2011 shorebird numbers were any different than in 2010. Bird counts in 2010 did not have

the benefit of camera images to conduct a systematic quantification, and are therefore less substantiated than the 2011 characterization. Therefore, any significant difference in bird presence between the two years was unable to be adequately tested or demonstrated.

The visual representations of Figures 17 - 19 are strongly suggestive that even when Poche CBP achieves expected maximum treatment efficiency and consistency, an acceptable water quality outcome within the surfzone will be extremely difficult to achieve if treated runoff is unable to be discharged in a manner that will bypass the beach pond. The pond has been demonstrated to maintain persistently high bacteria levels well in excess of an order of magnitude higher than treated outflow from the Poche CBP. While some volume of channel influent unavoidably bypasses the Poche CBP and is conveyed untreated into the pond, other significant pond bacteria sources are believed to include sporadic waterfowl usage, intermittent tidal inflow carrying wrack and shorebird feces from the exposed intertidal zone, and enterococcus which propagate within the fine sands and sediments of the pond itself.

The beach pond could be considered as an independent point source of ocean bacteria loading. Under this perspective, a pond bypass of treated channel runoff would not only direct high quality water to the ocean, it would also tend to isolate and minimize beach pond volume and impacts by depriving it of inflow, thereby reducing the frequency, duration, and magnitude of bacteria-rich pond outflow to the surfzone. Pond bypass of treated outflow would also have an important secondary benefit of reducing the frequency of beach public access impairment due to high pond backwater levels, as well as the frequency of mechanized sand berm modifications to lower pond levels and reinstate that access.

SECTION 5.0 SUMMARY CONCLUSIONS AND LESSONS LEARNED

5.1 Summary Conclusions

The Poche Clean Beach Project (Poche CBP) 2010 performance experience clearly demonstrated that the water quality benefit of treated runoff was unable to be delivered to the surfzone from its discharge location immediately downstream from the Poche CBP, due to commingling and recontamination in its passage through the beach pond. Results supported the need to bypass the beach pond in order to discharge treated outflow directly to the ocean.

In 2011 the County requested that resource agencies permit a summer 2011 demonstration trial of the original County proposal to bypass the beach pond and discharge treated outflow directly to the ocean via a 50-foot flexible pipe extension to the end of the rigid pipe along the bulkhead. The San Diego Regional Water Quality Control Board (Regional Board) expressed concerns with permitting a direct ocean discharge demonstration trial, on the basis that: 1) the County had not yet demonstrated the facility's ability for treated outflow to consistently meet AB411 bacteria standards; and 2) cadmium concentrations in treated outflow exceeded Ocean Plan standards.

Therefore, the 2011 performance season featured a revised demonstration trial arrangement, whereby the treated outflow discharge point was relocated from immediately downstream of the Poche CBP to the end of the rigid pipe along the wooden bulkhead. Under this arrangement, treated outflow continued to discharge into the beach pond, albeit closer to its outlet to the ocean. This location was expected to result in shorter residence time for recontamination of treated runoff within the pond than in 2010, and in improved quality of pond outflow to the surfzone.

The 2011 performance evaluation produced the following findings and conclusions:

1. Poche CBP 2011 demonstration trial operated for the period August through October, where water quality monitoring of treatment performance and receiving water response was successfully conducted over an 8-week period during September through October.

2. Poche CBP 2011 operations had no apparent effect in improving water contact recreation beneficial use along Poche Beach. Orange County Health Care Agency surfzone station S-15 at Poche was characterized by persistent exceedances of enterococcus standards, which resulted in continuous water quality advisory postings throughout the Poche CBP 2011 operational period.

