Preliminary Water Quality Screening Plan
2003/04 Wet Season

Lake Merced Restoration – Phase 2 Pilot Stormwater Enhancement Project

Prepared by the North San Mateo County Sanitation District
and the San Francisco Public Utilities Commission
with assistance from EOA, Inc.

JAN 26, 2004

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INTRODUCTION

North San Mateo County Sanitation District (NSMCSD), a subsidiary of the City of Daly City, and the San Francisco Public Utilities Commission (SFPUC) are working to address a number of integrated resource management issues associated with improving water levels at Lake Merced. A Memorandum of Understanding between the parties dated November 26, 2001 established a work effort to assess the reintroduction of stormwater runoff from the Vista Grande drainage basin back into Lake Merced as a source of lake recharge. A proposed Supplemental Environmental Project (SEP) (NSMCSD 2003) would expand upon NSMCSD's efforts to evaluate the feasibility of using diverted Vista Grande stormwater runoff as a means to increase source water to Lake Merced. The ultimate goals include implementing Best Management Practices (BMPs) to treat stormwater, increasing the water level of the lake and potentially alleviating flood control problems associated with peak stormwater flows adjacent to South Lake Merced.

Phase I of the pilot stormwater enhancement project involved the installation of structural stormwater treatment units supplied by Continuous Deflection System (CDS) Technologies. The CDS units were put into operation during the 2002/03 rainy season, during which stormwater flows of up to 19 cubic feet per second were diverted, treated, tested, and then returned to the Vista Grande canal (i.e., no discharge has occurred from the units to Lake Merced to date). Performance data are summarized for 8 storms in CH2MHill, 2004. Data from the CDS treatment system effluent shows that it did not reduce elevated coliform and nutrient levels. However, the CDS units were effective in removing trash and debris. Daly City has been unable to locate the source of coliform, even after numerous sanitary sewer investigations.

Phase 2 of the pilot project is currently under design, and involves using a vegetated area along a small section of the southwestern shoreline of South Lake Merced (Figure 1) as a stormwater treatment wetland (CASQA 2003). The primary goal of this phase of the project is to determine the extent to which water quality in Lake Merced is impacted by the introduction of Vista Grande stormwater after passage through the vegetated area. To facilitate this phase of investigation, a limited volume of Vista Grande Stormwater runoff will be treated and diverted to Lake Merced on a pilot basis during the 2003/04 wet season. Stormwater discharged from the CDS units will enter the treatment wetland for further removal of pollutants before entering the lake. NSMCD and SFPUC plan to perform the water quality screening described in this plan as a preliminary evaluation of potential water quality impacts of the pilot diversion.

OVERVIEW OF PRELIMINARY WATER QUALITY SCREENING PLAN

This Preliminary Water Quality Screening Plan was prepared collaboratively by NSMCSD and SFPUC. The objective of the field program described in this plan is to provide preliminary data on the water quality impacts of diverting Vista Grande stormwater runoff (treated by the CDS units and treatment wetland) to Lake Merced. The goal is that stormwater added to the lake will not degrade, and may potentially improve, the ambient water quality of Lake Merced. The general strategy will be to collect water samples from the lake during several storm events during the 2003/04 and 2004/05 wet seasons. Treated Vista Grande stormwater will be diverted to Lake Merced during some but not all of the sampling episodes. The water quality data will be used to

make a preliminary evaluation of the incremental effect of the diversion on the lake's water quality during storm events. In other words, the screening will gather preliminary data on water quality impacts of the diversion in comparison to existing impacts when runoff from other sources enters the lake during storm events.

The water quality screening described in this plan is limited to gathering preliminary data on selected water quality parameters. The focus will be on selected pollutants and bacterial indicators with water quality objectives or USEPA criteria in the Basin Plan (CRWQCB 1995) and nutrients. Sample locations will be limited to South Lake Merced. The screening will help evaluate the potential for using the treatment wetland to remove nutrients and induce coliform die-off from a portion of the Vista Grande canal flow. If Phase 2 is successful, then additional environmental engineering design and regulatory permitting will be required to "scale up" the pilot project for full scale implementation.

