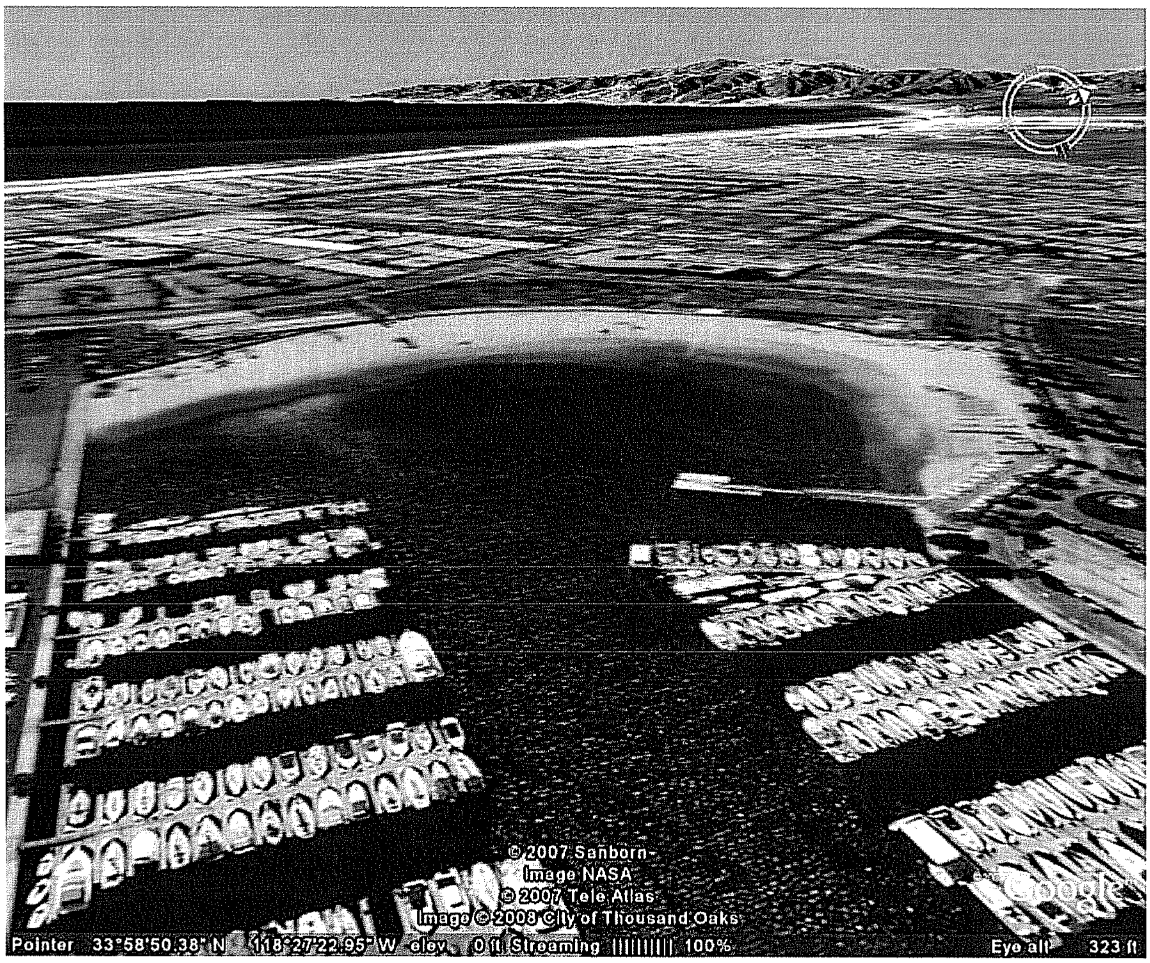
COUNTY OF LOS ANGELES
DEPARTMENT OF BEACHES AND HARBORS

Marina Beach Water Quality Improvement Project
Marina del Rey, California



Final Report
February 2008

TABLE OF CONTENTS

COUNTY OF LOS ANGELES
DEPARTMENT OF BEACHES AND HARBORS
MARINA BEACH WATER QUALITY IMPROVEMENT PROJECT

Final Report

1. INTRODUCTION

Marina Beach (Figure 1) is a protected, man-made sandy beach located at the western end of Basin D in the Marina del Rey harbor (Figure 2). It is owned by the County of Los Angeles and maintained by the Department of Beaches and Harbors (Beaches and Harbors). While this sheltered beach receives an average of 200,000 visits annually, it suffered from chronic bacterial contamination thought to be caused by poor water circulation, a high level of human activities, and bird guano accumulation. Daily monitoring of Marina Beach by the City of Los Angeles Environmental Monitoring Division (EMD) for bacterial indicator organisms showed that Marina Beach frequently exceeded State of California water quality objectives for body contact beneficial use (REC-1). These exceedances occurred mostly in the winter rainy season, but also occurred during dry weather conditions.

Figure 1 – Marina Beach

When a water body is deemed polluted, it is required by Section 303(d) of the federal Clean Water Act to be designated as impaired water where cleanup efforts are to follow. Marina Beach and Basins D, E, and F of Marina del Rey harbor (Back Basins) have been declared impaired water bodies and listed on California's 1998 Section 303(d) list, because elevated bacteria and beach closures prevented full support of the beach's designated use for water contact recreation (REC-1). The California Regional Water Quality Control Board, Los Angeles Region, (LA Regional Water Board) subsequently adopted a Bacterial Total Maximum Daily Load (TMDL) to address bacteriological water quality impairments during dry and wet weather for Marina Beach and Back Basins on August 7, 2003.

TMDL is a calculation of the maximum amount of a pollutant a water body can receive and still meet the water quality objectives necessary to protect its beneficial uses, and an allocation of that amount to the pollutant's sources. TMDL standards for Marina Beach are intended to eliminate exceedances of State standards by anthropogenic sources while allowing a certain number of exceedances from natural sources. The LA Regional Water Board selected a reference beach approach in order to specify the number of allowed exceedances at Marina Beach. The reference beach selected for the Santa Monica Bay watershed was Leo Carillo State Beach, which is located along the open coast of Santa Monica Bay and is associated with the Arroyo Sequit Canyon drainage area.

