CONTINGENCY PLAN

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MASSACHUSETTS WATER RESOURCES AUTHORITY

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Dear Reader:

Enclosed is the Massachusetts Water Resources Authority's revised Contingency Plan, describing the process by which MWRA will identify and respond to water quality changes that potentially could be related to effluent discharges. The Contingency Plan is designed to build on and be consistent with MWRA's existing obligations under the Federal Court Order, the Outfall Monitoring Plan and the NPDES Permit. The Plan also represents the matching of MWRA's obligations with a clear line of accountability to the Court, regulatory agencies and the public.

MWRA developed and distributed a first draft of the Contingency Plan to appropriate state and federal agencies, the MWRA Advisory Board, the Wastewater Advisory Committee and environmental and community organizations and their members in March 1995. Responding to a number of comments from various reviewers, MWRA circulated a second draft in February 1997. MWRA has since revised the Plan in response to comments from EPA.

It is anticipated that EPA and DEP will seek formal public comment on the Contingency Plan as part of the public comment process for the draft NPDES permit. In addition, anyone who has an interest in commenting directly to MWRA, either in writing or over the telephone, is welcome to contact Dr. Michael Connor, Director of the Environmental Quality Department, or Mary Robbins, Policy and Planning Manager at the MWRA.

Sincerely,

Douglas B. MacDonald
Executive Director

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Section 1.0 Introduction

1.1 Program Description

In 1986 the Massachusetts Water Resources Authority (MWRA) began an ambitious program to upgrade its regional sewage treatment facilities and alleviate the long-standing pollution associated with the discharge of inadequately treated sewage sludge and effluent into the shallow waters of Boston Harbor. Major components of the multi-billion dollar capital program include new primary and secondary sewage treatment facilities on Deer Island, a new discharge point for treated sewage effluent, located 9.5 miles offshore in Massachusetts Bay, a sludge-to-fertilizer plant, and combined sewer overflow (CSO) control projects. Critical aspects of the operating program include an aggressive industrial pretreatment/pollution prevention program designed to remove toxins and other contaminants before they enter the sewer system, comprehensive operator training, sophisticated process control and maintenance tracking systems, and an extensive water quality monitoring program at the treatment plant, in Boston Harbor and in Massachusetts Bay.

Computer models predict that with the new facilities, treated wastewater effluent will not only be cleaner but also much more diluted, not only in Boston Harbor, but also throughout Massachusetts and Cape Cod Bays, especially in near-shore waters (Blumberg et al. 1993). The Environmental Protection Agency's 1988 Supplemental Environmental Impact Statement (SEIS) predicted that the new facilities would meet all water quality standards set by the state. These findings were updated and confirmed in a design review performed by MWRA in 1995 which showed that flows and pollutant loadings transported to the facilities at Deer Island would be considerably lower than predicted earlier.

1.2 Oversight Mechanisms

The design of each major component of the MWRA's capital program, along with much of its operating program, has been carefully studied by state and federal agencies as well as accepted by the Federal Court. The planning has also been the subject of a wide-reaching public participation process. As the MWRA moves from design and construction into operation of its wastewater program, oversight of its activities continues to be substantial. Construction of the new treatment facilities, sludge-to- fertilizer plant, and CSO control projects, the industrial pretreatment program and treatment plant staffing are the subject of a Federal Court Order. MWRA submits a monthly compliance report and numerous supplemental documents to the Court each year. MWRA has also submitted to the Court its Outfall Monitoring Plan, which provides for water quality monitoring both before and after discharges from the new outfall take place. An Outfall Monitoring Task Force (OMTF) established under the Massachusetts Executive Office of Environmental Affairs (EOEA) has overseen the development and implementation of the Outfall Monitoring Plan.

As with all other discharges to surface waters, MWRA is obligated to comply with EPA and Massachusetts Department of Environmental Protection (EP) regulations for its discharge through the National Pollutant Discharge Elimination System (NPDES) and state permitting programs. Extensive requirements for effluent monitoring, reporting, plant maintenance and operations, and the industrial pretreatment program will be included in an NPDES permit issued to MWRA for the new outfall by DEP and EPA. Effluent limits will be based on requirements for secondary treatment and state Water Quality Standards which are pertinent to the discharge. Results of all required effluent monitoring must be submitted to DEP and EPA monthly. Any changes made to the treatment facility and any planned operation or maintenance which may lead to instances of anticipated non-compliance with permit limits or requirements must also be reported. Based on the information reported to them, as well as any information obtained under their right to request information and to inspect facilities, DEP and EPA will have the right to reopen the permit at any time to propose adding or changing permit requirements.

MWRA's program is also the subject of extensive public oversight encouraged and exercised through numerous forums. In addition to its active participation in the MEPA process, MWRA regularly meets with citizen advisory committees, environmental groups, other interest groups and the public at large, to share information about its operations and invite public input. Together with the regulatory and judicial oversight noted above, this participation by the public plays a big role in assuring that the Deer Island Treatment Plant and outfall are well-maintained and operated and that the impacts of the relocated, cleaner discharge really are as minimal as predicted.

1.3 Role of the Contingency Plan

To further ensure that discharge from the new outfall does not result in adverse impacts, MWRA has developed this Contingency Plan. In keeping with MWRA's commitment to public oversight, every step of the Contingency Plan implementation process will be open to public review and comment.

Using the parameters of the extensive monitoring MWRA is committed to perform under the Outfall Monitoring Plan and/or required to perform under the NPDES permit, the
Contingency Plan identifies numerical or qualitative thresholds that can suggest that effluent quality or environmental conditions may be changing or might be likely to change in the future. In the event that one of these thresholds is exceeded, the Contingency Plan sets in motion a process to confirm the threshold exceedance, to determine the causes and significance of the exceedance, and, if the suggested changes are attributable to the effluent outfall, to identify a response. A summary of the Contingency Plan process is presented in Figure 4-1. As described in Section 4, the first response to any threshold exceedance will be to determine whether plant operation can be altered to reduce the discharge of the relevant pollutant. In the event that significant environmental changes attributable to the outfall are identified, the proposed response will include both early notification to EPA and DEP and the quick development of a Response Plan. A Response Plan will include a schedule for implementing actions such as additional monitoring, making further adjustments in plant operations, or undertaking an Engineering Feasibility Study regarding one or more of the "corrective activities" included in Section 5. Where the response could include enhanced treatment, MWRA has identified feasible technologies that could be implemented. A summary of the current trigger parameters, thresholds and potential corrective activities is presented in Table 1-1.

In addition, MWRA will provide a Quarterly Wastewater Performance Report to provide information about key MWRA wastewater operations; demonstrate day-to-day progress in achieving goals and objectives; and compare actual performance against trigger parameters and other important water quality monitoring or plant performance targets. This report is starting to be available to the public in hard copy and will also be available on-line. An example of this report is included as Appendix A. The format and content of the report is still evolving and may continue to be altered and refined as time goes on.

1.4 Contingency Plan History

Development of the Contingency Plan was first recommended by the National Marine Fisheries Service (NMFS) at the time it issued its Biological Opinion concerning the potential effects of the proposed discharge from the outfall on threatened or endangered species. At the time, NMFS found that "based upon the best available information, the proposed discharge may affect listed species, but is not likely to jeopardize the continued existence of any endangered or threatened whales, sea turtles or fish under the jurisdiction of NMFS."

Nonetheless, because the movement of water in Massachusetts Bay is very complex, as are the natural interactions between living organisms and their environment, it is impossible to predict with absolute certainty all the effects of any discharge. In addition, Massachusetts Bay faces many other threats that have ecological impacts, including overfishing and non-point source discharges, and cumulative impacts are hard to predict. To minimize the possibility of any adverse effects on endangered or threatened species, NMFS recommended among various Conservation Recommendations the development of a Contingency Plan.

In developing the Contingency Plan, MWRA, with the assistance of the OMTF has identified potential issues of concern. The Contingency Plan includes an evaluation and reporting process that MWRA will use to investigate and report on problems/solutions, along with an array of potential corrective activities that can be considered in the event that a significant problem is linked to the effluent outfall. Further development of a corrective activity would take place as needed. In all cases, implementation of a corrective activity would be tailored to meet the specific needs of the problem in a timely fashion. And as experience, scientific understanding and technology evolve, other potential corrective activities could also be considered as needed.

For example, diversion of effluent from the new outfall back to the existing harbor outfall system has been suggested as a means of controlling adverse impacts to Massachusetts and Cape Cod Bays caused by the effluent discharge. Diversion is technically possible, since the original harbor outfalls will continue to exist and the technical challenges of clearing sediment from the harbor outfalls and preventing saltwater infiltration to the new outfall are surmountable. However, all the studies and planning conducted to date lead MWRA to conclude that there are few if any scenarios in which diversion of effluent would serve the environmental interest of the bays and justify the reintroduction of the discharge back into the shallow confined waters of Boston Harbor. Therefore, MWRA does not identify diversion as a potential corrective activity at this time. However, during a significant environmental occurrence linked to the outfall, and subject to EPA/DEP approval, MWRA is committed to considering all viable corrective activities that serve to protect the North Shore, Boston Harbor, and Massachusetts and Cape Cod Bays.

