Pathogens
in
Richardson Bay
Total Maximum Daily Load (TMDL)

Staff Report and Proposed Basin Plan Amendment

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TABLE OF CONTENTS

LIST OF FIGURES ..... **II**

LIST OF TABLES ..... **II**

1. INTRODUCTION ..... **I**

2. BACKGROUND **4**

2.1 RICHARDSON BAY 4
2.2 WILDLIFE RESOURCES 4
2.3 RECREATIONAL AND COMMERCIAL VESSELS 6
2.4 RESIDENTIAL VESSELS AND FLOATING STRUCTURES 6
2.5 RICHARDSON BAY SPECIAL AREA PLAN AND THE RICHARDSON BAY REGIONAL AGENCY 6
2.6 NO VESSEL WASTE DISCHARGE AREA 7

3. PROJECT DEFINITION **8**

3.1 PROBLEM STATEMENT 8
3.2 PROJECT DEFINITION 8

4. WATER QUALITY STANDARDS AND MONITORING RESULTS **10**

4.1 USE OF FECAL COLIFORM BACTERIA AS INDICATORS OF PATHOGENS 10
4.2 WATER QUALITY STANDARDS 11
4.3 U.S. EPA ENTEROCOCCI STANDARDS 12
4.4 HISTORICAL BACTERIAL MONITORING STUDIES 13
4.5 RECENT BACTERIAL MONITORING DATA 14
4.6 RICHARDSON BAY REGIONAL AGENCY (RBRA) MONITORING DATA 15
4.7 CONCLUSION 16

5. NUMERIC TARGETS **26**

5.1 NUMERIC TARGETS 26

6. POLLUTANT SOURCE ASSESSMENT **27**

6.1 OVERVIEW 27
6.2 SANITARY SEWER SYSTEMS 27
6.3 STORMWATER RUNOFF 28
6.4 HOUSEBOATS 30
6.5 VESSELS (RECREATIONAL, LIVE-ABOARD, AND ANCHOR-OUT BOATS) 32
6.6 WILDLIFE 32

7. TOTAL MAXIMUM DAILY LOAD AND LOAD ALLOCATIONS **34**

7.1 GENERAL APPROACH 34
7.2 PROPOSED TOTAL MAXIMUM DAILY LOAD 34
7.3 PROPOSED LOAD ALLOCATIONS 35
7.4 MARGIN OF SAFETY 36
7.5 SEASONAL VARIATION 36

8. LINKAGE BETWEEN WATER QUALITY TARGETS AND POLLUTANT SOURCES **37**

9. IMPLEMENTATION PLAN **38**

9.1 OVERVIEW 38
9.2 LEGAL AUTHORITIES AND REQUIREMENTS 38
9.3 PLANS & POLICIES IN THE RICHARDSON BAY WATERSHED 39
9.4 ACTIONS TO REDUCE PATHOGENS IN RICHARDSON BAY 43
9.5 EVALUATING PROGRESS TOWARDS ATTAINING IMPLEMENTATION GOALS 49

10. MONITORING AND EVALUATION PROGRAM 50

10.1 OVERVIEW 50
10.2 WATER QUALITY MONITORING 50
10.3 DATA MANAGEMENT AND EVALUATION 52
10.4 ADAPTIVE IMPLEMENTATION 52

11. REGULATORY ANALYSES 53

11.1. ENVIRONMENTAL IMPACT ANALYSIS 53
11.2. PROJECT DESCRIPTION 54
11.3. PROJECT OBJECTIVES 55
11.4. REASONABLY FORESEEABLE METHODS OF COMPLIANCE 55
11.5. ENVIRONMENTAL CHECKLIST 57
11.6. ALTERNATIVES ANALYSIS 80
11.7. ECONOMIC CONSIDERATIONS 81

12. REFERENCES 88

APPENDIX A: PROPOSED BASIN PLAN AMENDMENT

LIST OF FIGURES

FIGURE 1. RICHARDSON BAY 3
FIGURE 2. HISTORIC SHELLFISH BED LOCATIONS IN RICHARDSON BAY 5
FIGURE 3A. RICHARDSON BAY WATER QUALITY MONITORING STATIONS 17
FIGURE 3B. RICHARDSON BAY WATER QUALITY MONITORING STATIONS 18
FIGURE 4. SUMMARY OF FECAL COLIFORM DATA FOR RICHARDSON BAY (1994-2003) 20
FIGURE 5. RICHARDSON BAY FECAL COLIFORM MONITORING DATA (SUMMER 2006 VS. WINTER 2007) 25
FIGURE 6. RICHARDSON BAY LAND USE MAP 29
FIGURE 7. HOUSEBOAT MARINAS IN RICHARDSON BAY 31

LIST OF TABLES

TABLE 1. BENEFICIAL USES OF RICHARDSON BAY RELEVANT TO PATHOGENS TMDL 11
TABLE 2. BASIN PLAN'S WATER QUALITY OBJECTIVES FOR FECAL COLIFORM BACTERIA 12
TABLE 3. SUMMARY OF FECAL COLIFORM MONITORING RESULTS FOR RICHARDSON BAY (1994-2003) 19
TABLE 4. RICHARDSON BAY FECAL COLIFORM MONITORING DATA (SUMMER 2006) 21
TABLE 5. RICHARDSON BAY FECAL COLIFORM MONITORING DATA (WINTER 2007) 22
TABLE 6. RICHARDSON BAY FECAL COLIFORM MONITORING DATA (SUMMER 2006 VS. WINTER 2007) 23
TABLE 7. RICHARDSON BAY REGIONAL AGENCY'S WATER QUALITY MONITORING DATA (SUMMER 2004, 2005, 2006) 24
TABLE 8. NUMERIC TARGETS FOR RICHARDSON BAY 26
TABLE 9. SEWAGE COLLECTION AGENCIES SERVING RICHARDSON BAY MUNICIPALITIES 28
TABLE 10. RICHARDSON BAY BOAT MARINAS 33
TABLE 11. TOTAL MAXIMUM DAILY LOADS OF PATHOGEN INDICATORS FOR RICHARDSON BAY 35
TABLE 12. DENSITY-BASED POLLUTANT WASTELOAD AND LOAD ALLOCATIONS FOR RICHARDSON BAY 35
TABLE 13. PROPOSED WATER BOARD IMPLEMENTATION ACTIONS TO REDUCE PATHOGEN LOADING 43
TABLE 14. PROPOSED IMPLEMENTATION ACTIONS TO REDUCE PATHOGEN LOADING FROM SANITARY SEWER SYSTEMS 44
TABLE 15 PROPOSED IMPLEMENTATION ACTIONS TO REDUCE PATHOGEN LOADING FROM STORMWATER RUNOFF 44
TABLE 16. PROPOSED IMPLEMENTATION ACTIONS TO REDUCE PATHOGEN LOADING FROM HOUSEBOATS 45
TABLE 17. PROPOSED IMPLEMENTATION ACTIONS TO REDUCE PATHOGEN LOADING FROM VESSELS (RECREATIONAL, LIVE-ABOARDS, ANCHOR-OUT BOATS) 46

TABLE 18. CONSTITUENT, LOCATION, FREQUENCY, SAMPLING ENTITIES FOR WATER QUALITY MONITORING 51
TABLE 19. IMPLEMENTATION PLAN REQUIREMENTS EVALUATED IN THIS CEQA ANALYSIS 56
TABLE 20 RICHARDSON BAY IMPLEMENTATION ACTIONS AND ESTIMATED COSTS 82

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1. INTRODUCTION

This Staff Report presents the supporting documentation for a proposed Basin Plan amendment that will be considered by the California Regional Water Quality Control Board, San Francisco Bay Region (Water Board) that establishes a Total Maximum Daily Load (TMDL) and implementation plan for Pathogens in Richardson Bay. The TMDL is based on attainment of pathogen indicator[1] (i.e., fecal coliform) concentrations protective of shellfish harvesting and water contact recreation. This report contains the results of analyses of pathogen impairment assessments, sources and loadings, linkage analyses, proposed pathogen indicator load reductions, and implementation actions.

The Clean Water Act requires California to adopt and enforce water quality standards to protect all waterbodies within the San Francisco Bay Region. The Water Quality Control Plan for the San Francisco Bay Region (Basin Plan) delineates these standards, which include beneficial uses of waters in the Region, numeric and narrative water quality objectives to protect those uses, and provisions to enhance and protect existing water quality (antidegradation). Section 303(d) of the Clean Water Act requires states to compile a list of “impaired” water bodies that do not meet water quality standards and to establish a TMDL for the pollutant that causes impairment. The proposed TMDL and implementation plan are designed to resolve Pathogen impairment in Richardson Bay.

The Richardson Bay pathogens TMDL also encompasses and addresses the pathogens impairment at another 303 (d)-listed waterbody, the Schoonmaker Beach. Therefore, there will be no need for completing a separate TMDL for this impaired waterbody.

This report provides the rationale and the technical basis for the required TMDL elements and associated implementation plan. This report meets the requirements of the California Environmental Quality Act (CEQA), including the preparation of a checklist (Section 11) for adopting Basin Plan amendments and serves in its entirety as a substitute CEQA environmental document.

The process for establishing a TMDL includes compiling and considering available data and information, conducting appropriate analyses relevant to defining the impairment problem, identifying sources, and allocating responsibility for actions to resolve the impairment. This report is organized into sections that reflect background information, the key elements of the TMDL process, and regulatory analyses required to adopt the amendment.

[1] The direct detection and measurement of pathogens in ambient waters is not practicable due to high cost, time, equipment, the need for highly skilled laboratory personnel, and other considerations. A class of non-pathogenic indicator organisms (bacteria) called fecal coliform is therefore commonly used to indicate the presence and assess the magnitude of human fecal pathogenic microorganisms in the environment. Fecal coliforms live and reproduce in the intestinal tracts of all warm-blooded animals (including humans) and are abundantly found in the waste of all warm-blooded animals .The presence of fecal coliform in a water sample indicates the possible presence of pathogens that originate from feces. For more discussion, please refer to Section 3.

In addition, the scientific basis of the Basin Plan amendment was subjected to external scientific peer review. This step is required under §57004 of the Health and Safety Code, which specifies that an external review is required for work products that serve as the basis for a rule, "…establishing a regulatory level, standard, or other requirements for the protection of public health or the environment." The scientific basis of the Richardson Bay Pathogens TMDL, as presented in the Staff Report, was evaluated by two peer reviewers whose comments were considered in finalizing this staff report and the proposed Basin Plan Amendment.

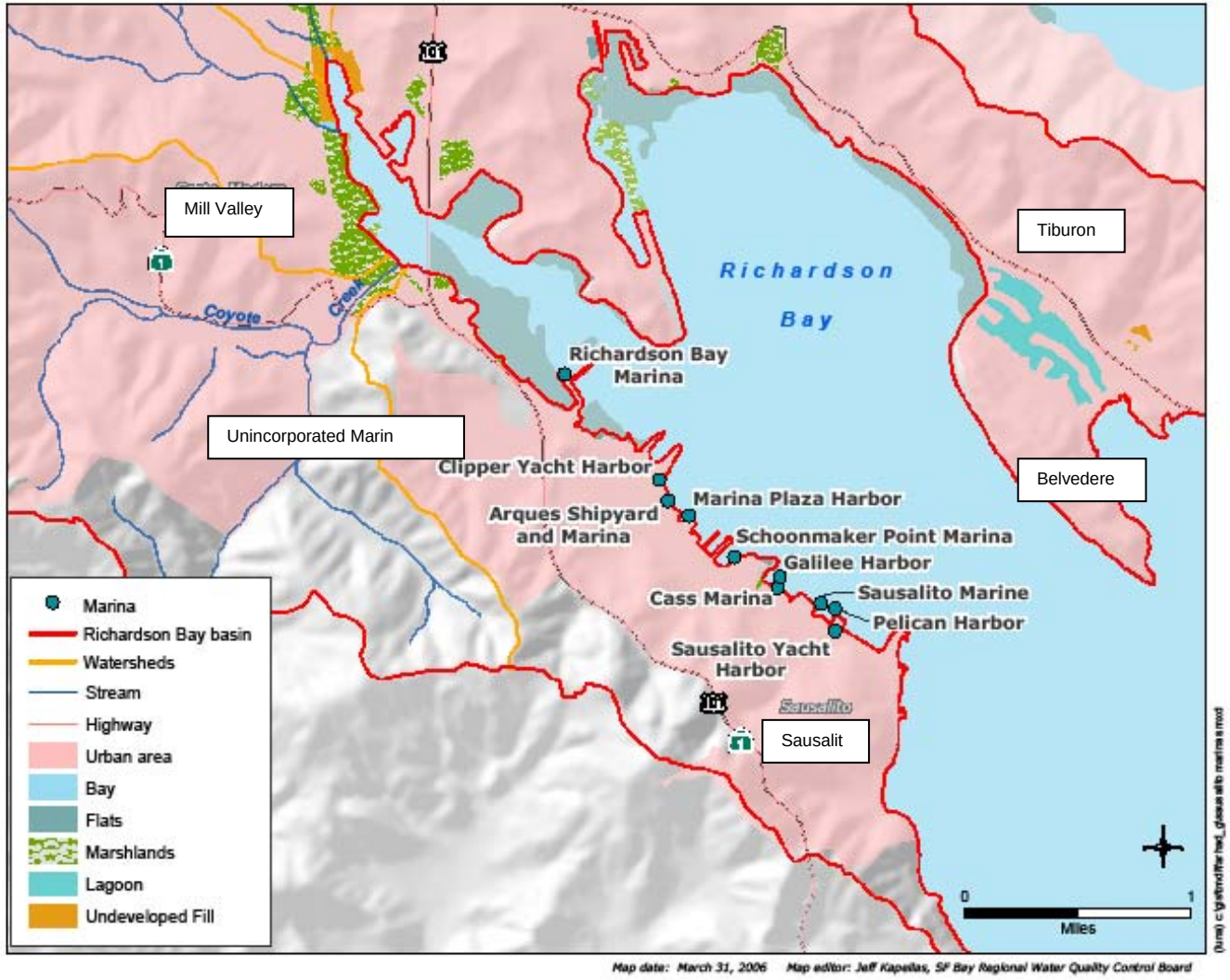
Section 2 presents the background information about the physical setting of Richardson Bay, wildlife resources, and main uses and jurisdictions. Section 3 presents the problem definition that the project is based on and defines the project, why it is necessary and its objectives. Section 4 includes the applicable water quality standards as well as the results of the historic and recent bacterial water quality studies in Richardson Bay.

Section 5 presents the proposed numeric targets. Section 6 provides our understanding of the potential sources of loading of Pathogens to the Bay. Section 7 presents the proposed TMDL and the allocations of the TMDL to categorical sources.

Section 8 presents the linkage analysis which describes the relationship between pathogens sources, load allocations, and the proposed targets. Section 9 presents the Implementation Plan which includes actions and requirements deemed necessary to resolve the pathogens impairment. Section 10 specifies monitoring activities to demonstrate attainment of numeric targets. It also presents an adaptive implementation strategy to review implementation progress and to evaluate any new information generated and/or needed, which may lead to improved implementation actions, and refinement of the TMDL, the numeric targets or the water quality standards in the future.

Section 11 presents the results of CEQA analyses including an environmental impact assessment, an evaluation of alternatives to the proposed Basin Plan amendment, and economic considerations. Chapter 12, References, lists all the information sources cited and relied upon in preparation of this report. The proposed Basin Plan amendment is contained in Appendix A.

Figure 1. Richardson Bay



2. BACKGROUND

2.1 Richardson Bay

Richardson Bay is a small arm of San Francisco Bay located just northeast of the Golden Gate in southern Marin County (Figure 1). It is widely used for recreational activities including boating, kayaking, rowing, and swimming. The Bay has poor pollutant dispersion capability and low assimilative capacity due to its enclosed shape, shallowness, and minimal tidal flushing action.

Although close to the Pacific Ocean, the Bay is protected from strong tides and winds by the Marin Headlands and Tiburon Peninsula, and provides an important shelter for sea birds and migratory waterfowl during the winter months. It provides habitat and refuge for harbor seals, spawning grounds for herring, and important spawning and feeding areas for other fishes, including year-round residents, migrating anadromous fishes, and pelagic ocean visitors. Richardson Bay contains San Francisco Bay's second largest remaining eelgrass bed (officially designated Essential Fish Habitat). Surrounding upland areas provide habitat for a wide range of aquatic and wildlife species in a diverse array of ecosystems, from open water estuary, to shallow mudflats, to tidal marshes, and rocky intertidal shoreline.

2.2 Wildlife Resources

The Audubon Society manages the Richardson Bay Audubon Sanctuary, 900 acres of Richardson Bay (generally between Tiburon and Belvedere). The Sanctuary contains significant biological resources including marsh birdlife, diverse mollusk population, and mammalian species such as harbor seals.

Birds

Richardson Bay has been dedicated as a Hemispheric Reserve of the Western Shorebird Network, and an Important Bird Area. Over one million migratory birds visit Richardson Bay each winter, many utilizing the upper mudflats and the area west of the U.S. Route 101. Migrating species that winter regularly at Richardson Bay include least sandpiper, western sandpiper, spotted sandpiper, American avocet, dunlin, marbled godwit, greater yellowlegs, western willet, long-billed curlew, and dowitcher. A special resident of the Bay is the non-migrating endangered species California clapper rail.

Mammals

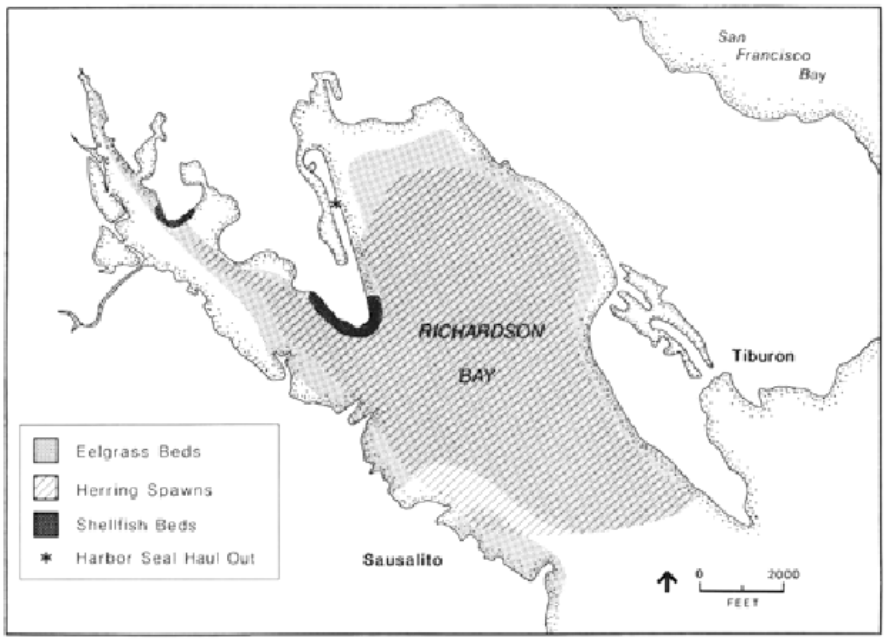
Richardson Bay is one of the few places in the San Francisco Bay System that supports a harbor seal population (SFBCDC et al., 1984). These harbor seals mostly reside and haul-out in DeSilva Island and the Tiburon shore near the Richardson Bay Audubon Sanctuary headquarters.

Shellfish

Historically, Richardson Bay supported oysters, mussels, and clams. Local populations of these shellfish have declined significantly since the 1920s. In 1984, the Richardson Bay Special Area Plan documented two shellfish beds in Richardson Bay, containing approximately 146,000 clams (Figure 2; SFBCDC et al., 1984). The plan noted that "Shellfish are not presently authorized to be taken from these beds for human consumption because they contain pollutants. The Richardson Bay shellfish population can be expected to be safely taken for consumption by recreational shellfishers after water pollution has been significantly reduced" (*ibid*., p.7)."

In 2004, San Francisco State University researchers partnered with the Tiburon Audubon Center in a project designed to test the viability of the historic oyster beds in the Bay. Researchers introduced inert oyster shells to the waters of the Richardson Bay Audubon Sanctuary. After a few months, they found that the native oysters had colonized the artificial reef habitat in very high numbers and had grown to remarkable size in a very short amount of time (Sculati, 2004). In 2007 the project continues under the auspices of the Richardson Bay Audubon Center and Sanctuary, with support from the Ocean Protection Council, the California Coastal Commission, and others. More than 20 organizations—government, not-for-profit, and volunteer—are working to reestablish the native oyster beds and the eelgrass habitat that supports both oysters and other Bay fish.

Figure 2. Historic Shellfish Bed Locations in Richardson Bay



Source: SFBCDC et al., 1984

2.3 Recreational and Commercial Vessels

Because of its sheltered location, size, and proximity to Sausalito and San Francisco, Richardson Bay is highly desirable as an anchorage and harbor for recreational and small commercial vessels. The Bay has a long history of maritime use as a watering station and harbor for careening, whaling, fishing, and shipbuilding since the first European settlement of the Bay Area. Since the Second World War, however, recreational boating has become the major maritime use of the Bay. There are now approximately 2,400 recreational marina berths, mainly located in marinas that have been constructed by dredging the shallows along the Sausalito waterfront (DBW, 2004).

2.4 Residential Vessels and Floating Structures

In all of San Francisco Bay, Richardson Bay is home to the largest number of houseboat marina and vessels and floating structures used for long-term residential purposes. Richardson Bay, especially the northwest Sausalito shoreline, and adjacent area under the jurisdiction of Marin County, has accommodated residential vessels since the early 1900s. The extensive use of the water area for residential use commenced after World War II when salvaged barges and other floating structures left over from the wartime ship building activity in the Marin shipyards were converted to houseboats. In early 1980s, the Sausalito/Marin County waterfront witnessed an increase in the numbers, sizes, designs, and shapes of houseboats and live-aboard vessels locating in the area (SFBCDC et al., 1984).

2.5 Richardson Bay Special Area Plan and the Richardson Bay Regional Agency

Five municipal jurisdictions share Richardson Bay's waters and shoreline: the County of Marin, and the cities of Sausalito, Mill Valley, Belvedere, and Tiburon. Richardson Bay is regulated by the San Francisco Bay Conservation and Development Commission (BCDC). BCDC, which administers the San Francisco Bay Plan, has jurisdiction over any proposed placement of fill, extraction of materials or substantial change of use of any water, land, or structure in the Bay. BCDC works with local jurisdictions to make the provisions and policies of its Bay Plan more specific in particular areas by adoption of Special Area Plans. Such a plan was developed for Richardson Bay in 1984.

Because Richardson Bay is a relatively small and enclosed body of water, activities that occur in one local jurisdiction impact all. Recognizing this, the local governments determined there was need for a unified set of planning policies and regulatory controls that would be common to the local governments and BCDC. Accordingly, in April 1984 the six entities finalized the Richardson Bay Special Area Plan (*Ibid*.).

The following year, the County of Marin and the cities of Belvedere, Mill Valley, Sausalito, and Tiburon formed a joint powers agency, called the Richardson Bay Regional Agency (RBRA), to implement the Richardson Bay Special Area Plan.