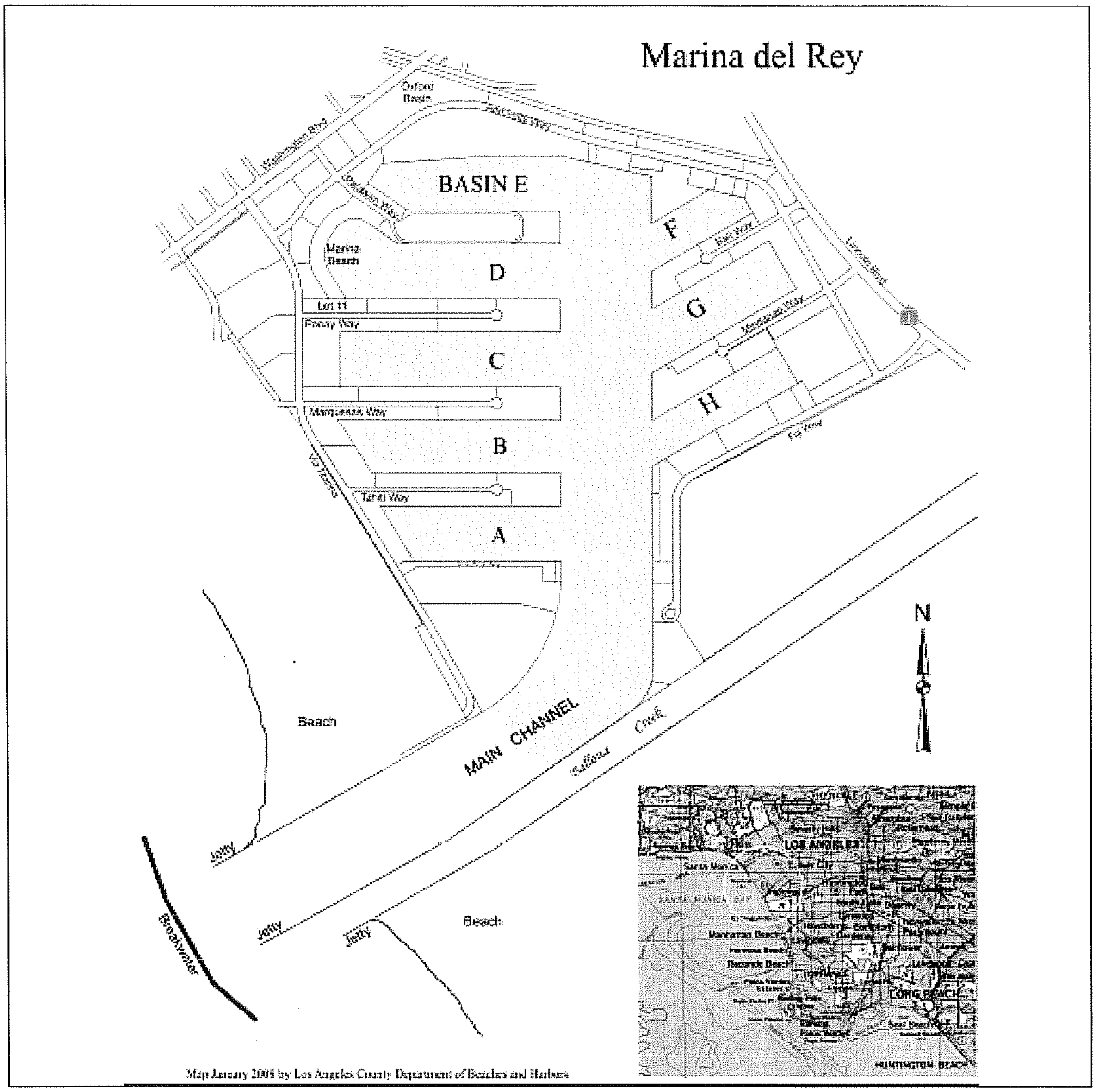


Figure 2 – Marina del Rey and Regional Map

Based on the numeric water quality objectives adopted by the LA Regional Water Board in the Water Quality Control Plan for Los Angeles Region (Basin Plan), the Marina Beach TMDL waste load allocations consist of multiple single sample numeric targets. These targets are numbers of allowable exceedance days on an annual basis, for summer dry weather (April 1 to October 31), winter dry weather (November 1 to March 31), and wet weather (at least 0.1 inches of rain plus the 72 hours following the end of rainfall). According to the bacterial TMDL document for Marina Beach and Back Basins, no single day bacterial exceedances during the summer dry weather are allowed, three exceedance days per year are allowed for the winter dry weather, and 17 exceedance days are permissible for the wet weather. In response to the TMDL requirements, municipalities within the Marina del Rey Watershed have been collaborating with LA Regional Water Board, Heal the Bay, and Santa Monica BayKeeper, to develop plans for implementing water quality improvement and monitoring programs to meet the compliance deadlines set forth in the TMDL. The plans are presently in the review and approval process. While the implementation plans will eventually address the water quality of Marina Beach and Back Basins in the long term, an immediate and more specific water quality improvement plan was deemed necessary for Marina Beach due to the concerns of public health and safety in using the beach for swimming and other body contact recreation.

In March 2000, California voters approved Proposition 13 (2000 Water Bond) to support safe drinking, water quality, flood protection, and water reliability projects throughout the state. On July 27, 2001, Governor Gray Davis signed the Budget Act of 2001 providing for Proposition 13 grants to be made available to fund 38 Clean Beaches Initiative (CBI) projects, including the Marina Beach Water Quality Improvement Project. The major goal of the CBI grants was to reduce health risks and increase the public's access to clean beaches. The State Water Resources Control Board (State Water Board) is responsible for administering these funds.

The State Water Board's technical advisory committee recommended a total of $2 million be allocated under the CBI for the Marina Beach Water Quality Improvement Project. On February 19, 2002, the State Water Board approved a grant of $250,000 to cover the first phase of the Marina Beach Water Quality Improvement Project – an assessment of the hydrodynamic options between Basin D (containing Marina Beach) and adjacent basins, the preparation of a water quality improvement plan identifying migration strategies for improving water quality at Marina Beach, and sediment sampling to identify potential soil contamination and the recommendation of resulting mitigation measures.

The first phase study, conducted by the County's environmental consultant, Kinnetic Laboratories, Inc. (Kinnetic), indicated that sources of contamination local to Marina Beach and to Basin D could be mitigated. Storm water runoff from the public parking lots and facilities just above the beach, which has been documented to contain elevated levels of bacterial contamination, flows onto and across the beach. Additionally, the study showed that random occurrences of contamination due to bird contributions or patches of contamination brought to the shoreline from further out in the Basin or the harbor are also causes of high levels of bacteria at Marina Beach.

Kinnetic recommended a two-part approach to address the chronic bacterial contamination at Marina Beach. The first part would divert the local storm water runoff into Basin E to the north or Basin C to the south to prevent it from flowing across Marina Beach and into Basin D (Basin C was later decided to be the outfall destination). While the swimming area in Basin D is designated as REC-1 for water contact recreation, Basins C and E are designated REC-2 for non-water contact recreation. The proposed diversions were not expected to significantly degrade water quality in those basins so as to impair the assigned beneficial use.

The purpose of the second part of the proposed project was to increase mixing and circulation of the waters at the shallow beach face in order to improve water quality and to reduce contamination caused by random occurrences. This was to be accomplished by placing two water circulators into the waters adjacent to the beach. These two units would each consist of a pump with a large, slowly rotating propeller encased in a cage (for public and aquatic species safety).

The storm water diversion system that diverts the storm water runoff from the adjacent parking lot above Marina Beach to Basin C was completed in July 2007. The water circulator system was installed in October 2006. A minor field adjustment to the gangway of the dock under which the two circulators are housed, is still ongoing as of this writing to comply with the regulations of the Americans with Disabilities Act (ADA). The total cost for the project is approximately $4,036,000. A Summary of Work Completed to Date table is shown in Exhibit A attached hereto.

2. STATEMENT OF WORK – PHASE I

A major emphasis of the Phase I work was to investigate the sources of bacterial exceedances at Marina Beach in order to find a way to control them. Fundamental to these source studies was to investigate whether these sources of contamination were being transported to Marina Beach from elsewhere in the harbor, or local to Marina Beach itself and thus easier to control.

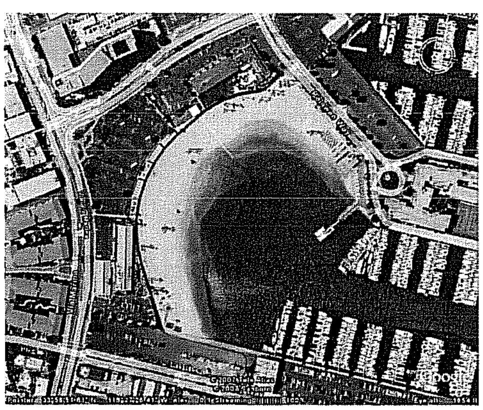


Figure 3 – Marina Beach Local Area

Kinnetic conducted the following source studies:

- Monitoring Records Review and Examination
- Contamination Migration Studies
- Inspections of Storm Drain and Sanitary Sewer Systems
- Marina Beach Local Source Studies
- Marina Operation Practices

2.1 Monitoring Records Review and Examination

The City's EMD collects daily water samples at Marina Beach for water quality monitoring. Kinnetic reviewed and examined EMD's data from January 1995 to April 2004 in connection with other factors, such as wind, tide, rain, etc. for indications of a causal relationship between them. In addition to EMD's records, Kinnetic also studied the information collected from the ongoing monthly Marina-wide surveys for bacterial concentration and other environmental parameters performed by the Aquatic Bioassay and Consulting Laboratories (ABC Lab), the County's environmental consultant.

Based on the data reviewed, Kinnetic found that one out of every two samples collected during wet weather conditions exceeded State objectives while only one out of every ten samples collected during dry weather exceeded the objectives. Kinnetic therefore concluded that engineering control would be needed to focus on storm water runoff in order to control contamination transported to the beach and into the sand from storm events.

Kinnetic acknowledged that a solution for reducing dry weather exceedances to meet TMDL requirements could not be determined by simply analyzing EMD's data. Instead, a holistic view of possible mechanisms contributing to the transport of bacterial pollutants in Basin D would also have to be explored. The analyzed data suggested that, during the dry weather summer months when winds blew onshore to Marina Beach, during an incoming tide, a greater possibility existed for a sample collected at Marina Beach to exceed one of the State's single sample objectives. This suggested a source in Basin D may be contributing to State exceedances during these dry conditions. However, Kinnetic pointed out the probability of getting an exceedance during the onshore winds was a narrow margin of 6% compared with 3.6% for an offshore wind.