1.5 Contingency Plan Organization

The Contingency Plan is organized into three primary areas:
(1) this introduction that discusses the reasons for and objectives of the Contingency Plan and its relationship to the overall effort to enhance and protect the marine and coastal
environment; (2) three sections that elaborate on this effort, including the specific details of how the Contingency Plan will be implemented; and (3) one section, considered the heart of the Contingency Plan, that discusses the potential issues of concern that could emerge following operation of the outfall, the trigger parameters and thresholds that will be used to determine whether significant environmental changes may be occurring or might occur in the future, and the array of corrective activities that could be potentially pursued in the event that significant environmental changes attributable to the outfall are identified.

Table 1.1 ***SUMMARY MATRIX***

Nutrients			
Parameter Type/Location	**Parameter**	**Caution Level**	**Warning Level**
effluent	total nitrogen	12,500 tons/year	14,000 tons/year
water column nearfield bottom, Stellwagen bottom	dissolved oxygen	6.5 mg/L, 80% saturation for any one month during stratification (June-Oct.)	6 mg/L, 75% saturation for any one month during stratification (June-Oct.)
water column, nearfield bottom	oxygen depletion rate	1.5 x baseline for any one month during stratification	2 x baseline for any one month during stratification
water column, nearfield	chlorophyll	1.5 x baseline annual mean	2 x baseline annual mean
water column, nearfield	chlorophyll	95th percentile of the baseline seasonal distribution	-
water column, nearfield	nuisance algae	95th percentile of the baseline seasonal mean	-
water column, nearfield	zooplankton	shift toward inshore community	-
water column, farfield	PSP extent	new incidence	-
sediments, nearfield	redox potential discontinuity	0.5 x baseline	-
Potential Corrective Activities			
Advanced nitrogen removal; nitrification technologies; denitrification technologies			

Toxic Contaminants			
Parameter Type/Location	**Parameter**	**Caution Level**	**Warning Level**
effluent	chlorine	-	631 ug/L average daily 456 ug/L average monthly
effluent	PCBs	PCB (as Arochlors) limit 0.0045 ug/L	
lab test	effluent toxicity	-	acute: effluent LC50 < 50% for shrimp; chronic: effluent NOEC for fish growth and sea urchin fertilization < 1.5%
water column, zone of initial dilution	initial dilution	-	effluent dilution predicted by EPA as basis for NPDES permit
sediments, nearfield	toxics	-	NOAA Effects Range Median sediment guideline
sediments, nearfield	toxics	90% EPA sediment criteria	EPA sediment criteria
fish tissue, outfall	mercury	0.5 ug/g wet	0.8 ug/g wet
fish tissue, outfall	PCB	1 ug/g wet	1.6 ug/g wet
fish tissue (mussel only), outfall	lead	2 ug/g wet	3 ug/g wet
fish tissue, outfall	lipid-normalized toxics	2 x baseline	-
fish tissue (flounder only)	liver disease incidence	greater than harbor prevalence over time	-
Potential Corrective Activities			
Enhance pollution prevention efforts; enhance removal of toxic contaminants during treatment			

Organic Material			
Parameter Type/Location	**Parameter**	**Caution Level**	**Warning Level**
effluent	cBOD	-	40 mg/L weekly 25 mg/L monthly
Potential Corrective Activities			
Effluent filtration; organic polymer addition			

Human Pathogens			
Parameter Type/Location	**Parameter**	**Caution Level**	**Warning Level**
effluent	fecal coliforms	-	1400 fecal coliforms/100 ml
Potential Corrective Activities			
Improve or change disinfection process			

Solids			
Parameter Type/Location	**Parameter**	**Caution Level**	**Warning Level**
effluent	TSS	-	45 mg/L weekly 30 mg/L monthly
sediments, nearfield	benthic diversity	appreciable change	-
Potential Corrective Activities			
Enhance solids removal during treatment			

Table 1-1 (Cont'd)

Floatables			
Parameter Type/Location	**Parameter**	**Caution Level**	**Warning Level**
effluent	floatables	-	5 gallons/day in final collections device
effluent	oil and grease (petroleum)	-	15 mg/L weekly
Potential Corrective Activities			
Primary effluent screening; enhanced public educational programs			

Overall Plant Performance			
Parameter Type/Location	**Parameter**	**Caution Level**	**Warning Level**
effluent	plant performance	5 violations/year	noncompliance 5% of the time; pH <6 or >9 at any time; flow >436 for an annual average dry day
Potential Corrective Activities			
Revise Standard Operating Procedures			

Section 2.0 Underlying Pollution Control Strategies

Overview

MWRA's commitment to identify proactively and respond to any issues of concern related to the outfall is important. Equally important, however, is its commitment to plan, design, and build facilities that will protect the environment, to operate and maintain those facilities as designed and to run an effective industrial pretreatment and pollution prevention program.

2.1 Design of the treatment plant and outfall

The centerpiece of MWRA's pollution control strategy is the design and construction of a new primary and secondary treatment plant. The new primary treatment plant, on-line since January 1995, is already removing 55% of the solids and reducing oxygen-consuming material by more than 30% (as compared to <50% and <15%, respectively, for the old primary treatment plant). Secondary treatment, the first phase of which began during 1997, will further purify the effluent by removing 85% of the solids, and reducing oxygen consuming material by 85%. Secondary treatment will also significantly enhance the removal of toxic contaminants.

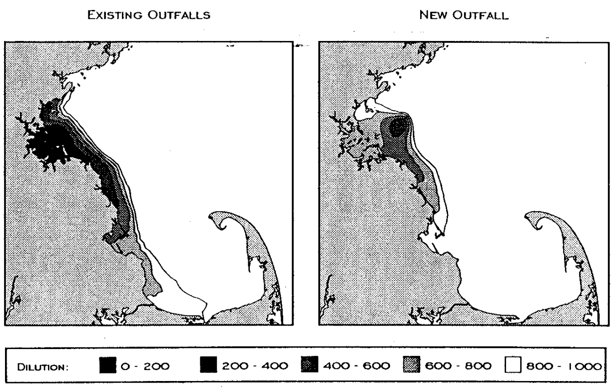
The new plant has capacity to meet secondary treatment requirements for the highest historical inflow which is 998 mgd. The average inflow is 361 mgd. During a typical year, inflow exceeds 630 mgd for 8 days or less. Consequently, the treatment plant has considerable built-in redundancy that allows plant components and equipment to receive preventive maintenance on a rotating basis, and should any part not be operational for any

Table 2-1

Component	Total Units	Maximum Required Units	Minimum Redundancy
North Main Pump Station	10	8	25%
Winthrop Terminal Facility (Pumps)	6	4	50%
South System Pump Station	8	6	33%
North System Grit Chambers	16	14	14%
South System Grit Chambers	6	5	20%
Primary Clarifiers	48	42	14%
Secondary Clarifiers	54	49	10%
Sludge Thickeners	6	5	20%
Sludge Digesters	12	10	20%
Hypochlorite Storage	4	2	100%
Hypochlorite Feed Pumps	4	2	100%
Power (Electric)	2	1	100%

reason, to be out of service for repair without affecting plant performance. *Table 2-1* shows the redundancy for each major component of the plant (minimum redundancy refers to the percent of operating units that may be out of operation without impairing treatment capability during maximum flow conditions).

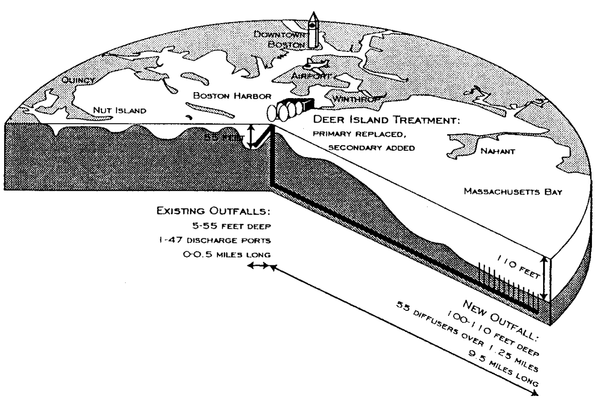
Figure 2-1



Designing and building an effective effluent outfall is equally important. One of the most important considerations in designing the outfall was to maximize the dilution achieved prior to reaching sensitive areas.

The new outfall will do this by discharging effluent through a series of discharge points (called diffusers),located a sufficient distance away from critical habitats, beaches and shellfishing areas, in water that is 100-110 feet deep *(see Figure 2-1)*. Studies by Professor Eric Adams at MIT have shown that most pollutants from the old plant's discharge of poorly treated sewage to Boston Harbor eventually entered Masssachusetts Bay due to tidal currents.

Figure 2-2



Moving the effluent discharge to its new location significantly improves effluent dilution in western Massachusetts Bay (except in the immediate vicinity of the diffusers) without significantly changing the dilution elsewhere in the bays *(see Figure 2-2)*.