3. Poche CBP achieved acceptable treated outflow concentrations for total coliform and fecal coliform, but did not achieve acceptable treated outflow concentrations for enterococcus. Treated outflow consistently exceeded the AB411 geomean standard of 35 CFU/100 ml. However, 2011 performance was qualified by two factors: 1) the 2011 enterococcus geomean of channel influent samples was over twice that observed in 2010; and 2) Poche CBP was obliged to operate for the entire 2011 performance period with only 3 of 4 UV disinfection lamp systems operational. Despite these constraints, Poche CBP achieved average

treatment efficiencies of approximately 97% for all three fecal indicator bacteria in 2011, compared to 93 – 95% removal in 2010 when all lamps were operational. Future Poche CBP operations are expected to consistently meet bacteria removal objectives (> 99%) once facility operational integrity is entirely under the control of South Coast Water District and is no longer dependent upon timely construction contractor warranty response.

4. Pond outlet bacteria levels were substantially lower in 2011 relative to 2010, despite markedly higher 2011 channel influent concentrations and slightly higher 2011 treated outflow concentrations. Results demonstrated that relocation of the treated runoff discharge from immediately downstream of the Poche CBP to the ocean end of the beach pond was effective in reducing bacteria levels in outflow from the pond.

5. Notwithstanding improvements realized from relocation of the treated discharge site within the pond, pond outlet concentrations were still unacceptably high. Despite the optimal orientation of the pond outlet throughout the 2011 performance period, there was still sufficient commingling of treated outflow within the pond for outlet geomeans to exceed values corresponding to AB411 geomean standards for all indicator bacteria. An estimated average effective pond bypass of 61% for treated outflow indicated that there was still substantial commingling with, recontamination by, and outflow of pond water.

6. A reduced dispersive effect on bacteria concentrations in the surfzone was observed in 2011 compared to 2010. In 2011 there was only a 20 - 67% reduction in geomeans observed relative to pond outflow, compared to an average 1 – 2 order magnitude (91 – 97%) reduction in all bacteria geomeans in 2010. The cause of the lower surfzone dispersive effect observed in 2011 was not determined. The most likely cause is contributory bacteria loading from the persistent presence of hundreds of shorebirds along the exposed intertidal area between the beach pond and surfzone throughout the performance period. However, the difference in dispersive response between 2011 and 2010 is not readily attributable to differences in bird numbers, as bird quantification in 2010 was comparable although not as well substantiated as in 2011. The limited and undetermined nature of 2011 dispersive response precludes a dependency upon surfzone dispersion of pond outflow to achieve acceptable surfzone quality at Poche Beach.

7. The 2011 findings of continued beach pond recontamination and limited dispersion within the surfzone strongly suggest that, even with optimal (>99%) Poche CBP treatment efficiency of channel influent and with optimal pond outlet orientation for minimal treated runoff residence time within the pond, it may not be possible to avert or even reduce persistent summer exceedances of AB411 bacteria standards in the Poche surfzone if treated outflow continues to be required to be discharged into the pond.

8. Pond bypass and direct ocean discharge of treated runoff continues to be the most promising approach to effectively improve surfzone quality in the near term until additional runoff reduction and bacteria source control measures can be developed within the contributory watershed. The pond is not only a conduit to the ocean for bacteria conveyed in runoff from the watershed, it is a likely source of ocean bacteria loading itself, through sporadic waterfowl usage, tidal inflow of shorebird feces and wrack from the beach intertidal area, and enterococcus propagation within pond bottom sediments. Pond bypass

would result in lower pond inflow and pond levels, which would reduce the frequency, duration, and magnitude of bacteria-rich outflow from the pond to the ocean. Lower pond levels through treated outflow bypass would also reduce the frequency of both persistent public beach access impairment and the corresponding mechanized sand berm modifications required to reinstate access.

5.2 Intended 2012 Management Measures

The County intends to implement the following measures in an ongoing effort to improve the beneficial impact of facility operation on water quality along Poche Beach:

1. The County will continue to work closely with South Coast Water District (SCWD) in an effort to improve the long term bacteria treatment efficiency of the Poche CBP. SCWD has capably demonstrated their operational expertise in their first year of facility operation. Their ability to respond immediately to necessary facility issues will markedly improve in 2012 once the facility construction warranty period has expired. The County expects that the Poche CBP will consistently meet bacteria removal expectations (> 99%) once facility operational integrity is entirely under control of SCWD.