During the winter dry season, the data revealed the probability of exceedances was significantly higher if a sample was collected during an outgoing tide. Kinnetic noted there was a 20.4% chance of a sample exceeding State standards if it was collected during an ebbing tide compared to a 14.4% chance during a flooding tide. Kinnetic suggested a possible explanation could be that the beach acted as a bacterial reservoir for contaminated runoff and when the tide receded, this contamination flowed more freely into the receiving waters.

Kinnetic also noted from viewing the data that there had been a considerable reduction in the number of bacteria exceedances during the summers of 1999 through 2002. A study was therefore conducted to determine if there was some contributing factor that was more pronounced in the summers of 1995 through 1998 and 2003 than in the summers of 1999 through 2002. Wind speed and direction, tidal height and direction, and air temperature data were examined for possible contributing factors. No significant statistical difference in wind, tide, or temperature could be found between summers.

2.2 Contamination Migration Studies

2.2.1 Marina Water Monitoring

One of the prime water quality concerns has been whether the exceedances at Marina Beach were due to migrating contamination from elsewhere in the Marina del Rey harbor. It was important to know in finer time and spatial detail whether clean water existed in Basin D and in other parts of the harbor during the dry season. These data along with the routine monthly monitoring data compiled by ABC Lab provided insight on the migration of indicator bacteria and whether the exceedances on Marina Beach were due to local sources. These data also assisted in evaluating how effective local beach cleanup and sanitation measures might be in reducing exceedances and the source of contamination on the beach. Furthermore, these data were used to evaluate the possibility of infusing water into the Marina Beach swash zone from further out in Basin D or from Basin C, depending on where a clean water source exists in dry weather.

To provide documentation of bacterial water quality, ABC Lab has collected monthly bacteria samples since 1996 at 14 fixed sampling locations throughout the Marina del Rey harbor and at four storm water outlets in the harbor. In addition to the collection of indicator bacteria, ABC Lab measured the temperature, pH, salinity, dissolved oxygen, and light transmittance throughout the water column at each station. It also collected top, middle, and bottom samples for ammonia and biochemical oxygen demand (BOD) analysis.

The contributory role of Marina-wide sources in exceedances at Marina Beach was important to the source study and to determine the benefits of a possible water infusion mitigation measures. Further measurements of bacterial levels in the Marina waters were therefore added to Kinnetic's adaptive source study scope of work. In addition to determining the levels of water quality, it was important to document the changes that occurred during and after significant rain events. Data were also collected in the Marina waters immediately after some rain events and for a series of days following these events.

Based on the historical routine monitoring record Kinnetic reviewed and the special rain events data it collected, Kinnetic found that, (1) exceedances of public health criteria (REC-1 Standards) were infrequent in Marina del Rey harbor waters during the dry season and during dry winter periods; (2) indicator bacteria exceeded public health criteria throughout Basins C, D, and E after significant rain events, but these numbers were reduced substantially within two to four days after a significant storm event with greater persistence occurring in the swash zone of Marina Beach; (3) bacteria exceedances persisted in Oxford Basin (a flood control retention basin that outlets into Basin E) during both dry and wet weather conditions, and elevated levels of bacteria occurred in Basin E relative to Basin D as well as relative to those in Basins B and C; and (4) the sub-exceedence level of indicator bacteria present in Marina waters did not explain frequent exceedances measured at the swash zone of Marina Beach..

2.2.2 Hydrodynamic Modeling and Dye Study

A hydrodynamic modeling study of Marina del Rey was undertaken for two purposes. The first was to investigate the relationship of bacterial contamination introduced elsewhere in the Marina to the occurrence of water quality violations measured at Marina Beach. The known bacterial contamination introduced into the Marina from the Oxford Basin and from urban storm drains into Basin E was of particular interest along with potential sources from the highly contaminated Ballona Creek that discharges near the

Marina del Rey harbor entrance. The second purpose of the hydrodynamic modeling study was to investigate whether the exceedences at Marina Beach's beach face could be reduced by circulation changes such as infusion of clean water to the beach face or into Basin D.

Hydrodynamic modeling were used as follows: (1) model the exchange of water between Basin D and adjacent basins within the harbor; (2) evaluate potential for transport of contaminants to Basin D from other areas of the harbor, particularly from Basin E to determine whether discharge from the Oxford Basin storm drain complex into Basin E was the source of contamination in the upper part of Basin D; and (3) evaluate flushing alternatives with respect to improving water quality standards throughout the Marina Beach area; in particular, evaluate the case of infusion/circulation improvements at the beach face using locally available water from Basin D, or water from the adjacent Basin C.

For the above purposes, a numerical model of the Marina del Rey harbor was developed using the hydrodynamic programs and water quality transport model designed by Resource Management Associates, sub-consultants for Kinnetic. Model calibrations were done using dye studies and bacterial monitoring carried out under both non-stratified dry weather conditions and stratified conditions following storm events. The calibrated Marina del Rey models were then used to examine specific questions about the transport of bacteria contamination within the Marina, the potential impacts from small sewage spills, potential benefits of infusing water to the Marina Beach from Basins C or D, and the potential benefits to water quality near Marina Beach due to diversions of storm water runoff away from Basin D.

2.2.3 Contamination Transportation Study

Tracer simulation results indicated that with a conservative decay rate, the minimum dilution of contamination from the Oxford Basin reaching the Marina Beach water was approximately 1000:1 with 10 knot average winds, 1700:1 with 5 knot average winds, and with no wind virtually no tracer reached Marina Beach. With realistic bacterial decay rates, simulation results indicated that contamination from Oxford Basin did not reach Marina Beach at all.

Tracer simulation results indicated that with the conservative decay rate and a 10-knot wind, the minimum dilution of contamination from the Marina entrance reaching Marina Beach was approximately 90:1. Without the wind-driven circulation applied to the model, minimum dilution at Marina Beach is approximately 1400:1. A simulation was also performed using full decay process appropriate for bacteria and wind-driven circulation representing a 10-knot wind and resulted in the minimum dilution of 1000:1 reading at mid-channel. With realistic bacteria decay rates, simulation results indicated that contaminants from the Marina entrance do not reach Marina Beach at all.

According to the 2000 "Marina del Rey Feasibility Study" from the U.S. Army Corps of Engineers, contaminants from Ballona Creek can be transported into Marina del Rey harbor on the flood tide. This report asserted that most of the contaminants from Ballona Creek only reach the entrance channel, while the contaminants in the main channel are about 15% of the concentration at the channel entrance, reduced to 5% further inside the harbor.

Simulations of small sewage discharge from boats within Basin D and other basins were performed to examine the possible impacts on Marina Beach. The simulation results showed that under certain circumstances small sewage discharges from boats in Basin D might contaminate Marina Beach. Contamination was most likely due to discharges from the slips near the western end of Basin D. Simulations were also done of discharges in the entrance of Basin C, in the eastern basin across from Basin D, and in the eastern basin across from Basin C. Sewage discharges at these three locations outside Basin D had virtually no impact on Marina Beach.

2.2.4 Infusion of Water to Marina Beach from Basin D or Basin C

Infusion of water to the Marina Beach face has been proposed from either Basin D or Basin C to mitigate bacterial exceedances in the Marina Beach waters. Monitoring data within the harbor indicate that bacterial water quality in both Basins are similar and generally meet REC-1 standards except following rain events. Thus clean water is available locally in Basin D as well as from the adjacent Basin C during dry conditions for use as an infusion source.

In order to assess the potential effectiveness of the infusion options, base models of both a continuous bacterial source at Marina Beach and a transient source at the beach were constructed. A continuous distributed bacterial load was applied at Marina Beach sufficient to cause a 200 ml/100 ml concentration of Enterococcus in the beach face water, whereas the contamination source for transient load was limited in a smaller area and duration of only one hour. These baseline conditions were then compared to modeled cases utilizing an infusion pump offshore in Basin D and a channel opening to Basin C.

The installation of a pump offshore of Marina Beach has been proposed for increasing the circulation of clean water at the beach face in order to reduce the observed bacterial levels. The infusion pump would be of the type employed to circulate water in sewage lagoons and aeration tanks, where a large diameter propeller (5.5 feet) is driven at a low revolutions per minute (RPM). The numerical model was set up to simulate the presence of a 29,000 gallons per minute (GPM) circulation pump in water eight to ten feet deep at mean tide at varying locations. For the case of continual beach source, the results showed up to a 50% or greater reduction in peak bacterial concentrations relative to the no pump, or base condition. For the case of the transient beach load, the infusion pump reduced bacterial concentrations relative to the no pump case, with contamination removed nearly completely in 12 hours.