2.2 Treatment plant operation and maintenance

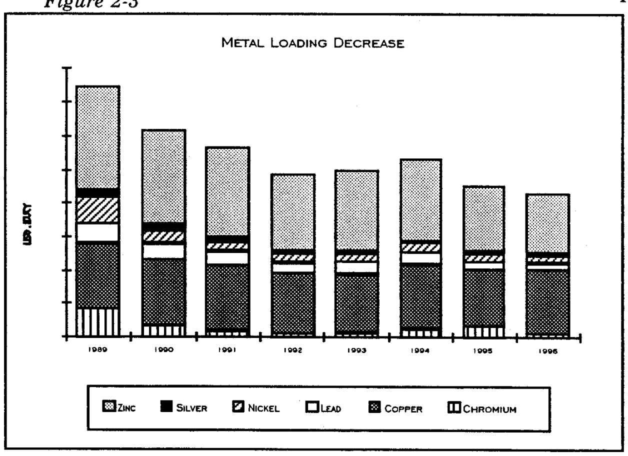
Effective operation and maintenance activities at the new treatment plant are also critical. These activities are supported by sophisticated process control and maintenance tracking systems. With these systems in place, operators have the ability to trigger an immediate response to any emergency or disruption in the functioning of any component of the plant. These systems will also allow operators to watch longer term trends and refine operations to optimize plant performance.

Operators at the plant are extensively trained in plant operations as well as in emergency response. Plant personnel work closely with the MWRA Toxic Reduction and Control (TRAC) Department to prepare for and respond to the potential threat of an incoming hazardous spill to the treatment plant. Together with TRAC, plant personnel periodically execute drills to ensure that they are adequately prepared to handle such a spill.

2.3 Industrial pretreatment and pollution prevention

While being prepared for and responding to a potential spill is an important component of TRAC's job, its primary mission is to regulate the day-to-day use of the sewer system for pollutant disposal. TRAC regulates the discharge of toxic pollutants from industries by setting strict limits on the types and amounts of pollutants that may be discharged to the sewer system; inspecting and issuing discharge permits to more than 1,100 industrial sewer users and sampling their wastewater; and taking enforcement actions against those sewer users who violate their permit requirements. TRAC also provides technical assistance to industrial sewer users on methods of pollution reduction and prevention, and works cooperatively with industry groups and residents on solutions to difficult discharge problems. As a result of TRAC's efforts, the amount of metals in MWRA effluent has dropped dramatically in recent years *(see Figure 2-3)*.

Figure 2-3



Section 3.0 Outfall Monitoring Plan: the Foundation for the Contingency Plan

Overview

The Outfall Monitoring Plan provides the basis for evaluating potential impacts associated with the relocated outfall and the need for action under the Contingency Plan. The environmental parameters or analyses included in the Outfall Monitoring Plan were selected to measure the health/quality of the relevant environment. The results of these measurements can be used to provide meaningful clues that effluent quality of environmental conditions may be changing or might be likely to change in the future. Certain of these parameters or analyses have been designated in the Contingency Plan as "trigger parameters". Once discharge begins, the exceedance of trigger parameter threshold values will automatically trigger MWRA action.

3.1 Monitoring plan background, design and objectives

The development of a monitoring program to establish baseline conditions of the Massachusetts and Cape Cod Bay ecosystem and measure any impacts on the system due to outfall relocation was required by EPA in its 1988 SEIS Record of Decision. The Certificate issued by the Massachusetts EOEA on the Secondary Treatment Facilities Plan/Final Environmental Impact Report in 1988 contained a similar requirement. MWRA developed the Outfall Monitoring Plan with the help of the OMTF to collect data both before and after discharges from the new outfall take place. It also includes effluent sampling and testing required under the NPDES permit.

The Outfall Monitoring Plan focuses on six critical constituents in treatment plant effluent:

- Nutrients
- Toxic contaminants
- Organic Material
- Pathogens
- Solids
- Floatables

These six constituents are evaluated within the context of four different environmental measurement areas: *Effluent, Water Column, Sea Floor Environments, and Fish and Shellfish.*

The primary objective of **effluent monitoring** is to measure the concentrations and variability of chemical and biological constituents in the effluent. Data for contaminants regulated by the NPDES permit are analyzed and compared to the permit limits to determine compliance; data for other contaminants are analyzed and compared to Water Quality Standards to determine if the levels continue to be below concern, or if not, whether regulation may be required. Effluent samples are collected twice monthly. Additional effluent samples are also collected on an as-needed basis to supplement effluent characterization.

Water column monitoring is designed to measure water quality and plankton in Massachusetts and Cape Cod Bays. Water column monitoring includes five major components: nearfield surveys, farfield surveys, plume track surveys, continuous recording, and remote sensing. Nearfield surveys are designed to provide vertical profiles of physical, chemical and biological water column characteristics near the outfall location. The purpose of farfield surveys is to determine differences across the bays and assess seasonal changes over a large area. Plume track surveys are performed to determine the location, migration, and biological and chemical characteristics of the effluent plume leaving the outfall and mixing with ambient waters. The continuous recording component of the program captures temporal variations in water quality between nearfield water quality surveys. Continuous monitoring occurs at three depths at a single mooring station near the future outfall location. Remote sensing captures spatial variations in water quality on a regional scale.

Sea floor studies are designed to provide a means to document recovery of Boston Harbor following the cessation of sludge discharge and improvement in CSO treatment and discharge. The studies also collect information needed to assess potential impacts of effluent discharged from the new outfall on the surrounding sea floor environment.

The ***fish and shellfish monitoring*** program evaluates potential risks to human health and the environment arising from contamination of fish and shellfish. Fish and shellfish monitoring is performed throughout the harbor and the bays.

Trigger parameters and thresholds

The environmental monitoring performed through the Outfall Monitoring Plan provides the basis for evaluating the need for action under the Contingency Plan. Those parameters and/or analyses which have been identified as providing the most meaningful flues that effluent quality or environmental conditions may be changing or might be likely to change in the future have been designated in the Contingency Plan as "trigger parameters". To alert MWRA to different degrees of observed change, each trigger parameter has thresholds that are defined as "*caution*" or *"warning"* levels. In the event that one of these thresholds is exceeded, an MWRA action will be automatically triggered in response.

"Caution level" exceedances indicate the need for increased study or attention, along with the possible need for operational adjustments.

"Warning level" exceedances indicate the need to respond to avoid potential environmental impact, triggering the development of a plan and schedule for doing so (for more detail see Section 4, "Contingency Plan Implementation").

If a trigger parameter's value exceeds the *warning level*, this does not necessarily mean that any environmental impact has occurred, but that effluent quality or environmental conditions have moved sufficiently far from the baseline that it would be prudent to respond in order to prevent impact. In this event, MWRA would take action to return the trigger parameter to a level, which is at or below the threshold exceeded or else show that there is either no likelihood of harm or that MWRA is not responsible for the exceedance. For example, if an effluent threshold is exceeded, it is clearly MWRA's responsibility to examine the operation of the treatment plant. When a threshold measured in Massachusetts or Cape cod Bay is exceeded, it indicates that the environment is behaving in an unexpected way, but the effects may or may not be significant and the causes may or may not involve the MWRA.

MWRA has used the following sources and/or processes to establish thresholds for the trigger parameters:

- Limits expected in the forthcoming EPA/DEP NPDES permit

- State water quality standards
- Predictions made about the impacts of discharge during preparation of EPA's SEIS

- Guidance or expert opinion.

Other relevant parameters

In addition to the trigger parameters, the monitoring program collects information about numerous other related parameters, both in the bays and from the treatment plant. These parameters do not have thresholds as defined by the Contingency Plan, but are very useful for improving our overall understanding of the bays, tracking the movement of MWRA effluent, and for evaluating any threshold exceedances.

Temperature is an example of such a parameter.
Temperature measurements alone are unlikely to indicate the presence or absence of environmental impact. But knowledge of a long, warm summer combined with low dissolved oxygen concentrations in bottom waters at the end of the summer would indicate that the low dissolved oxygen is more likely due to an unusual weather pattern rather than a response to treatment plant effluent.

Section 4 Contingency Plan Implementation

Overview

To ensure that the Contingency Plan provides appropriate environmental protection, every step of the implementation process, from creation and modification of the Contingency Plan document to the development and implementation of a response to a threshold exceedance, will be open to public input and review from outside the MWRA.

4.1 Annual reporting and evaluation of the Contingency Plan

As part of the Outfall Monitoring Overview report developed each year, MWRA will include information relevant to the Contingency Plan, including a summary of activities taken pursuant to the Contingency Plan, and results relating to the trigger parameter thresholds levels. If monitoring data has suggested that trigger parameters or thresholds be added or modified, the report will propose such changes.

4.2 Contingency Plan actions

During the course of monitoring and preliminary lab analysis, if any trigger parameter included in the Contingency Plan exceeds the corresponding “caution” or “warning” level, MWRA’s first response, even before the cause has been discovered, will be to notify Deer Island staff and the OMTF, and to decide whether plant operations can be adjusted to reduce the discharge of the relevant pollutant. EPA and MADEP will also be notified.

If the threshold exceeded is a *caution* level, MWRA will also likely expand its monitoring to closely track any change in effluent quality and environmental conditions, and provide the information necessary to:

- Evaluate the cause and effect of the exceedance; and

- Review applicable trigger parameters and thresholds for necessary and appropriate revisions.

If a caution level exceedance is confirmed by the OMTF, it will be reported in the next Quarterly Wastewater Performance Report provided to the public, EPA and MADEP. Summaries of actions taken or planned to evaluate the effect of and responsibility for the exceedance or to adjust operations, will also be included in this and/or subsequent Quarterly Wastewater Performance Reports.