2.6 No Vessel Waste Discharge Area

Because of its shallow waters, enclosed shape, and limited tidal flushing, Richardson Bay is particularly susceptible to pollutant contamination. This, and the heavy recreational use of Richardson Bay, led the local agencies and the Water Board to conclude that water quality in Richardson Bay requires greater protection than can be provided under normal federal regulations for sewage discharge by vessels. In 1986, in response to a petition from the County of Marin and the cities of Belvedere, Mill Valley, Sausalito, and Tiburon, the Water Board passed a resolution (resolution no. 86-0006) amending the Basin Plan to prohibit all discharges of sewage from vessels into the Bay. The resolution asked the State Water Board to petition the United States Environmental Protection Agency (EPA) to designate the Bay as a “no vessel waste discharge area.” In response, EPA approved the discharge prohibition, which took effect on August 11, 1987. RBRA is the primary agency responsible for enforcing the vessel waste discharge prohibition and other regulations.

The 1986 Water Board resolution required RBRA to develop an implementation plan for enforcement of the vessel waste discharge prohibition. RBRA’s plan, “Richardson Bay Water Quality Improvement Plan Regarding Vessel Discharge,” was adopted by the Water Board in resolution no. 91-118 on July 17, 1991. The plan includes adoption of ordinances, development of a strategy to deal with anchor-outs and unsewered and sewered houseboats, boater and marina education, and ongoing monitoring. Although there have been periodic delays due to staffing changes, budget problems, and myriad long-standing logistical, legal, and political issues that have complicated abatement of the situation, RBRA has made continuing progress in dealing with the anchor-outs and houseboats.

In 1987, when RBRA adopted Ordinance 87-1 (RBRA, 1987) prohibiting the mooring or anchoring of any vessel in Richardson Bay for residential use, there were a number of pre-existing anchor-out vessels not covered by the ordinance. For the past 20 years, resolution of the anchor-out situation has been progressing through various legal and technical obstacles. Since 1993, the anchor-out population has dropped in the Bay and now stands at about 105 (40 of which are live-aboards) (Price, 2007). RBRA also operates a sewage pumping vessel that services live-aboard boats (both those berthed at marinas and those anchored out outside of marinas on the Bay); however, only twelve of these live-aboard vessels that are anchored-out outside of marinas currently use this service.

The long-standing issue of sewage discharges from unsewered houseboats has been resolved by installing sewer systems, typically connected by flexible lines to a shoreside sewer system. However, recent water quality monitoring results by both the Water Board and RBRA indicate that sewage discharges from substandard/unmaintained sewage collection systems in some houseboat marinas are still a problem (see section 43 for more detail).

3. PROJECT DEFINITION

This section presents the problem statement upon which the proposed Basin Plan amendment project is based. It also presents the project definition and objectives which form the basis of the assessment required by the CEQA.

3.1 Problem Statement

Richardson Bay is impaired by the types of pathogens that are found in warm-blooded animal (e.g., human) waste. We infer the presence of pathogens from high fecal coliform bacteria (pathogen indicator) concentrations. Pathogens pose potential health risks to recreational users and shellfish consumers.

Richardson Bay is listed as an impaired water body (by the U.S. Environmental Protection Agency, under section 303(d) of the Clean Water Act) due to high coliform bacteria levels. The listing of the Bay as impaired is based on widespread exceedance of bacterial water quality objectives (e.g., fecal coliform water quality objectives) for two beneficial uses designated in the Basin Plan: shellfish harvesting and water contact recreation.

3.2 Project Definition

The project is the adoption of a proposed Basin Plan Amendment (see Appendix A) to establish a TMDL and an implementation plan to attain bacterial water quality standards in Richardson Bay. The Water Board is obligated under Section 303(d) of the Clean Water Act to develop a TMDL for Richardson Bay to address its pathogen impairment. The following components form the basis of the proposed regulatory provisions and define the project:

1. Numeric targets for pathogen-indicator concentrations in water column;
2. Density-based total maximum daily pathogen-indicator loads to Richardson Bay;
3. Allocation of the density-based total maximum daily pathogen-indicator load among the categorical source categories in Richardson Bay;
4. Plan to implement the TMDL that includes actions to reduce pathogen-indicator loads to achieve load allocations in Richardson Bay;
5. Monitoring program to evaluate progress in meeting the numeric targets; and,
6. Plan and schedule for reviewing progress toward meeting targets, implementing actions and evaluating continued appropriateness and effectiveness of actions and targets.

3.3 Project Objectives

The objectives of the proposed Basin plan amendment are consistent with the mission of the Water Board and the requirements of the federal Clean Water Act and California's Water Code. The objectives are to:

- Comply with CWA requirement to adopt a TMDL for a Section 303 (d) listed water body
- Protect existing and potential beneficial uses of recreation and shellfish harvesting in Richardson Bay
- Attain the numeric water quality objectives of fecal coliforms of 200 MPN/100 mL for water contact recreation and 14 MPN/100 mL for shellfish harvesting for Richardson Bay established in the Basin Plan in as short a time frame as feasible
- Set numeric target(s) to attain relevant water quality standards in Richardson Bay
- Avoid imposing regulatory requirements that are more stringent than necessary to meet numeric targets and attain water quality standards
- Complete implementation of the TMDL in as short a time as is feasible

4. WATER QUALITY STANDARDS AND MONITORING RESULTS

Sections below discuss the applicable bacterial water quality standards, and results of past and recent bacteriological studies.

4.1 Use of Fecal Coliform Bacteria as Indicators of Pathogens

More than 100 types of pathogenic microorganisms can occur in water polluted by fecal matter and cause outbreaks of waterborne disease (Havelaar, 1993). Recreational waters polluted by fecal matter, and shellfish harvested from waters contaminated by human sewage and/or animal wastes can be vectors of pathogenic disease.

For a number of reasons, the detection and enumeration of all pathogens of concern is impractical in most circumstances. Many different pathogens can reside in a single water body, and organism-specific detection methods are extremely costly and time consuming (USEPA, 2002). Therefore, indicator organisms are commonly used to assess microbial water quality for both shellfish growing and recreational uses. Several types of indicator bacteria colonize the intestinal tracts of warm-blooded animals and are routinely shed in their feces. These organisms are not necessarily pathogenic, but are abundant in wastes from warm-blooded animals and are easily detected in the environment. The detection of these indicator organisms indicates that the environment is contaminated with fecal waste and that pathogenic organisms may be present.

Commonly used bacterial indicators of fecal contamination include total coliforms, fecal coliforms, *E. coli*, and fecal enterococci.

- Total coliforms include several genera of bacteria commonly found in the intestines of warm-blooded animals. However, many types of coliform bacteria grow naturally in the environment—that is, outside the bodies of warm-blooded animals.
- Fecal coliforms are a subset of total coliform and are more specific to wastes from warm-blooded animals, but not necessarily to humans.
- *E. coli* are a subset of fecal coliforms, and are thought to be more closely related to the presence of human pathogens than fecal coliforms (*ibid*.).
- Fecal enterococci represent a different bacterial group from the coliforms, and are also regarded to be good indicators of fecal contamination, especially in salt water (*Ibid.*).

Although fecal coliform bacteria have historically been the indicator organisms of choice, they have some shortcomings as these indicators are not human-specific, and therefore do not fully assess the health risk from human-specific pathogens. This limitation is of less importance than might be assumed, since fecal contamination from a wide range of non-human species—both domesticated and wild—often carry human pathogens (Ibid.). Despite these shortcomings, no practical alternative to the use of fecal indicator bacteria is currently available.

At present, federal and state standards used to assess water quality for shellfish growing (the most sensitive beneficial use of the Bay in terms of becoming impaired by pathogens) and protect public health are all based on coliform bacteria concentrations.

Further, fecal coliform bacteria are a better and more specific indicator of human pathogens than the total coliform bacteria. For these reasons, the Richardson Bay Pathogens TMDL uses fecal coliforms to indicate and regulate pathogen presence. However, if during the adaptive implementation phase of the TMDL, better indicator organisms become available and accepted and new shellfish growing water standards are put into place for these organisms, the TMDL will be modified accordingly.

4.2 Water Quality Standards

Under the authority of the Clean Water Act, the Water Board has established water quality standards for Richardson Bay. Water quality standards consist of:

Beneficial uses[2] for the waterbody, Water quality objectives (WQOs)[3] (numeric or narrative) to protect those beneficial uses, and the state of California's Antidegradation Policy, which requires continued maintenance of existing high-quality waters.

The Water Board's Basin Plan specifies beneficial uses for each water body in the Region and the WQOs and implementation measures necessary to protect those uses. The beneficial uses of Richardson Bay that are impaired by high levels of pathogens (as inferred from high pathogen indicator levels) (Table 1) are water contact recreation and shellfish harvesting. The purpose of this TMDL is to protect and restore these beneficial uses by reducing the levels of pathogens (as inferred from reduction in pathogen indicator levels) in this waterbody. WQOs for shellfish harvesting use are more stringent than those for recreation, and therefore this TMDL project protects both Bay beneficial uses by requiring actions to attain the shellfish harvesting WQOs. Table 1 is excerpted from the Basin Plan.

Table 1. Beneficial Uses of Richardson Bay Relevant to Pathogens TMDL

Designated Beneficial Uses	Description
Shellfish Harvesting	Uses of water that support habitats suitable for the collection of crustaceans and filter feeding shellfish (e.g., clams, oysters, and mussels) for human consumption, commercial, or sport purposes.
Water Contact Recreation	Uses of water for recreational activities involving body contact with water such that ingestion of water is reasonably possible. These uses include, but are not limited to, swimming, wading, water-skiing, skin and scuba diving, surfing, whitewater activities, and fishing.

[2] Synonymous with "designated uses" as used in the CWA.
[3] Synonymous with "water quality criteria" as used in the CWA.

Table 2, also from the Basin Plan, shows the Water Board Basin Plan's water quality objectives for fecal coliforms for each of the beneficial uses listed in Table 1.

Table 2. Basin Plan's Water Quality Objectives for Fecal Coliform Bacteria [a]

Beneficial Use	Fecal Coliform (MPN[b]/100 mL)
Water Contact Recreation	Geometric Mean < 200 90th percentile < 400
Shellfish Harvesting	Median < 14 90th percentile < 43

a. Based on a minimum of five consecutive samples equally spaced over a 30-day period.
b. Most Probable Number (MPN) is a statistical representation of the results of the standard coliform test.

4.3 U.S. EPA Enterococci Standards

On November 16, 2004, EPA promulgated a rule, "Water Quality Standards for Coastal and Great Lakes Recreation Waters" (69 FR 67217 et seq.). This rule, in effect since December 2004, and requires marine coastal waters (including estuarine waters) of California (except those covered by Los Angeles Basin Regional Water Quality Control Board) to achieve certain bacteria standards. The Water Board interprets this rule to apply to Richardson Bay based on the designated water contact recreation beneficial uses.

According to the rule, designated "bathing beach waters must meet an enterococci concentration of no more than 35 / 100 mL (geometric mean, using analytical methods 1106.1 or 1600 or equivalent method) and a single sample maximum of no more than 104 / 100 mL (75% confidence level). These values explicitly apply to enterococci regardless of origin, unless a sanitary survey shows that the source of the indicator bacteria is non-human and an epidemiological study shows that the indicator densities are not indicative of human health risk. This enterococci standard has not been adopted for inclusion into the Basin Plan. Board staff is currently working on a Basin Plan amendment to incorporate these standards into the Basin Plan.

The current Basin Plan fecal coliform standards for protecting the beneficial uses of shellfish harvesting in the Bay are protective of the federal standards, because the fecal coliform standards for shellfish harvesting protection are roughly an order of magnitude more stringent than the standards set to protect water contact recreation. In other words, the fecal coliform standards are sufficiently stringent to result in attainment of the enterococci standards, and there is no need to establish a separate enterococci TMDL for Richardson Bay.

4.4 Historical Bacterial Monitoring Studies

Water Board staff conducted bacteriological studies in Richardson Bay in 1973 and 1981. In the 1973 study, the data showed excessively high total and fecal coliform counts in the houseboats area on the northern edge of Sausalito. Sewage discharge from houseboats was identified as the source. Coliform counts at the other Richardson Bay marinas were no higher than those in the surrounding waters (SFBRWQCB, 1973).

The 1981 study was more detailed and provided more information (SFBRWQCB, 1981). Its purpose was to see if vessel waste discharges were causing violations of bacteriological water quality objectives for water contact and shellfish harvesting beneficial uses. Water Board staff conducted sampling during September and October 1981. Water samples were analyzed for total and fecal coliform. Sampling in the late summer avoided inclusion of waste contributions from stormwater runoff or sanitary sewer overflows.

The 1981 study sampled at 24 stations at marinas in Richardson Bay, plus 4 control stations located in the main channel, away from the shore. Results at the control stations were good; coliform levels were low enough to meet both the water contact recreation and shellfish harvesting WQOs. At 13 of the non-control stations, coliform levels exceeded both objectives. Another 9 stations had coliform levels in excess of the shellfish harvesting WQO. Two stations met both objectives (ibid.).

High coliform counts at some stations were attributed to unsewered houseboats. However, the report stated that unsewered houseboats did not explain all of the high coliform counts. It concluded that vessel waste discharges contributed significantly to the excessive coliform counts in 12 marinas.

Coliform data collected in 1990, 1991, and 1992 were analyzed based on water contact recreation WQOs. In general, in comparison with the 1981 survey, these subsequent studies showed overall improvements in water quality, with some exceedances of fecal and total coliform water contact recreation WQOs at the Gates Co-op and Galilee Harbor areas. The 1992 water quality results demonstrated significant improvement from 1981, in both fecal and total coliform levels at Gates Co-op and Galilee Harbor, following installation of temporary sewage lines at Gates Co-op and temporary sewage disposal strategies at Galilee Harbor. Both the 1991 and 1992 survey results indicated the possibility of episodic sewage discharges in 40 percent of the recreational boating marinas. However, overall water quality was good, meeting WQOs for water contact recreation (calculated based on the average of five sampling events).

Coliform sampling was resumed in 1994 and continued annually until 2004. The locations of monitoring stations are shown in Figures 3a and 3b. The results of fecal coliform monitoring from 1994 to 2003 are summarized in Table 3 and Figure 4.

Fecal coliform monitoring data from 1994-2003 show that approximately 70 percent of the samples exceed the WQO for shellfish harvesting beneficial use. The data show that 9 percent of the samples also exceed the WQO for water contact recreation beneficial use. Of the sampling stations exceeding the shellfish WQO, those located in the houseboat marinas clearly have the largest number of exceedances. Waldo Point Marina, Yellow Ferry Dock, Kappas House Boat Marina, and the outer part of the

Galilee Harbor (station 8) exceeded the shellfish objective nearly every year from 1994 to 2003. Among the houseboat marinas, as well as overall, sampling stations at Waldo Point's Gates Coop (stations 41 and 42) by far show the highest fecal coliform counts of all stations.

Among the sampling stations located within the boat marinas, Sausalito Yacht Harbor (station 5), Pelican Yacht Harbor (station 6), Arquez Marina (station 37), and Clipper Basin 4 (station 14) have the highest number of exceedances over the monitoring period of 1994–2003.

Among the control sites, control station B, located somewhat closer to the recreational boat marinas, shows some exceedances of the shellfish objective. Control station C, which is a good representative of open waters away from any pollution sources, exceeds the shellfish WQO only once.

In summary, results of fecal coliform monitoring between 1994 and 2003 reveal that both in terms of frequency and magnitude, houseboat marinas were consistently the most significant sources of pollution in Richardson Bay during that period. The data also suggest that a number of recreational boat marinas have been consistent, yet less frequent, sources of pollution in the Bay.

In 2004, RBRA staff agreed to take the lead on continued annual bacteriological monitoring. In doing so however, RBRA staff decided to discontinue fecal coliform monitoring and instead initiated monitoring for *E.coli*, and Enterococcus.

4.5 Recent Bacterial Monitoring Data

To assess the current (most recent) fecal coliform levels in the Bay, Water Board staff and the RBRA harbor administrator conducted five consecutive weekly sampling events in September and October of 2006. In addition, since all previous monitoring data were gathered during the dry-season, staff conducted five weeks of wet-season fecal coliform monitoring in January and February of 2007. Wet-season sampling generally indicates contributions from other sources such as stormwater runoff and sanitary sewer overflows (SSOs). All wet weather samples were taken at the same sampling stations as those used during dry-season monitoring. Only the last wet-weather sampling event (February 9, 2007) coincided with a rainfall event. The other four wet-weather sampling events were conducted under "no-rainfall" condition. Results of these recent dry and wet-weather monitoring studies are summarized in Tables 4 and 5 and Figure 5. Comparisons of these data are presented in Table 6.

2006

During the summer 2006 monitoring, 10 of 19 sampling stations exceeded the shellfish median WQO. Of these ten exceedances, seven were at stations located in houseboat marinas: Waldo Point South 40 (station 15), Waldo Point Gates Coop (station 41), Waldo Point Gates Coop (station 42), Waldo Point "A" Dock (station 40), Yellow Ferry (station 19), Kappas Houseboats (station 43), and Kappas Houseboats (station 43A). The other three exceedances were at stations located in boat marinas: Sausalito Yacht Harbor (station 5), Pelican Harbor (station 6), and Clipper Basin 4 (station 14). The highest median fecal coliform values were measured at three of the stations located in

houseboat marinas, Waldo Point's Gates Coop (stations 41&42), and Kappas Houseboats (station 43).

Further, with the exception of control station B, control station C, Galilee (station 31), Schoonmaker (station 32), and Schoonmaker Beach (station 33), all other stations exceeded the 90th percentile shellfish WQO. Overall, 14 of the 19 stations exceeded this benchmark.

This information tells us that the houseboat marinas are still the largest sources of bacterial pollution in Richardson Bay; however, certain recreational boat marinas also appear to consistently contribute pollution to the Bay.

2007

During winter 2007 monitoring, 14 of 19 sampling stations exceeded the shellfish median WQO, and 17 of 19 stations exceeded the shellfish 90th percentile objective. The relatively mild increase observed in both the concentrations and the number of wet season exceedances may be attributed to wet-season-specific sources such as stormwater runoff and sanitary sewer overflows. However, as mentioned above, only one of the five wet-season sampling events coincided with an actual rainfall event. Therefore, no definitive conclusions could be made as to what are the actual contributions from season-specific sources, such as stormwater runoff and sanitary sewer overflows, in Richardson Bay. To determine the real contributions from these sources, additional wet-weather monitoring during or immediately after rainfall events needs to be conducted. Additionally, to better characterize the relative contributions of stormwater runoff vs. sanitary sewer overflows, specific future monitoring sites should be chosen such that they are directly downstream of large stormwater drains and likely sanitary sewer overflow conduits.

4.6 Richardson Bay Regional Agency (RBRA) Monitoring Data

Since 2004, RBRA staff have been conducting annual bacteriological monitoring in the Bay. In doing so however, RBRA staff decided to discontinue fecal coliform monitoring and instead initiated monitoring for two other pathogens indicator organisms: *E.coli*, and Enterococci. These monitoring data are summarized in table 7 below.

The RBRA data shows exceedances of U.S. EPA water quality standards for E.coli and Enterococci for water-contact recreation use in several locations in the Bay. The data shows that certain houseboat marinas (Waldo point Gates Coop station 41, Waldo Point Gates Coop station 42, Kappas Houseboats Marina station 43, and Kappas Houseboats Marina station 43A) as well as some recreational boat marinas such as Sausalito Yacht Harbor (Stations 3 and 5) exceed EPA's enterococcus standards for recreational use. The RBRA monitoring data corroborates the findings of bacterial water quality monitoring conducted by Water Board staff in that it identifies houseboats and recreational boat marinas as two important potential sources of pathogens in the Bay.

4.7 Conclusion

In conclusion, recent and historic bacterial water quality studies in Richardson Bay provide a consistent picture of widespread, but somewhat localized potential pathogen impairment. Data indicate that houseboats consistently have been and still are a significant source of potential pathogen pollution in the Bay. They also indicate that vessel discharges in certain recreational boat marinas are a significant potential pathogen source. The fact that the exceedances of the fecal coliform WQOs are higher during the wet-season than the dry-season suggests that wet-weather-specific sources, such as stormwater runoff and sanitary sewer overflows, are also potential sources of pathogens to the Bay. However, to better characterize the magnitude and the relative contributions from these sources, additional wet-weather monitoring is needed.