SFPUC (2003) has begun evaluating impacts to water quality, vegetation, wildlife and other beneficial uses associated with using various make-up waters, including Vista Grande stormwater runoff, to raise water levels in Lake Merced. The evaluation includes preliminary modeling of stratification energetics, nutrient dynamics and habitat changes. SFPUC plans to develop additional technical information that will include a comprehensive long-term monitoring program plan and evaluation of the regulatory process for augmentation of the lake, including California Environmental Quality Act (CEQA) analysis and appropriate permitting documentation. SFPUC anticipates establishing a target lake level range and supplemental water source(s) over the next 12 to 18 months with public input.

It should also be noted that direct evaluation of the performance of the CDS units and treatment wetland is not part of this plan. NSMCSD and the SFPUC will separately collect additional data on the performance of the CDS units during the 2003/04 wet season. Staff from the SFPUC's Bureau of Environmental and Regulatory Management (BERM) will collect samples and flow measurements.

FIELD PROGRAM

Staff from the SFPUC's Water Quality Bureau will be responsible for collecting water samples from Lake Merced, making associated observations and *in-situ* probe measurements in the field, and arranging delivery of the samples to SFPUC's analytical laboratory. NSMCSD will provide funding to SFPUC for analysis of the lake samples. NSMCSD/Daly City and SFPUC will work cooperatively to operate the stormwater diversion/treatment equipment and collect water quality data on the CDS unit discharge before it enters the treatment wetland. Attachment 1 contains an Operations Plan for the pilot project, which includes roles and responsibilities, planned flows and durations, contingency planning and a public information program.

Lake Sample Collection and Analysis

This preliminary plan assumes that water samples will be collected from Lake Merced during six storm events during the 2003/04 wet season. The actual number of sampling episodes may vary, depending on factors such as weather patterns and the availability of staff and equipment.

Treated Vista Grande stormwater runoff will be diverted to Lake Merced during four of the six sampling episodes. Water quality samples will be collected from the lake as soon as possible after the diversion is closed and/or the end of the storm event but no longer than 48 hours after the diversion is closed. SFPUC and NSMCSD staff will record the duration and rates of flow through the CDS units during each sampling episode.

SFPUC will collect lake water samples at the seven sample station locations shown on Figure 1 during each sampling episode. Stations LM-1, LM-2 and LM-3 are located adjacent to the stormwater discharge area, immediately adjacent to the bulrush that rings the shoreline. Stations

LM-4, LM-5 and LM-6 were selected to potentially reveal attenuation of pollutant levels (e.g., coliform die-off) with increasing distance from the stormwater discharge area. Station LM-PR is intended to provide background ambient water quality data in the lake during storm events. Historical ambient water quality data are available from this sample station. During each of the six sampling events, a field duplicate will be collected. In summary, 42 samples (seven stations during each of six sampling episodes), and six field duplicates will be collected, for a total of 48 samples.

All samples will be surface grab samples. Dissolved oxygen, pH, temperature and conductivity will be measured *in-situ* at each sampling location using field probe instruments. In addition, a vertical temperature profile will be collected at each sampling location to gather data on potential thermal stratification of the lake at the time of sampling. Appropriate visual observations will also be recorded at the time of sampling, including weather conditions, water levels, the presence of any sheens, foams, floating trash, and wildlife observed (i.e., the number and type). In addition, observations regarding any recreational use of Lake Merced at the time of each sampling episode will be recorded. Such observations will include the number of people recreating, the approximate location, and the types of recreational activities. The form in Attachment 2 will be used to record all visual observations. Photographs will also be taken during each sampling episode to help document the visual observations and general conditions of the lake.

The bacteriologic and chemical analyses presented in Table 1 will be conducted on each lake water sample by SFPUC's DHS-certified laboratory.

Table 1 – Summary of Lake Water Sample Bacteriologic and Chemical Analyses

Analyte	Analysis Method	Reporting Limit
Cr, Total	EPA 200.7	10.0 ug/L
Cu, Total	EPA 200.7	10.0 ug/L
Ni, Total	EPA 200.7	10.0 ug/L
Pb, Total	EPA 200.7	3.0 ug/L
Zn, Total	EPA 200.7	20.0 ug/L
Alkalinity	EPA 310.1	20 mg/L
Hardness	EPA 130.2	2.0 mg/L
Total Dissolved Solids	EPA 160.1	10 mg/L
Total Suspended Solids	EPA 160.2	10 mg/L
Orthophosphate	SM 4500-P A,B,C	0.060 mg/L
Phosphorus, Total	SM 4500-P A,B,C	0.2 mg/L
Ammonia	SM 4500-NH_3 C,E,N	0.7 mg/L
Total Kjeldahl Nitrogen	SM4500-N B	0.6 mg/L
Nitrate	SM4500-NO_3B B	0.20 mg/L
Nitrite	SM4500-NO_2B B	0.20 mg/L
Total Coliform & *E.Coli*	Quantitray*	10 – 24,190 MPN/100 ml
Enterococci	Quantitray**	10 – 24,190 MPN/100 ml