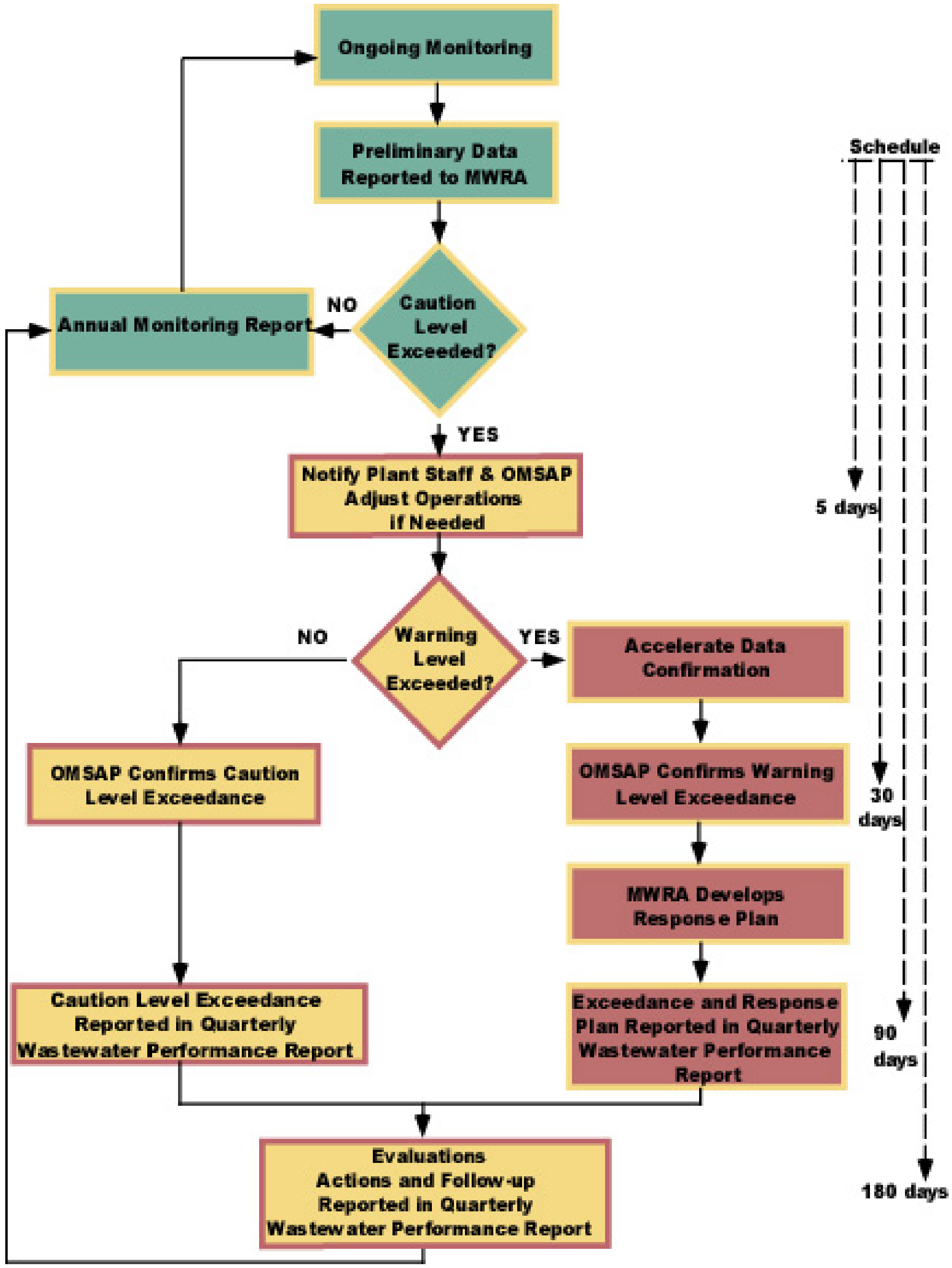
If the threshold exceeded is a *warning* level, MWRA will:

- Determine whether there are any adverse environmental impacts from the exceedance; and

- Evaluate the extent to which MWRA discharges contribute to any such impacts.

If a warning level exceedance is confirmed by the OMTF, it will be reported in the next Quarterly Wastewater Performance Report provided to the public, EPA and MADEP. A “Response Plan” including (1) a plan and schedule for identifying and implementing actions to address any impacts from the exceedance to the extent caused by MWRA’ or (2) a demonstration of evidence that no adverse impacts occurred from the exceedance and/or that MWRA discharges did not contribute to such impacts, will also be included in this and/or subsequent Quarterly Wastewater Performance Reports. In the event MWRA action appears to be needed, such actions may range from further adjustments in plant operations to an Engineering Feasibility Study regarding specific engineering and/or construction-related “corrective activities", including any necessary treatment.

Figure 4-1

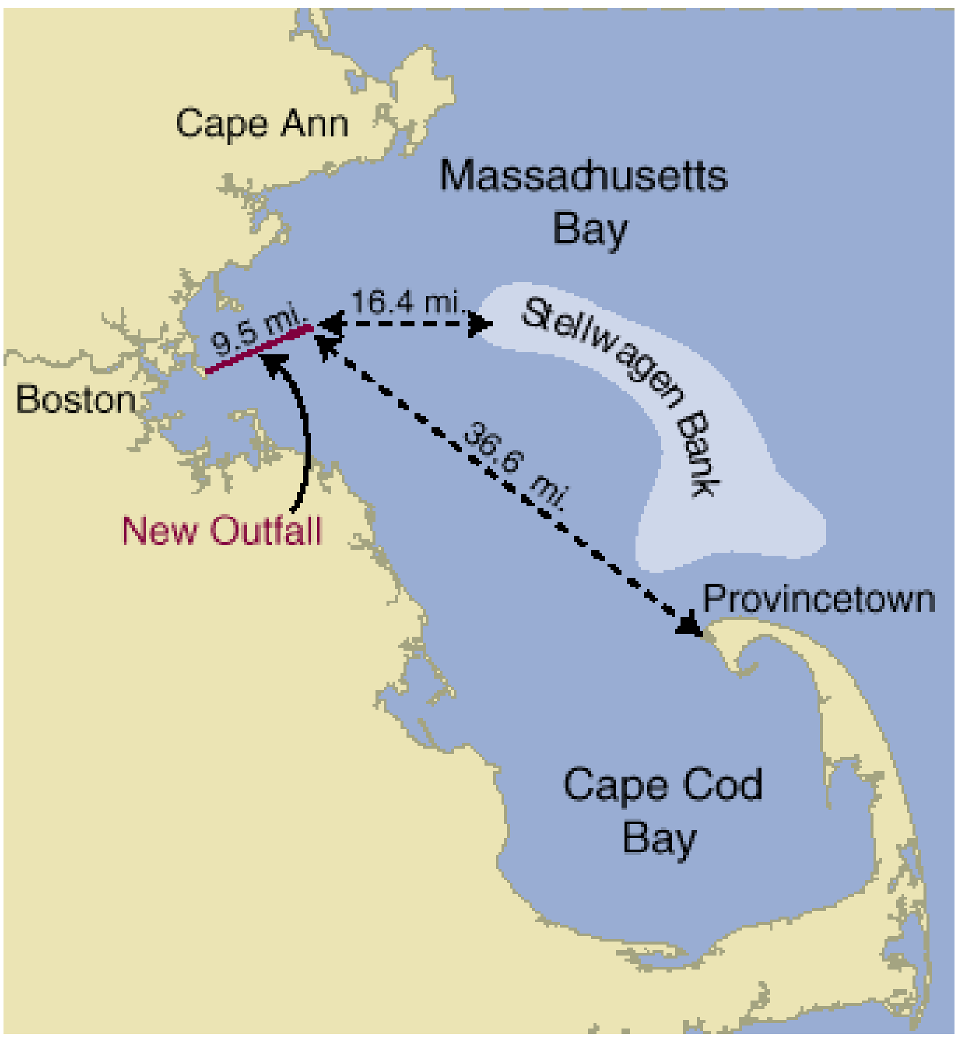


Section 5 — Trigger Parameters, Thresholds and Potential Corrective Activities

Overview

With the help of the OMTF, MWRA has identified six potential issues of concern that could emerge following operation of the outfall. The identification of these potential issues of concern, the trigger parameters and thresholds that will be used to determine whether changes in effluent quality and/or environmental conditions may be occurring or might occur in the future, and the array of potential corrective activities that could be potentially pursued in the event that significant environmental changes attributable to the outfall are identified, form the heart of the Contingency Plan. Following each subsection is a table summarizing the trigger parameters and associated thresholds identified below. *Figure 5-2* shows the locations referred to in the summary tables.

Figure 5-1



5.1 Nutrients

5.11 Water quality issues

Nutrients are necessary for the growth of all plants, aquatic and terrestrial. The amount of nutrients in the water, along with several other factors, controls the growth of aquatic plants, including algae. Since algae are the foundation of the marine food web, nutrients have a great effect on how much life a marine ecosystem can support. In particular, there are two basic ways in which nutrients from MWRA effluent could have a negative effect on marine environments: through the effects of algae on *dissolved oxygen concentration* and through *changes in algal community structure*. *Nitrogen* is the nutrient of greatest concern. These issues are explained below.