Figure 3a. Richardson Bay Water Quality Monitoring Stations

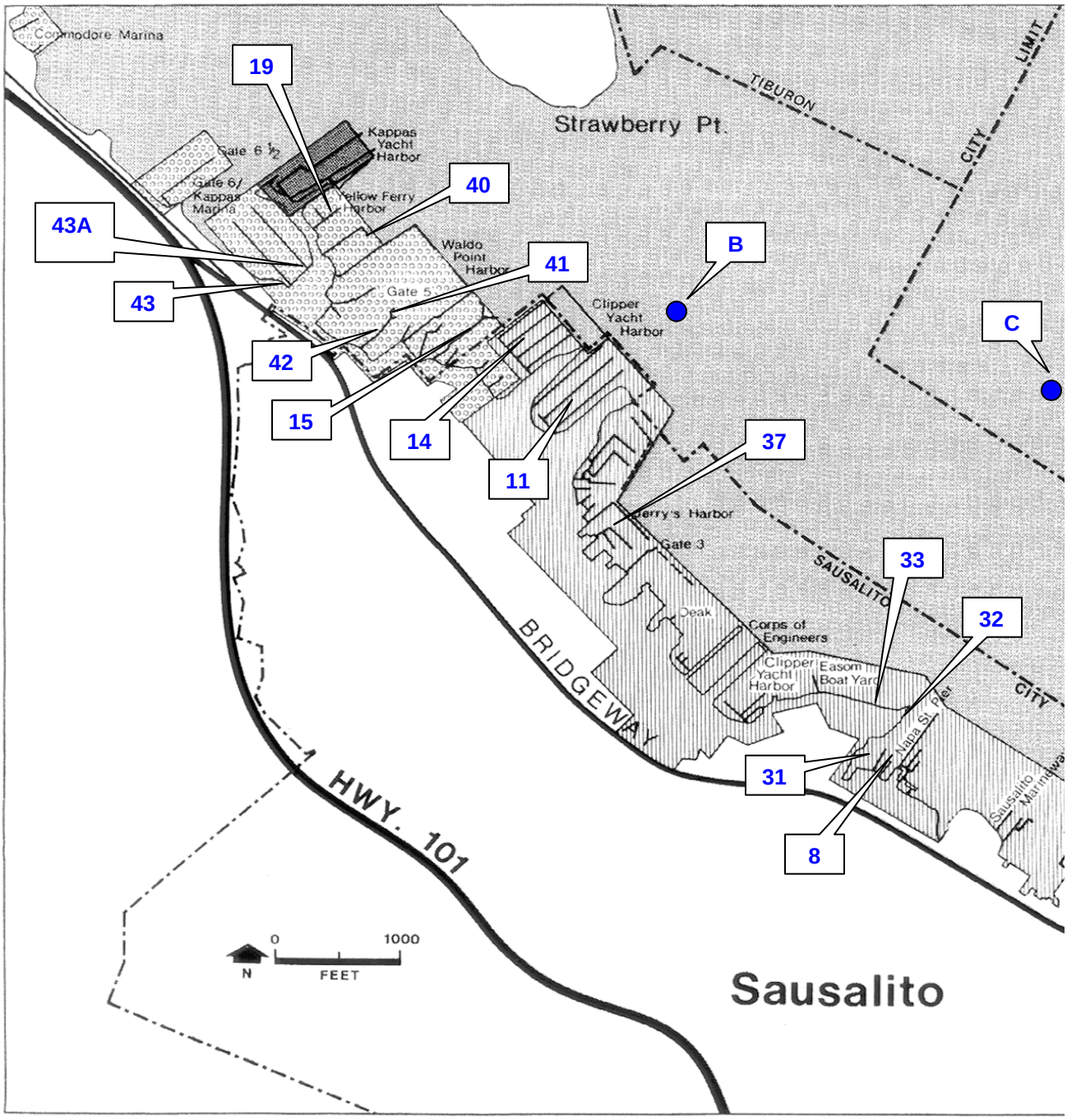
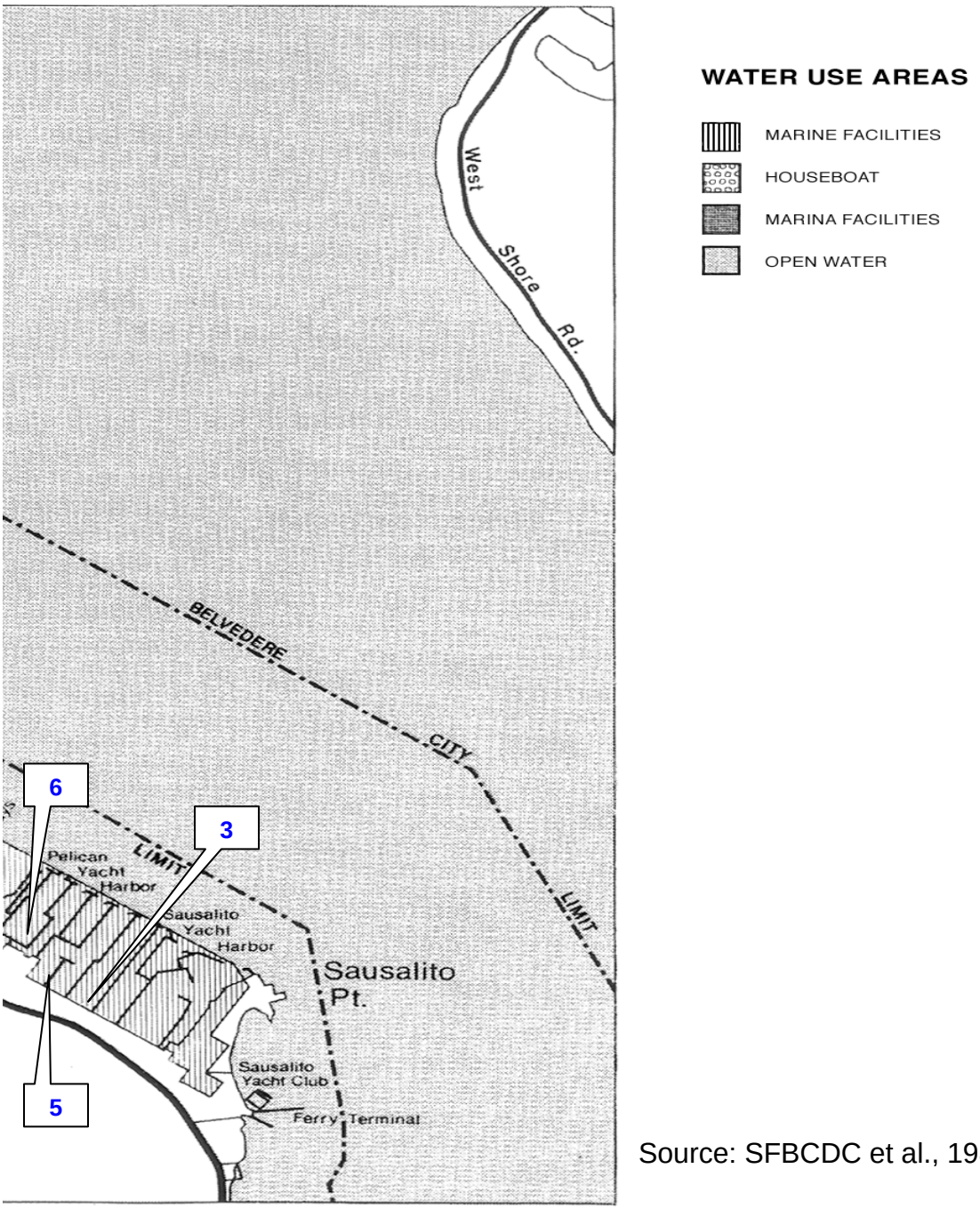


Figure 3b. Richardson Bay Water Quality Monitoring Stations



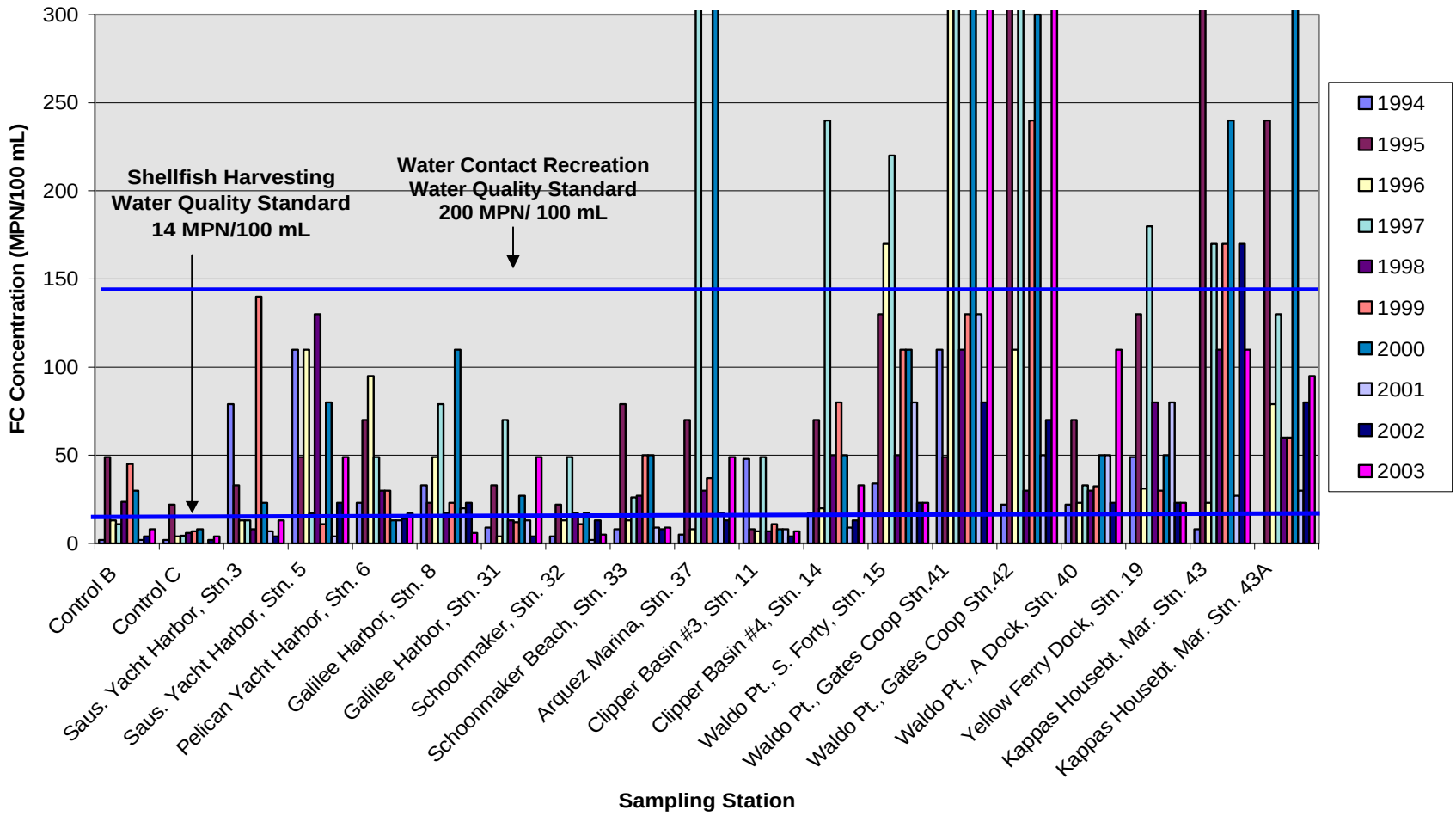
Source: SFBCDC et al., 1984

Table 3. Summary of Fecal Coliform (FC) Monitoring Results for Richardson Bay (1994-2003)
Median of five sampling event (MPN/100 mL)

Station No.	Location	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
B	Control	2	49	13	11	24	45	30	2	4	8
C	Control	2	22	4	5	6	7	8	0	2	4
3	Saus. Yacht Harbor	79	33	13	13	8	140	23	7	4	13
5	Saus. Yacht Harbor	110	49	110	17	130	11	80	4	23	49
6	Pelican Yacht Harbor	23	70	95	49	30	30	13	13	14	17
8	Galilee Harbor (outer)	33	23	49	79	17	23	110	20	23	6
31	Galilee Harbor (inner)	9	33	4	70	13	12	27	13	4	49
32	Schoonmaker	4	22	13	49	17	11	17	2	13	5
33	Schoonmaker Beach	8	79	13	26	27	50	50	9	8	9
37	Arquez Marina	5	70	8	**350**	30	37	**500**	17	13	49
11	Clipper Basin #3, (outer)	48	8	7	49	7	11	8	8	4	7
14	Clipper Basin #4, (inner)	17	70	20	**240**	50	80	50	9	13	33
15	Waldo Pt., S. Forty,	34	130	170	**220**	50	110	110	80	23	23
41	Waldo Pt., Gates Coop	110	49	**920**	**580**	110	130	**900**	130	80	**920**
42	Waldo Pt., Gates Coop	22	**350**	110	**460**	30	**240**	**300**	50	70	**9200**
40	Waldo Pt., A Dock	22	70	23	33	30	33	50	50	23	110
19	Yellow Ferry Dock	49	130	31	180	80	30	50	80	23	23
43	Kappas Houseboat Marina	8	**540**	23	170	110	170	**240**	27	170	110
43A	Kappas Houseboat Marina	NS	**240**	79	130	60	60	**500**	30	80	95

Notes:
Shaded numbers exceed fecal coliform Water Quality Objective for shellfish harvesting waters (Median FC <14 MPN/100 mL).
Bold numbers also exceeded fecal coliform water quality objective for water contact recreation (Geometric Mean < 200 MPN/100 mL).
NS = not sampled

Figure 4. Summary of Fecal Coliform Data for Richardson Bay (1994-2003), Median of Five Sampling Events



Note: To achieve a better resolution, the maximum fecal coliform concentration plotted was kept to 300 MPN/100 mL

Table 4. Richardson Bay Fecal Coliform (FC) Monitoring Data (Summer 2006), MPN/100mL

Station No.	Location	9/13/06	9/20/06	9/27/06	10/4/06	10/6/06	Median FC	90th % Value Exceedance
B	Control	22	4	11	2	2	4	
C	Control	2	2	5	2	4	2	
3	Sausalito Yacht Harbor	11	4	4	81	14	11	X
5	Sausalito Yacht Harbor	2	13	20	14	81	14	X
6	Pelican Harbor	4	7	220	41	140	41	X
8	Galilee / Napa	**1600**	1	11	5	11	11	X
31	Galilee / Mono	1	4	7	11	8	7	
32	Schoonmaker	1	4	5	5	2	4	
33	Schoonmaker Beach	11	2	8	2	14	8	
37	Arquez Marina	4	13	18	8	240	13	X
11	Clipper Basin #3	7	2	180	5	46	7	X
14	Clipper Basin #4	2	4	20	14	81	14	X
15	Waldo Point South 40	**500**	30	24	8	46	30	X
41	Waldo Point Gates Coop	300	220	**810**	330	200	**300**	X
42	Waldo Point Gates Coop	240	70	69	17	46	69	X
40	Waldo Point "A" Dock	2	30	46	41	20	30	X
19	Yellow Ferry	8	27	11	20	180	20	X
43	Kappas Houseboats	50	23	46	18	140	46	X
43A	Kappas Houseboats	23	8	22	200	46	23	X

Notes:
Shaded numbers exceed fecal coliform Water Quality Objective for shellfish harvesting waters (Median < 14 MPN/100 mL).
Exceedances of the 90% values for fecal coliform Water Quality Objective for shellfish harvesting waters (90th % < 43 MPN/100 mL) are indicated by an "X" and shaded in blue.
Bold numbers also exceed fecal coliform water quality objectives for water contact recreation (Geometric Mean < 200 MPN/100 mL; 90th % < 400 MPN/100 mL).

Table 5. Richardson Bay Fecal Coliform (FC) Monitoring Data (Winter 2007), MPN/100mL

Station No.	Location	1/12/07	1/19/07	1/26/07	2/2/07	2/9/07	Median FC	90th % Value Exceedance
B	Control	50	2	14	2	180	14	x
C	Control	17	2	17	8	11	11	
3	Sausalito Yacht Harbor	30	8	140	69	**1200**	69	x
5	Sausalito Yacht Harbor	**800**	9	110	5	**760**	110	x
6	Pelican Harbor	**500**	22	81	20	110	81	x
8	Galilee / Napa	2	2	110	5	**400**	5	x
31	Galilee / Mono	2	2	110	2	81	2	x
32	Schoonmaker	17	8	18	5	69	17	x
33	Schoonmaker Beach	20	11	11	17	27	17	
37	Arquez Marina	2	2	22	240	**1200**	22	x
11	Clipper Basin #3	13	2	4	110	**400**	13	x
14	Clipper Basin #4	34	11	46	18	**400**	34	x
15	Waldo Point South 40	50	22	18	24	**540**	24	x
41	Waldo Point Gates Coop	**1600**	18	11	180	240	180	x
42	Waldo Point Gates Coop	300	41	240	20	220	**220**	x
40	Waldo Point "A" Dock	27	8	22	46	240	27	x
19	Yellow Ferry	22	81	17	20	110	22	x
43	Kappas Houseboats	30	14	22	20	69	22	x
43A	Kappas Houseboats	13	8	4	46	33	13	x

Notes:
Shaded numbers exceed fecal coliform Water Quality Objective for shellfish harvesting waters (Median < 14 MPN/100 mL).
Exceedances of the 90% values for fecal coliform Water Quality Objective for shellfish harvesting waters (90th % < 43 MPN/100 mL) are indicated by an "X" and shaded in blue.
Bold numbers also exceed fecal coliform water quality objectives for water contact recreation (Geometric Mean < 200 MPN/100 mL; 90th % < 400 MPN/100 mL).

Table 6. Richardson Bay Fecal Coliform (FC) Monitoring Data (Summer 2006 vs. Winter 2007), Median of five sampling events (MPN/100mL)

Station No.	Location	Summer 2006 (Median FC)	Winter 2007 (Median FC)
B	Control	4	14
C	Control	2	11
3	Sausalito Yacht Harbor	11	69
5	Sausalito Yacht Harbor	14	110
6	Pelican Harbor	41	81
8	Galilee / Napa	11	5
31	Galilee / Mono	7	2
32	Schoonmaker	4	17
33	Schoonmaker Beach	8	17
37	Arquez Marina	13	22
11	Clipper Basin #3	7	13
14	Clipper Basin #4	14	34
15	Waldo Point South 40	30	24
41	Waldo Point Gates Coop	**300**	180
42	Waldo Point Gates Coop	69	**220**
40	Waldo Point "A" Dock	30	27
19	Yellow Ferry	20	22
43	Kappas Houseboats Marina	46	22
43A	Kappas Houseboats Marina	23	13

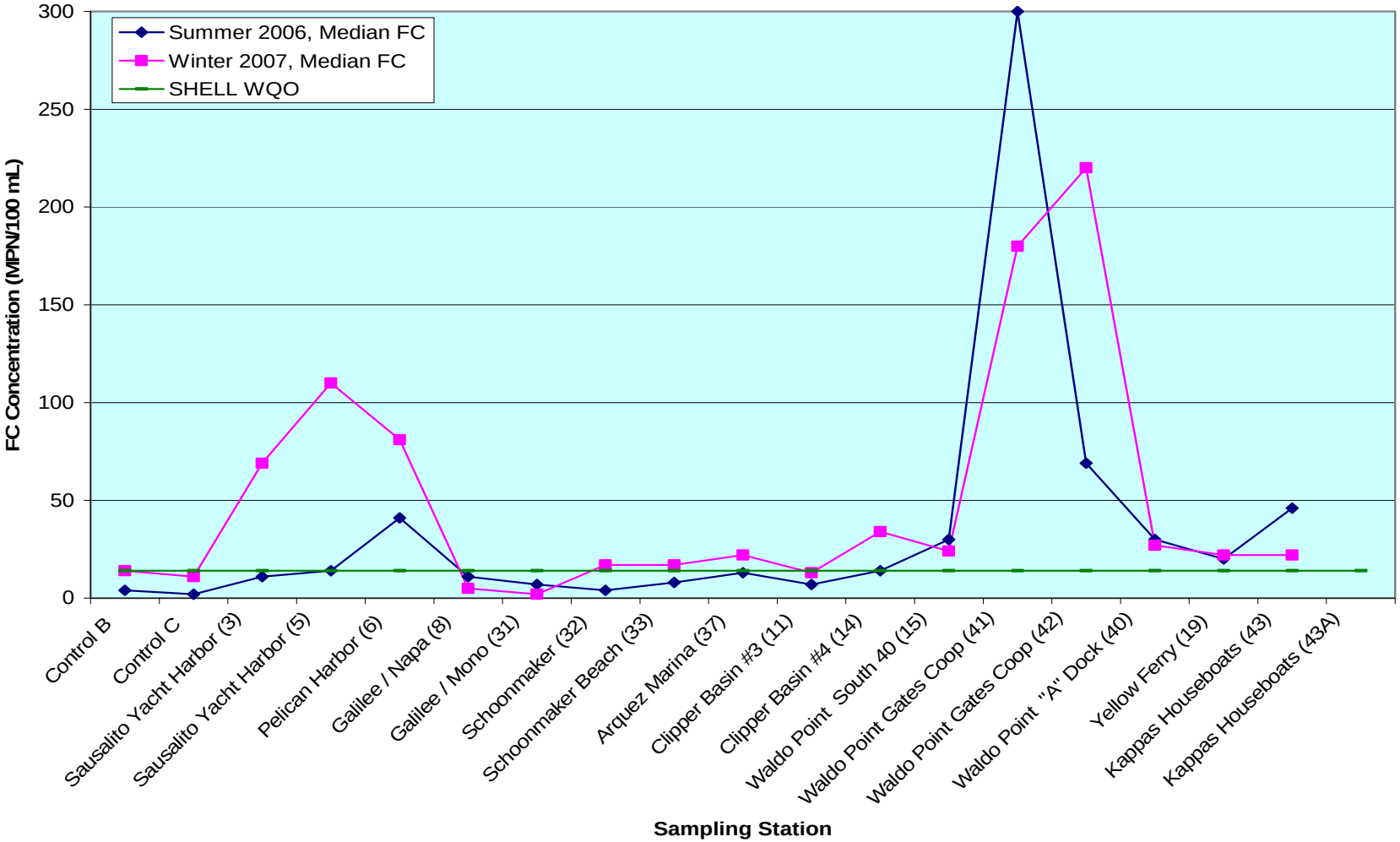
Notes:
Shaded numbers exceed fecal coliform Water Quality Objective for shellfish harvesting waters (Median FC <14 MPN/100 mL).
Bold numbers also exceed fecal coliform water quality objectives for water contact recreation (Geometric Mean < 200 MPN/100 mL).

Table 7. Richardson Bay Regional Agency's Water Quality Monitoring Data (Summer 2004, 2005, 2006) Geometric Mean of five sampling events (Colony Forming Unit [CFU]/100mL)

		Sep.-Oct. 2004		Sep.-Oct. 2005		Sep.-Oct. 2006	
Station No.	**Location**	**E. Coli**	**Enterococci**	**E. Coli**	**Enterococci**	**E. Coli**	**Enterococci**
B	Control	14	9	18	13	10	9
C	Control	16	9	12	9	9	9
3	Saus. Yacht Harbor	9	19	**637**	**80**	16	11
5	Saus. Yacht Harbor	30	23	91	**41**	16	9
6	Pelican Yacht Harbor	38	11	50	22	23	9
8	Galilee Harbor (outer)	38	18	28	12	18	12
31	Galilee Harbor (inner)	18	12	38	12	9	9
32	Schoonmaker	20	11	73	16	11	9
33	Schoonmaker Beach	26	9	NS	NS	11	9
37	Arquez Marina	16	9	56	12	9	9
11	Clipper Basin #3, (outer)	28	19	18	9	20	9
14	Clipper Basin #4, (inner)	43	9	70	32	17	13
15	Waldo Pt., S. Forty,	58	13	30	15	87	12
41	Waldo Pt., Gates Coop	**155**	**119**	**191**	**91**	**315**	**94**
42	Waldo Pt., Gates Coop	**290**	**201**	54	20	51	**40**
40	Waldo Pt., A Dock	113	16	48	15	54	15
19	Yellow Ferry Dock	109	21	36	19	59	14
43	Kappas Houseboat Marina	**160**	**45**	74	**58**	46	22
43A	Kappas Houseboat Marina	**167**	**38**	100*	**58***	90	**49**

Notes:
Bold numbers exceed EPA's *E.coli* (126 CFU/100 mL) and Enterococci (35 CFU/100 mL) geometric mean standards for water-contact recreation
NS = Not Sampled
* Geometric means for these numbers were calculated based on data from four sampling events

Figure 5. Richardson Bay Fecal Coliform Monitoring Data (Summer 2006 vs. winter 2007) Median of Five Sampling Events



5. NUMERIC TARGETS

5.1 Numeric Targets

Each TMDL plan establishes a desired or target condition for the subject pollutant. The "TMDL target" enables us to identify measurable environmental management goals and a clear linkage to attainment of the applicable water quality objectives. The numeric targets (desired future long-term conditions) proposed for pathogen indicators in Richardson Bay are presented in Table 8.

Table 8. Numeric Targets for Richardson Bay [a]

Beneficial Use	Numeric Target
Shellfish Harvesting	Median fecal coliform density[b] < 14 (MPN/100 mL) 90th percentile fecal coliform density < 43 (MPN/100 mL)
Water Contact Recreation	Geometric mean fecal coliform density < 200 90th percentile fecal coliform density < 400 Geometric mean Enterococci density < 35 CFU[d]/100 mL 90th percentile Enterococci density < 104 CFU/100 mL

a. Based on a minimum of five consecutive samples equally spaced over a 30-day period
b. "Density" refers to the number of bacteria in a given volume of water (U.S. EPA, 1986, 2002, 2003). The term is analogous to "concentration," which refers to the mass of chemical pollutant in a given volume of water. "Bacterial density" and "bacterial concentration" are sometimes used interchangeably.
c. Most Probable Number (MPN) is a statistical representation of the standard coliform test results.
d. CFU stands for colony forming unit (e.g., as in number of bacterial colonies)

The bacterial density targets are based on the Basin Plan's shellfish harvesting and water contact recreation water quality objectives for fecal coliform and on U.S. EPA's recommended Enterococci criteria for water contact recreation in salt water. It should be noted that the Water Board intends to adopt bacterial water quality objectives based on Enterococci for water contact recreation in salt water. U.S. EPA recommended Enterococci criteria is included as a numeric target because it is anticipated that Staff will be proposing to the Board in the future that the existing Basin Plan fecal coliform water quality objectives for water contact recreation in salt water be replaced by these Enterococci objectives.