*MMO-MUG using Colisure™ Media
**Enterolert™ Media

CDS Unit Sampling and Analysis

During the first two of the four sampling episodes with stormwater diversion, a CDS unit discharge water sample will be collected soon after the diversion is commenced. Each of these two samples will be analyzed for the CAM 17 list of metals (which includes mercury) identified in the California Code of Regulations and petroleum hydrocarbons (EPA Method 8015 and/or 8020).

One CDS unit discharge water sample will also be collected from each storm event to monitor for all analytes in Table 1. This will allow for a screening level comparison of coliform die-off and of the efficiency of the wetlands to remove pollutants.

Treatment Wetland Soil Sampling and Analysis

Surface soil samples will be collected from the treatment wetland in the three locations shown on Figure 1. Two episodes of soil sampling will be performed, resulting in the collection of a total of six soil samples. The first episode will take place before the pilot diversion commences and the second episode after all the pilot diversion work is complete for the 2003/04 wet season. Each sample will be analyzed for the Cr, Cu, Ni, Pb and Zn. Comparison of the results between the first and second episodes will help determine whether metals are entering the soils of the treatment wetland during the diversions.

REPORTING

NSMCSD and SFPUC will prepare a pilot project report by August 2004 that summarizes and discusses the water sampling program methodologies and analytical results. The results of the pilot project will be analyzed numerically to characterize, to the extent feasible, if there are incremental impacts to Lake Merced water quality that are attributable to the diversion of Vista Grande stormwater into Lake Merced.

A secondary objective will be to determine if there are any surrogate contaminants that could act as rapid indicators of fecal pollution in Lake Merced during diversion of Vista Grande stormwater into Lake Merced. In a recent study of the Tomales Bay watershed, preliminary indications are that nitrate and/or conductivity may be appropriate rapid indicators that can be used to identify conditions of high fecal contamination. Based on a conversation with Golden Gate National Recreation Area staff, it is believed that these preliminary relations (between nitrate and conductivity, and fecal contamination) are likely watershed and source dependent (that is, the primary source of contamination in Tomales Bay also results in increased levels of nitrate and conductivity). It is not clear if the results from Tomales Bay are applicable to Lake Merced because the sources of contamination in an urbanized area could be very different than those in the Tomales Bay watershed. However, based on the results of that study, it seems plausible that there may be a surrogate that could indicate high levels of fecal contamination in Lake Merced. Therefore, the results of this pilot study will be analyzed numerically to determine if conductivity, nitrate, nitrite, TSS, or TDS (constituents investigated during the GGNRA investigation) could be used in this watershed as a rapid indicator for high levels of fecal contamination. Based on the results of this numerical analysis, appropriate recommendations will be made.

REFERENCES

CASQA 2003. *Stormwater Best Management Practice Handbook, New Development and Redevelopment.* California Stormwater Quality Association. January 2003.

CH2MHill 2004. Evaluation of Vista Grande Phase 1 Stormwater Treatment Project, 2002/2003.

CRWQCB 1995. *Water Quality Control Plan, San Francisco Bay Basin (Region 2).* California Regional Water Quality Control Board, San Francisco Bay Region. June 21, 1995.

NSMCSD 2003. *Supplemental Environmental Project Proposal, Lake Merced Restoration – Pilot Stormwater Enhancement Project.* Submitted by North San Mateo County Sanitation District, a subsidiary of the City of Daly City. September 8, 2003.

SFPUC 2003. DRAFT. *Task 4 Technical Memorandum: Impacts to Water Quality, Vegetation, Wildlife, and Beneficial Uses.* Initiative to Raise and Maintain Lake Level and Improve Water Quality - Lake Merced. San Francisco Public Utilities Commission. November 2003.