2. The County has submitted CWA Section 401 Water Quality Certification Application No. 10C-106 for long term outlet maintenance at Poche Beach for natural resource agency approval. Requested provisions would allow OC Parks to perform outlet maintenance with minimal notification to and authorization by resource agencies. While the primary purpose of this greater operational flexibility is to improve safe public beach access, its provision would also result in greater urban runoff treatment operational efficiency, where facility suboptimal operation conditions due to high beach pond levels will be less frequent and of shorter duration.

3. In spring 2012, the County will submit another Coastal Zone Development Permit amendment application to the California Coastal Commission in order to reauthorize the treated outflow discharge to the end of the rigid pipe for the 2012 operating season.

4. In spring 2012, the County will meet with the Regional Board and other interested parties to review 2011 performance findings and further discuss the feasibility for bypass of the beach pond and direct ocean discharge of treated runoff at Poche Beach.

5. OC Watersheds will consult with OC Waste & Recycling and the City of San Clemente to determine whether the seasonal congregation of shorebirds at Poche Beach is unnaturally derived due to anthropogenic conditions; i.e., unnatural feeding opportunities created at the landfill. If so, OC Watersheds intends to explore with OC Waste & Recycling methods by which feeding opportunities at the landfill could be reduced or eliminated.

6. The County will continue to cooperate with the City of San Clemente in the City's ongoing management efforts to identify and control sources of urban runoff and fecal bacteria within the Prima Deshecha Canada watershed. Last year the City commissioned a watershed study involving bacteria and channel flow source identifications as well as special bacterial investigations within the scour pond and intertidal area of the beach. Investigation

findings are expected to be released in spring 2012, and should provide helpful additional insight into beach pond bacterial dynamics and receiving water response. Successful runoff reduction and bacteria source control measures would serve to further improve treatment efficiency and outflow quality from Poche CBP and potential improvements in the surfzone.

5.3 Project Lessons Learned

The Poche project experience resulted in identification of several considerations which may be helpful for implementation of beachfront runoff treatment facilities of a similar nature. The following are considered the most important to impart to future sponsors.

Regulatory Constraints and Beach Ponds. Beach ponds similar to the Poche pond are created by a combination of scouring from storm flows, dry weather inflow from the contributory watershed, and sand bar development along the beachfront. Such ponds appear to be significant detrimental sources of bacteria loadings to the surfzone themselves, as they appear to be conducive to harboring and propagation of fecal bacteria, and, at least at Poche, appear to provide limited or minimal intrinsic environmental value or beneficial use. The experience at Poche demonstrated that efforts to improve water quality in the pond through introduction of treated runoff had no discernible benefit to either the pond or the surfzone. A more productive water quality management scenario would be to limit pond development through a combination of bypass of treated runoff in the short term and dry weather runoff reduction measures in the long term. Future sponsors of runoff treatment facilities near the beach should review the Poche Beach experience with state and federal resource agencies in order to avoid the loss of time and funds in sustained operation under ineffective conditions, and to instead implement more successful water quality operational scenarios.

Project Design and Specification. While the sand filtration - UV disinfection treatment technology was specified in the project bid documents, the actual treatment components were not. Rather the treatment components were bid as a single item under a performance specification, which means the contractor had greater discretion to furnish components of his selection as long as the system met the treated outflow quality specification. This approach worked reasonably well; however, the project sponsor should still retain an expert in UV disinfection (or any treatment technology being applied) to ensure that the performance specification is carefully written within the context of the treatment technology used, that the water to be treated is adequately characterized in terms of chemical constituents to ensure the treatment technology is sized appropriately, and that contractor-furnished components meets minimum acceptable standards of the industry.

Construction Progress Payments. Construction managers generally prepare or approve a schedule of values by which progress of work is quantitatively identified for lump sum work items as a basis for appropriate progress payments to the contractor. On performance specified projects similar to Poche, it is recommended that, in addition to recognition of work progress for the provision and assembly of treatment components, a meaningful value be placed upon the successful completion of water quality performance trials. This will incentivize the contractor to modify the facility or operation in a timely manner as necessary to achieve the specified performance results.

SECTION 6.0 – REFERENCES

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