6. POLLUTANT SOURCE ASSESSMENT

6.1 Overview

Due to data and resources limitations, this report does not quantitatively estimate loads for the different pathogen sources in the Richardson Bay area. However, as discussed above, recent and historic bacterial water quality studies in Richardson Bay lead us to general conclusions about the likelihood and significance of the different identified potential pathogen sources. These sources have been identified based on elevated coliform bacteria levels at and/or downstream of the source and from documentation of inadequately treated human waste discharges. Available data reveals that houseboats have been and continue to be the most significant source of potential pathogen pollution in the Bay. They also indicate that vessel discharges in certain recreational boat marinas are a significant potential pathogen source. The fact that exceedances of fecal coliform WQOs are higher at some sampling stations during the wet season than the dry season suggests that wet-weather-specific sources such as stormwater runoff and sanitary sewer overflows (SSOs) are potential sources of pathogens to the Bay. Additionally, reported SSO data for Richardson Bay municipalities (Table 9) further implicate SSOs as likely potential sources of pathogens. These sources contribute significant, controllable pathogen indicator loads into the Bay and will be addressed in the implementation plan presented later in this report.

The following sections discuss the location, magnitude, and significance level of each source.

6.2 Sanitary Sewer Systems

The cities of Sausalito, Mill Valley, Tiburon, and Belvedere are served by sanitary sewer systems. Table 9 lists the sanitary sewer agencies which serve these municipalities. Sanitary sewer overflows from these systems may well be a potential source of pathogens pollution to Richardson Bay. Sanitary sewer overflows usually occur during and after rainstorms when stormwater infiltrates sanitary sewers and overloads system capacity. In addition to the wet-weather overflow discharges, any major sewer line breakage could potentially result in high short-term loading of untreated human waste to the Bay (San Francisco Bay Regional Water Quality Control Board, 2006).

Table 9 lists the number of reported sanitary sewer overflows for the Richardson Bay municipalities for the period between 12/1/04 and 5/2/07. During this time period 151 sanitary sewer overflows were reported.

Further, the monitoring data from winter 2007 (Tables 5 & 6) revealed a somewhat larger number of WQO exceedances as compared with those collected over the dry season. This observation, although not definite, does suggest that wet-weather-specific pathogen indicator sources such as sanitary sewer overflows could be a source of pathogens to the Bay during the wet seasons, especially given that stormwater runoff is likely to facilitate transport of discharged sewage to the Bay during wet weather.

Table 9. Sewage Collection Agencies Serving Richardson Bay Municipalities

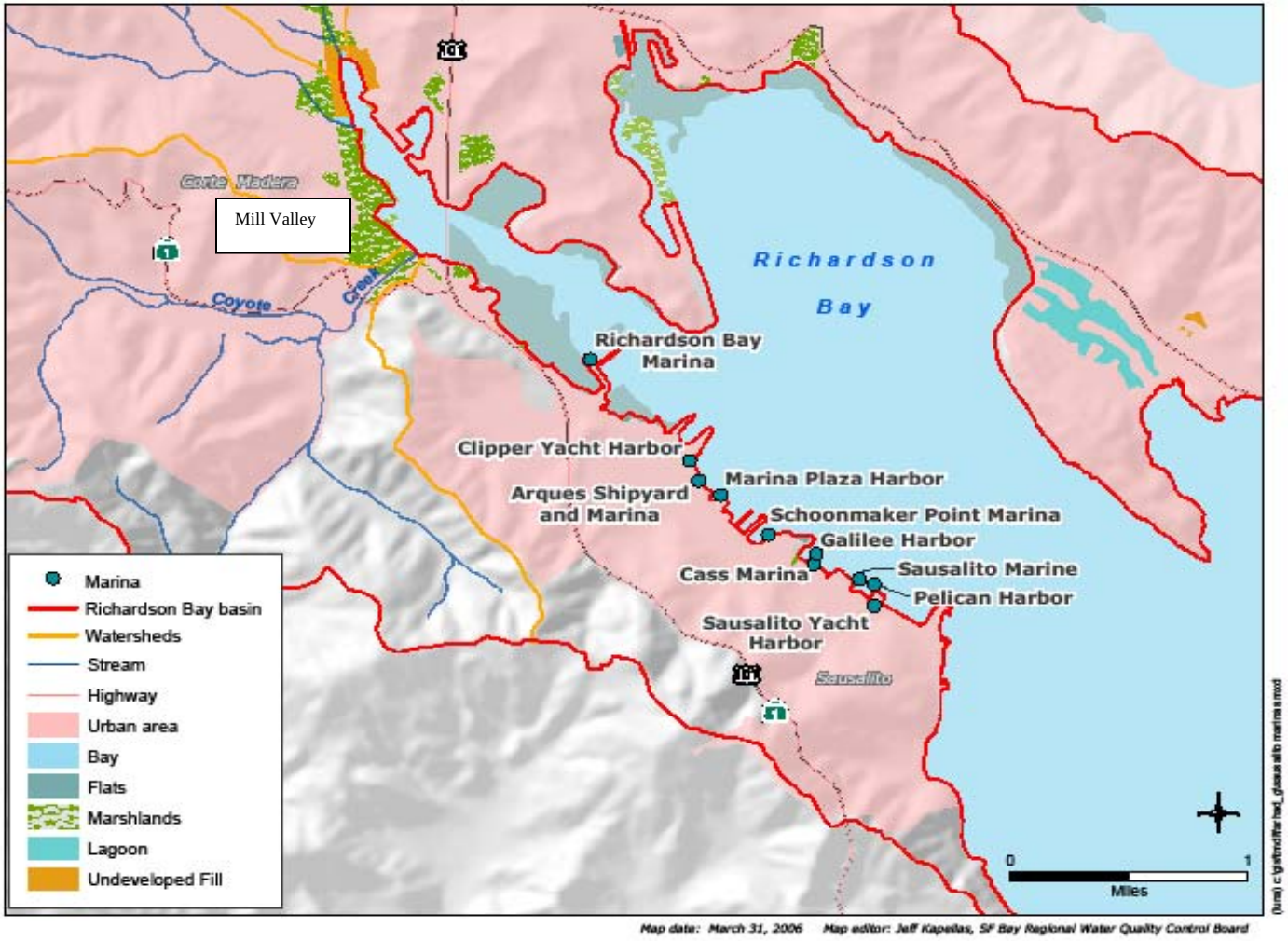
No.	Sewage Collection Agencies/Entities	Serving	Number of SSOs from 12/1/04 – 5/2/07
1	Marin County Sanitary District No. 5 (Tiburon)	Belvedere, Tiburon	47
2	Sewerage Agency of Southern Marin	Mill Valley	3
3	Tamalpais Community Services District	Mill Valley	24
4	City of Mill Valley	Mill Valley	46
5	Homestead Valley Sanitary District	Mill Valley	0
6	Alto Sanitary District	Mill Valley	1
7	Almonte Sanitary District	Mill Valley	8
8	City of Sausalito	Sausalito	2
9	Sausalito Marin City Sanitary District	Sausalito, Marin City	6
10	Richardson Bay Sanitary District	Mill Valley, Tiburon	14

6.3 Stormwater Runoff

As seen in Figure 6, almost the entire Richardson Bay basin consists of “urban area” land use. Stormwater runoff delivers pathogens to surface waters from pets (dogs and cats) and other domestic animals; trash; wildlife; and in some cases human waste from homeless populations. Dog wastes are readily observed near many of the sampling stations along the Richardson Bay shoreline and are a potential source of pathogens loading to the Bay.

As discussed in the previous section, a comparison of the recent dry-season (summer 2006) monitoring data versus the wet-season (winter 2007) data reveals a higher number of WQOs exceedances in winter. During the summer 2006 monitoring, overall 10 of the 19 sampling stations exceeded the shellfish median WQO (53 percent). During the winter 2007 monitoring, overall 14 of the 19 sampling stations exceeded this WQO (74 percent). The increase in the number of exceedances in the wet season as opposed to the dry season could be attributed to the wet-season-specific sources such as stormwater runoff. This observation lead to the conclusion that stormwater runoff could potentially be a source of pathogens loading to the Bay. However, as mentioned in Section 4 above, only one of the five wet-season sampling events coincided with an actual rainfall event. Therefore, no definitive conclusions could be made as to what the actual contributions from stormwater runoff are in Richardson Bay. To better characterize the magnitude and the relative contributions from these sources, additional targeted wet-weather monitoring is need.

Figure 6. Richardson Bay Land Use Map



6.4 Houseboats

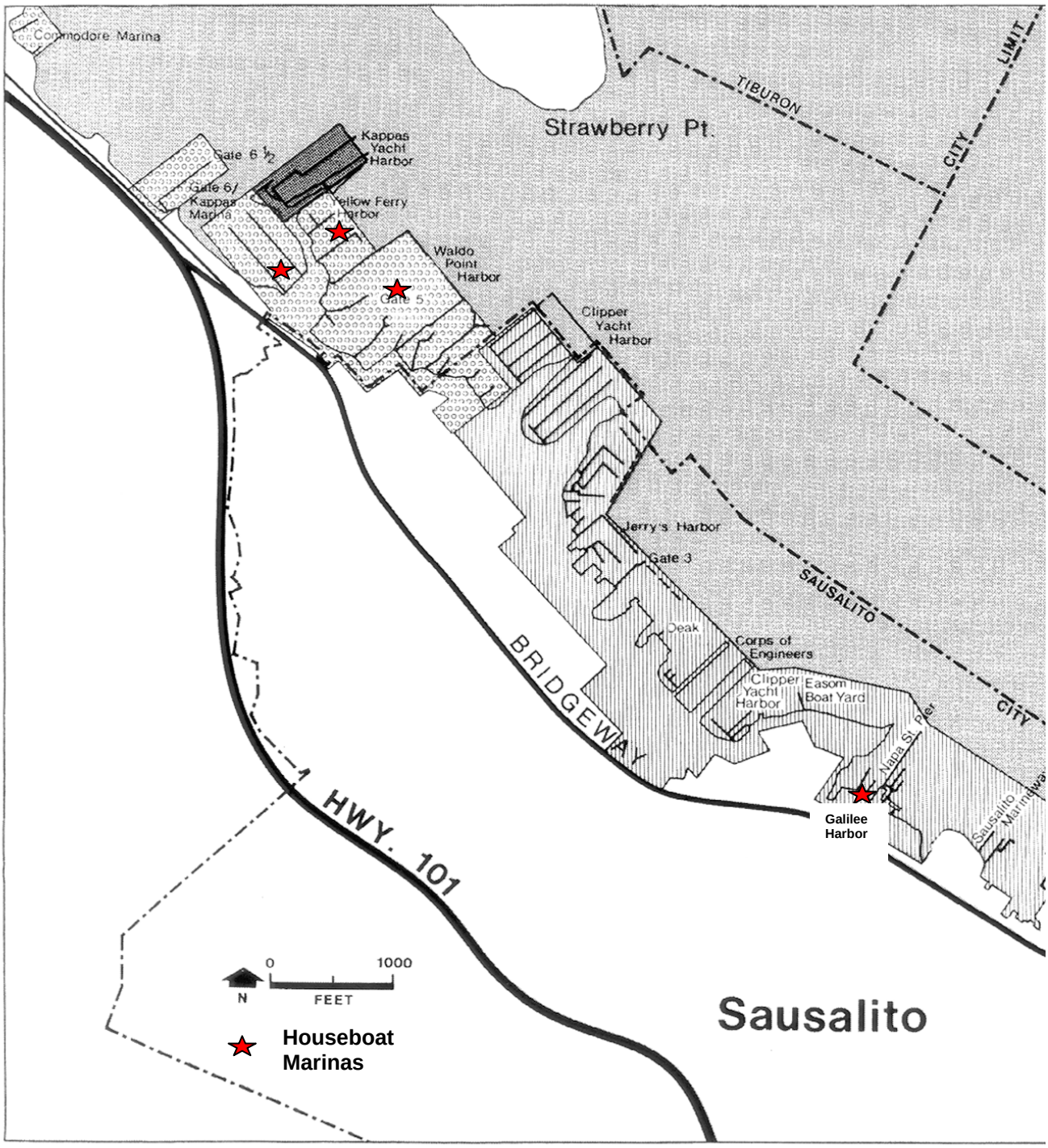
Houseboats in Richardson Bay are designed and used primarily as permanent floating homes, although in some cases they are used as offices. In either case, they are not designed or used for active self-propelled navigation. In addition to houseboats specifically constructed for use as homes, there are former barges, tugboats, ferries, and fishing vessels that have been converted to residences and are no longer used for navigation. It is estimated that there are currently more than 400 houseboats in Richardson Bay (Floating Home Association, 2008). They are primarily located along the western waterfront, in Kappas, Waldo point, Yellow Ferry, and Galilee harbors (Figure 7).

Both sewage (human wastes) and graywater (galley, bath, and shower water) from houseboats in Richardson Bay pollute its waters. Fecal contamination from improper disposal of human waste by houseboats can result in human health hazards, beach closures, shellfish contamination, and loss of recreational opportunities. Sewage discharged from houseboats also impairs the health of the aquatic environment by stimulating algae growth, which can reduce the available oxygen needed by fish and other organisms.

Although all houseboats in Richardson Bay have been sewered, the adequacy, integrity, and reliability of these sewage systems remain questionable. This is particularly true of the Gates Coop at the Waldo Point Harbor. As discussed in section 4 above, both past and recent water quality monitoring in Richardson Bay clearly shows that the houseboat harbors have consistently exhibited the highest number of WQO exceedances in the Bay. Episodic and/or chronic sewage discharges from faulty and un-maintained systems is the likely cause. Such sewage system failures have also been readily observed during sampling events.

Given the large number of houseboats in the Bay and consistent exceedances of the WQOs measured in these harbors, houseboats are considered a significant and serious potential source of pathogens pollution in the Bay.

Figure 7. Houseboat Marinas in Richardson Bay



6.5 Vessels (Recreational, Live-aboard, and Anchor-out Boats)

Because of its sheltered location, size, and proximity to Sausalito and San Francisco, Richardson Bay is especially desirable as an anchorage and harbor for recreational and small commercial vessels. Its long history of maritime use as a watering station and harbor for careening, whaling, fishing, and shipbuilding goes back to the first settlement of the Bay Area. Since the Second World War, however, recreational boating has grown to become the major maritime use of the Bay. Based on a marina survey conducted by California Department of Boating and Waterways in August 2004, there are now approximately 2,400 recreational marina berths in Richardson Bay, primarily located in marinas along the Sausalito waterfront (Table 10; DBW, 2004). In addition, approximately 500 transient boats visit Richardson Bay each year. Also, some private small boat docks have been built next to homes in the Strawberry area, in Belvedere, and in Shelter Bay.

Most boats are designed for active self-propelled navigation and also to accommodate living onboard. Boats that are used as long-term private residences as well as for navigation are referred to as “live-aboards.” Currently, there are approximately 140 live-aboards berthed in Richardson Bay marinas (*Ibid*.). This number is difficult to verify since overnight stays and vacationing on boats are permitted uses.

Boats or houseboats that are moored outside of marinas in open water are referred to as “anchor-outs.” RBRA staff estimates that there are approximately 105 anchor-outs in the Bay (Price, 2007). About 40 of these anchor-out boats are live-aboards (Price, 2007).

As with waste from houseboats, any waste discharge from vessels in Richardson Bay will result in water pollution. Improper disposal of human waste by boaters poses a threat to public health as it can result in shellfish contamination, beach closures, and loss of recreational opportunities. Sewage discharges form boats also impair the health of the aquatic ecosystem by stimulating algal growth.

As discussed in Section 4 above, historic and recent Richardson Bay water quality monitoring results indicate that specific marinas have been consistent potential sources of pathogens pollution in the Bay. Sausalito Yacht harbor (station 5), Pelican Harbor (station 6), and Clipper Basin 4 (station 14) have exceeded the Basin Plan’s WQOs consistently. Less frequent exceedances occur at all marinas.

Given the large number of vessels berthed in Richardson Bay and the persistent exceedance of WQOs at these marinas, vessel discharges are considered a significant potential source of pathogens pollution in the Bay.

6.6 Wildlife

A variety of terrestrial wildlife, such as birds and rodents that inhabit the open space lands adjacent to the Bay, may contribute pathogens to the Bay through stormwater runoff. No accurate information as to the magnitude and geographic dispersion of this waste source is available.

Marine birds and mammals are also present in the Bay. Migratory waterfowl are numerous during the winter months. Increased numbers of sea birds are also attracted

to the Bay during the Pacific Herring spawning season, from December through February. Richardson Bay Audubon Society estimates that close to one million migratory birds visit the Bay during the winter season. Many of these birds utilize the upper mudflats and Bothin Marsh, connected to the area west of the U.S. Route 101. Mammals visiting Richardson Bay include the harbor seals that haul out on DeSilva Island and the Tiburon shore near the Richardson Bay Audubon Sanctuary headquarters.

Table 10. Richardson Bay Boat Marinas

#	Facility	Location	Slips	Boats Requiring Pumpout	Portable Toilets	Transient Boats Requiring Pumpout (boats/yr)	Live Aboards at Marina
1	Arques Shipyard and Marina	Sausalito	89	13	0	0	8
2	Cass Marina	Sausalito	30	5	20	0	0
3	Clipper Yacht Harbor	Sausalito	600	575	Few	75	50
4	Galilee Harbor	Sausalito	38	9	20	0	38
5	Liberty Ship Marina	Sausalito	54	45	0	0	0
6	Marina Plaza Harbor	Sausalito	103	90	Few	4	0
7	Pelican Harbor	Sausalito	90	90	0	0	9
8	Richardson Bay Marina	Sausalito	220	165	Few	0	22
9	Sausalito Marine	Sausalito	60	30	0	0	Few
10	Sausalito Yacht Harbor	Sausalito	580	250	Some	unknown	unknown
11	Schoonmaker Point Marina	Sausalito	161	125	0	360	12
12	Corinthian Yacht Club	Tiburon	93	70	0	60	0
13	San Francisco Yacht Club	Belvedere	187	47	unknown	Some	0
14	Shelter Cove Marina	Mill Valley	17	unknown		unknown	
15	The Cove Apt. & Marina	Tiburon	55	10	3	0	0
Total			**2377**	**1524**	**43**	**499**	**139**

Because of the great variety, complex distribution and dispersal patterns, and fluctuating populations of water birds it is very difficult to assess their impact on water quality in the Bay. They have a potential for localized, intermittent impact, especially during the winter months. As with avian populations, marine mammals follow the herring runs into the Bay, and may also cause intermittent impacts on water quality in some areas in winter.

While localized problems may be present in certain areas of the Bay where wildlife densities are particularly high, only low fecal coliform levels have been observed at the control sampling station that is not heavily affected by human activities (control station C). This suggests that wildlife (the only other potential source) is not, in general, a significant pathogen source in the Bay. However, based on the available data, wildlife contribution cannot be fully characterized at this point. Since the wildlife source category is not readily controllable, it will not be addressed in the implementation plan.

7. TOTAL MAXIMUM DAILY LOAD AND LOAD ALLOCATIONS

7.1 General Approach

US EPA's protocol for developing Pathogens TMDLs (USEPA, 2001) defines a total maximum daily load as the allowable loadings, of a specific pollutant, that a water body can receive without exceeding water quality standards. A TMDL is the sum of the individual wasteload allocations (for point sources) and load allocations (for nonpoint sources) for a given waterbody. The total amount of pollutant contributed by point and nonpoint sources must not exceed water quality standards for the waterbody. In addition, the TMDL must include a margin of safety, either implicit or explicit, which accounts for uncertainty in the relationship between pollutant loads and the quality of the receiving water body.

For most pollutants, TMDLs are expressed on a mass-load basis (e.g., kilograms per year). For pathogen indicators such as fecal coliforms, however, it is the number of organisms in a given volume of water (i.e., their density), and not their total number (or mass) that is significant with respect to public health risk and protection of beneficial uses. The density of fecal coliform organisms in a discharge and/or in the receiving waters is the technically relevant criteria for assessing the impact of discharges, water quality, and public-health risk. US EPA guidance recommends establishing density-based TMDLs for pollutants that are not readily controllable on a mass basis. Therefore, we propose density-based TMDLs and pollutant load allocations, expressed in terms of fecal coliform concentrations.

Establishment of a density-based, rather than a mass-based TMDL carries the advantage of eliminating the need to conduct a complex and potentially error-prone analysis to link loads and projected densities. A load-based Pathogens TMDL would require calculation of acceptable loads based on acceptable bacterial densities and anticipated discharge volumes, and then back-calculation of expected densities under various load reduction scenarios. Since discharge volumes in Richardson Bay are highly variable and difficult to measure, such an analysis would inevitably involve a great deal of uncertainty with no increased water quality benefit.

7.2 Proposed Total Maximum Daily Load

Table 11 shows the proposed TMDL for Richardson Bay. Because shellfish harvesting is the most sensitive beneficial use, we propose basing the TMDL on the more stringent shellfish harvesting water quality objective, expressed as the density of fecal coliform organisms. The total maximum daily load is the total number of fecal coliform organisms that can be discharged from all sources, while not causing water quality in the Bay to exceed a five sample per month median fecal coliform density of 14 organisms/100 mL, and with no more than 10 percent of water samples exceeding 43 organisms/100 mL in a 30-day period. This TMDL will be applicable year-round.

Table 11. Total Maximum Daily Loads of Pathogen Indicators for Richardson Bay	
Indicator Parameter	**TMDL**
Fecal coliform	Median [a] < 14 MPN/100 mL 90th Percentile [b] < 43 MPN/100 mL
a. Based on a minimum five consecutive samples equally spaced over a 30-day period. b. No more than 10% of total samples during any 30-day period may exceed this number.	

7.3 Proposed Load Allocations

To achieve the TMDL, we propose density-based load allocations for houseboats, vessels, sanitary sewer systems, stormwater runoff, and wildlife. Note that unlike mass-based load allocations, density-based load allocations such as these do not add up to equal the TMDL, since densities of individual pollution sources are not additive. In order to achieve the density-based TMDL, it is only necessary to ensure that each discharge category itself meets its density-based load allocation (SARWQCB, 1998).

Table 12. Density-Based Pollutant Wasteload and Load Allocations [a] for Richardson Bay		
Categorical Pollutant Source	**Wasteload and Load Allocations Fecal Coliform (MPN/100 mL)**	
	For Direct Discharges to the Bay	
	Median [b]	**90th Percentile[c]**
Stormwater Runoff	<14	< 43
Wildlife [d]	<14	< 43
Sanitary Sewer Systems	0	0
Houseboats	0	0
Vessels (Recreational, Live-aboard, Anchor-out Boats)	0	0
a. These allocations are applicable year-round. Wasteload allocations apply to any sources (existing or future) subject to regulation by a NPDES permit. b. Based on a minimum of five consecutive samples equally spaced over a 30-day period. c. No more than 10% of total samples during any 30-day period may exceed this number. d. Wildlife is not believed to be a significant or readily controllable source of pathogens; therefore, no management measures will be required.		

Table 12 presents density-based load allocations for Richardson Bay pathogens source categories. These load allocations will apply year-round to the different source

categories of pathogens in the Richardson Bay area. The attainment of these load allocations will ensure protection of the water quality and beneficial uses of the Bay.