The Marina del Rey model was also modified to determine if the addition of a channel connecting the ends of Basin D and Basin C could effectively increase the circulation of clean water near Marina Beach. A conceptual connecting channel model was 10 feet wide at the channel bottom, with 1:1.5 side slopes. Channel depth was 10.8 feet below mean sea level (MSL). The same distributed beach load simulation performed for the base and pump infusion cases was run for the infusion channel alternative. The results showed the presence of the infusion channel only slightly reduced the bacteria concentration on the beach. In addition, modeling of the transient beach load case indicated no reduction in bacteria on the beach relative to the no infusion condition.

2.2.5 Diversion of Storm Water Discharge from Basin D

To investigate the water quality improvements that might be accomplished by diverting storm water flows out of Basin D, bacteria simulations were performed with normal storm water discharges and with storm drain flows diverted from Basin D. The laterally averaged model was used and storms of 0.50 and 2.00 inches respectively were modeled. Significant reductions in bacteria in waters in Basin D near Marina Beach were predicted by model results for the cases where local storm water discharges were diverted from Basin D. The results also showed that bacteria contamination penetrated Basin D from elsewhere in the Marina during storm events facilitated by stratified freshwater flow near the surface.

2.2.6 Findings

Based on the hydrodynamic modeling results, Kinnetic found that, (1) during non-storm conditions, transport of bacterial contamination from Basin E to the Marina Beach face did not appear to be an important factor in the exceedances at Marina Beach; (2) contamination from Ballona Creek and the Marina channel entrance, likewise, did not seem to be causing bacterial exceedances at Marina Beach; (3) transport of small sewage discharges from boats could possibly be a factor under certain tide and wind conditions causing random exceedances of bacterial objectives at Marina Beach but only from sources near the upper end of Basin D; (4) installation of an infusion pump with appropriate design size and power offshore Marina Beach could reduce the bacterial concentration of continual source up to 50% or higher; (5) the channel-connecting model showed only a marginal improvement of water quality at Marina Beach; and (6) storm event simulation showed that bacteria contamination penetrated Basin D from elsewhere in the Marina during storm events facilitated by stratified freshwater flowing near the surface; nevertheless, significant reduction in bacteria concentration at Marina Beach was predicted by model results for the cases where local storm water discharges were diverted from Basin D.

2.3 Inspections of Storm Drain and Sanitary Sewer Systems

2.3.1 Storm Drain System

Inspections of the local storm drain and sanitary systems were carried out to determine whether sources of contamination existed that were local to the beach rather than being transported to the beach by ambient Marina waters from more distant sources. Information obtained from the Los Angeles County Department of Public Works showed the locations of the storm drain and sanitary system local to Basin D, and their respective inspections, repairs, and lining records.

The land surrounding Marina del Rey has been divided up into 20 individual drainage areas. No major storm drains from surrounding areas enter Basin D. However, a significant quantity of sheet and rooftop flows from the surrounding parking lots, restaurants, and hotels drains to Marina Beach across the sand. A significant portion of the runoff from the Palawan and Panay Way peninsulas enters Basin D through a series of street and private drains. Major storm drains do enter adjacent Basins C and E including the Oxford Basin drainage, which enters Basin E.

Physical inspections were performed for both the storm drain system and sanitary sewer system surrounding Basin D, with emphasis on potential discharges or leaks in the vicinity of Marina Beach. To assess the overall condition of the two major storm drains near Marina Beach, inspections of nearby manholes and drain inlets were conducted. These inspections revealed the overall condition of the drainage system was good. There were no visual observations that would suggest that these drains contained leaks that could adversely affect the water quality at Marina Beach.

Numerous photos were taken to document runoff onto and through Marina Beach along with the various entry points where runoff concentrates. To verify the extent and direction of sheet flow from the drainage areas above Marina Beach, parking lot elevations were measured. This information was used to study the collection and potential future diversion of the sheet flow runoff.

A large drainage area incorporating surrounding urban areas, discharges into the head of Basin E through Oxford Basin, a flood control reservoir. Runoff is retained in the basin during high tides and is released through floodgates into Basin E during low tides. One seven-foot slide gate controls flow through an 81-inch diameter pipe and another six-foot slide gate controls flow through a 6-foot by 6-foot box culvert. Oxford Basin receives runoff from an urban area of about 672 acres in size.

Oxford Basin waters have high and consistent bacterial counts. Potential sources to the basin are both wet and dry weather discharges through the storm drain channels, bird use of the basin, and possible leakage from nearby sewer lines.

2.3.2 Sanitary Sewer System

The inspections of the sanitary sewer system surrounding Basin D were essentially visual and photographic but also included salinity measurements. Most manholes surrounding Basin D were inspected for overall condition. The conveyances directly entering and leaving the manholes were also inspected. However, inspections along the entire length of the conveyances were not conducted. The inspection process involved looking for leaks and seepage into the sewer system, noting the condition of the manholes, the integrity of any liners, the salinity of the flow, and the elevation of the manholes and conveyances determined in relation to Mean Lower Low Water (MLLW). Photographs were also taken of most inspection points.

Visually, the sewer inspections indicated that most manholes and the visual portions of each conveyance were structurally in good condition. The concrete and bricks in some of the older manholes showed signs of decay. Liners, where they exist, were for the most part in good condition. However, in many cases, the liners in the pipes were not sealed at the manholes, and seawater was observed coming into the manholes around the sides of the liners. Some of the manhole liners, however, also showed visual signs of decay.

Inspections were done during high tide conditions so that communication with ambient/ground waters could be measured by measuring salinity in the sewage system. Very significant salinity values were found in all sewage conveyance lines tested, ranging from 6 to 21 parts per thousand (ppt) salinity (ambient Marina seawater is 31-33 ppt). The salinity of the sewer water often increased from upstream to downstream, suggesting that integrity of the lined conveyances is compromised in places. The sewer lines along the peninsulas are only a few feet away from the seawalls separating the land from that of the Basin waters.

Besides the conveyances entering and leaving manholes, likely locations to have leakage would be where small laterals enter the conveyances between manholes. A more detailed video survey of the sewer conveyances would be necessary to detect actual leaks at these laterals.

Despite evidence of seawater infiltration, measurements to indicate whether sewage actually leaks back into Basin D through seepage of ground water were not made. The most likely sites for this would be from the lines that parallel the peninsula that are only a few feet from the seawall. Thus the possibility does not exist for some conveyances to leak towards Basin D where the elevations of these conveyances are above low-tide elevations, though the head differences are not large. Since sewage has extremely high indicator counts (millions) possible seepage is a concern.

2.4 Marina Beach Local Source Studies

As part of a study to investigate the sources of bacterial contamination at this swimming beach, bacterial studies on interstitial and seep waters have been carried out along with sterile seawater extractions of beach sands to determine whether sources local to the beach could be causing the water quality violations measured at the beach face.

To put Marina Beach in perspective, the beach is a low energy beach located at the west end of Basin D in the upper end of Marina del Rey harbor. As such, the beach slope is very shallow, and the lower tidal sections have an obvious content of estuarine mud mixed with the sand (though the lower intertidal is still firm to walk on). The beach was constructed as part of the Marina. Several feet of sand have been placed onto an estuarine mud substrate, so the entire beach is not made of porous sand but is a layered structure of dry or wet sand with dry clay/mud immediately underneath, then underlain by wet clay/mud of the original marshland.

In order to investigate local beach sources of bacteria, three different types of samples were taken at Marina Beach: (1) Extracts of beach sand to investigate potential contamination or growth in the beach sands; (2) Seepage or storm water runoff samples taken at the beach face; and (3) Interstitial water samples taken in the ground water under the beach sand.

The sand extractions were designed to investigate whether the beach sands themselves were contaminated, such as from bird sources, and the ability of sand from the beach to leach indicator bacteria into seawater. The questions were examined by extracting the sand sample with sterilized, natural seawater. Specifically, sand was sampled on Marina Beach and the adjacent intertidal area for the following purposes:

- Determine the bacterial contamination present in beach sands and the distribution of the contaminated sand on the beach, and with depth both on the beach and in the intertidal area.

- Determine the ease with which contaminated sand can contaminate sterile seawater on contact.

- Identify any reservoirs of bacteria existing locally in the sand during the dry season before rains discharge new storm water into Marina del Rey, and then determine if bacteria contamination is enhanced through rainfall and runoff.

- Formulate possible beach sand management practices based upon the results of the sand and water analysis.