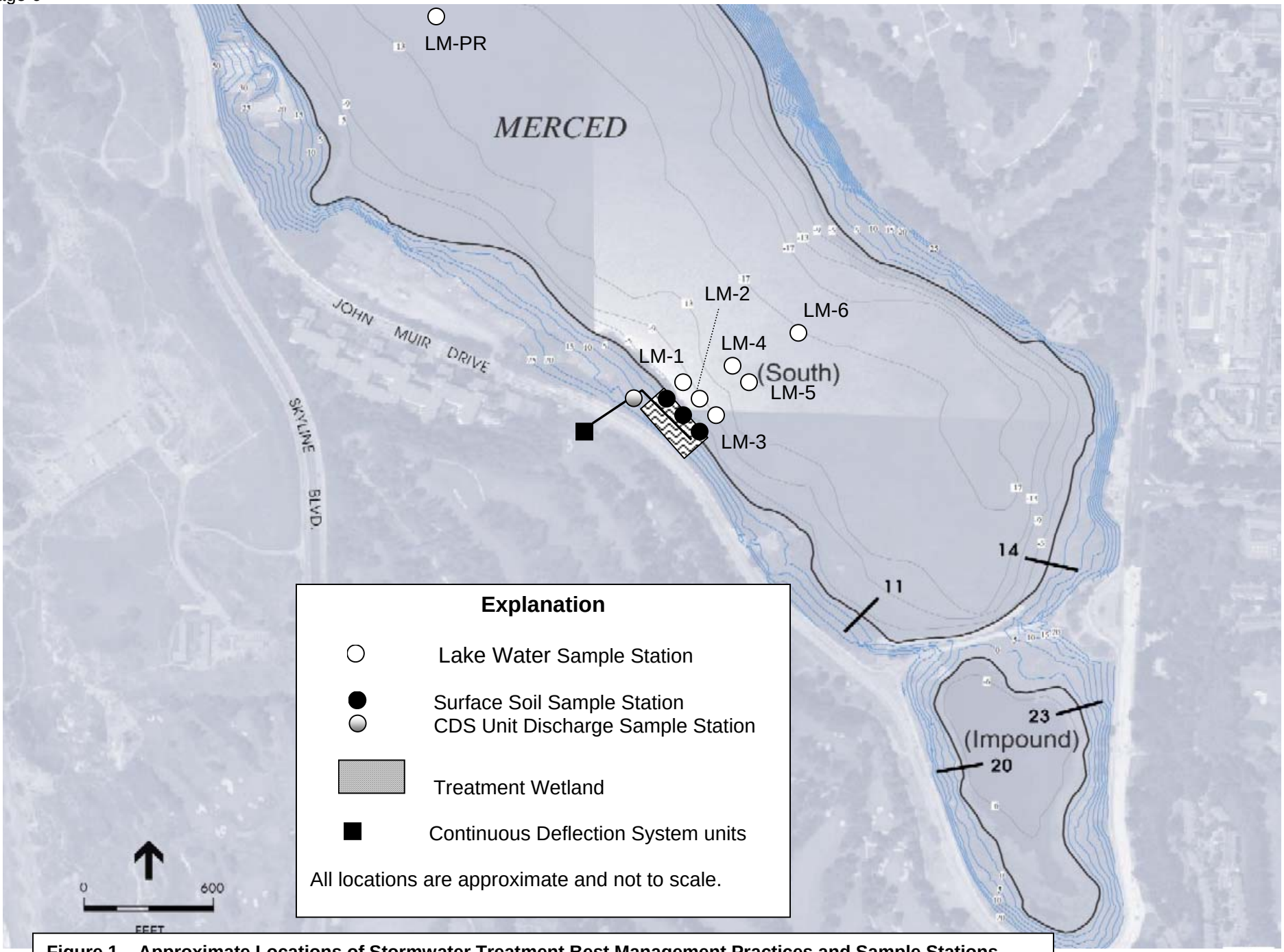


Figure 1 – Approximate Locations of Stormwater Treatment Best Management Practices and Sample Stations

ATTACHMENT 1

OPERATION OF VISTA GRANDE STORMWATER PILOT PROJECT

The North San Mateo County Sanitation District, a subsidiary of the City of Daly City, will be the lead agency responsible for the operation of the gate valve at the headworks of the Vista Grande Tunnel, and the cleaning and maintenance of the Continuous Deflection System (CDS) units installed near the headworks structure. Crews from the Collection System section have been assigned to these tasks. The CDS units are cleaned and washed down using vacuum suction supplied by one of two Vac-Con trucks used in the Collection System fleet. Each Vac-Con truck is staffed by two members of the Collection System crew of which at least one crew member will possess, at a minimum, a Grade I Certificate issued by the California Water Environment Association (CWEA).