Low Dissolved Oxygen (Hypoxia). An algal bloom is a burst of algal growth, which occurs when a variety of conditions come together. Sufficiently high nutrient levels is one of the requirements, but other conditions such as sunlight and temperature are also important. Algal production is the basis of the food web, without which fish, whales, and most other marine life would not survive. Algal production is a necessary, common occurrence in the marine environment, but it can be a cause for concern, depending on the intensity, frequency, and type of algae produced.

If a body of water receives too great a nutrient load, it may become subject to eutrophication: over-stimulation of algal growth and excessive algal blooms. When algae grow faster than they are consumed, the excess algae die, sink to the bottom, and decompose. Decomposition of organic material consumes dissolved oxygen (DO). DO is oxygen dissolved in water and available to marine animals for respiration. If DO concentrations are low (a condition known as hypoxia), sensitive animals may suffocate. Hypoxia can occur when the DO demand of decomposition outstrips natural resupply. The resulting deficit is measured as the oxygen depletion rate, which describes how quickly DO concentration drops.

Algal Community Structure (Growth of Undesirable Algae). Adding effluent to the marine environment could change the amount of nutrients or the relative levels of different nutrients so that undesirable algae dominate or are present along with useful algae. The nutrient composition of effluent is different from that in Massachusetts Bay, and there is public concern that undesirable algae may be better able to take advantage of this difference than desirable algae. Two types of undesirable algae can have direct effects on the marine environment: nuisance algae, such as brown tides, affect the appearance of the water; noxious algae, such as red tides, are toxic to marine mammals and some fish, and, if concentrated in shellfish, to humans. Undesirable algae can also have an indirect effect on the marine environment by out-competing another algae species. If the out-competed species is a primary food source for a marine animal, that animal may suffer. For instance, it has been suggested that the food chain links right whales in Cape Cod Bay to a kind of algae that might be impacted by effluent-induced changes in nutrient concentrations.

Nitrogen Control. For Massachusetts Bay, the solution to both types of potential nutrient problems, hypoxia and undesired algal species, may be nitrogen control. According to the best available scientific knowledge about algal blooms, nitrogen is the nutrient that has the greatest effect on algal growth in marine waters. Thus, if algal blooms lead to hypoxia, reduction of nitrogen discharge is probably an effective remedy. Likewise, studies have shown that the risk of undesired changes in algal community structure becomes significant if there is too much nitrogen relative to the amount of phosphorus or silica (silica is another nutrient, like nitrogen and phosphorus). Because adding phosphorus could have negative side effects, reducing the nitrogen load is probably the best option for controlling undesired algal species.

5.12 Trigger parameters and thresholds

To observe and understand the effects of nutrients in Massachusetts and Cape Cod Bays, the MWRA monitors eutrophication and hypoxia events, oxygen depletion rate, nuisance and noxious algae growth, and nutrient concentrations in MWRA effluent and the bays. So far, the MWRA has developed quantitative caution and warning levels for 25 trigger parameters based on nitrogen, dissolved oxygen, chlorophyll, and nuisance/noxious algae.

Effluent parameters/ thresholds

Nitrogen. Because nitrogen is the most important nutrient to monitor when discharging effluent to marine waters, MWRA tests treatment plant effluent for the concentration of total nitrogen. Assuming certain loadings of nitrogen from the effluent, the SEIS predicted little or no impact from the outfall discharges. These predictions were verified using more sophisticated three-dimensional water quality models. Caution and warning levels have been set to verify that the loads assumed in those predictions (14,000 tons/yr. total nitrogen) are not exceeded.

Water column parameters/ thresholds

Dissolved Oxygen: When DO is too low, there may not be enough oxygen for animals to breathe. Because of DO’s importance, the state has set a water quality standard that DO should not fall below 6 mg/L and 75% saturation in Massachusetts Bay. MWRA is using these standards as the basis for caution and warning levels.

Oxygen Depletion Rate. There are limitations to the conclusions that can be drawn from DO concentration data, since many of the factors that cause low DO are independent of MWRA influence (e.g. weather). Oxygen depletion rate is a more direct measure of MWRA impact than DO, because it is less dependent of on weather patterns. Furthermore, a high oxygen depletion rate is a good predictor of future hypoxia, even if DO concentrations are presently healthy.

As there are no state or federal regulations regarding oxygen depletion rate, MWRA thresholds have been developed to indicate a degree of change from the baseline established by MWRA monitoring since 1992 under the Outfall Monitoring Plan.

Chlorophyll. Chlorophyll, a photosynthetic chemical in all green plants, is the most common measure of algal biomass, the total amount of algae present in the water. Since algal blooms are sudden increases in algal biomass, chlorophyll is a good measure of algal blooms and thus eutrophication. As described above, eutrophication is partially dependent on nutrient loads and can lead to hypoxia. Algal biomass is central to understanding the effect of nutrients on bay water quality, because of its intermediary position between nutrient loading and hypoxia. Thus, chlorophyll is a good indicator of future hypoxia.

Unlike low DO concentrations, high chlorophyll does not necessarily mean that there is environmental degradation. The risk that high chlorophyll concentrations will lead to hypoxia depends on the rate of oxygen resupply. Although chlorophyll is not directly linked to DO, it is a good measure of the overall health of an ecosystem. Consequently, some of the following thresholds have broader applicability than merely as hypoxia identifiers.

As there are no state or federal regulations for chlorophyll, MWRA thresholds are based on predictions in the SEIS and compared to the National Oceanographic and Atmospheric Administration’s Estuarine Eutrophication Survey (NOAA, 1993). The thresholds are designed to identify two types of problems: high annual average algal biomass after outfall start-up and increased algal biomass in any one season.

Because algal biomass (and thus chlorophyll concentrations) are highly variable, meaningful change is best represented as averages or percentiles over time and space. Chlorophyll-a is the type of chlorophyll measured in the EPA approved standard test for chlorophyll and adopted by the MWRA.
According to the National Oceanographic and Atmospheric Administration (NOAA). "normal blooms become problematic when chlorophyll-a values reach 20 g/Liter" (ORCA, 1993). Since baseline concentrations of chlorophyll-a average about 2-3 g/Liter, or well before there is a likelihood of biological significance. The warning level was based on peer review comments to the Outfall Monitoring Task Force.

Nuisance/Noxious Algae: Nuisance and noxious algae are present in Massachusetts and Cape Cod Bays annually in small numbers. There is public concern that effluent nutrients could feed a red tide bloom in the vicinity of the new outfall. At the 1996 peer review workshop, it was recommended that the Massachusetts shellfish toxicity monitoring program be used to set red tide caution levels. The state program monitors the toxicity of Paralytic Shellfish Poisoning (PSP) at shellfish beds along the edge of Massachusetts and Cape Cod Bays. In addition, if the seasonal abundance of *Alexandrium Pseudonitzchia* or phaeocystis becomes unusually high, a threshold will be triggered.

Sea floor parameters/ thresholds

Depth of Oxygenated Sediments. Although often overlooked, oxygen in the sediments is also a very important measure of environmental health. If not enough oxygen has penetrated into the sediments, it is difficult for animals to live in the sediments. Although there is no state standard, the MWRA has developed a sediment oxygen warning level based on the depth of oxygen penetration. The depth to which oxygen penetrates sediments is also an important measure of organic material discharge and is measured as the Redox Potential Discontinuity (RPD). The RPD depth is the location where the sediments changed from oxic to anoxic. The threshold refers to stable stations, which are those where storms have not markedly changed the sediment texture from year to year.

Table 5-1

Nutrients Summary

Parameter Type/Location	Parameter	Caution Level	Warning Level
effluent	total nitrogen	12,500 tons/year	14,000 tons/year
water column nearfield bottom, Stellwagen bottom	dissolved oxygen	6.5 mg/L, 80% saturation for any one month during stratification (June-Oct.)	6 mg/L, 75% saturation for any one month during stratification (June-Oct.)
water column, nearfield bottom	oxygen depletion rate	1.5 x baseline for any one month during stratification	2 x baseline for any one month during stratification
water column, nearfield	chlorophyll	1.5 x baseline annual mean	2 x baseline annual mean
water column, nearfield	chlorophyll	95th percentile of the baseline seasonal distribution	-
water column, nearfield	nuisance algae	95th percentile of the baseline seasonal mean	-
water column, nearfield	zooplankton	shift toward inshore community	-

water column, farfield	PSP extent	new incidence	-
sediments, nearfield	redox potential discontinuity	0.5 x baseline	-

5.13 Potential corrective activities

On a long-term basis, if there were nutrient-related concerns related to MWRA effluent, the most probable response would be to increase nitrogen removal during treatment. As described below, there are a variety of nitrogen removal techniques that could be undertaken to address potential long-term concerns, each with advantages and disadvantages. As technology changes, these options may vary. As opportunities regarding water shed management initiatives are refined or developed, MWRA could also participate in discussions regarding options for basin-wide control of nitrogen, including loads from rivers and land areas in Massachusetts Bay and the Gulf of Maine.

Advanced treatment nitrogen removal. In the unlikely event that a long-term problem makes a permanent reduction in nitrogen loading necessary, the MWRA could implement advanced treatment nitrogen removal. Advanced treatment nitrogen removal represents the removal of nitrogen from wastewater through biological, chemical, or physical processes beyond those used in conventional primary and secondary treatment. For long-term nitrogen removal on the scale MWRA would require, chemical and physical removal are not viable, however biological removal could be considered.