It is well documented in the literature that fecal indicator bacteria exist in sediments and in sand on beaches in both freshwater and marine environments and that persistence and growth can occur. Growth of fecal coliforms in storm sewer sediments has also been documented. In addition, differing methods of extraction and analysis of indicator bacteria have been used by differing investigations.

Initial surveys of sand contamination were carried out before the first rains to document the status of the beach before the wet season. After the first significant storms, a similar sand survey was taken at Marina Beach to document any changes, and a third survey was taken later in the wet season to document cumulative effects of storm water runoff into the Marina. The two storm surveys were performed over several days to document the changes in bacterial contamination subsequent to a significant storm event.

For the initial sand survey, a total of 43 locations within 11 transects were sampled. For each transect, samples were collected in the lower intertidal, at mean sea level and at mean high tide. Two additional locations in the upper beach were sampled at five of the 11 transects. Only surface sand was sampled in the mid and lower intertidal. At the mean high-tide line, a sample was collected from the surface and at six and 12 inches below the surface for each transect. In the upper beach, samples were collected from the surface and six inches below the surface.

The interstitial water measurements were designed to investigate whether contamination sources were present in the ground water, such as from sewer leakage on the land water side of the beach. Specifically, interstitial water, and water flowing over the sand from seeps or runoff were sampled on Marina Beach and adjacent intertidal areas.

Interstitial water present in the sand was determined by direct sampling. A well-point sampler used under aseptic protocols was used away from the beach face. Sampling of water draining out of the beach face at low-tide (seeps) was done by digging a small trench in the beach sand (about 2-3 cm deep) and directly filling a sterilized bacterial bottle with the water seeping into the hole. These seep samples were either seawater draining from the sand due to low tide, or perhaps groundwater contribution from sources further inland. Conductivity/salinity measurements were taken on these seep samples to assist in source interpretations. These interstitial water and seep samples were thus taken from the sand with no dilution involved.

Specific findings from the sand and interstitial groundwater surveys along with results from seeps and storm water runoff samples collected are summarized as follows:

- During dry weather conditions, few public health exceedances for indicator bacteria occurred in water from seepage at the Marina Beach face during low tide conditions. Dry weather seepage was predominantly marine water with generally low indicator bacteria concentrations.

- Wet weather (post storm) seepage was predominantly fresh water. Numerous public health exceedances for all indicator bacteria occurred in seep water collected after a storm.

- All samples of direct storm water runoff running across the beach or being discharged from local drains exceeded public health criteria for all three indicator bacterial analyses.

- After the storm season, samples of seep water taken at points across the beach face did not exhibit any indicator bacteria exceedances. This water was seawater that had flooded into the sand at higher tide, then was draining out, representing natural extraction of the sand by the ambient seawater.

Beach sand conclusions are the following:

- The dry season sand survey data does not indicate widespread contamination of Marina Beach sands. Indicator bacteria do not easily leach out and therefore do not contaminate water at the beach face.

- Wet season sand survey data shows that the quality of the beach sands deteriorated to a certain extent after significant storm events as a direct result of storm water flowing directly over and through the beach sands from surrounding parking lots and urban areas. This degradation disappeared in a time frame of less than six days.

Interstitial water conclusions are the following:

- Ground water flowing through Marina Beach does not appear to be a major source of coliform contamination to the Basin D waters in that a consistent plume to the beach face was not found. However, the data suggests that the groundwater could contribute to some of the *Enterococcus* violations at the beach face monitoring site (S-9) since nearly 30% of the interstitial water samples collected contained enterococcus in numbers exceeding the public health criterion. A direct link to the beach face through measured seeps was not established.

- When enterococcus violations occurred in the interstitial groundwater, the wells were often influenced by fresh water.

2.5 Marina Operation Practices

Marina del Rey is a heavily urban area with intense residential, commercial, and visitor uses along with small boat and water related activities. Marina operational practices were examined for potential impacts to bacterial exceedances at the beach. Since both Marina del Rey waters and Marina Beach itself are designated for water contact recreational uses, sources of bacterial contamination need to be identified and corrected. However, bacterial contamination can often be attributed to multiple sources. It is often hard to attribute high indicator bacteria levels to any particular source or to distinguish between sources at differing times. Therefore, controls of all sources of potential bacterial contamination must be considered for implementation.

Specific topics explored in this study are those of Marina maintenance practices and include the following: (1) Sewage disposal practices from vessels in the Marina, including liveaboards; (2) Street and parking lot sweeping and control of Marina wash-down practices; (3) Bird exclusion structure at Marina Beach; and (4) Beach operations and sand management practices at Marina Beach.

2.5.1 Marina Sanitary Sewage Management

Based on the number of both liveaboard and other vessels in the harbor, it appeared the use of the existing four marine pump-out sewage facilities within Marina del Rey was low, with utilization estimated at only 20% of capacity. However, the results of the Marina del Rey monthly monitoring program in the channels and basins, along with the results of the Kinnetic's Marina water quality and modeling efforts indicate the cumulative bacterial loadings from boat discharges is not of a magnitude to generally impact the quality of the water throughout the harbor. Indeed, monitoring data indicated harbor waters met REC-1 water quality standards almost all of the time except during rain events. Modeling of sewage discharge from a small boat indicated it has a local effect. A plume from an individual boat discharge could cause a water quality violation at Marina Beach (where daily monitoring takes place) if the discharge occurred in the west end of Basin D during the right conditions of tide and wind, but not likely from other areas of the Marina. A small but statistically significant correlation of increased beach violations during dry weather conditions was found with east (onshore Marina Beach) winds. The monthly monitoring program is not detailed enough in time or space to detect the frequency of such patches of isolated contamination in the Marina.

2.5.2 Storm Drainage, Street/Parking Lot Sweeping, and Control of Marina Wash Down Practices

Federal Clean Water Act regulations generally prohibit non-storm water discharges to the storm drain system or directly to receiving waters with some exceptions, such as urban and irrigation water runoff, etc. unless prohibited by local regulations. In the case of a marina, washing down boats while in the water for routine cleaning or as part of regular maintenance is not prohibited (USEPA, 2001; California Coastal Commission, 2004). Recommended practices include limiting in-water boat maintenance activities to those that have minimal or no impacts to waterways, and encouraging soapless boat washing methods.

Storm water discharge diversions out of Basin D in the vicinity of Marina Beach have been separately discussed and recommended. In addition, local wash down activities are a possible concern, though water quality monitoring and hydrodynamic modeling results discussed above seem to indicate that these discharges only have local and transient effects. Nevertheless, since the dry weather TMDL objectives are zero exceedences throughout the entire eight-month dry weather season, attention to wash down activities local to Basin D and Marina Beach is recommended..

2.5.3 Bird Exclusion Structure at Marina Beach

A bird exclusion structure exists at Marina Beach consisting of metal poles placed on the beach, with fishing line strung from the poles to form a barrier to bird use. However, the birds, almost exclusively seagulls, are not deterred from roosting and feeding at the edges of the protected areas, at the shoreline. They frequent the lower beach face area, especially at low tide conditions, preening and feeding in the shallow water on food sources of the intertidal zone. This is also the area nearest to the children's swim zone, and the water quality monitoring site. It is suggested the bird exclusion zone be expanded to cover this critical area to see if it reduces bird use and excrement onto the sand.

2.5.4 Marina Beach Maintenance Practices

Beaches and Harbors manages Marina Beach, including controlling the type of activities permitted on the beach. Signage displaying information and regulations for beach use are posted at the beach. Daily management and maintenance services are provided by Beaches and Harbors personnel. These services include observations and inspections of activities and facilities, and maintenance of public facilities including restrooms. The upper beach up to the high tide line is routinely raked mechanically to remove debris left by the tide or by public use. During periods of low use, sand maintenance is done by hand as the beach often receives only a minor amount of debris deposited by the high tide.

Kinnetic recommended that present raking practices be continued. If bacterial exceedances continue at Marina Beach not related to rain events, clean sand replenishment at the lower beach swimming area could be considered to cover the present sand now somewhat elevated in mud and organic content that may serve as a reservoir for bacteria

2.6 Phase I Study Findings and Recommendations

Examination and statistical analysis of the ten-year bacterial monitoring data on Marina Beach show a strong correlation between exceedances and wet weather events, but no other definitive causal relationship. During dry weather, somewhat increased frequencies of exceedances occurred when associated with east (onshore) winds and incoming tides, and with rising tides.