Establishing flow rates for each of the storm events to be sampled will involve project coordination between the City of Daly City Collection System and the San Francisco Public Utilities Commission Bureau of Environmental and Regulatory Management (BERM). Weather forecasts will be tracked to provide as much lead-time as possible to assure mobilization of resources. The gate valve will not be opened without the advance knowledge of BERM staff. First priority within the first sampling event with stormwater diversion will be to wait a minimum of one-hour from the commencement of rainfall before opening the Vista Grande tunnel headworks gate valve that will allow stormwater to flow into the Vista Grande Canal CDS units. Crew will be stationed at the headworks and open the gate valve using a turn key. Crews will also be stationed across John Muir Drive adjacent to the Lake Merced Overflow Structure where flows will be measured following the flow equalization at the headworks and CDS units before stormwater flows head towards the outfall box. Once flows have commenced through the perforated drainage pipe, the crew at the outfall box will measure the rate of flow, using the SFPUC installed flow meter, and communicate through the use of two-way radio whether the flow needs to be increased or decreased. The crew at the gate valve will record the number of “turns” on the gate valve turn key to achieve the desired flow rate. Once flow rate has been established, the crews will begin the initial operation of the sampling event noting the time when the event started. The initial first test will last no more than 24 hours at which time the gate valve at the Vista Grande Headworks will be closed. To avoid tampering with the operation of the gate valve, Daly City Collection System will provide a locked gate valve cover cap and provide BERM staff with a back-up copy of the key.

For health and safety reasons, opening the gate valve and assessing rate of flow during the pilot program will only take place during daylight hours. The gate valve area is enclosed by a gated fence that is locked at all times to prevent trespassing. The CDS units are accessed through a hatch which remains closed and locked at all times until the sump areas is cleaned following the end of a storm event. This is to further ensure safety of Collection System crews and any trespassers. Confined space entry is not required to effectively clean out the CDS units using a Vac-Con truck. At the Lake Merced Overflow Structure, a small access hatch is also locked at all times. The study area is cordoned off and barricaded to prevent trespassing.

Once a storm event has ceased or flow discharge has run its allotted time, the gate valve will be closed and it will remain closed pending the results from testing. Results of testing will dictate the manner in which the gate valve is operated during the course of the pilot study.

At least once each day during a storm event with stormwater diversion, BERM staff will inspect the perforated pipe discharge using the visual observation log (Attachment 2).

CONTINGENCY PLANS

Erosion

Based on observations during the 3,000 gpm dye test, erosion is not expected to be a concern given the relatively gentle topography, thick vegetation, and engineered geotextile underlying the alignment

of the perforated pipe. However, in the event that significant erosion is observed, the discharge will be stopped or modified to minimize erosion.

Bacteria levels

Water quality objectives for Lake Merced are set conservatively using full body water contact standards even though such use is prohibited at Lake Merced by SFPUC Resolution No. 10,435. The water quality objectives for body contact recreation are derived from epidemiological studies of bathers recreating in surface waters, which received bacteriological contamination via wastewater treatment effluent[1]. The basis for the objectives is an assumed tolerable gastrointestinal (GI) illness rate of 19 illnesses per 1000 recreation events (in freshwater)[2]. In assigning a relation between indicator organism concentration and risk of GI illness, an implied assumption is made that each recreator ingests a constant volume of water. Although no such volumes are directly documented in the regulations, state and federal guidance documents typically estimate volumes ingested of between 50 and 100 ml per recreation event. A summary of the applicable water quality standards for body contact recreation is provided in Table 1.

Table 1. Water Quality Objectives and Criteria for Body Contact Recreation

Constituent	Estimate of Central Tendency (MPN/100mL)	Basis	Single Sample Max (MPN/100mL)	Basis
Total coliform	240 (median)	Basin Plan	10,000	Basin Plan
Fecal coliform	200 (log mean)	Basin Plan	400 (90th percentile)	Basin Plan
E coli[b]	<126 (g. mean)	U.S. EPA, SFPUC criteria for issuing a health advisory for swimming beaches[a]	576	Infrequently used full body contact recreation (upper 95%CL)
Enterococci[b]	<33 (g. mean)	U.S. EPA, SFPUC criteria for issuing a health advisory for swimming beaches[a]	151	Infrequently used full body contact recreation (upper 95%CL)