In biological nitrogen removal, microorganisms in the treatment plant convert and eliminate nitrogen in the wastewater before it is made available to algae in the receiving water. Nitrogen removal is achieved by transforming ammonia (NH_3) into nitrogen gas (N_2), which is inert and harmless. The transformation is achieved in two steps:

1) the process of *nitrification* oxidizes nitrogen from ammonia to nitrate (NO_3);

2) the process of *denitrification* reduces nitrogen from nitrate to nitrogen gas. Denitrification requires the addition of a food source which leads to increased solids removal and sludge production.

The basic idea behind nitrification and denitrification systems is to provide the best possible environment for concentrating the growth of microorganisms that consume nitrogen. The nitrification process would occur within expanded aeration tanks (part of the secondary treatment process) or in separate aerated filters. Nitrification is an aerobic (with oxygen) process that operates best with air aeration (as opposed to pure oxygen) and the addition of lime to maintain appropriate pH. Denitrification could take place in new treatment facilities built on the remaining unoccupied areas of Deer Island.

It is an anaerobic (without oxygen) process and requires the addition of methanol to provide sufficient substrate for the denitrifying organisms.

Most modern *nitrification* and *denitrification* processes are separate treatment units. Thus, almost any nitrification process can be matched with almost any denitrification process. If the MWRA were to implement nitrogen removal, it would choose one nitrification method followed by one denitrification method. The MWRA has studied numerous alternatives, including both proven and developing technologies. The alternatives vary in the levels of effluent quality attained, the area of land required, capital cost, operations and maintenance cost, and ease of addition to the existing plant. MWRA has considered technologies that provide maximum reliability while meeting space and cost constraints. The technologies are differentiated by the way they encourage growth of the appropriate microorganisms.

Nitrification Technologies: Suspended growth nitrification would require two major modifications of the Deer Island Treatment Plant. The first major modification would be addition of Chemically Enhanced Primary Treatment (CEPT). In the CEPT process, the addition of chemicals such as ferric chloride and polymers enhances the settling and removal of suspended wastewater particles (TSS) and organic material (BOD), but not nitrogen. With less TSS and BOD entering the aeration tanks, there would be fewer non-nitrifying microorganisms and more room for nitrifying microorganisms. The second major modification would be addition of systems to aeration tanks that would increase the surface area available for microorganism growth. These systems include biomass carriers (highly porous polyurethane foam pads), fiber-media systems (polyvinyl chloride ropes), and the moving bed biofilm reactor (10 mm long cylinders with an internal frame structure). In the event that these modifications were not sufficient, additional facilities, such as those described below, would be necessary.

The **biological aerated filter (BAF) system** is the most common current approach to fixed material attached nitrification. BAF consists of a stationary bed of medium (e.g. aluminum silicate, expanded shale, or polystyrene) through which wastewater flows up or down, depending on the media. Air is injected from the bottom of the medium. Periodic backwashing of the filters is required to reduce solids accumulation in the tanks. BAF is used in approximately 100 full-scale facilities in Europe, Japan, and Canada.

Fluidized-bed reactors are similar to BAFs, often using sand as the medium. The primary difference is that wastewater is introduced from the bottom of the bed at sufficient velocity to separate very slightly ("fluidize") the individual grains of medium. As a result, there is increased surface area for microorganism growth, and the granular media does not need backwash cleaning. Granular medium must be replenished at 5% per year. Excess microorganisms are continuously drawn off the top of the fluidized portion of the tank. Fluidized-bed reactors are in the development stage for nitrification, but are widely used for denitrification (see below).

Denitrification Technologies: Denitrification systems are physically similar to nitrification systems, except that denitrification is anaerobic (occurs in the absence of oxygen) and requires an additional carbon food source (generally provided by methanol). **Packed bed reactors** are similar to BAF. To exclude oxygen from the filter bed, the medium is fully submerged. In general, backwashing must be carried out on a weekly basis to remove solids and nitrogen gas. The medium provides some physical filtration, which improves overall effluent quality. Packed bed reactors are also relatively simple to operate. **Fluidized-bed reactors** are one of the most space-efficient means of denitrification, an important consideration for Deer Island. However, fluidized bed reactors are particularly sensitive to changes in the amount of methanol added. **Deep-bed filters** are similar to packed bed reactors, except that the media is coarser and the filter is backwashed briefly about five times per day.

Using current technologies, MWRA's recommended approach would be to use BAF for nitrification and fluidized bed reactors for denitrification. These treatment facilities could be fit in to the site of the Deer Island Treatment Plant. However, if technological advancements continue, suspended growth or fluidized bed reactors may prove to be better options for the nitrification step. These emerging technologies and improvements to existing technologies will probably be more effective, less land intensive, more reliable, and less costly than anything currently available will.

5.14 Important considerations

One of the issues that must be addressed before designing and implementing nitrogen removal hinges on the timing of algal blooms. The time of year that nitrogen removal is needed has a large effect on the sizing of a treatment facility. Biological nitrogen removal processes are highly sensitive to temperature, functioning better in warm weather than in cold weather. Although nitrogen concentration does not significantly affect algal growth in winter, it can be important as early as February, when wastewater temperature is at its annual lowest point. Consequently, MWRA studies of potential nitrogen removal systems to date consider it likely that year-round nitrogen removal would be most useful, if any removal were needed. However, if nitrogen reduction were necessary only in the warmer months, the appropriate facility size could be smaller and the appropriate treatment method could be different than that required for year-round treatment. Typically, dissolved oxygen concentrations are lowest in August to October; red tides are most common in May and June.

The amount of nitrogen removal needed is another important consideration. Most of the nitrogen removal systems studied by MWRA perform most efficiently when reducing total nitrogen to 3 to 4 mg/L in effluent. If, however, nitrogen concentration could be higher than 4 mg/L, it would be possible to provide nitrogen removal facilities for less than the entire flow. The required effluent quality would be achieved by blending secondary effluent with denitrified effluent. The capital construction, operation, and maintenance costs of reduced flow options would be significantly lower than the costs of full flow treatment. Changes in the amount of water entering the sewage collection system would also affect sizing of nutrient removal facilities.

While some interested groups have suggested that nitrogen removal be included in the treatment facilities currently being constructed, choosing and designing nitrogen removal facilities at this time would probably not help the environment since scientific evidence provided by both the MWRA and the EPA suggests very strongly that nitrogen from MWRA effluent will not impact Massachusetts Bay. Moreover, nitrogen removal is still a developing technology and other, more cost-effective ways to reduce loadings on a watershed-wide basis may develop in the future. Should new evidence come to light and demonstrate a need for reducing MWRA nitrogen loads to the bay, MWRA can use the information summarized above to expedite the planning process. The first step would be to choose a treatment option, but this choice cannot be made without knowing the specific nitrogen impacts to be prevented or remediated.

Nitrogen removal systems are being developed and improved worldwide. MWRA monitoring is leading to a better understanding of Massachusetts and Cape Cod Bays. However, the best information about the effect of the new outfall will come when the new outfall goes on line. The nitrification and denitrification options discussed represent the best available technologies at this time, but MWRAL is monitoring the development of a variety of other technologies.

5.2 Toxic Contaminants

5.21 Water quality issues

Toxic contaminants are substances that can cause diseases such as cancer through direct contact with or accumulation in living tissue. Generally, toxic contaminants are harmless or may even be necessary for marine life at very low concentrations, but are harmful at higher concentrations. The concentration at which a toxic contaminant becomes harmful changes depending on whether exposure is constant (chronic) or temporary (acute). These substances will be referred to in this report as "toxic contaminants" whether of not they are at harmful concentrations in the specific instance.

Chronic impact of toxic contaminants in the marine environment is most likely to be felt by filter feeders like mussels and bottom dwellers like flounder. Mussels filter toxic contaminants out of the water and into their tissue, which inhibits growth and reproductivity. Flounder suffer increased incidences of fin rot and liver disease when in contact with high levels of toxic contaminants in their food or in sediments. When humans or other predators eat animals that have accumulated toxic contaminants, the toxic contaminants are passed up the food chain to the predators. Through this process, humans who eat contaminated fish and shellfish may increase their risk of cancer and other diseases.

Acute marine impact is greatest on passively floating plants and animals, including fish larvae, invertebrate larvae, and algae. These may die if they come into contact with high concentrations of certain toxic contaminants.

MWRA's goal is to reduce the concentrations of toxic contaminants in the effluent so that with the initial dilution from the discharge, the receiving water is not negatively impacted. The most effective method is to prevent toxic contaminants from entering the waste stream by requiring or encouraging reduction in the use of products containing toxic contaminants and by properly disposing of toxic contaminants when they must be used. As described in Section 2, "Underlying Pollution Control Strategies," MWRA is aggressively pursuing this approach.

There is always the potential for toxic contaminants entering the MWRA system from illegal dumping. Changes in products, such as household cleaners, and new industries may also have unanticipated effects on the wastewater that enters the MWRA collection system. It is for these types of contingencies that the MWRA has developed the caution and warning levels discussed below.

Chlorine from MWRA wastewater treatment is also a possible source of toxicity, but because it is used for disinfection, it is discussed in the Pathogens Section. Ammonia is another possible source of toxicity, and it would be identified through the toxicity tests discussed below. Because ammonia is a form of nitrogen, the appropriate ways to reduce ammonia discharge are those described for nutrients.