We assign load allocations of zero to houseboat discharges, vessel discharges, and sanitary sewer system discharges (the primary potential sources of untreated human waste to Richardson Bay) for the following reasons:

- As sources of human waste (as opposed to animal waste) they pose the greatest threat to the public health.
- The zero load allocation is consistent with the existing Basin Plan sewage/wastewater discharge prohibitions for Richardson Bay (Discharge Prohibitions 5, 15, 18).
- The zero load allocation is consistent with the existing designation of the Richardson Bay as a no vessel waste discharge area.
- When operated properly and lawfully, these sources should not cause any human waste discharges.
- Human waste discharges from these sources are fully controllable and preventable.

For all of these reasons, zero load allocations for these source categories are both feasible and warranted.

7.4 Margin of Safety

TMDLs are required to include a margin of safety to account for data uncertainty, critical conditions, and lack of knowledge. Because the load allocations in this TMDL are identical or more stringent than the existing numeric WQOs, which are established as protective standards and inclusive of all uncertainties, the margin of safety is implicitly incorporated into the proposed TMDLs and load allocations. Therefore, staff asserts that no additional and/or explicit margin of safety is needed for this TMDL.

7.5 Seasonal Variation

While indicator bacteria densities appear to be greater during the winter wet season due to factors such as stormwater runoff, they can be high at any time of year. Dry season densities were higher than wet season densities at a number of sites monitored in winter 2007.

Shellfish harvesting use of the Richardson Bay could occur at any time of the year. Recreational uses of the Richardson Bay are most prevalent during the summertime, but can also occur at any time of year. Therefore, we are not proposing seasonal variations to the above-listed TMDLs and load allocations.

8. LINKAGE BETWEEN WATER QUALITY TARGETS AND POLLUTANT SOURCES

An essential component of a TMDL plan is a “linkage analysis,” which clearly establishes the relationship between the pollutant loadings from identified sources and the numeric targets chosen to measure attainment of beneficial uses. For this TMDL plan, we assert that the proposed load allocations protect the beneficial uses (i.e., the linkage is established) because:

- Fecal waste from warm-blooded animals can contain pathogens;
- Fecal coliform bacteria are present in fecal waste from warm-blooded animals and are routinely used as a monitoring surrogate for pathogens;
- The proposed density-based load allocations are identical or more stringent than proposed numeric water quality targets;
- The proposed numeric targets are the same as current Basin Plan bacterial water quality objectives for shellfish harvesting and water contact recreation waters; and
- The Basin Plan water quality objectives, which are conservatively based on epidemiological studies, are protective of beneficial uses.

9. IMPLEMENTATION PLAN

9.1 Overview

TMDL projects are strategies to restore clean water. Implementation plans, which specify actions needed restore water quality and protect beneficial uses, are required under section 13242 of the California Water Code. As with many TMDLs, the implementation plan for reducing pathogens in Richardson Bay relies primarily existing regulatory controls and the sections of the Water Code that establish the Water Board's authority to enforce the provisions enumerated below.

The intent of this implementation plan is to restore and protect beneficial uses of Richardson Bay by reducing pathogen loadings. Potential pathogen sources in the watershed include: houseboats, vessels (recreational, live-aboard, and anchor-out boats), sanitary sewer system failures, stormwater runoff, and wildlife. The Water Board recognizes the technical, institutional, and financial challenges that each source category may face in designing and implementing measures to reduce their respective pollution loadings. Consequently we believe that our implementation approach for reducing pathogen loading is as flexible as we can make it. We anticipate that enforcement of the requirements in this plan will only be necessary where individuals or entities choose not to assess, address, and reduce their potential to harm water quality.

This implementation plan describes the Water Board's regulatory authority (Section 9.2) as well as other plans and policies in effect in the Richardson Bay Area watershed that affect pathogen source management activities (section 9.3). A description of the proposed implementation actions is provided in section 9.4. Evaluation of progress toward attaining implementation goals is described in section 9.5, and a long-term water quality monitoring program is discussed in section 10.

9.2 Legal Authorities and Requirements

The Water Board has the responsibility and authority for regional water quality control and planning according to the state's Porter-Cologne Water Quality Control Act. The Water Board regulates point source pollution by implementing a variety of programs, including the National Pollutant Discharge Elimination System (NPDES) permit program, which permits point sources of pollution that discharge into waters of the United States. The state also regulates nonpoint source pollution as specified in the state's Plan for California's Nonpoint Source Pollution Control Program (SWRCB and California Coastal Commission, 2000; "the State Nonpoint Source Program"). California's Policy for Implementation and Enforcement of the Nonpoint Source Program (SWRCB, 2004) requires regulation of current and proposed nonpoint source discharges under waste discharge requirements (WDRs), waivers of waste discharge requirements, Basin Plan discharge prohibitions, or some combination of these tools. The State's Porter-Cologne Water Quality Control Act gives the Water Board authority to issue WDRs for point and nonpoint sources of contamination.

9.3 Plans & Policies in the Richardson Bay Watershed

Below is a description of the current regulations, policies, and plans for each of the potential categorical pathogen sources in the Richardson Bay watershed. Source categories of concern include:

- Sanitary Sewer Systems
- Stormwater Runoff
- Houseboats
- Vessels (Recreational, Live-aboard, and Anchor-out Boats)

Sanitary Sewer Systems

In October 2003, Water Board resolution R2-2003-0095 established a collaborative program between the Water Board and Bay Area Clean Water Agencies (BACWA) to reduce sanitary sewer overflows. The collaborative program includes four key tasks:

- Establish reporting guidelines for sewer overflows
- Develop an electronic reporting system
- Establish guidelines for sewer system management plans (SSMPs)
- Conduct a series of regional workshops to provide training on these measures

Reporting guidelines, the electronic reporting system, and the regional workshops were completed in 2004. In cooperation with BACWA, the Water Board completed the SSMP Development Guide in July 2005. Some of the SSMP requirements direct wastewater agencies to:

- Develop an overflow emergency response plan to contain overflows and prevent wastewater from reaching surface waters
- Develop a Fats, Oils, and Grease Control Program if needed
- Allocate adequate resources for the operation, maintenance, and repair of its collection system,
- Prioritize preventive maintenance activities, such as scheduled sewer cleaning, root control, and investigation of customer complaints
- Identity structural deficiencies and prioritize repairs
- Monitor effectiveness of each SSMP element

The Water Board notified wastewater collection agencies of the requirements for preparing SSMPs in July 2005; the notification included required completion dates for each SSMP element.

On May 2, 2006, the State Water Board adopted general waste discharge requirements (WDRs) for sanitary sewer systems (Resolution 2006-0003). All public entities that own or operate sanitary sewer systems that are greater than one mile in length and/or convey untreated or partially treated wastewater to a publicly owned treatment facility in the State of California were required to apply for coverage under these WDRs by November 2, 2006. The WDRs contain provisions for sewer overflow prevention and

reduction measures, including development and implementation of SSMPs. Further, the WDRs prohibit any overflow that results in a discharge of untreated or partially treated wastewater to waters of the United States.

Stormwater Runoff

The Water Board has a comprehensive runoff control program that is consistent with Federal regulations (40 CFR 122-24). This program is implemented through the issuance of NPDES permits to owners and operators of large storm drain systems and systems discharging significant amounts of pollutants. Each stormwater permit requires that the entities responsible for the system develop and implement comprehensive control programs. The Cities of Sausalito, Mill Valley, Belvedere, and Tiburon, and Marin County are covered by the general stormwater permit issued by the State Water Resources Control Board and enforced by the Regional Water Board.

Current stormwater runoff program requirements include the following elements:

- Requirements that agencies develop, implement, and enforce a stormwater management plan to reduce the discharge of the pollutants to the maximum extent practicable. (In accordance with 40 CFR section 122.44(k)(2), the inclusion of best management practices in lieu of numeric effluent limitations is appropriate in stormwater permits.)
- Requirements that agencies address specific program areas, including public education and outreach on stormwater impacts, public involvement, illicit discharge detection and elimination, construction site stormwater runoff control, post construction stormwater management in new development and redevelopment, and pollution prevention/good housekeeping for municipal operations
- Evaluation and assessment of measures
- Monitoring and reporting

Houseboats

In April 1984, the County of Marin, the cities of Belvedere, Mill Valley, Sausalito, and Tiburon, and the San Francisco Bay Conservation and Development Commission (BCDC) prepared the Richardson Bay Special Area Plan (RBSAP) in order to provide uniform policies and regulations for the future use and protection of Richardson Bay. The RBSAP water quality policies related to houseboats states that:

> All houseboat marinas which have houseboats which have sewage or graywater producing facilities onboard should install and maintain sewage and graywater facilities that will directly connect a houseboat to a shoreside sewage treatment system. Houseboats which have sewage and graywater producing facilities onboard should be equipped with and use a system that connects the facilities to a shoreside sewage treatment facility (SFBCDC et al., 1984, p. 16).

In addition, the Basin Plan includes two discharge prohibitions (nos. 5 and 15) that apply to houseboat waste in Richardson Bay, and prohibit any discharge of human

waste, including raw sewage or inadequately treated waste, to the waters of the state. Prohibition 5 prohibits "any wastewater which has particular characteristics of concern to beneficial uses to Tomales Bay, Drakes Estero, Limantour Estero, Bolinas Lagoon, or Richardson Bay (between Sausalito Point and Peninsula Point)." Prohibition 15 prohibits discharge of "raw sewage or any waste failing to meet waste discharge requirements to any waters of the Basin."

Vessels (Recreational, Live-aboard, Anchor-out Boats)

Numerous plans and policies, both statewide and specific to Richardson Bay, prohibit discharge of human waste from vessels in the Bay. As explained in the Background section above, Richardson Bay was designated a no discharge area for vessel waste in 1987.

The Water Board has delegated enforcement of the vessel waste discharge prohibitions to the Richardson Bay Regional Agency (RBRA). RBRA ordinance 87-1 (adopted on July 9, 1987) prohibits mooring or anchoring a vessel in Richardson Bay for residential use. Section 9 of the ordinance states that "it shall be a violation of this ordinance to discharge or permit discharge into the waters of the harbor any refuse, untreated sewage,…or foreign matter of any kind" (RBRA, 1987).

All recreational boats with toilets are required by US Coast Guard to have a US Coast guard-approved marine sanitation device (MSD). Discharges from MSDs into Richardson Bay are strictly prohibited.

California's Plan for Nonpoint Source Pollution Control Program identifies marinas and recreational boating as nonpoint sources of pollution. The plan includes 16 management measures that address nonpoint source pollution from these sources. One of these measures states that: "marinas should maintain pumpout facilities in operational condition and encourage their use so as to prevent and control untreated sewage discharges to surface waters."

In addition to Basin Plan discharge prohibitions 5 and 15 discussed above, Basin Plan discharge prohibition 18 applies to vessels in Richardson Bay as well. Prohibition 18 prohibits discharge of "sewage, whether treated or untreated, from any vessel into that portion of Richardson Bay bounded by the shore and by a line bearing 257 degrees from peninsula point to the shore at Sausalito, In Marin County."

The Regional Water Board has the authority to require that all vessel terminals be equipped with adequate sewage pumpout facilities (Harbors and Navigation Code Section 775-786). The State Water Board may also require that any marine terminal provide adequate vessel sewage pumpout capability, if needed for protection of water quality (California Code of Regulations Title 23, Division 3, Chapter 20). The California Department of Boating and Waterways recently completed a study of the adequacy of sewage disposal facilities in Richardson Bay and recommended installation of several additional sewage pumpout and dump stations in various marinas (DBW, 2004). Grants from the California Department of Boating and Waterways are available to public and private marinas for construction and renovation of pumpout facilities and port-a-potty dump stations through provisions of the Clean Vessel Act of 1992 (covering up to 75 percent of the cost).

Section 4431 of the Health and Safety Code prohibits dumping of sewage into marinas and yacht harbors from any vessel tied to a dock, slip, or wharf that has toilet facilities available for persons on such vessels.

Lastly, the Richardson Bay Special Area Plan (1984) states that:

> Marinas and yacht harbors should install sewage and graywater Pumpout facilities available for public use in easily accessible locations and provide the service free of charge or at a reasonable fee to offset maintenance costs. Marinas should provide on land conveniently located public restrooms. In addition marinas and yacht harbors with vessels used as residences should provide on land conveniently located restrooms, showers, parking and garbage disposal facilities adequate to serve authorized resident live-aboard occupants, and, wherever possible, transient recreational boaters.
>
> There should be no discharge of sewage into Richardson Bay and existing discharges should be eliminated. The local governments and the Bay Commission should request the Regional Water Quality Control Board to petition the federal Environmental Protection Agency (EPA) to designate Richardson Bay as a vessel sewage no discharge area.
>
> Subsequent to Richardson Bay being declared a no discharge area by U.S. EPA:
>
> - All recreational boat marinas and yacht harbors which have live-aboards which have sewage or graywater producing facilities onboard should either provide and maintain sewage and graywater facilities that will directly connect live-aboard vessels to a shoreside sewage treatment facility or provide conveniently located sewage Pumpout facilities and provide the Pumpout service free or at reasonable fee to offset maintenance costs;
> - Live-aboards which have sewage producing facilities onboard should be equipped with and use a system consistent with U. S. Coast Guard regulations that connects the facility to a holding tank which can either be directly connected to a shoreside sewage treatment facility or be emptied at a sewage Pumpout station; and
> - Transient vessels should comply with the sewage no discharge requirements.
>
> Commercial fishing boat dock facilities should provide onshore restrooms and shower facilities for resident fleet and transient fishing vessel crew use. If live-aboards are authorized at the facility, and subsequent to Richardson Bay being declared a no discharge area by the US EPA, the dock owner should either provide and maintain sewage and graywater facilities that will directly connect live-aboard vessels to a shoreside sewage treatment facility or provide a conveniently located sewage Pumpout facility and provide the service free or at a reasonable fee to offset maintenance costs. The live-aboard vessels with sewage producing facilities onboard should be equipped with and use a system consistent

with US Coast Guard regulations that connects the facility to a holding tank which can either be directly connected to a shoreside sewage treatment facility or be emptied at a sewage Pumpout station (SFBCDC, 1984 p. 15-17).

9.4 Actions to Reduce Pathogens in Richardson Bay

This section describes potential management measures for each source category in the Richardson Bay area. Table 13 presents proposed implementation actions to be undertaken by the Water Board. These actions are applicable to all source categories. Tables 14 through 17 describe proposed actions implementing parties must take in order to reduce potential pathogen loading from each major source category. Details of the implementation actions will be worked out by Water Board staff in close coordination with parties responsible for implementation actions and other interested stakeholders.

It is important to note that the numeric targets and load allocations in the TMDL are not directly enforceable. To demonstrate attainment of applicable allocations, responsible parties must demonstrate that they are in compliance with specified implementation measures and any applicable waste discharge requirements or waste discharge prohibitions.

Table 13. Proposed Water Board Implementation Actions to Reduce Pathogen Loading
1. In collaboration with implementing parties, conduct a monitoring program to measure progress toward and attainment of water quality objectives and evaluate compliance with TMDL implementation plan.
2. Assist dischargers in identifying funding mechanisms for implementation and monitoring.
3. Enforce, as necessary, discharge prohibitions, waste discharge requirements, or waste discharge requirements waiver conditions related to pathogens reduction in Richardson Bay.

Table 14. Proposed Implementation Actions to Reduce Pathogen Loading from Sanitary Sewer Systems

Implementing Party	Action	Completion Date
Marin County Sanitary District No. 5, Sewerage Agency of Southern Marin, Tamalpais Community Services District, City of Mill Valley, Homestead Valley Sanitary District, Alto Sanitary District, Almonte Sanitary District, City of Sausalito, Sausalito Marin City Sanitary District, Richardson Bay Sanitary District	1. Comply with the Statewide General Waste Discharge Requirements for Sanitary Sewer Systems including its Monitoring and Reporting Program.	As specified in applicable WDR permit

Table 15 Proposed Implementation Actions to Reduce Pathogen Loading from Stormwater Runoff

Implementing Party	Action	Completion Date
Marin County, City of Sausalito, City of Mill Valley, City of Tiburon, City of Belvedere, Caltrans	1. Implement applicable stormwater management plan.	As specified in approved stormwater management plan and in applicable NPDES permit
	2. Update/amend applicable stormwater management plan to include specific measures to reduce pathogen loading, including additional education and outreach efforts, and installation of additional pet waste receptacles.	
	3. Report progress on implementation of pathogen reduction measures to Water Board.	

Table 16. Proposed Implementation Actions to Reduce Pathogen Loading from Houseboats

Implementing Party	Action	Completion Date
RBRA; Marin County; local cities	1. Submit to the Executive Officer for approval a plan and schedule for 1) evaluating adequacy and performance of sewage collection systems (onboard holding tanks, pumps, sewer lines, etc.) for all houseboats in Richardson Bay, 2) ongoing evaluation of sewage collection system operation and maintenance for all houseboats once they have been repaired/upgraded such that they do not discharge any sewage into the Bay.	July 2009
	2. Conduct evaluation per submitted plan.	July 2010
	3. Report progress on implementation of the plan to Water Board.	Annually
Houseboat marina owners	1. Submit to the Executive Officer for approval a plan and implementation schedule for 1) repairing/upgrading identified leaky/malfunctioning sewage collection systems (onboard holding tanks, pumps, sewer lines, etc.) such that they do not discharge any sewage into the Bay, 2) long-term operation and maintenance of the systems.	July 2011
	2. Report progress on implementation of the plan to Water Board.	Annually
Houseboat owners, houseboat marina owners	1. Repair/upgrade identified leaky/ malfunctioning sewage collection systems (onboard holding tanks, pumps, sewer lines, etc.) such that they do not discharge any sewage into the Bay.	July 2013
	2. Operate and maintain sewage collection systems such that they do not discharge any sewage into the Bay.	Ongoing

Table 17. Proposed Implementation Actions to Reduce Pathogen Loading from Vessels (Recreational, Live-aboards, Anchor-out Boats)

Implementing Party	Action	Completion Date
RBRA; Marin County; local cities	1. Submit to the Executive Officer for approval a plan and implementation schedule for 1) evaluating adequacy and performance of sewage collection systems (sewage dump stations, sewage pumpout stations, onboard holding tanks, sewer lines, etc.) for all vessel marinas and vessels with toilet facilities in Richardson Bay, 2) ongoing evaluation of sewage collection system operation and maintenance for all vessel marinas and vessels once they have been repaired/upgraded such that they do not discharge any sewage into the Bay.	July 2009
	2. Conduct evaluation per submitted plan.	July 2010
	3. Report progress on implementation of the plan to Water Board.	Annually
Vessel marina owners	1. Submit to the Executive Officer for approval a plan and schedule for 1) installing, as needed, an adequate number of sewage pumpout and dump stations. If no new sewage pumpout and dump stations are needed, provide an explanation as why they are not needed. 2) repairing/upgrading identified leaky/malfunctioning sewage collection systems (sewage dump stations, sewage pumpout stations, onboard holding tanks, sewer lines, etc.) such that they do not discharge any sewage into the Bay, 3) long-term operation and maintenance of the systems such that they do not discharge any sewage into the Bay.	July 2011
	2. Report progress on implementation of the plan to Water Board.	Annually

Table 17. Proposed Implementation Actions to Reduce Pathogen Loading from Vessels (Recreational, Live-aboards, Anchor-out Boats)		
Vessel marina owners vessel owners	1. Repair/Upgrade identified leaky/ malfunctioning sewage collection systems (sewage dump stations, sewage pumpout stations, onboard holding tanks, sewer lines, etc.) such that they do not discharge any sewage into the bay.	July 2013
	2. Operate and maintain sewage collection systems such that they do not discharge any sewage into the Bay.	Ongoing
	3. Enroll in RBRA's mobile sewage collection and disposal service for all live-aboards (anchor-outs and marina-berthed vessels).	July 2010

Discussion

In most cases, implementation efforts should focus on the source categories that exist in portions of the waterbody where water quality impairment due to high pathogen indicator levels has been identified through data presented earlier in this report or through future monitoring activities discussed in section 10 below.

In determining the appropriate level and type of source control and regulatory actions needed to achieve water quality objectives and a TMDL, the Water Board considers the following factors:

- The feasibility of achieving the required level of performance (assigned pollutant load allocations) for each source;
- The magnitude of the water quality impairment caused by each source; and
- The history of source control efforts and regulatory requirements

Feasibility is a function of the technical capability of the discharger and the cost of implementing management measures. The significance of the water quality impairment is a function of the type of pollutant (i.e. human versus animal waste) and its potential for causing an exceedance of water quality objectives.

The Water Board will not hold discharging entities responsible for uncontrollable coliform discharges originating from wildlife/natural background sources. If pathogen indicator contributions from wildlife/natural background are determined to be the primary cause of water quality objectives exceedances, the attainability/applicability of water quality objectives will be evaluated as part of the adaptive implementation program.

Many implementation activities are already underway in the watershed. These activities include:

- Implementation of the countywide stormwater management plan (by local county and city stormwater pollution prevention programs)
- Implementation of the statewide stormwater management plan by the California Department of Transportation (Caltrans)
- Implementation of provisions, and compliance with prohibitions, of the State Water Resources Control Board's waste discharge requirements for sanitary sewer systems(by sanitary sewer agencies), as noted in section 9.3 above
- Implementation of the vessel waste discharge prohibition by RBRA, through its mobile sewage collection and disposal service for live-aboards (both those live-aboards that are anchored-out on the Bay and those that are berthed inside marinas), and through annual water quality monitoring in Richardson Bay)

The Water Board strongly supports these activities and recommends that all of these efforts be continued.

Each source category is required to assess and identify potential pathogen contributions associated with their facilities and/or properties, and to develop a plan for reducing and/or eliminating potential pathogen contributions. Dischargers must then 1) implement site-specific management measures to eliminate or reduce their potential pathogen contributions, and 2) provide documentation on progress made toward implementation of control measures.

For example, in the case of Houseboats and Vessels source categories, we envision that the local jurisdictions (RBRA, Marin County, local cities) will first develop and implement a plan to evaluate the adequacy and performance of the sewage collection systems. The houseboat and vessel marina owners will then use the results of those evaluations to develop a plan for installing adequate number of sewage collection facilities and/or bringing identified substandard/ malfunctioning sewage collection systems up to appropriate operating standards. Finally, once the plan is approved by the Water Board's executive officer, the houseboats and vessels owners as well as the houseboat and vessel marina owners will implement appropriate actions identified in the plan to eliminate any potential discharge of sewage to the Bay.

In the case of the sanitary sewer systems, we anticipate that compliance with the provisions and requirements of the existing general waste discharge requirements (WDRs) for sanitary sewer systems will be adequate in preventing occurrences of sanitary sewer overflows to the Bay.

For the stormwater runoff source category, we anticipate that the municipal stormwater management plan for Richardson Bay area municipalities will need to be revised to include specific pathogens reduction measures such as additional education and outreach efforts, and installation of additional pet waste receptacles. We do not anticipate that Caltrans' stormwater management plan will need to be revised because we believe that the source of bacteria in highway runoff is wildlife.

Throughout the implementation process, the Water Board and local stakeholders must evaluate compliance with management measure implementation and assess, at regular intervals, whether water quality is improving. The implementation plan includes steps for evaluation and follow-up for assessing compliance with the TMDL. The long-term

success of the TMDL implementation plan will be measured by attaining the TMDL numeric targets (designated water quality objectives).