Examinations of the waters offshore Marina Beach and throughout the Marina were done using both the existing bacterial monitoring data and new survey data. Marina del Rey waters generally met REC-1 objectives, including Basin D waters offshore Marina Beach except for periods during and following storm events. Over a period of 2 - 4 days after these storm events, Marina waters returned to normally low indicator bacteria concentrations, to meeting REC-1 objectives standards.

Hydrodynamic modeling results during dry weather conditions indicated that neither the elevated bacterial concentrations from the Oxford Basin drainage into Basin E, or from the mouth of Ballona Creek at the entrance of Marina del Reyld, had any influence on bacterial exceedances at Marina Beach. Similar modeling of individual boat discharges of sewage in Basin D showed that conditions of east wind and/or incoming tides could cause transient exceedances at the beach only if the discharges were local to the upper end of Basin D. Thus based on both monitoring data and hydrodynamic modeling results, Marina-wide sources do not appear to be the cause of bacterial exceedances at Marina Beach during periods of dry weather.

Inspections of sanitary sewer lines that cross the upper beach and exist along the peninsulas of Basin D found these lines to be in contact with ambient salt waters. Leakage into the lines was documented at high tide conditions by physical observations of seawater leaking into the sanitary system with resulting salinities running at 16 to 24 parts per thousand indicating up to two thirds seawater. Bacterial contamination, particularly enterococcus, was also measured in interstitial waters under the beach. However, Marina Beach was constructed by adding a layer of sand over the original wetland mud substrate and consists of a foot to two feet of sand over a hard, dry clay layer underlain by wet estuarine mud with low porosity. Direct transport of this contamination to the beach face was not documented. Also, the contribution of the peninsula sewer lines to contamination in Basin D was not detected.

Inspections of the storm drain system and observations during rain events showed that local storm water sheet flows directly across the Beach from large parking lots, restaurants, and hotels. Additional local drainage from the peninsulas on either side of Basin D flows directly into Basin D. Storm water from these urban sources was high in indicator bacteria concentrations, and contamination of water at the beach face and in the beach sands was documented. Beach sands were tested for easily extractable bacteria using sterile seawater (25 gms sand/ 250 ml sterile seawater) and found to be generally clean before the rainy season, contaminated after a rain event, and relatively clean again over a period of about a week.

Hydrodynamic modeling results for periods of rain showed that bacterial contamination was introduced to the beach area in Basin D from local drainage and drainage from elsewhere in the Marina, notably from the large discharges into Basin E immediately to the north. Similar hydrodynamic modeling indicated that diversion of local storm water drainage from Basin D would substantially reduce the level and duration of bacterial concentrations in the water in Basin D near the beach face. Eliminating sheet flow across the beach sands would prevent the contamination of these sands and the creation of a reservoir of bacteria at the beach face. Since water quality in Basin D is generally good, infusion of local water to the area of the beach face was modeled as a potential mitigation of transient contamination. Additional dilution of such transient sources could be accomplished by use of a low RPM, large-diameter, banana blade paddle pump moving about 30,000 gpm to the beach face.

Based on Kinnetic's study they recommended the following implementation alternatives to mitigate contamination sources at Marina Beach:

Part 1 – Divert local storm water drainage from Marina Beach and upper Basin D areas into Basin C to address exceedances at the beach due to storm water runoff which appears to be the dominant source of bacterial contamination.

Part 2 – Install local water infusion pumps to increase local circulation, mixing, and dilution at the Marina Beach face in order to address transient instances of bacterial exceedances in the beach water.

Part 3 – Line/repair local sanitary sewers (manholes) at the upper Basin D area, install floor drains in local bathrooms at Marina Beach.

Part 4 – Incorporate guidelines into Marina operation practices to reduce local sources of contaminants in Basin D, including the following: (1) control boat discharges; (2) control Marina wash down practices of docks, boats, and pavement to prevent discharges to Marina waters; and (3) document other management practices for upper Basin D and beach cleanliness, including bird exclusion device maintenance and sand management practices to mitigate contamination from birds.

Project descriptions and CEQA documents (Mitigated Negative Declaration) were developed for Parts 1 and 2 of the recommended project. Part 3 (Repair of Sanitary Sewers) and Part 4 (Modifications to Operating Practices) are actions exempt from CEQA since they are either repairs to existing facilities or are modifications to internal maintenance procedures.

3. STATEMENT OF WORK – PHASE II

Based on Kinnetic's findings and recommendations, the County proceeded with a two-part approach to mitigate bacterial contamination at Marina Beach. The first part of the Phase II work was the construction of a storm water diversion system to divert storm waters that would have run across the Marina Beach sand from adjacent parking lots into Basin D waters to the south into Basin C. While the swimming area in Basin D is designated REC-1 (water contact recreation) by the LA Regional Water Board, Basin C is designated REC-2 (non-water contact recreation), and the proposed diversion is not expected to significantly degrade water quality in Basin C so as to change its presently designated beneficial use. The second part of Phase II project was to increase the mixing and circulation of the waters at the beach face of Marina Beach to improve water quality and reduce contaminations caused by random occurrences of bacterial concentrations. This was to be accomplished by mounting two water circulators (Flygt 4410 water pumps) encaged underneath a newly constructed ADA compliant dock, that replaced the current transient dock at Marina Beach.

Kinnetic completed the necessary environmental documents in compliance with the California Environmental Quality Act (CEQA) for both parts of Phase II. In commencing Phase II, Beaches and Harbors engaged one of its harbor-engineering consultants, David Evans and Associates (DEA), to provide survey and civil engineering services, including, plans and specifications drafting, and construction consultation for the recommended projects. In turn, DEA recruited DMJM+Harris (DMJM) as a sub-consultant to provide final plans and specifications for the water circulation project. DMJM also worked with Kinnetic in Phase 1 and continued to provide services between the two phases. For the Phase II construction, the County's Internal Services Department and Department of Public Works provided the construction administration for the water circulation and storm drain projects, respectively.

3.1 Water Circulation Project

Presently, compliance monitoring is carried out by EMD through sampling the very shallow water in the swash zone at the beach face in three different locations. The water quality standards defined by the TMDL process calls for zero violations during the long summer dry period and only three times per year during the winter periods between storms. Therefore, this option of additional dilution/circulation at the beach face was considered as an additional measure after other local sources such as eliminating sheet flow over the beach, were mitigated or managed (mitigation and management conducted under other projects).

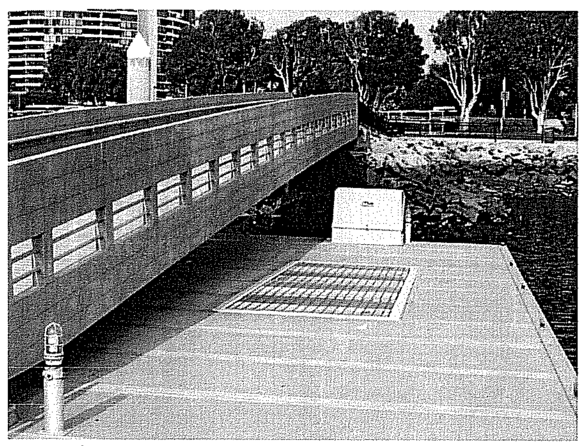


Figure 4 – Water Circulators & ADA Dock

Two water circulators have been placed on guide poles underneath the floating dock to about 6 feet below the water surface (Figure 4). The water depth is about -10ft MLLW. It is proposed to use two mixing pumps manufactured by ITT Flygt, specifically a pump with a large, slowly rotating "banana-blade" propeller made of fiberglass reinforced polyurethane (See Exhibit C for Operation and Maintenance Data for the water circulators). Mixing pumps are submersible pumps that are used in industrial applications. They are installed in tanks, reservoirs, and ponds to circulate liquids. The proposed banana-blade pump is used for mixing and current creation. The circulators were mounted underneath the main 76' x 20' platform at the north-east side. A fiberglass grating (ADA compliant) will provide a flush cover of the opening for the circulator pumps.

The Flygt pumps selected is a Submersible Mixer with a 55-inch diameter banana blade propeller. This pump has a 6.2 horsepower electric motor (4.6 KW), which turns at 1715 RPM. The reduction gears in the pump produce a propeller speed of 55 RPM (e.g. less than 1 revolution per second), thus acting like a large paddle instead of the fast turning propellers on boats in the Marina. At this speed, the pump will provide a primary flow rate of 29,100 GPM or close to 60,000 GPM for two pumps. Maximum velocity at the pump will be about 4 feet/sec, dropping to a velocity of less than 0.5 feet/sec at about 200 feet downstream. Bottom and water surface clearances are about 2 feet each. The pumps are encased in a cage for safety. The slow speed and the lack of the need for a fine screen will eliminate any concerns about damage to aquatic organisms, whether to fish or plankton due to either entrainment or impingement. The slow current of less than 4 feet/sec will minimize any turbidity or seabed erosion.