Notes: DHS: CCR Title 17, Article 4, 7958
RWQCB: Basin Plan
[a]Swimming in Lake Merced is prohibited by SFPUC Resolution No. 10,435 adopted in 1950.
[b]EPA 1986 Ambient Water Quality Criteria for Bacteria, EPA 440/5-84-002

A recent review of epidemiological studies supports the use of E. Coli as the currently best available predictor of GI illness for the regulation of recreational water[3]. However, the applicability of bacterial indicator organisms to predict health risks associated with stormwater has been widely questioned in recent research[4]. The underlying question is whether or not it is reasonable to assume that the same pathogens are present and are in the same ratios in stormwater, as compared to effluent impacted

[1] Stevenson, 1953; Cabelli, 1982; US EPA, 1986, and Wymer and Dufour, 2002.
[2] US EPA, 1986
[3] Wade et al., 2003
[4] Noble and Fuhrmann 2001; Jiang et al., 2001; Noble et al., 2003;

surface waters. The only published studies addressing this question investigated the health effects associated with human exposure to dry weather urban runoff[5].

Historic bacteriological data from Lake Merced indicates that bacteriological levels in Lake Merced are typically below the water quality objectives for body contact recreation during dry (non-storm) periods. Recent monitoring data collected in association with the dye testing corroborate this assertion (Table 2)[6].

Table 2. Lake Merced Water Quality Monitoring Data Collected December 22, 2003

Sample Location	Collection Date	Total Coliform (MPN/100mL)	*E. coli* (MPN/100mL)	*Enterococcus* (MPN/100mL)
LMVG - 1	12/22/03	437	63	<10
LMVG - 2	12/22/03	650	41	<10
LMVG - 3	12/22/03	481	<10	<10
LMVG - 4	12/22/03	820	20	<10
LMVG - 5	12/22/03	547	31	<10
LMVG - 6	12/22/03	703	10	<10
LMPR	12/22/03	314	10	<10

It is not unusual for the concentration of indicator organisms in stormwater to be high. Such concentrations have been reported to cause increased levels of bacteria in receiving waters[7]. This observation is also true for Lake Merced, whose bacterial concentrations have exceeded full body water contact standards, during the storm season, particularly near the shoreline where bird and animal waste can wash into the lake.

The pilot project planned flow rates and durations of discharge are shown in Table 3. The flow rates and discharge durations have been designed so that the lowest flow rates and shortest discharge durations will occur first, followed by increased flows and durations. This strategy is employed as insurance that impacts on the lake are minimized during this pilot project. Lake water samples will be collected at seven monitoring stations as indicated on Figure 1 of the Screening Plan.

Table 3. Vista Grande Stormwater Phase 2 Discharge Rate and Duration

Storm Number	Flow Rate (gallons per minute)	Duration (hours)	Volume[1]
1	Background Storm #1	No diversion	0
2	Background Storm #2	No diversion	0
3	500	24	720,000
4	1500	24	2,160,000
5	1500	48	4,320,000
6	3000	48	8,640,000

1 – Volume assumes that flow rate can be maintained for entire duration of diversion.

[5] Haile et al., 1999.
[6] Approximately one-half inch of rainfall was recorded in downtown San Francisco on both December 19 and 20, 2003.
[7] Ackerman and Weisberg, 2003; Noble et al., 2003

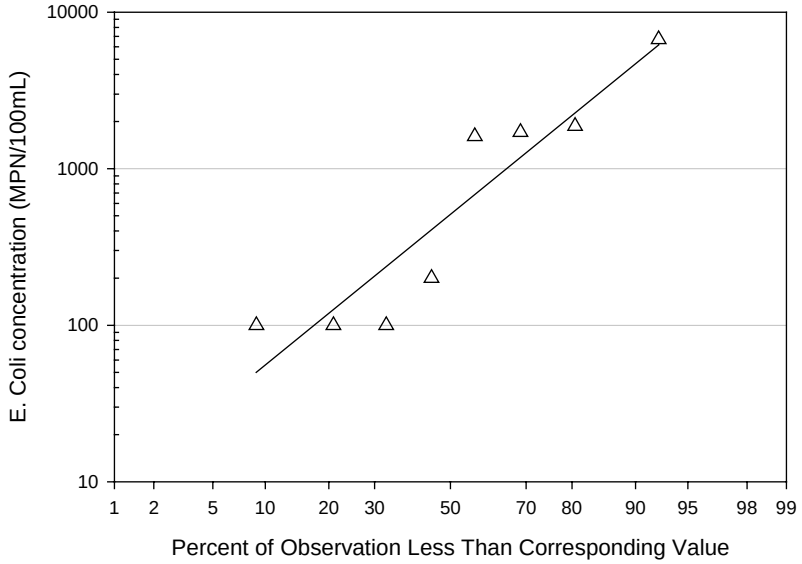
For purposes of evaluating the incremental impact of adding Vista Grande stormwater runoff to Lake Merced during a storm event, bacterial water quality from the lake will be evaluated for two background storms (Storm Nos. 1 and 2 in Table 3). Because bacterial water quality data are known to be highly variable, the E. coli data from those storms will be fit to a lognormal distribution via the Method of Maximum Likelihood[8,9]. The resulting distribution can be used to estimate the concentration of E. Coli in Lake Merced during storm events and will be used as a guide to determine how the stormwater runoff from the diversion impacts bacterial water quality in the Lake.