If dischargers demonstrate that all reasonable and feasible management measures have been implemented for a sufficient period of time (e.g., five years after the approval of the TMDL Plan) and TMDL targets (designated water quality objectives) are still not met, Water Board staff may reevaluate and revise the TMDL accordingly.

9.5 Evaluating Progress towards Attaining Implementation Goals

Approximately every five years after the adoption of the TMDL, the Water Board will evaluate compliance with the trackable implementation measures described in Tables 13 through 17 and in the Basin Plan. The results of the evaluation will be reported to stakeholders in the Richardson Bay area.

If source control actions are fully implemented and the TMDL targets (water quality objectives) are not met, the Water Board may consider re-evaluating the attainability/applicability of the TMDL and the numeric targets (water quality objectives). If, the required actions are not fully implemented, the Water Board may consider additional regulatory controls or take enforcement actions against parties or individual dischargers not in compliance.

10. MONITORING AND EVALUATION PROGRAM

10.1 Overview

Monitoring water quality improvement is an important element of a TMDL plan. Monitoring water quality, tracking TMDL implementation, and modifying the TMDL and implementation plan as necessary allows the Water Board, dischargers, and other stakeholders to:

- Assess trends in water quality to ensure that improvement is being made
- Oversee TMDL implementation to ensure that implementation measures are being carried out
- Address any uncertainty in various aspects of TMDL development
- Ensure that the TMDL remains effective, given changes that may occur in a watershed after TMDL development

The primary measure of success for the TMDL for pathogens in Richardson Bay is attainment and/or continuous progress toward attainment of TMDL targets and load allocations. However, in evaluating successful implementation of this TMDL, attainment of trackable implementation actions will also be heavily relied upon. Therefore, we propose: 1) water quality monitoring, which is discussed in this section, and 2) evaluation of compliance with trackable implementation measures, discussed in Section 9 above.

10.2 Water Quality Monitoring

In order to assess improvements in water quality and obtain additional information for further refinement of the TMDL, Water Board staff and stakeholders will collaborate to monitor selected water quality testing stations within the Bay. The main objectives of the Monitoring Program are to:

- Assess attainment of TMDL targets (i.e., water quality objectives in ambient waters)
- Evaluate spatial and temporal water quality trends in the Bay
- Obtain additional information about significant potential pathogens source areas
- Collect sufficient data to prioritize implementation efforts and assess the effectiveness of implementation actions

The following is a list of existing water quality monitoring stations for the Bay. We anticipate that this list may change in the course of implementation of this TMDL to include better spatial coverage of the Bay (e.g., stations that are directly downstream of large stormwater drains and in major wildlife habitats, as well as “control” stations that are better representative of the background conditions in the Bay):

1. Waldo Pt. Gates Co-op, Stn. 42 (outer dock area)
2. Waldo Pt. Gates Co-op, Stn. 41 (inner dock area)
3. Kappas Houseboat Marina, Stn. 43 (middle bay)
4. Kappas, Stn. 43A (corner closest to street, bayside)

5. Waldo Pt., A Dock, Stn. 40 (end of pier by houseboat 16)
6. Yellow Ferry Houseboat Dock, Stn. 19 (by houseboat #7)
7. Waldo Pt., South Forty, Stn.15 (middle left down ramp by three houseboats)
8. Control Station B (outer Bay, off Clipper Basin 3, buoy 12)
9. Clipper Basin 4, Stn. 14 (middle dock)
10. Clipper Basin 3, Stn. 11
11. Arquez Marina, Stn. 37
12. Schoonmaker Beach, Stn. 33, near shore (from boat)
13. Galilee Harbor, Stn. 31 (inner area)
14. Galilee Harbor, Stn. 8 (outer area, by A. Rose houseboat)
15. Schoonmaker, Stn. 32 (from dock, access from Galilee Harbor)
16. Pelican Yacht Harbor, Stn. 6 (past remains of Peliwash)
17. Sausalito Yacht Harbor, Stn. 5 (down row, past “Taj Mahal” houseboat)
18. Sausalito Yacht Harbor, Stn. 3
19. Control Station C (off Schoonmaker Pt., buoy 6)

Table 18 outlines the locations, constituents, sampling frequency, and the responsible parties for the long-term water quality monitoring program. In addition to water quality monitoring, precipitation and sanitary sewer overflows should also be documented during the wet-weather monitoring, so that the timing of likely contamination events can be correlated with the water quality data. All water quality monitoring (including quality assurance and quality control procedures) will be performed pursuant to the State Water Board’s Quality Assurance Project Plan for the Surface Water Ambient Monitoring Program.

Table 18. Constituent, Location, Frequency, Sampling Entities for Water Quality Monitoring

Constituent	Location	Frequency	Sampling Entities
Fecal Coliform	19 water quality stations listed above	Weekly for five consecutive weeks in each wet season (from November to April) Weekly for five consecutive weeks in each dry season (from May to October)	Water Board, RBRA, MCSTOPPP [b]
Enterococci [a] *E.coli*	19 water quality stations listed above	Weekly for five consecutive weeks in each dry season (from May to October)	Water Board, RBRA

[a.] In order to further evaluate the protection of water-contact recreation uses of Richardson Bay, dry-season concentrations of enterococci and *E.coli* bacteria will be monitored in addition to fecal coliform concentrations.
[b.] MCSTOPPP would participate in the wet season sampling of the receiving waters near the stormwater drain outfalls only.

10.3 Data Management and Evaluation

Water Board staff will compile and analyze monitoring data, including data from RBRA, from all stations on an annual basis. Water Board staff will use the monitoring data to: 1) determine whether appropriate bacterial levels are attained; 2) make any necessary adjustments to the monitoring plan; 3) revise, as necessary, various aspects of the TMDL including the implementation plan; 4) obtain a more refined assessment of contributing sources; and 5) determine whether TMDL targets (water quality standards) are attainable.

10.4 Adaptive Implementation

Approximately every five years after the TMDL adoption, the Water Board will review the Richardson Bay Pathogens TMDL and evaluate new and relevant information from monitoring, special studies, and scientific literature. At a minimum, the following questions will be used to conduct the reviews. Additional questions will be developed in collaboration with stakeholders during each review.

1. Is Richardson Bay progressing toward TMDL targets? If progress is unclear, how can monitoring efforts be modified to detect trends? If there has not been adequate progress, how might the implementation actions be modified?
2. What are the pollutant contributions for the various source categories? How have these contributions changed over time? How do they vary seasonally? How might source control measures be modified to improve load reduction? If the answers to these questions are not clear, how can monitoring efforts be modified to answer these questions?
3. Is there new, reliable, and widely accepted scientific information that suggests modifications to targets, or implementation actions? If so, how should the TMDL be modified?

Any necessary modifications to the targets or implementation plan will be incorporated into the Basin Plan via an amendment process.

11. REGULATORY ANALYSES

This section of the Staff Report provides the regulatory analyses required to adopt the Basin Plan amendment to establish the Richardson Bay Pathogens TMDL (referred to here as the Pathogens TMDL). It includes a discussion of the results of an environmental impact analysis required under the California Environmental Quality Act (CEQA) and a discussion of economic considerations. The environmental impact analysis is required under CEQA when the Water Board adopts a Basin Plan amendment under the Water Board's certified regulatory program (California Public Resources Code § 15251 [g]). The environmental analysis also satisfies Public Resources Code § 21159 which applies when adopting rules or regulations requiring installation of pollution control equipment, compliance with a performance standard, or treatment requirement. It evaluates the reasonably foreseeable environmental impacts of the methods of compliance with the implementation plan in Section 9, and describes the reasonably foreseeable and feasible mitigation measures that could be used to reduce significant environmental impacts. The discussion of economic considerations is provided in accordance with Public Resources Code § 21159 [a] [3] [c] which requires an analysis of economic factors related to costs of implementation of the new rules or regulations. This Staff Report, including the CEQA checklist and these analyses, constitute a substitute environmental document.

The results of the assessment of environmental impacts and economic considerations show that the TMDL is not likely to result in long-term, significant impacts and will not cause immediate, large scale expenditures by the entities required to implement the TMDL. Much of the implementation plan of the TMDL is built on existing efforts to improve management of efforts to eliminate sewage discharges from live-aboard and recreational, houseboats and stormwater runoff. This section analyzes environmental impacts for many of the potential individual projects that may be developed to implement the TMDL to the extent such impacts can be identified at this time. At such time as individual projects are proposed, the impacts of those individual projects will be evaluated as to location, specific technologies, size, quantity, feasibility and any mitigation necessary to address the identified potential environmental impacts. These implementation project-specific impacts are too speculative to evaluate at this time. We anticipate that these projects would be required to mitigate any potential environmental impacts. Potential mitigation measures, which are both feasible and already in common use, are discussed in this analysis of environmental impacts.

This section of the Staff Report is organized into three main parts: 1) Environmental Impact Analysis, including the Environmental Checklist, 2) Alternatives Analysis; and 3) Economic Considerations.

11.1. Environmental Impact Analysis

The Water Board is the Lead Agency responsible for evaluating the potential environmental impacts of the Richardson Bay Pathogens TMDL. This section of the Staff Report contains a description of the project, presents the environmental checklist evaluating the environmental impacts of the projects and includes an explanation of the results of the analysis. Sections 2 and 3 of this Staff Report also provide details about

the project definition, objectives and a description of the environmental setting that provide the basis for the CEQA evaluation. The environmental checklist frames the analysis, which includes a discussion of the potential environmental impacts as well as probable mitigation measures that could be used to eliminate or reduce those impacts.

Pursuant to section 13360 of the Water Code, the Water Board cannot dictate which compliance measures implementing parties may choose to adopt or which mitigation measures they would employ to implement the Pathogens TMDL. However, the Water Board does recommend that appropriate compliance and mitigation measures as discussed herein, which are readily available and generally considered to be consistent with industry standards, be applied in order to reduce, and if possible avoid, potential environmental impacts, such that there is no significant impact. Since the decision to perform these measures is strictly within the responsibility and jurisdiction of the individual implementing agencies, such measures can and should be adopted by these parties. (Title 14, California Code of Regulations, Section 15091(a)(2).)

To satisfy CEQA's recommendation to engage the public and interested parties in early consultation about the scope of the environmental analysis, a scoping meeting was held at the Bay Model in Sausalito on September 25, 2007.

11.2. Project Description

The project is composed of a Basin Plan amendment that includes a TMDL for pathogens in Richardson Bay, and an implementation plan to protect beneficial uses (hereinafter referred to in the CEQA analysis as the Pathogens TMDL.) The primary objective of the project is to restore and protect the beneficial uses of contact recreation and shell fishing in the Bay. The project includes three pathogen-related numeric targets: fecal coliform targets of 200 MPN/100 mL and 14 MPN/100 mL to protect water contact recreation and shellfish harvesting, respectively, and an enterococci target of 35 CFU/100 mL to protect water contact recreation. The TMDL assigns wasteload and load allocations to dischargers that, over time, are expected to result in attainment of the targets.

Pathogen sources identified in the TMDL include stormwater runoff, sanitary sewer systems, houseboats; vessels; and wildlife (see Section 6). The TMDL Implementation Plan (Section 9) specifies management measures to reduce pathogens from all of these sources except wildlife, because wildlife is not a readily controllable source of pathogens to Richardson Bay. Implementation actions are described in Section 9.4 of this staff report and in Table 7-4 of the proposed Basin Plan Amendment, and are summarized below.

The implementation plan requires actions to reduce potential pathogen discharges associated with key sources: stormwater runoff, sanitary sewer systems, houseboats, and vessels. The reasonably foreseeable methods of compliance with the implementation plan are discussed below.

11.3. Project Objectives

The objectives of the proposed Basin plan amendment with respect to pathogens in Richardson Bay are consistent with the mission of the Water Board and the requirements of the federal Clean Water Act (CWA) and California's Water Code:

- Comply with CWA requirement to adopt a TMDL for a Section 303 (d) listed water body
- Protect existing and potential beneficial uses of recreation and shellfish harvesting in Richardson Bay
- Attain the numeric water quality objectives of fecal coliforms of 200 MPN/100 mL for water contact recreation and 14 MPN/100 mL for shellfish harvesting for Richardson Bay established in the Basin Plan in as short a time frame as feasible
- Set numeric target(s) to attain relevant water quality standards in Richardson Bay
- Avoid imposing regulatory requirements that are more stringent than necessary to meet numeric targets and attain water quality standards
- Complete implementation of the TMDL in as short a time as is feasible

11.4. Reasonably Foreseeable Methods of Compliance

Some of the TMDL implementation plan requirements of the Basin Plan amendment are not evaluated in this analysis because they are requirements that do not cause a direct physical change in the environment or a reasonably foreseeable indirect physical change in the environment. These requirements include development and implementation of public outreach and monitoring.

Implementation measures that are reasonably foreseeable methods of compliance with the Basin Plan amendment implementation plan that result in physical changes in the environment are reviewed in this analysis. These measures are identified in Table 19, below. The potential environmental impacts of these reasonably foreseeable methods of compliance are evaluated in the environmental checklist.

Table 19. Implementation Plan Requirements Evaluated in this CEQA Analysis

Source	Implementation Action	Reasonably Foreseeable Compliance Measures
Houseboats	Evaluate, repair and/or replace sewage collection systems (holding tanks, pumps, and sewer lines, etc.) as necessary to ensure no sewage is discharge into the Bay	Minor construction on houseboats to make repairs Minor repairs on slips and marina landside facilities to repair/replace wastewater equipment, including above-ground pipes
Vessels	Evaluate performance and adequacy of sewage collection systems (sewage dump stations, sewage pumpout stations, onboard holding tanks, pumps, and sewer lines, etc.) Install, as needed, an adequate number of sewage pumpout and dump stations Repair/upgrade identified leaky/ malfunctioning sewage collection systems (sewage dump stations, sewage pumpout stations, onboard holding tanks, sewer lines, etc.) such that they do not discharge any sewage into the Bay Enroll in mobile sewage collection and disposal service	Repair and/or construction of new marina sewage pump out and dump stations Minor marina construction and above ground sewer line replacement Increase mobile sewage collection and disposal services
Sanitary Sewer Systems	Comply with Statewide General Waste Discharge Requirements for sanitary sewer systems (which aim to prevent sanitary sewer overflows[1])	Continuation of ongoing activities of sanitary districts in Richardson Bay, which are regulated under NPDES permits issued by the Water Board (see Table 7-4 under Sanitary Sewer Systems)
Stormwater Runoff	Update stormwater management plans to include specific measures to reduce pathogens in stormwater runoff. Implement pathogen reductions measures.	Installation of additional pet waste receptacles and signage.

[1] The ongoing activities relied on for achievement of the TMDL are those specified in the General Waste Discharge Requirements for sanitary sewer systems that pertain to sanitary sewer overflow prevention, not to other aspects of sanitary district operations.

11.5. Environmental Checklist

1. **Project Title:** Proposed Basin Plan amendment for a Total Maximum Daily Load (TMDL) for Pathogens in Richardson Bay.

2. **Lead Agency Name and Address:** California Regional Water Quality Control Board, San Francisco Bay Region
1515 Clay Street, Suite 1400
Oakland, California 94612

3. **Contact Person and Phone Number:** Farhad Ghodrati
(510) 622-2331

4. **Project Location:** Richardson Bay, Marin County, California

5. **Project Sponsor's Name & Address:** California Regional Water Quality Control Board, San Francisco Bay Region
1515 Clay Street, Suite 1400
Oakland, California 94612

6. **General Plan Designation:** Not Applicable

7. **Zoning:** Not Applicable

8. **Description of Project:**

   The project is a proposed Basin Plan amendment and Implementation Plan for a TMDL for Pathogens in Richardson Bay.

9. **Surrounding Land Uses and Setting:**
   The proposed Basin Plan amendment would affect Richardson Bay, as described in Section 2 of the Staff Report. Implementation is likely to involve the Bay itself and upland urban watershed areas that drain to the Bay. Richardson Bay watershed land uses include a mix of commercial, residential, and industrial urban uses, marinas, and open space uses.

10. **Other public agencies whose approval is required:** (e.g., permits, financing approval, or participation agreement.): The California State Water Resources Control Board, the California Office of Administrative Law, and the U.S. Environmental Protection Agency must approve the Basin Plan amendment following adoption by the San Francisco Bay Regional Water Quality Control Board (Water Board)

ENVIRONMENTAL IMPACTS:

Issues:	*Potentially Significant Impact*	*Less Than Significant With Mitigation Incorporation*	*Less Than Significant Impact*	*No Impact*
I. AESTHETICS -- Would the project:				
a) Have a substantial adverse effect on a scenic vista?	☐	☐	☒	☐
b) Substantially damage scenic resources, including, but not limited to, trees, rock outcroppings, and historic buildings within a state scenic highway?	☐	☐	☐	☒
c) Substantially degrade the existing visual character or quality of the site and its surroundings?	☐	☐	☒	☐
d) Create a new source of substantial light or glare which would adversely affect day or nighttime views in the area?	☐	☐	☐	☒
II. AGRICULTURE RESOURCES -- In determining whether impacts to agricultural resources are significant environmental effects, lead agencies may refer to the California Agricultural Land Evaluation and Site Assessment Model (1997) prepared by the California Department of Conservation as an optional model to use in assessing impacts on agriculture and farmland. **Would the project:**				
a) Convert Prime Farmland, Unique Farmland, or Farmland of Statewide Importance (Farmland), as shown on the maps prepared pursuant to the Farmland Mapping and Monitoring Program of the California Resources Agency, to non-agricultural use?	☐	☐	☐	☒
b) Conflict with existing zoning for agricultural use, or a Williamson Act contract?	☐	☐	☐	☒
c) Involve other changes in the existing environment which, due to their location or nature, could result in conversion of Farmland, to non-agricultural use?	☐	☐	☐	☒

ENVIRONMENTAL IMPACTS:

Issues:	*Potentially Significant Impact*	*Less Than Significant With Mitigation Incorporation*	*Less Than Significant Impact*	*No Impact*
III. AIR QUALITY -- Where available, the significance criteria established by the applicable air quality management or air pollution control district may be relied upon to make the following determinations. **Would the project:**				
a) Conflict with or obstruct implementation of the applicable air quality plan?	☐	☐	☐	☒
b) Violate any air quality standard or contribute substantially to an existing or projected air quality violation?	☐	☐	☒	☐
c) Result in a cumulatively considerable net increase of any criteria pollutant for which the project region is non-attainment under an applicable federal or state ambient air quality standard (including releasing emissions which exceed quantitative thresholds for ozone precursors)?	☐	☐	☐	☒
d) Expose sensitive receptors to substantial pollutant concentrations?	☐	☐	☐	☒
e) Create objectionable odors affecting a substantial number of people?	☐	☐	☒	☐
IV. BIOLOGICAL RESOURCES -- Would the project:				
a) Have a substantial adverse effect, either directly or through habitat modifications, on any species identified as a candidate, sensitive, or special-status species in local or regional plans, policies, or regulations, or by the California Department of Fish and Game or U.S. Fish and Wildlife Service?	☐	☐	☐	☒

ENVIRONMENTAL IMPACTS:

Issues:	*Potentially Significant Impact*	*Less Than Significant With Mitigation Incorporation*	*Less Than Significant Impact*	*No Impact*
b) Have a substantial adverse effect on any riparian habitat or other sensitive natural community identified in local or regional plans, policies, and regulations or by the California Department of Fish and Game or U.S. Fish and Wildlife Service?	☐	☐	☒	☐
c) Have a substantial adverse effect on federally protected wetlands as defined by Section 404 of the Clean Water Act (including, but not limited to, marsh, vernal pool, coastal, etc.) through direct removal, filling, hydrological interruption, or other means?	☐	☐	☒	☐
d) Interfere substantially with the movement of any native resident or migratory fish or wildlife species or with established native resident or migratory wildlife corridors, or impede the use of native wildlife nursery sites?	☐	☐	☒	☐
e) Conflict with any local policies or ordinances protecting biological resources, such as a tree preservation policy or ordinance?	☐	☐	☐	☒
f) Conflict with the provisions of an adopted Habitat Conservation Plan, Natural Community Conservation Plan, or other approved local, regional, or state habitat conservation plan?	☐	☐	☐	☒
V. CULTURAL RESOURCES -- Would the project:				
a) Cause a substantial adverse change in the significance of a historical resource as defined in §15064.5?	☐	☐	☐	☒
b) Cause a substantial adverse change in the significance of a unique archaeological resource pursuant to §15064.5?	☐	☐	☐	☒
c) Directly or indirectly destroy a unique paleontological resource or site or unique geologic feature?	☐	☐	☐	☒

ENVIRONMENTAL IMPACTS:

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

ENVIRONMENTAL IMPACTS:

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

ENVIRONMENTAL IMPACTS:

Issues:	*Potentially Significant Impact*	*Less Than Significant With Mitigation Incorporation*	*Less Than Significant Impact*	*No Impact*
VIII. HYDROLOGY AND WATER QUALITY -- Would the project:				
a) Violate any water quality standards or waste discharge requirements?	☐	☐	☐	☒
b) Substantially deplete groundwater supplies or interfere substantially with groundwater recharge such that there would be a net deficit in aquifer volume or a lowering of the local groundwater table level (e.g., the production rate of pre-existing nearby wells would drop to a level which would not support existing land uses or planned uses for which permits have been granted)?	☐	☐	☐	☒
c) Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, in a manner which would result in substantial erosion of siltation on- or off-site?	☐	☐	☐	☒
d) Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, or substantially increase the rate or amount of surface runoff in a manner which would result in flooding on- or off-site?	☐	☐	☐	☒
e) Create or contribute runoff water which would exceed the capacity of existing or planned stormwater drainage systems or provide substantial additional sources of polluted runoff?	☐	☐	☐	☒
f) Otherwise substantially degrade water quality?	☐	☐	☐	☒
g) Place housing within a 100-year flood hazard area as mapped on a federal Flood Hazard Boundary or Flood Insurance Rate Map or other flood hazard delineation map?	☐	☐	☐	☒

ENVIRONMENTAL IMPACTS:

Issues:	*Potentially Significant Impact*	*Less Than Significant With Mitigation Incorporation*	*Less Than Significant Impact*	*No Impact*
h) Place within a 100-year flood hazard area structures which would impede or redirect flood flows?	☐	☐	☐	☒
i) Expose people or structures to a significant risk of loss, injury or death involving flooding, including flooding as a result of the failure of a levee or dam?	☐	☐	☐	☒
j) Inundation of seiche, tsunami, or mudflow?	☐	☐	☐	☒
IX. LAND USE AND PLANNING -- Would the project:				
a) Physically divide an established community?	☐	☐	☐	☒
b) Conflict with any applicable land use plan, policy, or regulation of an agency with jurisdiction over the project (including, but not limited to the general plan, specific plan, local coastal program, or zoning ordinance) adopted for the purpose of avoiding or mitigating an environmental effect?	☐	☐	☐	☒
c) Conflict with any applicable habitat conservation plan or natural community conservation plan?	☐	☐	☐	☒
X. MINERAL RESOURCES -- Would the project:				
a) Result in the loss of availability of a known mineral resource that would be of value to the region and the residents of the state?	☐	☐	☐	☒
b) Result in the loss of availability of a locally-important mineral resource recovery site delineated on a local general plan, specific plan or other land use plan?	☐	☐	☐	☒

ENVIRONMENTAL IMPACTS:

Issues:	*Potentially Significant Impact*	*Less Than Significant With Mitigation Incorporation*	*Less Than Significant Impact*	*No Impact*
XI. NOISE -- Would the project result in:				
a) Exposure of persons to or generation of noise levels in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies?	☐	☐	☒	☐
b) Exposure of persons to or generation of excessive groundborne vibration or groundborne noise levels?	☐	☐	☐	☒
c) A substantial permanent increase in ambient noise levels in the project vicinity above levels existing without the project?	☐	☐	☐	☒
d) A substantial temporary or periodic increase in ambient noise levels in the project vicinity above levels existing without the project?	☐	☐	☒	☐
e) For a project located within an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport, would the project expose people residing or working in the project area to excessive noise levels?	☐	☐	☐	☒
f) For a project within the vicinity of a private airstrip, would the project expose people residing or working in the project area to excessive noise levels?	☐	☐	☐	☒
XII. POPULATION AND HOUSING -- Would the project:				
a) Induce substantial population growth in an area, either directly (for example, by proposing new homes and businesses) or indirectly (for example, through extension of roads or other infrastructure)?	☐	☐	☐	☒
b) Displace substantial numbers of existing housing, necessitating the construction of replacement housing elsewhere?	☐	☐	☐	☒

ENVIRONMENTAL IMPACTS:

Issues:	*Potentially Significant Impact*	*Less Than Significant With Mitigation Incorporation*	*Less Than Significant Impact*	*No Impact*
c) Displace substantial numbers of people necessitating the construction of replacement housing elsewhere?	☐	☐	☐	☒
XIII. PUBLIC SERVICES --				
a) Would the project result in substantial adverse physical impacts associated with the provision of new or physically altered governmental facilities, need for new or physically altered governmental facilities, the construction of which could cause significant environmental impacts, in order to maintain acceptable service ratios, response times, or other performance objectives for any of the public services:				
Fire protection?	☐	☐	☐	☒
Police protection?	☐	☐	☐	☒
Schools?	☐	☐	☐	☒
Parks?	☐	☐	☐	☒
Other public facilities?	☐	☐	☐	☒
XIV. RECREATION --				
a) Would the project increase the use of existing neighborhood and regional parks or other recreational facilities such that substantial physical deterioration of the facility would occur or be accelerated?	☐	☐	☐	☒
b) Does the project include recreational facilities or require the construction or expansion of recreational facilities which might have an adverse physical effect on the environment?	☐	☐	☐	☒

ENVIRONMENTAL IMPACTS:

Issues:	*Potentially Significant Impact*	*Less Than Significant With Mitigation Incorporation*	*Less Than Significant Impact*	*No Impact*
XV. TRANSPORTATION / TRAFFIC -- Would the project:				
a) Cause an increase in traffic which is substantial in relation to the existing traffic load and capacity of the street system (i.e., result in a substantial increase in either the number of vehicle trips, the volume-to-capacity ratio on roads, or congestion at intersections)?	☐	☐	☐	☒
b) Exceed, either individually or cumulatively, a level of service standard established by the county congestion management agency for designated roads or highways?	☐	☐	☐	☒
c) Result in a change in air traffic patterns, including either an increase in traffic levels or a change in location that result in substantial safety risks?	☐	☐	☐	☒
d) Substantially increase hazards due to a design feature (e.g., sharp curves or dangerous intersections) or incompatible uses (e.g., farm equipment)?	☐	☐	☐	☒
e) Result in inadequate emergency access?	☐	☐	☐	☒
f) Result in inadequate parking capacity?	☐	☐	☐	☒
g) Conflict with adopted policies, plans, or programs supporting alternative transportation (e.g., bus turnouts, bicycle racks)?	☐	☐	☐	☒
XVI. UTILITIES AND SERVICE SYSTEMS -- Would the project:				
a) Exceed wastewater treatment requirements of the applicable Regional Water Quality Control Board?	☐	☐	☐	☒
b) Require or result in the construction of new water or wastewater treatment facilities or expansion of existing facilities, the construction of which could cause significant environmental effects?	☐	☐	☐	☒

ENVIRONMENTAL IMPACTS:

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

XVII. MANDATORY FINDINGS OF SIGNIFICANCE

a) Does the project have the potential to degrade the quality of the environment, substantially reduce the habitat of a fish or wildlife species, cause a fish or wildlife population to drop below self-sustaining levels, threaten to eliminate a plant or animal community, reduce the number or restrict the range of a rare or endangered plant or animal or eliminate important examples of the major periods of California history or prehistory?	☐	☐	☐	☒
b) Does the project have impacts that are individually limited, but cumulative considerable? ("Cumulative considerable" means that the incremental effects of a project are considerable when viewed in connection with the effects of past projects, the effects of				

ENVIRONMENTAL IMPACTS:

Issues:	*Potentially Significant Impact*	*Less Than Significant With Mitigation Incorporation*	*Less Than Significant Impact*	*No Impact*
other current projects, and the effects of probable future projects)?	☐	☐	☐	☒
c) Does the project have environmental effects which will cause substantial adverse effects on human beings, either directly or indirectly?	☐	☐	☐	☒

Discussion of Environmental Impact Analysis by Checklist Category

An explanation for each box checked on the environmental checklist is provided below. The following sections are numbered to correspond to the checklist.

I. Aesthetics

a) Any physical changes to the aesthetic environment as a result of the Pathogens TMDL would be small in scale. No actions or projects associated with implementation of the Pathogens TMDL would result in tall or massive structures that could obstruct views from, or of scenic vistas. Construction of pump-out stations or other equipment may result in minor changes to the scenic waterfront area along the Bay margin. These aesthetic affects are considered less than significant.

b) Actions or projects implemented for the Pathogens TMDL would occur mainly along the bay margin and at marinas and would not occur within a state scenic highway, and therefore do not result in adverse aesthetic impacts to state scenic highways.

c) Projects associated with implementation of the Pathogens TMDL would not substantially affect or degrade the existing visual character or quality of any site or its surroundings and are expected to be less than significant because physical changes to the aesthetic environment would be small in scale.

d) Actions and projects that could result from the Pathogens TMDL would not include new lighting or installation of large structures that could generate reflected sunlight or glare, and therefore do not result in adverse light and glare impacts.

II. Agriculture Resources

a) The Pathogens TMDL would mainly affect urban land in the area that drains to Richardson Bay, not land designated as Prime, Unique, or

Farmland of Statewide Importance by the California Resources Agency. No impacts would result.

b) The Pathogens TMDL would not affect existing agricultural zoning or any aspects of Williamson Act contract. It would have no adverse impacts in this regard.

c) The Pathogens TMDL would not result in changes to land use; it would not result in the conversion of farmland to non-agricultural uses. Therefore, no impacts would result.

III Air Quality

a) Because the Pathogens TMDL would not cause any significant changes in population or employment, it is not expected to generate ongoing traffic-related emissions. It does not require construction of any permanent emissions sources. For these reasons, no permanent change in air emissions would occur, and the Pathogens TMDL would not conflict with applicable air quality plans. Therefore, no air quality impacts would result.

b) The Pathogens TMDL would not "violate any air quality standard or contribute substantially to an existing or project air quality standard." Nor would it involve the construction of any permanent emissions sources or generate ongoing traffic-related emissions. Construction and minor earthmoving that would occur as a result of Pathogens TMDL implementation (such as new sewage pump-out stations, pet waste receptacles, and replacement piping) would be of short-term duration and would likely involve discrete, small-scale projects as opposed to extensive earthmoving activities.

   If specific construction projects were proposed to comply with requirements derived from the proposed Pathogens TMDL, such projects would have to comply with the Bay Area Air Quality Management District's (BAAQMD) requirements with respect to the operation of portable equipment. Moreover, BAAQMD has identified readily available measures, routinely employed at most construction sites, to control construction-related air quality emissions (BAAQMD 1999). These measures include watering active construction areas; covering trucks hauling soil; and applying water or applying soil stabilizers on unpaved areas. Therefore, the Pathogens TMDL would not violate any air quality standard or contribute substantially to any air quality violation, and its temporary construction-related air quality impacts would be less than significant.

c) Because the Pathogens TMDL would not generate ongoing traffic-related emissions or involve the construction of any permanent emissions sources, it would not result in a cumulatively considerable net increase of any pollutant for which the project region is in non-attainment of air quality standards. No air quality impact would result.

d) Because the Pathogens TMDL would not require the construction of any permanent emissions sources but rather involves short-term and discrete

construction activities, it would not expose sensitive receptors to substantial pollutant concentrations. No air quality impact would result.

e) The Pathogens TMDL would not cause construction of any permanent sources of odor and therefore would not create objectionable odors affecting a substantial number of people. However, inspection and repair of sewage collection systems could result in temporary, localized odors in the vicinity of recreational boating activities. Because vessel repairs would be conducted at marinas, which are areas of low-density population, possible odors would not affect substantial numbers of people and impacts would be less than significant.

IV Biological Resources

a) Projects proposed as a result of implementation of the Pathogens TMDL are likely to be small in scale and are located in areas that are currently developed. Actions would not disturb unpaved areas, trees, or other potential habitat areas for special-status species. Therefore, the Pathogens TMDL would not have a substantial adverse effect, either directly or through habitat modifications, on any sensitive or special-status species.

b) Implementation measures that involve repair of sewage systems or minor construction along the shoreline of Richardson Bay, are not expected to have a significant impact on sensitive natural communities because they would be subject to review and/or approval by the Water Board, which under its existing regulatory authority is expected to require mitigation measures to reduce impacts to less than significant levels. The Water Board will work with California Department of Fish and Game, U.S. Fish and Wildlife Service, and proponents of specific compliance measures to design projects that not only meet and further the Pathogens TMDL requirements, but also have minimal impacts.

   Moreover, in discharging its regulatory program responsibilities, the Water Board is expected to require mitigation measures for work it approves that may impact coastal ecosystems or other sensitive natural communities. Such requirements include but are not limited to pre-construction surveys; construction buffers and setbacks; restrictions on construction during sensitive periods of time; employment of on-site biologists to oversee work; and avoidance of construction in known sensitive habitat areas or relocation and restoration of sensitive habitats, but only if avoidance is impossible. Therefore, the Pathogens TMDL would not have a substantial adverse effect, either directly or through habitat modifications to sensitive natural communities.

c) Projects proposed to comply with the Pathogens TMDL would occur on vessels, on existing bay cover (such as marina slips and ramps), and on land. The Pathogens TMDL does not include construction of new bay cover or filling of wetlands or the Bay. Therefore, the Pathogens TMDL would result in less than significant adverse impacts on wetlands.

d) The Pathogens TMDL would not substantially interfere with the movement of any native resident or migratory fish or wildlife species, or with established native resident or migratory wildlife corridors, or impede the use of native wildlife nursery sites. Future projects to reduce pathogen concentrations could result in small increased boat traffic, one to two additional boat trips per day, to collect and dispose of vessel waste. Therefore, the Pathogens TMDL would not substantially affect fish or wildlife movement, migratory corridors, or nurseries, and its impacts would be less-than-significant.

e) The Pathogens TMDL does not conflict with any local policies or ordinances protecting biological resources such as trees. Projects proposed to comply with the Pathogens TMDL would not affect riparian zones nor would they include tree removal and would not conflict with local policies or ordinances.

f) The Pathogens TMDL does not conflict with any adopted Habitat Conservation Plan, Natural Community Plan, or other approved local, regional or state habitat conservation plan. Projects proposed to comply with Pathogens TMDL requirements are likely to be subject to local agency review, and therefore will not conflict with local policies or ordinance.

V. Cultural Resources

a) Proposed projects to comply with the Pathogens TMDL would include only, minor construction and would not require changes to historic buildings or structures. Nor would Basin Plan-related projects involve construction of structures that could alter the value of historic resources in the Richardson Bay area. Therefore, the Pathogens TMDL would have no impacts on historic resources.

b) Proposed projects to comply with the Pathogens TMDL would involve minor construction that would not include large scale grading or deep excavations in areas that are likely to contain significant archeological resources. Therefore, the Pathogens TMDL would have no impacts on archeological resources.

c) Projects implemented due to the Pathogens TMDL would involve minor construction in paved, urban areas. No known paleontological resource or areas containing unique geologic features have been identified in the vicinity of Richardson Bay marina or surrounding areas. Therefore the Basin Plan amendment would have no impact on paleontological resources.

d) The Pathogens TMDL would result in minor construction in paved, urban areas. No deep excavation is foreseeable. No known sites of human remains have been identified in the vicinity of Richardson Bay marina or surrounding areas. Therefore the Pathogens TMDL would have no impacts on human remains.

VI. Geology and Soils

a) The Pathogens TMDL would not require construction of habitable structures or addition of new population; therefore, it would not result in any human safety risks related to fault rupture, seismic ground-shaking, ground failure, or landslides.

b) Implementation of the Pathogens TMDL may result in minor construction and earthmoving. Such activities are not likely to result in substantial soil erosion or loss of topsoil because they are small in size. Any impacts are expected to be less than significant.

c) Projects proposed to comply with the Pathogens TMDL would be located on low-lying, level land along the Bay margin and would not be at risk of landsliding. Although some of these locations may be underlain by artificial fill, Bay mud, or other materials that could be prone to failure in an earthquake due to liquefaction or subsidence, the Pathogens TMDL would not create structures that could be damaged or create new geologic hazards. No adverse impacts to local geologic conditions, including on- or off-site landslides, lateral spreading, subsidence, liquefaction, or collapse are expected to occur as a result of adoption of this amendment.

d) Construction of buildings (as defined in the Uniform Building Code) or any habitable structures is not reasonably foreseeable due to the Pathogens TMDL. Minor grading could occur in areas with expansive soils but this activity would not create a substantial risk to life or property. Therefore, the Pathogens TMDL would not result in impacts related to expansive soils or risks to life or property.

e) The Pathogens TMDL would not require construction of new septic systems; therefore, affected soils need not be capable of supporting the use of septic tanks or alternative wastewater disposal systems. No impacts from septic tanks or alternative wastewater disposal systems would result from the project.

VII Hazards and Hazardous Materials

a) The Pathogens TMDL is not expected to involve the routine transport, use, or disposal of hazardous materials. Therefore, no impacts from the use, transport or disposal of hazardous materials would result.

b) The Pathogens TMDL is not expected to include actions that are likely to result in upset or accident conditions involving the release of hazardous materials. Sewage is not considered a hazardous material. Laws and regulations restrict handling and disposal of sewage during repair and replacement of holding tanks and sewer pipes. Small amounts of cement, grease or solvents may be used for repairs or minor construction. These materials would be handled in accordance with relevant laws and regulations, which would minimize hazards to the public or the environment, and the potential for accidents or upsets. Therefore, hazardous waste transport and disposal would not create any significant public or environmental hazard or environmental impact.

c) Implementation measures for the Pathogens TMDL would take place in marinas along the northern shore of Richardson Bay. No schools are located or planned in this area. Therefore, no impact from hazardous materials would occur within one-quarter mile of an existing or proposed school.

d) It is unlikely that Pathogens TMDL actions would occur on sites that are included on lists of hazardous material sites compiled pursuant to Government Code Section 65962.5, such as leaking underground storage tank sites or sites where hazardous materials violations have occurred. It is possible that hazardous materials or substances may be encountered during project activities on or near these sites. The Water Board regulates listed hazardous material sites and would require mitigation to ensure that the Basin Plan amendment would not create a significant hazard to the public or the environment due to hazardous materials. Therefore, impacts from hazardous materials would be less than significant.

e) The Basin Plan amendment does not include actions that would result in a safety hazard for people residing or working within two miles of a public airport or vicinity. There are no airports located in the vicinity of Richardson Bay.

f) The Basin Plan amendment would not result in construction of buildings or others structures that could result in safety hazards for people residing or working near a private air strip and no impact would result because not private airstrips are located in this area.

g) Hazardous waste management activities resulting from the Basin Plan amendment would not interfere with any emergency response plans or emergency evacuation plans, and no impacts would result.

h) The Basin Plan amendment would not affect the potential for wildland fires. Therefore no impacts from wildfires would result.

VIII Hydrology and Water Quality

a) It is not expected that implementation projects for the Pathogens TMDL would result in violations of water quality standards or waste discharge requirements. The purpose of the project is to attaing applicable water quality standards; therefore, it would not violate standards or waste discharge requirements.

b) The Pathogens TMDL would not deplete groundwater supplies or interfere with groundwater recharge. No adverse impacts to groundwater would result.

c) Specific projects to comply with requirements derived from the proposed Pathogens TMDL could involve minor earthmoving or construction. These actions would not include large scale grading, deep excavation, construction on unpaved areas, vegetation removal, or stream course alteration. They would not result in substantial erosion or siltation, either on- or off-site.

d) Compliance with the Pathogens TMDL could involve minor construction and earthmoving, which could have minor affects on existing drainage patterns, particularly for conveyance of urban storm water. Actions could include construction of drainage swales or other changes to storm water systems. Projects would be described in municipal storm water permit applications that would be subject to Water Board review and/or approval; the Water Board will ensure that these projects are designed to not adversely affect upstream areas or contribute to flooding. Therefore, the Pathogens TMDL would not result in significant impacts related to increased flooding.

e) Pathogens TMDL-related activities are, by design, intended to decrease peak runoff rates from upland land uses, as needed to reduce fine sediment inputs to channels and channel erosion. Therefore, the Pathogens TMDL would not increase the rate or amount of runoff or exceed the capacity of storm water drainage systems and no adverse impact impacts to channels would occur.

f) Pathogens TMDL-related activities are intended to reduce pathogens in Richardson Bay and improve water quality. No adverse water quality impacts would occur.

g) The Pathogens TMDL will not require or result in construction of housing. Therefore no housing would be placed within the 100-year flood hazard zone as a result of the proposed action.

h) The Pathogens TMDL will not result in construction of structures that could impede or redirect flood flows within a 100-year flood hazard zone.

i) The Pathogens TMDL will not result in construction or modification of dams or levees or activities that would expose people or structures to flood hazards from dam or levee failure.

j) Pathogens TMDL-related construction would occur along the margins of Richardson Bay. Risks of damage to vessels, sewage systems, and marinas from inundation by seiche, tsunami, or mudflow, would not be changed by Pathogens TMDL-related activities.

IX Land Use and Planning

a) Pathogens TMDL-related construction is not expected to physically divide any established community.

b) The Pathogens TMDL would not conflict with any land use plan, policy, or regulation. Projects proposed to comply with Pathogens TMDL requirements would be subject to local agency review and therefore would not conflict with local land use plans or policies.

c) The Pathogens TMDL would not conflict with any habitat conservation plan or natural community conservation plan. Projects proposed to comply with Pathogens TMDL requirements would be subject to local agency review and would therefore not conflict with habitat conservation plans or natural community conservation plans.

X Mineral Resources

a) Pathogens TMDL-related excavation and construction would be small in scale and would not result in loss of availability of any known mineral resources that would be of value to the region or the residents of the State.

b) Pathogens TMDL-related excavation and construction would be relatively small in scale and would not be located in areas of mineral resources of local importance,

XI Noise

a) Earthmoving and construction could temporarily generate noise. Projects that local agencies propose to comply with requirements derived from the Pathogens TMDL would be required to comply with local agencies' own noise and nuisance standards.

b) To comply with requirements derived from the Pathogens TMDL, specific projects could involve minor construction and the use of some heavy equipment, including pump trucks, which could result in temporary ground-borne vibration or noise. These activities would typically last no more than a few hours during the day, and would be carried out in compliance with local standards. Therefore, the Pathogens TMDL would not result in substantial noise, and noise impacts would be less-than-significant.

c) The Pathogens TMDL would not cause any permanent increase in ambient noise levels. Any noise would be short-term in nature.

d) As indicated in response to XI b), above, specific projects would have to comply with local city and county noise standards, and would not result in substantial noise impacts.

e) The Richardson Bay watershed is not within two miles of an airport land use plan area. The Pathogens TMDL would not result in increased population in the watershed and no impacts from airport noise exposure to residents or workers would result.

f) The Richardson Bay watershed does not contain any private airports.

XII Population and Housing

a) The Pathogens TMDL would not result in population growth in Marin County nor would it in any way increase the number of live-aboards or anchor-outs in Richardson Bay marinas. It would not induce growth through construction of new housing or businesses, or by extending roads or infrastructure.

b) The Pathogens TMDL would not affect population of the Richardson Bay watershed. It would not displace any existing housing or any people who would need replacement housing, and no adverse housing impacts would occur.

c) The Pathogens TMDL would not displace people or create a need for construction of replacement housing.

XIII Public Services

a) The Pathogens TMDL would not affect any governmental facilities or service ratios, response times, or other performance objectives for any public services, including fire protection, police protection, schools, or parks.

XIV Recreation

a) The Pathogens TMDL could result in temporary construction in marinas along the shore of Richardson Bay. Minor construction to repair or replace sewer systems would be short term and localized and would not result in significant impacts to recreation. The project would improve and enhance marina facilities for boaters and would not result in physical deterioration of park or recreation facilities. No recreational facilities would need to be constructed or expanded and no recreational impacts would occur.

b) The Pathogens TMDL would not result in the need for construction or expansion of recreational facilities that could have an adverse affect on the environment. Any short-term changes would be less than significant.

XV Transportation / Traffic

a) Pathogens TMDL actions could result in minor construction requiring the use of heavy equipment to repair and pump out old sewer systems and replace them. Any increase in traffic would be temporary and would be limited to local areas in individual marinas and would not create substantial traffic in relation to the existing load and capacity of existing street systems.

b) Because the Pathogens TMDL would not increase population or provide employment, it would not generate any ongoing motor vehicle trips and would not affect level of service standards established by the county congestion management agency. Therefore, the Pathogens TMDL would not result in permanent, substantial increases in traffic above existing conditions. Impacts would be less than significant.

c) The Pathogens TMDL would not affect air traffic and no impacts are anticipated.

d) The Pathogens TMDL does not include provisions for construction of new roads. No new hazards due to the design or engineering of the road network in the Richardson Bay watershed would occur.

e) The Pathogens TMDL would not result changes to roads used for emergency access. Therefore, the project would not result in inadequate emergency access.

f) Because the Pathogens TMDL would not increase population or provide employment, it would not affect parking demand or supply.

g) Because the Pathogens TMDL would not generate ongoing motor vehicle trips, it would not conflict with adopted policies, plans, or programs supporting alternative transportation.

XVI Utilities and Service Systems

a) The project would amend the Basin Plan, which is the basis for wastewater treatment requirements to improve water quality and the environment in the Bay Area; therefore, the Pathogens TMDL would be consistent with such requirements.

b) The Pathogens TMDL includes changes to local wastewater collection and conveyance systems but does not require construction of any new wastewater treatment facilities.

c) Pathogens TMDL-related projects could result in improvements to urban storm water runoff systems designed to reduce pathogen discharges to Richardson Bay. However, it would not include construction of new or expanded stormwater drainage facilities that would increase capacity of those systems or cause adverse environmental impacts.

d) Because the Pathogens TMDL would not increase population or provide employment, it would not require ongoing additional water supply or entitlements.

e) Because the Pathogens TMDL addresses a pathogen problem linked to the wastewater conveyance system, not the treatment plants themselves, compliance would not require any increased wastewater treatment capacity or construction.

f) Pathogens TMDL implementation would not substantially affect municipal solid waste generation or landfill capacities. No impacts would occur.

g) Pathogens TMDL implementation would not substantially affect municipal solid waste generation or landfill capacities and no impacts would occur.