5.22 Trigger parameters and thresholds

MWRA is able to identify changes in the toxic contaminants entering into the MWRA system and in the treatment plant's removal of toxic contaminants, by monitoring the amounts of toxic contaminants that go into and out of the treatment system. MWRA also monitors the effect of those contaminants once they reach the marine environment.

Effluent parameters/ thresholds

Priority Pollutant Concentration and Effluent Toxicity. As required by the EPA, the MWRA tests wastewater treatment plant influent and effluent directly for all 126 EPA priority pollutants. Priority pollutants are substances that the EPA has determined to be of national concern because of their toxicity at certain concentrations.

In developing an NPDES permit for MWRA, EPA and the state set limits for the concentrations of priority pollutants in the effluent that have a reasonable potential to violate water quality standards which have been established by Massachusetts for state waters. NPDES toxic contaminant limits are based on water quality standards and very protective assumptions about water conditions within the effluent/sea water mixing zone such as background contamination, extent of dilution and mixing, depth of discharge, currents, tides, winds and temperature. The mixing zone is the small volume (approximately 200 feet from each diffuser) around the outfall in which initial, turbulent mixing of effluent with seawater takes place. A limit for chlorine is expected in the new NPDES permit, which will serve as the warning level for effluent toxic contaminant concentrations.

In addition to concentration-based tests, the NPDES permit may also require the use of laboratory-based tests known as bioassays. Bioassays measure the response of indicator species such as shrimp to toxicity in the effluent under specified laboratory conditions. Bioassays designed to assess acute toxicity are expressed in measurement units know as "LC50s". An LC50 is the concentration of effluent at which 50% of a shrimp population survives. For example, an LC50 of 60 means that half the shrimp survived a mixture that was 60% effluent and 40% dilution water. An LC50 of 45 means that the effluent concentration cannot be more than 45% for half the shrimp to survive. To assess chronic toxicity, the MWRA measures the effluent's "No Observed Effects Concentration (NOEC)". The NOEC is the highest concentration of effluent at which there is no statistical difference in test organism response when compared against a control with no effluent.

Water column parameters/ thresholds

Initial Dilution and Marine Chronic Water Quality. Since all evaluations of toxic impacts depend on concentrations after initial mixing, the MWRA will measure both the actual dilution of effluent by seawater around the new outfall and the concentrations of representative toxic contaminants and toxic contaminants most likely to cause problems. The results will be compared with EPA predictions of effluent dilution/contaminant concentrations. Because EPA's estimates are very conservative, it is extremely unlikely that actual dilution will be less than EPA's prediction. However, if the study showed that real dilutions were less than anticipated and therefore did not reduce toxic contaminant concentrations enough to protect the environment, the EPA and the state could revise the MWRA's NPDES permit by lowering allowable discharge concentrations for toxic contaminants.

Sea floor parameters/ thresholds

Toxic Concentrations in Sediments. As part of an ongoing monitoring program, the MWRA will study the effect of the outfall on sediments in the area around the outfall. The results from this study will be used to assess the validity of the prediction that deposition of sediments in the vicinity of the outfall will not be significant and will not lead to toxic contamination of the sea floor. Thresholds for toxic contamination of sediments are tied to EPA sediment criteria currently at the draft stage and will reflect any changes adopted by those agencies.

Fish and shellfish parameters/ thresholds

Mercury Concentration, PCB Concentration, Lead Concentration, and Liver Disease. The bottom line of environmental impact is the effect on species in the habitat. To track the chronic environmental impact of toxic contaminants from MWRA effluent discharged through the new outfall, the MWRA studies flounder, lobsters, and mussels in Boston Harbor, at the site of the new outfall, and in Cape Cod Bay (lobsters and flounder only). The MWRA measures the concentrations of a variety of toxic contaminants in animal tissue. It also determines the incidence of diseases associated with toxic contamination, including liver disease in flounder and black gill disease in lobster.

These measurements currently show that toxic contamination of marine life is greatest in the harbor, less at the new outfall site, and much less in Cape Cod Bay. When effluent is discharged through the new outfall, contamination is expected to decrease in the harbor, stay roughly the same at the new outfall site, and be unchanged in Cape Cod Bay. Thresholds are designed to identify unexpected effects on marine life. Except for lead, the caution levels are 50% of U.S. Food and Drug Administration (FDA) Action Limits; the warning levels are 80% of FDA Action Limits. Lead Thresholds are based on EPA risk assessment of lead in drinking water. There are also thresholds based on predictions of liver disease prevalence in fish and shellfish. The thresholds apply to the new outfall site.

Table 5-2

Toxic Contaminants Summary

Parameter Type/Location	Parameter	Caution Level	Warning Level
effluent	chlorine	-	631 ug/L average daily 456 ug/L average monthly
effluent	PCBs	PCB (as Arochlors) limit 0.0045 ug/L	
lab test	effluent toxicity	-	acute: effluent LC50 < 50% for shrimp; chronic: effluent NOEC for fish growth and sea urchin fertilization < 1.5%
water column, zone of initial dilution	initial dilution	-	effluent dilution predicted by EPA as basis for NPDES permit
sediments, nearfield	toxics	-	NOAA Effects Range Median sediment guideline
sediments, nearfield	toxics	90% EPA sediment criteria	EPA sediment criteria
fish tissue, outfall	mercury	0.5 ug/g wet	0.8 ug/g wet
fish tissue, outfall	PCB	1 ug/g wet	1.6 ug/g wet
fish tissue (musssel only), outfall	lead	2 ug/g wet	3 ug/g wet
fish tissue, outfall	lipid-normalized toxics	2 x baseline	-
fish tissue (flounder only)	liver disease incidence	greater than harbor prevalence over time	-

5.23 Potential corrective activities

There are two ways to reduce the effect of MWRA toxic contaminants in Massachusetts Bay: (1) further reduce toxic contaminants from entering the MWRA system and (2) increase the removal of toxic contaminants from wastewater during treatment. These corrective activities are discussed below.

Enhance Pollution Prevention Efforts. If toxic contaminant concentrations in effluent were too high even though the treatment plant was operating properly, efforts to enhance pollution prevention would be the appropriate response. If the responsible sources were already regulated for the toxic contaminant, MWRA could reinforce existing activities and review discharge limits. If the source were previously unregulated (because the toxic contaminant or its existing concentrate had not been identified as harmful), MWRA could target the source and issue sewer discharge permits with specific limits or management practices for the pollutant of concern in order to reduce the entry of toxins into the sewer. MWRA regularly works with industries and businesses to improve pretreatment and source reduction programs. MWRA has a strong incentive to reduce the amount of toxic contaminants entering its system, because toxic contaminants may end up in MWRA sludge, jeopardizing the MWRA's ability to market the sludge as fertilizer pellets.

Enhance Removal of Toxic Contaminants During Treatment. There are a variety of options for removing toxic contaminants after secondary treatment. They focus on increasing removal of solids from effluent, because most toxic contaminants attach to solids. Low does of *organic polymers* enhance the settling rate of solids. As organic polymer technology develops, it has seen increasing use in the wastewater treatment industry. As part of its design of secondary treatment, the MWRA is including the capability of organic polymer addition. *Effluent filtration*, a more long-term option, essentially filters fine solids from the effluent before it goes to the outfall tunnel. The filters catch some suspended solids, thus removing the toxic contaminants attached to them. There are also removal methods that use *bacteria* to break down some toxic contaminants. *Activated carbon,* another option, removes soluble organic material that escapes biological treatment systems. Activated carbon could be placed either in secondary treatment tanks or in effluent filtration facilities. All of these options are very expensive and would generate significant additional sludge.

5.3 Organic Material

5.31 Water quality issues

Organic matter in effluent, such as dead algae, consumes dissolved oxygen (DO) as it decomposes. As described in the Nutrients Section, low DO concentrations may suffocate sensitive animals. Secondary treatment is designed so that the majority of decomposition takes place in a treatment plant rather than in the environment.

5.32 Trigger parameters and thresholds

Water quality models show that as long as the expected NPDES permit criteria are met, organic materials in effluent from the new treatment plant will not cause DO problems. The pilot plant is currently performing well within the expected NPDES limits. The standard measures of the amount of oxygen consumed by decomposing organic material are biochemical oxygen demand (BOD), and a closely related measure, carbonaceous biochemical oxygen demand (cBOD) which provides more consistent measurements of organic material than BOD.

Effluent parameters/ thresholds

CBOD. MWRA will monitor secondary effluent to see that treatment is removing the proper amount of organic material by measuring cBOD. The NPDES permit is expected to include limits for cBOD as part of mandated secondary treatment standards under the Clean Water Act, and the anticipated limits have been incorporated into the contingency plan.

In addition, the caution and warning levels for dissolved oxygen described in the Nutrients Section also apply to organic material.

Table 5-3

Organic Material Summary

Parameter Type/Location	Parameter	Caution Level	Warning Level
effluent	cBOD	-	40 mg/L weekly 25 mg/L monthly

5.33 Potential corrective activities

In the unlikely event that the designed treatment plant does not provide sufficient removal of organic material, MWRA could implement advanced treatment, which is discussed as a response for toxic contaminants in the previous Section. Effluent filtration and organic polymer addition are the advanced treatment processes most applicable to organic material removal from the effluent.