The procedure that will be used is illustrated here for a series samples that were collected in Lake Merced (although in a different area than the study area) during storms from 12/15/2002 through 2/27/2003. The E. coli data that were collected during those storms are summarized in Table 4. The data were fit to a lognormal distribution and plotted (Figure A-1). Inspection of Figure A-1 indicates that the data are reasonably approximated by a lognormal model.

Table 4. Summary of Bacteria Concentrations in along Lake Merced Shorline During Storm Events

Analyte (MPN/100mL)	Sample_Date	Concentration
E. Coli	12/15/2002	1610
	12/20/2002	200
	12/22/2002	100
	12/31/2002	1710
	1/10/2003	1870
	1/23/2003	6690
	2/25/2003	100
	2/27/2003	100

Figure A-1
Probability Plot of E. Coli Concentrations
in Lake Merced During Storm Events
(12/02 - 2/03)



To evaluate the incremental impact of adding Vista Grande stormwater to Lake Merced during a storm event with the diversion, the upper 80th percentile of the background distribution (of E. Coli concentration in Lake Merced during the first two monitored storm events) will be used as an upper

[8] Nash et al, 1979; Olivieri et al. 1999
[9] Note that US EPA recommends the use of a lognormal distribution for environmental data samples, US EPA 1991.

guide[10,11]. For this contingency plan, the geometric mean of the Lake Merced samples (during the diversion) will be compared to the baseline distribution of E. Coli in Lake Merced during storm events (based on the data from background storms No. 1 and No. 2). If the geometric mean of the samples exceeds the 80th percentile of the baseline storm E. Coli distribution, then subsequent storm discharge rates and durations will be evaluated and modified based on the monitoring results for the preceding storm.

PUBLIC INFORMATION PROGRAM

The boating contacts at Lake Merced will be kept informed of the monitoring results during the pilot test on an ongoing basis.

The project site will be posted with the following information:

Public Notice Public Notice Public Notice

The San Francisco Public Utilities Commission and the City of Daly City are conducting a demonstration project on this site. Stormwater from the Vista Grande Canal, located just across John Muir Drive, is being evaluated as a potential source of water to sustain the lake level of Lake Merced.

This demonstration involves testing the ability of plants located on shore and near the shoreline to absorb contaminants known to exist in this stormwater.

This is a limited test, with volumes of water small enough to pose no serious threat to overall water quality in Lake Merced. Both the stormwater and lake water near the shoreline are being monitored carefully to assure compliance with public health and safety standards.

For more information contact Amy Sinclair of the SFPUC at (415) 551-4659.

Please do not enter the demonstration site.

[10] Unless the 80th percentile of the background distribution is lower than water quality objectives shown in Table 1, in which case the water quality objectives will be used as an upper guide.
[11] The 80th percentile of the background distribution is approximately 2000 MPN/100mL in the example presented above.

December 5, 2003

Attachment 2
Lake Merced Restoration – Phase 2 Pilot Stormwater Enhancement Project
Record of Recreational Use of South Lake Merced During Water Quality Sampling and other Site Visits

Name, Position and Organization: _____

Date: _____ Timeframe Present at Site (e.g. 8am – 2pm): _____

Weather Conditions: _____

On the below map, record the approximate location of any recreational activities on or near the shoreline of South Lake Merced (e.g., boating, fishing, wading, hiking) observed anytime while you are at the site. Include the number of people recreating, the types of recreational activities observed, and the numbers and types of any pets observed. Record presence or absence of birds or other wildlife. Also include location of photos taken.