XVII Mandatory Findings of Significance

a) Taken as a whole, the Pathogens TMDL would not degrade the quality of the environment. The proposed Pathogens TMDL is intended to benefit water quality and the future of shellfish harvesting in Richardson Bay.

b) As discussed above, the Pathogens TMDL could pose some less-than-significant adverse environmental impacts related to minor sewage system repair, replacement, and re-construction, and other small construction projects, such as new pump out facilities at on-land

marinas. These impacts from repair and construction activities would be individually limited and of short-term duration. Therefore, these future projects would not lead to cumulatively considerable significant impacts.

c) The Pathogens TMDL would not cause any substantial adverse effects to human beings, either directly or indirectly. The Pathogens TMDL is intended to benefit human beings through implementation of actions to improve water quality in Richardson Bay.

Cumulative Impact Analysis

This section provides an analysis of the significant cumulative impacts of the proposed basin plan amendment (CEQA Guidelines § 15130). Cumulative impacts refers to “two or more individual effects which, when considered together, are considerable or which compound or increase other environmental impacts.”

The cumulative impact that results from several closely related projects is the change in the environment which results from the incremental impact of the project when added to other closely related past, present and reasonably foreseeable probable future projects, in this case the impacts from other municipal and private projects to reduce pathogens, which would occur in the Richardson Bay watershed during the period of implementation.

As noted above, the Pathogens TMDL would not result in significant adverse impacts to the environment and no cumulative impacts are anticipated. This analysis considers past, present, and reasonably foreseeable future projects that could have similar environmental impacts were evaluated to determine that no significant cumulative impacts would occur. These include projects that would involve construction at marinas or substantial changes to urban stormwater infrastructure, as well as adoption of other TMDLs in the watershed. This cumulative analysis considers projects located in the northern portion of Richardson Bay and the watershed areas that drain to the Bay covered by the proposed Basin Plan amendment.

The Waldo Point Harbor remediation and restoration project was the only marina project identified in the area. This project, under the jurisdiction of the U.S. Army Corps of Engineers and the Water Board under Sections 404 and 401 of the Clean Water Act, includes providing permanent mooring of 283 houseboats, removal of unauthorized fill, creation of a shoreline park and footpath, and improved parking areas and flood control provisions.

Other approved TMDLs that will affect water quality in Richardson Bay include the San Francisco Bay Mercury TMDL and the Urban Creeks Diazinon/Pesticide Toxicity TMDL. The San Francisco Bay PCBs TMDL is a future TMDL that could improve water quality in Richardson Bay. Other future TMDLs, to be prepared and adopted by the Water Board, would improve overall water quality in Richardson Bay and could include implementation actions that would further reduce pathogens in the Bay.

The cumulative impact of the Richardson Bay Pathogens TMDL with these other projects would be beneficial to the environment and would not result in significant adverse environmental impacts. Our review of other planned, proposed, and ongoing projects reveals none that would lead to significant environmental impacts.

11.6. Alternatives Analysis

This analysis presents several alternatives to the proposed Basin Plan amendment. An evaluation of alternatives is required under CEQA Section 15252 (a)(2)(A) in order to avoid or reduce any significant or potentially significant effects on the environment.

We considered a range of alternatives to the proposed Basin Plan amendment and provide a brief discussion of the alternatives below. The alternatives we have considered would not avoid or lessen any significant adverse impacts because the Pathogens TMDL does not pose any significant adverse environmental impacts. Thus it is not reasonable to look to other alternatives and the proposed project is the preferred alternative.

The alternatives that we considered are based on different targets, allocations, or implementation strategies:

1) No Basin Plan amendment to establish a Pathogens TMDL for Richardson Bay
2) Less stringent targets based solely on protection of water contact recreation beneficial Uses
3) Longer implementation timeline

Alternative 1: No Basin Plan Amendment

Under this alternative, the Water Board would not amend the Basin Plan to incorporate a Pathogens TMDL. Neither the proposed targets nor the proposed allocations would be adopted, and no new implementation activities would be initiated. If no actions are taken to address the Richardson Bay's pathogens impairment, pathogen concentrations could either stay the same or increase over time, due to the aging of sewage management systems.

Water Board staff rejected this alternative because it does not fulfill the project objective of complying with the CWA requirement to adopt a TMDL for impaired water bodies identified on the 303(d) list. In addition the "No-Project" alternative would not lessen the environmental impacts over the proposed project because other regulatory programs already require many of the actions of the proposed project.

Alternative 2: Less Stringent Targets Based Solely on Protection of Contact Recreation Beneficial Uses

We considered the possibility of proposing a TMDL that would set less stringent targets for pathogens, protective only of the water contact recreation beneficial use. Under this scenario, the TMDL targets would not include the target to

protect the shellfishing beneficial use, which is a more stringent target. This would result in raising the proposed fecal coliform load allocations.

Although higher numeric targets would protect recreational uses, they would not be protective of the shellfish harvesting beneficial use in Richardson Bay. In addition, the Clean Water Act requires a TMDL to address all water quality standards. This alternative does not meet the project objective to protect the shellfishing beneficial use, nor does it meet the objective of setting targets to meet water quality objectives protective of all designated beneficial uses.

Alternative 3: Longer Implementation

Under this alternative, compliance with the proposed pollutant load allocations would be phased in over a longer period of time (i.e., ten years) than what is proposed by the Basin Plan amendment. Therefore, attainment of water quality standards would take a longer period of time.

This alternative would not meet the project objectives because it would not attain standards in the shortest time frame possible. Further, most of the proposed implementation actions are and have been required under various established regulatory programs. Therefore, their implementation should be already underway, making a longer implementation time frame unnecessary.

11.7. Economic Considerations

Overview

Public Resources Code Section 21159 [a][3][c] under the CEQA requires that the Water Board conduct an environmental analysis of the reasonably foreseeable methods of compliance, including consideration of economic factors.

The proposed Richardson Bay pathogens TMDL Basin Plan amendment includes performance standards (i.e., targets and allocations), and therefore, requires consideration of economic factors.

The objective of this analysis is to estimate the costs of various implementation measures for pathogen reduction in Richardson Bay Watershed. The implementation plan call for reductions in the discharge of pathogens from stormwater runoff, sanitary sewer system overflows, houseboats, and vessels. In the Pathogens TMDL implementation plan, the Water Board describes implementation measures to control each potential pathogen source. These measures primarily entail evaluation, implementation of corrective actions, and reporting.

Our discussion of economic considerations or costs associated with various measures described by the TMDL's Implementation Plan is limited to those actions that are currently technically feasible and likely, in our view, to be adopted by dischargers. The TMDL is not prescriptive; no specific actions to achieve the numeric targets are required, rather dischargers are allowed to independently select implementation actions that will allow them to meet their allocations, based on their own considerations of need, budget, feasibility, or other criteria.

Table 20 provides cost estimates for each reasonably foreseeable TMDL implementation measure. In most cases, specific elements of the implementation action will be determined at some point in the future, and therefore the specifics are unknown. Because of consequent uncertainty about exact costs, we provide upper and lower range estimates. In other cases, where it is possible to make educated guesses about the likely elements of an implementation action, cost estimates are included. In instances where estimating the elements of a program would be decidedly speculative, no cost estimates are developed. Costs of implementing existing requirements are also not included in this report.

Table 20 Richardson Bay Implementation Actions and Estimated Costs

Implementation Action	Responsible Party	Estimated Quantity	Cost (Low)	Cost (High)
Stormwater Runoff				
1. Implementation of existing municipal stormwater management plan	MCSTOPPP, Local stormwater programs	1	No additional cost	No additional cost
2. Update of municipal stormwater managements plan to include additional pathogen reduction measures	MCSTOPPP, Local stormwater programs	1	$2,000 per year	$10,000 per year
3. Reporting	MCSTOPPP, Local stormwater programs	1	No additional cost	No additional cost
Sanitary Sewer Systems				
1. Compliance with existing Waste Discharge Requirements (WDRs)	Sewage collection agencies	10 sewage collection agencies	No additional cost	No additional cost
2. Reporting	Sewage collection agencies	10 sewage collection agencies	No additional cost	No additional cost
Houseboats				
1. Evaluation of adequacy and performance of sewage collection systems	RBRA, Marin County, local cities	400 houseboats	400 x $200 = $80,000	400 x $300 = $120,000
2. Repair and maintenance of sewage collection systems	Houseboat marina owners	400 houseboats	400 x 0.1 x $300 = $12,000	400x0.2 x $2,775 = $222,000
3. Reporting	RBRA, Marin County, local cities, houseboat marina owners	15 houseboats marinas	No cost estimated	No cost estimated
Vessels				
1. Evaluation of adequacy and performance of existing sewage collection systems at vessel marinas	RBRA, Marin County, local cities	1 Sewage dump station 7 Sewage pumpout stations	$200 x 8 = $1,600	$300 x 8 = $2,400

Table 20 Richardson Bay Implementation Actions and Estimated Costs

Implementation Action	Responsible Party	Estimated Quantity	Cost (Low)	Cost (High)
2. Installation of additional sewage collection systems at vessel marinas	Vessel marina owners	10 Dump stations 11 Pumpout stations	(0x$500)+(0x$3,000) = $0	(10x$10,000)+(11x$20,000) = $10,2200
3. Repair and maintenance of existing and additional sewage collection systems at vessel marinas	Vessel marina owners	11 Dump stations 18 Pumpout stations	(1x$100)+(7x$100) = $800	(11x500)+(18x$2,500) = $50,500
4. Enrollment in mobile sewage collection service by all live-aboards	Unenrolled Live-aboard vessels	28 Moored Live-aboard vessels; 70 Berthed Live-aboard vessels	28 x $6 = $168 per month	70 x $6 = $420 per month
5. Reporting	RBRA, Marin County, local cities, vessel marina owners	For all vessel marinas and anchor-out vessels	No cost estimated	No cost estimated

Cost Estimates

Sanitary Sewer Systems

The 10 sewage collection agencies listed in Table 9 operate the sanitary sewer collection systems in the Richardson Bay area. Water Board resolution (No. R2-2003-0095) established a collaborative program in October 2003 between the Water Board and Bay Area Clean Water Agencies to reduce sanitary sewer overflows. In 2006, the State Water Resources Control Board issued a Statewide General Waste Discharge Requirements Order for sanitary sewer systems (No. 2006-0003-DWQ). As a result, sanitary sewer collection system agencies are required to prepare and implement Sewer System Management Plans (SSMPs). A SSMP requires measures to contain sanitary sewer overflows, identify structures needing repair, and develop a preventive maintenance program. Requirements also include monitoring the effectiveness of each SSMP element, and submitting annual reports. The Water Board's program for reducing sanitary sewer overflows is being implemented independent of this Basin Plan amendment. The Basin Plan amendment would not impose any new requirements or actions for sanitary sewer systems; therefore, no additional costs to sanitary sewer collection agencies would be incurred as result of this Basin Plan amendment.

Stormwater Runoff

The Richardson Bay stormwater runoff program is managed by the Marin County Stormwater Pollution Prevention Program (MCSTOPPP). Stormwater runoff for the Richardson Bay Watershed is regulated under federal National Pollutant Discharge Elimination System (NPDES) stormwater permit requirements. MCSTOPPP's permit requires development and implementation of a storm water management plan that includes management practices to address specific

program areas. Program areas include public education and outreach; illicit discharge detection and elimination; construction and post-construction stormwater runoff and erosion control; and good housekeeping for municipal operations. MCSTOPPP's storm water management plan, Action Plan 2010 (Marin County, 2005), is now being implemented.

To meet the requirements of the TMDL, the county will be required to develop additional management measures for pathogen reduction; identify measurable goals and time schedules of implementation; and assign responsibility for each task. The specifics of these additional management measures to reduce pathogens in Richardson Bay are not yet known and will be described in MCSTOPP's future Stormwater Management Plan and Annual Reports. MCSTOPPP is required to submit the stormwater management plan to the Water Board for approval. The Water Board will review this document for its adequacy in meeting the storm water requirements. An estimate of the storm water program efforts and their costs is provided below.

Stormwater Plan Implementation: Development and implementation of a storm water program for this watershed is required independent of the Basin Plan amendment. Since this is an existing requirement under Phase II of the storm water program, no additional cost will be incurred as result of this Basin Plan amendment.

Some additional implementation measures or management programs may be needed in order to reduce pathogens in stormwater runoff. The specific measures are not known at this time. For the most part, these implementation measures would extend existing programs. For example, outreach to local residents on runoff may be expanded to include a description of specific sources of pathogens in the watershed (such as pet waste or leaking sewage handling systems) and information about how to reduce or eliminate these sources. To cover costs of additional outreach, we estimate a minimum increase in storm water program costs of 2 percent of the existing $100,000 annual budget ($2,000), and a maximum increase of 10 percent per year ($10,000) (Fashing, 2007).

Reporting: Reporting on the municipal stormwater program activities is required under Phase II of the municipal storm water program, independent of the TMDL. Therefore, no additional reporting costs to stormwater agencies will be incurred as result of this Basin Plan amendment.

Houseboats

The Basin Plan amendment requires the Richardson Bay Regional Agency (RBRA), Marin County, and local Cities to develop a plan and implementation schedule for evaluating the performance and integrity of the sewage collection systems of the houseboats in Richardson Bay. Subsequently, the Basin Plan amendment requires houseboat and houseboat marina owners to develop a plan and implementation schedule to bring identified substandard systems to proper operating standards.

There are approximately 400 houseboats in Richardson Bay (Floating Home Association, 2007). The cost of system repairs will vary according to the type, age, and size of the system.

Evaluation: The specifics of the program that will assess and document performance of houseboats' sewage collection systems have not yet been determined. Evaluation would likely include visual surveys of tanks, pumps, and conveyance lines. A hydraulic load and dye test may also be necessary. This type of evaluation could be performed by a qualified contractor and would cost approximately $200-$300 per system (Moody, 2007). Calculation of low-range cost estimates assumes that all 400 systems would be inspected at a cost of $200 per system. The high-range cost estimate is based on $300 per system.

Repair Program Implementation: Sewage collection system repair costs vary depending upon the problem. For a low-range cost estimate, we assumed a 10 percent failure rate and repairs that would require replacement of a leaking holding tank. Tank replacement would cost approximately $300 (including materials and labor) (Moody, 2007). For a high-range estimate, we used a failure rate of 20 percent, and a complete system replacement cost of $2,775 (including labor and materials) (Moody, 2007).

Reporting: The Basin Plan amendment also requires the Richardson Bay Regional Agency, Marin County, local Cities, and houseboat marina owners to annually report progress on evaluation and repair of houseboats' sewage collection systems until all measures are implemented. However, the specifics of this program have not yet been determined. Estimating the elements of such program would be decidedly speculative, and therefore, no cost estimates are developed.

Vessels (Recreational, Anchor-out, Live-aboard Boats)

The Basin Plan amendment requires the Richardson Bay Regional Agency, Marin County, and local Cities to develop a plan and implementation schedule for evaluating the performance and integrity of the sewage collection systems that serve all vessels in Richardson Bay. As with the requirements for houseboats, the Basin Plan amendment then requires marina owners to develop a plan and implementation schedule for bringing identified substandard systems to proper operating standards. Marina owners would be required to install and maintain an adequate number of systems. Both vessel owners and marina owners would be required to bring identified existing substandard/malfunctioning systems up to appropriate operating standards.

Evaluation: The specifics of the program that will assess and document performance of vessels' sewage collection systems have not yet been determined. Evaluation is likely to include inspection of the existing sewage pumpout and dump stations at marinas. This type of evaluation could be performed by a qualified contractor at a cost of between $200 and $300 per station. To calculate low-range estimates, we assumed that all eight existing pumpout and dump stations would be inspected at a cost of $200 per station. To calculate high-range estimates, we assumed that all stations would be inspected at a cost of $300 per station.

A comprehensive evaluation of vessels' sewage collection systems would also include a program for inspection of the holding tanks and discharge valves for those vessels with a head facility. However, the specifics of this program have

not yet been determined, and therefore, no cost estimates have been developed for this element of vessels' sewage collection systems evaluation.

Implementation: An evaluation of the adequacy of the number of sewage pumpout and dump stations has already been completed with funding from the State Water Resources Control Board (California Department of Boating and Waterways, 2004). It is anticipated that 10 additional dump stations and 11 additional pump-out stations will be needed in Richardson Bay unless alternative sewage collection measures such as utilization of a mobile sewage collection service is pursued instead. Estimates for installation of a dump station range from $500–$10,000. Estimate for installation of a pump-out station range from $3,000–$20,000 depending upon site conditions (California Department of Boating and Waterways, 2004).

For the low-range estimate, we assumed that all vessel marinas would pursue alternative measures instead of installing additional pumpout and dump stations (as provided in the California Department of Boating and Waterways 2004 marina survey report). Therefore, no additional sewage pumpout and/or dump stations will be needed. For a high-range estimate, we assumed that 10 additional dump stations will be installed at $10,000 per station, plus 11 additional pumpout stations at $20,000 per station.

Estimates for repair and maintenance for sewage dump stations range from $100 -$500. Estimates for repair and maintenance of sewage pump-out stations range from $100–$2,500 (California Department of Boating and Waterways, 2004). For the low-range estimate, we assumed that one existing dump station and 7 existing pumpout stations would need to be maintained at an annual maintenance cost of $100 each. For a high-range estimate, we estimated that 11 existing and new sewage dump stations and 18 existing and new sewage pumpout stations would need to be maintained at an annual maintenance cost of $500 and $2,500 each, respectively.

The Basin Plan Amendment also requires all live-aboard vessels to enroll in the existing mobile sewage collection service. Estimate cost for this service is $6 per month (Price, 2007). For the low range estimate, it is assumed that the 28 moored live-aboard vessels that are currently not enrolled in the mobile sewage collection service would need to enroll in the service at $6 per month. For the high range estimate it is assumed that the 28 unenrolled moored live-board vessels plus half of the estimated 140 berthed live-aboard vessels (Price, 2007) would need to enroll in the service at $6 per month.

Reporting: The Basin Plan amendment requires the Richardson Bay Regional Agency, Marin County, local Cities, and vessel marina owners to annually report progress on evaluation and/or installation/repair of the various vessels' sewage collection systems until all measures are implemented. However, the specifics of this program have not yet been determined. Without knowledge of the plan specifics it would be speculative to assign some type of program costs, therefore; no cost estimates are developed.

Water Quality Monitoring Cost

Currently two water quality monitoring programs are being implemented in Richardson Bay, one by the Water Board and one by the Richardson Bay Regional Agency. The cost of these monitoring efforts is estimated to be between $10,000 and $15,000. Additionally, the Bain Plan amendment requires Marin County and local stormwater programs to monitor pathogen indicator levels in the receiving waters near 10-20 stormwater drain outfalls in Richardson Bay. This monitoring will be conducted five times per year at an estimated cost of $750-$1,100 per each sampling event ($400 of staff time for each sampling event plus $35 analytical fee per sampling site) for a total cost of $3,750-$5,500.

Potential Sources of Funding

Several state and federal grant programs are aimed at pollution control and implementing TMDL actions. Potential funding sources for pathogen reduction measures include Prop 84 funds supporting stormwater management activities, and funds for the Nonpoint Source Pollution Control Program (funded by EPA with 319 grant program monies).

Specific projects for implementation of this TMDL could be accomplished through the existing Bay Area Integrated Regional Watershed Management Plan (funded under Prop 50, and by Department of Water Resources with funds from Prop 84). The State Water Resources Control Board administers a consolidated grant program that manages these funding sources and awards grants, working in cooperation with the Department of Water Resources. In addition, low-interest State Revolving Fund loans may be available. Funds for installation and maintenance of vessel sewage pumpout and dump stations are available through the California Department of Boating and Waterways.

Benefits of the Basin Plan Amendment

Richardson Bay is an important recreational resource. Successful implementation of the TMDL would provide improve water quality for many recreational uses including kayaking, swimming, wading, and other water activities. Improved water quality also contributes to tourism, which in turn benefits the local economy.

Benefits of implementing this TMDL are expected to include overall water quality improvement in Richardson Bay and achievement of the water quality objectives for shellfish harvesting and contact recreational uses. Successful implementation of the TMDL would reduce pathogen indicator concentrations to levels deemed safe for shellfish consumption and water contact recreation. However, it would be speculative to attempt to assign a monetary value to the important human health benefits that would result from the TMDL.

12. REFERENCES

California Department of Boating and Waterways (DBW). 2004. *Recommendations for Vessel Waste Disposal Facilities for Region 2 Marinas and Harbors, Excluding Tomales Bay.* Final Report to the State Water Resources Control Board. Sacramento, CA.

California State Water Resources Control Board (SWRCB). 2004. *Policy for Implementation and Enforcement of the Nonpoint Source Pollution Control Program.* Sacramento, California. Available online at: http://www.waterboards.ca.gov/nps/docs/oalfinalcopy052604.doc

California State Water Resources Control Board (SWRCB) and California Coastal Commission. 2000. *Nonpoint Source Program Strategy and Implementation Plan, 1998–2003.* Sacramento, CA: SWRCB. Available online at: http://www.coastal.ca.gov/nps/npsndx.html#NPS

Fashing, Terry. Marin County Stormwater Pollution Prevention Program. December 11, 2007. Personal Communication.

Floating Home association website, 2008. Webpage with information on floating homes in Richardson Bay. Sausalito, California. http://www.floatinghomes.org/index.htm. Active link as of January 25, 2008.

Havelaar A.H. 1993. "Bacteriophages as models of human enteric viruses in the environment." *Journal of American Society of Microbiology News* 59, No. 12: 614–619.

Moody, Ian. Aquamaison. December 4, 2007. Personal Communication.

Price, Bill. Richardson Bay Harbormaster. October 26, 2007. Personal communication.

Richardson Bay Regional Agency (RBRA). 1987. Ordinance No. 87-1. Sausalito, CA.

San Francisco Bay Conservation and Development Commission (SFBCDC), the cities of Belvedere, Mill Valley, Sausalito, and Tiburon, and Marin County. 1984. *Richardson Bay Special Area Plan*. San Francisco, CA: SFBCDC. Available online at http://www.bcdc.ca.gov/pdf/planning/plans/rbsap/rbsap.pdf

San Francisco Bay Regional Water Quality Control Board (SFBRWQCB). 1973. *Coliform Survey of San Francisco Bay Marinas*. Oakland, California.

San Francisco Bay Regional Water Quality Control Board (SFBRWQCB). 1981. *Vessel Waste Discharge Survey.* Oakland, California.

Santa Ana Regional Water Quality Control Board (SARWQCB). 1998. *Total Maximum Daily Load for Fecal Coliform Bacteria in Newport Bay.* Riverside, California.

San Francisco Bay Regional Water Quality Control Board (SFBRWQCB). *Water Quality Control Plan for the San Francisco Bay Basin.* Oakland, California.

Available online at
http://www.waterboards.ca.gov/sanfranciscobay/basinplan.htm

Sculati C. 2004. "The Bay's native oysters: still hanging on". *Bay Nature*, October-December 2004.

U.S. Environmental Protection Agency. (USEPA). 2001. *Protocol for Developing Pathogen TMDLs*. 1st Edition. EPA-841-R-00-002. Washington, DC: Office of Water.

U.S. Environmental Protection Agency. (USEPA). 2002. Draft Implementation Guidance for Ambient Water Quality Criteria for Bacteria. May 2002 Draft. EPA-8230-B-02-003. Washington, DC: Office of Water.