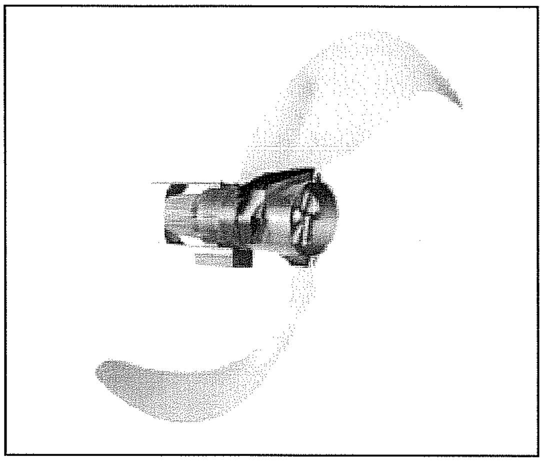


Figure 5 – Water Mixer Banana Blades

The two circulators are mounted underneath the new dock. The circulators induce a gentle current along the beach face. Power is provided by running an insulated cable from the concession building at 14110 Palawan Way through a conduit to the concrete pathway at the existing rock dike, and thereon along the concrete pathway to the new gangway. The power runs underneath the gangway to reach the pontoon circulator mounting location. A motor start controller regulates operation of the motors, which have breakers for controlling the motors, motor run light, and thermal overload protection. The pumps can also be programmed through the controller as to run times and conditions to run, controlled by water level or timing controls.

The Los Angeles County Board of Supervisors (the "County Board") approved an addendum to the Mitigated Negative Declaration (MND) on July 12, 2005, which MND had previously been filed with the State Clearinghouse in January 2004 and certified by the County Board in February 2004. The addendum reflected additional dock improvements to meet Americans with Disabilities Act (ADA) accessibility requirements and provide structural support for the underwater circulators.

The United States Army Corps of Engineers, Los Angeles District, approved the project pursuant to Nationwide Permit Number 5: Specific Measurement Devices (Sections 10 and 404) on May 10, 2005. The California Coastal Commission issued a Coastal Development Permit on May 11, 2005.

County's Internal Services Department (ISD) provided the construction administration service for the water circulation project. The electrical work was completed in May 2006 by ISD's contractor. The installation of the circulators and the new dock system was completed in early October 2006; it did not commence until early September 2006, because of the necessary lead times needed for manufacturing of the project components. The two water mixers have since been in operation on pre-programmed schedules. In compliance with this grant contract, Beaches and Harbors retained the service of Aquatic Bioassay & Consulting Laboratories (ABC Lab) to provide an evaluation of the performance of the water circulators. ABC Lab's report is discussed in the following section and attached in Exhibit A to this final report.

All the gangway work in the original project scope has been completed. However, there is additional work that is being performed to adjust for field conditions and comply with ADA regulations. According to the ISD project manager, the work is scheduled to be completed in March 2008.

3.2 Storm Water Diversion Project

In the Phase I study, bacteria simulations were performed with normal storm water discharges and with storm drain flows diverted from Basin D. The laterally averaged model was used and storms of 0.50 and 2.00 inches respectively were modeled. Significant reductions in bacteria in Basin D waters near Marina Beach were predicted by model results for the cases where local storm water discharges were diverted from Basin D.

The storm water diversion project consisted of an extensive excavation and backfill work to install approximately 2,700 linear feet of high density polyethylene pipe and a series of junction structures, transition structures and manholes to divert the water. The construction also installed six trench drains and one catch basin along the walkway adjacent to Marina Beach on the west and connected the three existing catch basins (two at Panay Way and one at the Parking Lot GR bulkhead) to the new storm drain. All trench drains and catch basins were installed with filters to collect and catch pollutants, such as sediment, silt, debris, grease/oil, and petroleum hydrocarbons. The storm drain outlet is under the existing seawall and directing flow into Basin C.

Figure 6 – Storm Drain Construction

For the permitting process, the LA Regional Water Board, issued a Water Quality Certification (401 Permit) on June 14, 2006 and a National Pollutant Discharge Elimination System (NPDES) permit on June 23, 2006. The California Coastal Commission issued a Coastal Development Permit on July 6, 2006, and the United States Army Corps of Engineers, Los Angeles District, approved the project under Nationwide Permit Number 12: Utility Line Activities (Sections 10 and 404) on July 12, 2006.

On September 12, 2006, the County Board adopted the plans and specifications and authorized advertising for construction bids on the Marina Beach storm water diversion project. On October 12, 2006, eight bids were received. The Mike Bubalo Construction Company submitted the lowest bid and was subsequently awarded the contract on December 5, 2006.

Construction commenced in May 2007 proceeded smoothly, and was completed in July 2007, in approximately 60 days. County's Department of Public Works provided the construction administration and inspection services. David Evans and Associates, a Beaches and Harbors' consultant, provided the engineering support services.

4. PROJECT PERFORMANCE EVALUATION

Upon completion of the storm water diversion system, Beaches and Harbors retained ABC Lab to conduct a performance evaluation on the water circulation system and the storm drain system. Particularly, ABC Lab was to evaluate: 1) if the circulators effectively reduced the bacterial exceedances at the Marina Beach face during the dry weather period, and, 2) if the diversion of storm water across Marina Beach effectively reduced bacterial exceedances at Marina Beach during the wet weather season. ABC Lab submitted its draft final report on December 11, 2007, which is attached to this report in Exhibit B.

4.1.1 Water Circulation System

The effectiveness of the water circulators was assessed in two ways. First, the frequency of REC-1 exceedances for each fecal indicator bacteria at each station was compared when the circulators were turned on and off. Fecal indicator bacteria concentrations were compared against the State REC-1 water quality standards.

Next, the differences in bacterial concentrations at each station were statistically tested using the Aspin-Welch Unequal Variance t-test on log transformed data. This analysis was not related to exceedances of REC-1 standards, but was instead looking for statistical differences in the mean bacterial concentrations at each station when the circulators were on and off. Finally, data collected before the circulators were installed at Station MDRH-2 between November 2003 and March 2006 were compared against REC-1 standards to determine if bacterial exceedances were different before and after the circulators were installed. For each of these analyses, samples collected on days when it rained and for the next three days following the rain event were excluded. As a result only dry weather samples were included in the assessment.

4.1.2 Findings for Water Circulation

A summary of the bacterial exceedances that occurred during the period between March and October 2007 are presented in Table 2 of ABC Lab's report. The results are organized so that the exceedances at each station can be compared during the on and off of the circulators. Statistical comparisons of bacteria concentrations when the circulators were on versus off for each station are presented in Table 3. This comparison was made to determine if the average concentrations of bacteria were significantly effected by the operation of the circulators. In addition, the bacteria concentrations for each fecal indicator bacteria for each day are graphed in Figures 3 through 5.

Total coliform concentrations did not exceed the single sample or 30-day geometric mean of REC-1 standards during the study period (Table 2 and Figure 3). In comparison, total coliform at Station MDRH-2 exceeded the single sample REC-1 standard (>10,000 MPN/100 mL) twice prior to the installation of the circulators during the period of November 2003 to March 2006. Average total coliform concentrations were significantly greater at Station MDRH-1 when the circulators were on, and there were no significant concentration differences at Stations MDRH-2 and MDRH-3 (Table 3).

E. coli concentrations exceeded the single sample of REC-1 standard more frequently when the circulators were on at each of the three stations (Table 2 and Figure 4). The greatest percentage of exceedances was found at MDRH-1 and MDRH-3 (10% and 12%, respectively). In comparison, the standard was exceeded by 4% only at Station MDRH-1 when the circulators were off. Exceedance of the 30-day geometric mean standard did not occur during the study, regardless of whether the circulators were in operation or not. The frequency of exceedances (7%) of the single sample standard at Station MDRH-2 prior to the circulators' installation was similar to the frequency of exceedances (6%) measured after the installation, when the circulators were on. The continuously lowest concentrations of E. coli were measured when the circulators were running once a week between June 30 and July 23 (Figure 4). The greatest concentrations were measured when the circulators were in continuous operation starting on September 12. The effects of the two light rain events on September 21 (0.25 inches) and October 12 (0.29 inches) may have added to these elevated concentrations. There were no significant differences in average E. coli concentrations when the circulators were on or off at all three stations (Table 3).

Enterococcus concentrations exceeded the single sample limit of REC-1 standard at a slightly greater frequency at Station MDRH-1 when the fans were on (Table 2 and Figure 5). The rate of bacterial exceedances at both Stations MDRH-2 and MDRH-3 were similar regardless of circulators operation. The frequency of exceeding the 30-day geometric mean of REC-1 standard was 13% at Station MDRH-1 and 9% at MDRH-2 when the circulators were on. No exceedance of the 30-day standard was found when the circulators were off. The frequency of exceedances at Station MDRH-2 prior to the installation of the circulators was greater for both standards compared to the post of circulators installation, regardless they were on or off. The concentration trends and rain effects described above for E. coli were similar for enterococcus with lowest concentrations measured when the circulators were mostly off in mid-summer and greatest when they were on continuously in the fall. Average enterococcus concentrations were significantly greater at Station MDRH-1 when the circulators were on, and there were no significant concentration differences at Stations MDRH-2 and MDRH-3 with the circulators either on or off (Table 3).

Modeling conducted by Kinnetics found that discharges from small boats in Basin D could only have created REC1 exceedances on the shoreline of Marina Beach under certain tidal and wind conditions. It is possible that the fans create these conditions by drawing water from the boat docks on the east side of Basin D toward the shore. However, this explanation does not answer why the greatest number of REC1 exceedances occurred at Station MDRH-1, located furthest from the fans. If the fans were creating the problem, it follows that REC1 exceedances should have been greater at Station MDRH-3 located immediately adjacent to the fans.

A single set of samples were collected to determine if bacterial concentrations were elevated on the shoreward side of the fans. These samples did not show that there was a greater concentration of FIBs on the shoreward side of the fans. It may be necessary to increase the frequency of these samples to determine if the fans are drawing contaminated water toward the beach.

It is possible that the current created by the fans disturbs the sand at the beach face so that FIBs sequestered in the interstitial spaces are released to the water column. Kinnetics found that there were few REC1 exceedances that occurred in interstitial seep water from the sand at the Marina Beach face during dry weather. Conversely, freshwater flow across the beach interface during storms caused seep water to routinely exceed REC1 standards. However, it seems highly unlikely that the current flow created by the fans at the beach face match the disturbances caused by freshwater flow across the sand during storm events.

It is possible that elevated REC1 exceedances are completely unrelated to the operation of the fans. There are numerous potential sources of FIBs to the Marina Beach face, including shorebirds, boats moored nearby and intrusion of seawater into the sanitary sewer system. As a result of the highly variable nature of these data, a longer term investigation of the fan operation is warranted.

The water circulators were put into operation starting in early October 2006. From the inception through June 30, 2007, they were scheduled to operate three times a week with a 12-hour period each time. From July 1 through October 31, 2007, the water circulators were originally set to run just once every week with each time a 10-hour period in conjunction with the performance evaluation conducted by the Aquatic Bioassay Consulting Laboratories as particularly described in its report in Exhibit B attached hereto. However, because of the frequent exceedances observed in the mid-September 2007, the circulators were turned on manually on September 13, and remain on since then except for the regular maintenance and repair (see table below).

Period	Operation Schedule
10/05/2006 – 06/30/2007	Weekly; Tuesday 9 pm – Wednesday 9 am; Thursday 9 pm – Friday 9 am; Sunday 9 pm – Monday 9 am.
07/01/2007 – 09/12/2007	Weekly, Tuesday 9 pm – Wednesday 7 am
09/13/2007 – Present	All time

4.2.1 Storm Water Diversion System

To assess the effectiveness of the storm water diversion system, bacteria data collected during storm events of similar intensity, both before and after the diversion system was completed, were compared. Only data from Station MDRH-2 were used in the assessment since, prior to March 2007, bacteria data were only collected at this site. In September and October 2007, two small storms dropped <0.35 inches of rain at Marina Beach. The bacteria data collected during these storm events were compared to storms from November 2003 to August 2007 that also had rainfall <0.35 inches. Employing the State rain rule, data for the day of the storm and three days following each event were used for the comparison. Rain gauge data taken from the Los Angeles Airport were used to determine rain events.

4.2.2 Findings for Storm Water Diversion System

Bacteria concentrations measured during the light rain events in September and October 2007 (0.25 and 0.35 inches, respectively) was similar when compared against bacteria concentrations measured during several rain events of similar magnitudes since November 2003 (Figures 6, 7 and 8). Note that the maximum concentrations of total coliform bacteria did not exceed the 10,000 MPN/100 mL single sample standard after the storm water diversion project had been completed. However, these results are based on a very limited amount of data and further work is necessary before the effectiveness of the storm water diversion can be accurately determined.

5. CONCLUSION

The water quality at Marina Beach is a matter of high concern to the County of Los Angeles. Beaches and Harbors, as the custodian and operator of Marina del Rey, has over the years endeavored to maintain Marina Beach as a wholesome environment that hosts an average of 200,000 visitors annually. To date, Beaches and Harbors has completed a majority of the remediation works recommended in the Kinnetic's Phase I studies report, including the diversion of local storm water runoff from Marina Beach; installation of two submerged water pumps to experimentally explore the effects of water circulation, mixing, and dilution on indicator bacteria concentrations at the beach face; repair of the bird exclusion structures; and implementation of a boat discharge and wash down program. When the fiscal conditions allowed, Beaches and Harbors will consider to remediate the sanitary sewer lines surrounding the Marina Beach as recommended in the Kinnetic report; meanwhile, plans such as extending bird exclusion poles at Marina Beach, posting signs not to feed the wildlife, trapping nuisance rodents, and installing bird exclusion devices on docks, roofs, and other popular perches are under consideration.

In a broader scale of improving the water quality at Marina Beach and Marina del Rey Back Basins, the County joined by other jurisdictional agencies envisions an 18-year program undertaking an integrated water resources approach to ameliorate the Marina del Rey's water quality to meet the State standards. A final implementation plan has been submitted to the LA Regional Water Board on October 31, 2005. Currently, as part of the regulatory review in Building and Safety permit process, the County is requiring new development projects adjacent to Marina Beach to implement the Best Management Practices by incorporating drainage systems in their development plans to avoid urban runoff from flowing across the beach and into the Marina waters.

The County will continue the water quality monitoring program at Marina Beach and analysis of the water sample data to assess the effectiveness of the storm water diversion system and water circulators as recommended in the ABC Lab's report. Studies of water circulators' reconfiguration and sources of contamination will also be conducted in conjunction with the compliance efforts for the Marina Beach and Back Basins TMDL requirements.

This report is prepared by the Los Angeles County Department of Beaches and Harbors. Please contact below for any questions:

County of Los Angeles
Department of Beaches and Harbors
Planning Division
13837 Fiji Way
Marina del Rey, CA 90292
Attn: MBWQIP Project Manager

EXHIBIT A

Task Description	Completed in This Period	Cumulative Completion	Completion Date
1. Project Management and Administration	2%	97%*	March 2008
2. CEQA Documentation and Permits			
2.1 CEQA Documentation	0%	100%	July 2005
2.2 Permits	0%	100%	July 2006
3. Quality Assurance Project Plan (QAPP)			
3.1 QAPP	0%	100%	October 2003
3.2 Monitoring & Reporting Plan	0%	100%	October 2003
3.3 Post Construction Monitoring Plan	10%	100%	November 2007
4. Statement of Work (Phase 1)			
4.1 Initial Feasibility Study	0%	100%	May 2004
4.2 Soil Sampling	0%	100%	February 2004
4.3 Water Quality Testing	0%	100%	February 2004
4.4 Hydrodynamic Modeling	0%	100%	March 2004
4.5 Water Infusion Program	0%	100%	May 2004
5.0 Statement of Work (Phase 2)			
5.1.1 Storm Water Diversion – Plans & Specs	0%	100%	November 2005
5.1.2 Storm Water Diversion – Construction	0%	100%	September 2007
5.2.1 Water Circulation – Plans and Specs	0%	100%	August 2005
5.2.1 Water Circulation & ADA Dock – Construction	0%	88%*	March 2008
6.0 Construction Support Services	0%	95%*	March 2008
7.0 Reporting			
7.1 Draft Final Report	100%	100%	December 2007
7.2 Final Report	100%	100%	January 2008

*The remaining work is related to the modifications of the new gangway to comply with the ADA regulations as described in subsection 3.1.

EXHIBIT B
(Aquatic Bioassay Consulting Laboratories Report)