5.4 Human Pathogens

5.41 Water quality issues

Human pathogens are bacteria and viruses that cause disease in humans. The term "pathogens" in this section refers only to human pathogens found in MWRA wastewater. Pathogens come from human and animal waste and are found at unsafe concentrations in wastewater that has not been properly disinfected. A properly operating disinfection facility reduces pathogen concentrations to low, safe levels. This section addresses the concern that pathogens may be discharged through the new outfall at concentrations that could adversely affect the health of humans and marine life. It also considers the concern that chlorination of wastewater to kill pathogens may cause residual toxicity in effluent. (The possibility of nutrients in MWRA effluent encouraging the growth of pathogens already in the marine environment is considered in Section 5.1, "Nutrients").

Pathogens from wastewater come into contact with humans via consumption of raw or inadequately cooked shellfish or swimming in affected areas. Shellfish filter pathogens out of water and into their tissues. Although pathogens do not harm shellfish, they can affect people who eat contaminated shellfish. Pathogens can also affect people who ingest contaminated water, which is primarily a problem in swimming areas. Like most other pollutants, pathogens are only a problem if they are present above certain concentrations. Regular MWRA disinfection before discharge reduces effluent pathogen concentrations below harmful levels. Combined sewer overflows, stormwater, and illegal discharge of waste from boats are much more significant sources of pathogens. Nonetheless, it is prudent to consider the effect of chlorination failure and the resulting elevated pathogen concentrations on swimming and shellfish.

Pathogens in the vicinity of the new outfall location, regardless of concentration, are extremely unlikely to affect humans. Swimming several miles offshore in the vicinity of the new outfall is not likely to occur. The outfall was carefully sited to avoid habitats where shellfish do or could live. The water around the outfall is too deep for most commercial shellfish to survive. As an additional safety measure, the Massachusetts Division of Marine Fisheries (DMF) will prohibit shellfishing near the outfall. A study of marine life in the vicinity of the new outfall site showed that the only other food animals were lobsters and fin fish, neither of which are likely to carry significant pathogen concentrations. Particularly considering that the bay outfall will have improved dilution and that fish and lobsters are rarely eaten raw.

The only way that pathogens from the new outfall could have a negative effect on humans would be if they were transported to an area where they could come in contact with humans through shellfish beds or swimming areas. This is an unlikely scenario because any pathogens surviving chlorination will be reduced below levels of concern by dilution, degradation by ultraviolet light, osmotic stress from salt water, and predation. Most pathogens are removed by these environmental processes within a few hours or days in salt water. Pathogens discharged from the new outfall are much less likely to cause problems than pathogens from the existing outfall because of the difference in distances from contact areas. Furthermore, if pathogens from the new outfall were to survive long enough to reach contact areas, they would become so dilute as they traveled that the risk of disease by that point would be unmeasureable.

It has been suggested, though not proven, that some human pathogens could impact sensitive marine animals, particularly right whales. Pathogens from wastewater are generally believed not to harm marine life. If information develops regarding the effect of pathogens on marine animals, mwra will incorporate this information into the Contingency Plan as needed.

Chlorination of wastewater kills pathogens and is thus a necessary part of the treatment process. However, too much chlorine residual in the effluent is toxic to marine life. It is essential to add enough disinfectant to kill pathogens, but not so much as to cause toxicity. Chlorine in MWRA effluent discharged through the new outfall is unlikely to cause toxicity as long as the plant operates properly. Residual chlorine in effluent will be at safe levels before discharge. Furthermore, since effluent travels the 9.5 miles from the chlorination facilities to the point of discharge, a certain degree of dechlorination occurs naturally. Therefore, in the unlikely event of a dechlorination system failure, at least some dechlorination will occur naturally in the 9.5 mile tunnel. As a result, the chlorine residual in underchlorinated effluent would be much smaller with the new outfall than with the existing outfall.

5.42 Trigger parameters and thresholds

Both public beaches and shellfish beds are tested regularly for pathogen contamination. Local authorities, such as the Metropolitan District Commission (MDC), test swimming areas, and the DMF tests both water and shellfish. MDC posts swimming areas as unsafe when counts of fecal coliform bacteria, a key indicator of the presence of pathogens, are above 200 counts/100 ml water. Shellfish beds are “restricted” (only specially licensed shellfishers may harvest, and shellfish must be purified at the state-run depuration plant before being sold) when fecal coliform counts are above 14/100 ml and prohibited at counts above 88/100 ml. In addition, shellfish cannot be sold if their fecal coliform contamination exceeds the disinfection capabilities of the purification plant.

Effluent parameters/ thresholds

Bacteria. Because of dilution achieved at the new outfall, it is nearly inconceivable that any bacterial water quality standards for fishing, shellfishing, or swimming would be exceeded (except in the immediate vicinity of the outfall, where DMF prohibits fishing and shellfishing) if effluent bacteria concentrations were below the NPDES permit limits. The MWRA thresholds are therefore based on the expected NPDES permit limits.

The bioassay effluent toxicity thresholds developed to protect against toxicity in the effluent and impact to marine life (see Toxic contaminants Section), also apply to chlorine toxicity.

Table 5-4

Human Pathogens Summary

Parameter Type/Location	Parameter	Caution Level	Warning Level
effluent	fecal coliforms	-	1400 fecal coliforms/100 ml

5.43 Potential corrective activities

Improve or Change the Disinfection Process. Properly executed chlorination is a proven, effective disinfection method. If pathogens from MWRA effluent were seriously suspected of harming marine life or humans, the most likely corrective activity would be more rigorous control of and attention to operation of chlorination facilities. The MWRA might have to use disinfection methods other than standard chlorination if it were found that certain pathogens harm marine life. Some alternative disinfection options that may be applicable use ultraviolet radiation and ozone (O_3). However, these options are still in the development stage and are currently very expensive for widespread use. If technological advances made these options practical, the MWRA would evaluate implementing alternative disinfection processes that proved cost-effective.

If measurements of the discharged effluent showed toxicity due to residual chlorine, the MWRA would lower the addition rate of sodium hypochlorite at the treatment plant to a level which adequately treats the bacteria but which does not result in residual chlorine toxicity. The MWRA would also look for new disinfection techniques and technologies that do not use chlorine. It is possible that new government regulations will require the development of these new techniques and technologies as they become practical. The MWRA would utilize them if it became necessary.

5.5 Solids

5.51 Water quality issues

Solids are tiny particles in wastewater (e.g. mud, sand, and organic debris). Many water quality issues are associated with solids present in the effluent because pollutants often attach to solids or are solids themselves (e.g. pathogens, toxic contaminants, and some nutrients). This section, however, considers the impact of solids deposition. Deposition of solids can change the nature of the bottom habitat, possible forming a physical barrier that keeps oxygen from reaching animals in the sediments. Marine life may be unable to develop settled solids into an oxygenated, livable environment if the rate of deposition is high.

MWRA is already implementing the most important responses to potential impacts from solids. The new Deer Island Treatment Plant and the new outfall will significantly reduce the environmental impact of solids from MWRA effluent. The new secondary treatment facilities will remove 85% of the solids and BOD that reach the plant, thereby reducing the amount of solids discharged. As described in the Section entitled "Underlying Pollution Prevention Strategies", the new outfall will discharge into water with improved dilution capacity, thus diminishing the effect of solids that remain after treatment. In addition, the new outfall has been located in an area without consistent deposition. Although some deposition does occur during the summer, winter storms clean sediments from the bottom annually, leaving the solids to disperse to virtually insignificant concentrations throughout the bay.

5.52 Trigger parameters and thresholds

MWRA will monitor for environmental impact from solids in three ways: 1) as part of its NPDES permit compliance, the MWRA measures the concentration of total suspended solids (TSS) in its effluent (this is also required to meet secondary treatment standards); 2) MWRA works with the United States Geological Survey (USGS) to monitor Massachusetts Bay for suspended solids and sediment deposition; and 3) MWRA will also carry out sediment sampling in Massachusetts Bay and video inspection of sediments in the immediate vicinity of the outfall. Using these three monitoring approaches, MWRA has developed a mix of quantitative and qualitative thresholds.

Effluent parameters/ thresholds

TSS levels. The expected NPDES permit limits for TSS have been incorporated into the contingency plan as warning thresholds.

Sea floor parameters/ thresholds

The predicted area of impact to the benthic community is defined in the SEIS. Based on this prediction, the following qualitative threshold has also been developed.

Thresholds for cBOD and depth of sediment oxygen are contained in the Organic Material Section and Nutrients Section, respectively, but may also be relevant to identifying the environmental impact of solids.

Table 5-5

Solids Summary

Parameter Type/Location	Parameter	Caution Level	Warning Level
effluent	TSS	-	45 mg/L weekly 30 mg/L monthly
sediments,	benthic	appreciable change	-

nearfield	diversity		

5.53 Potential corrective activities

Enhance Solids Removal during Treatment. In the unlikely event that the treatment plant as designed does not provide sufficient removal of solids, the MWRA could implement advanced treatment, which is discussed as a response for toxic contaminants (see Section 5.2, “Toxic Contaminants”). Effluent filtration and organic polymer addition are the advanced treatment processes most applicable to solids.

5.6 Floatables

5.61 Water quality issues

Floatables are pollutants that sit on the water surface, as opposed to being suspended or dissolved in the water or resting in the sediment. Typical floatables are plastic tampon applicators, oil, and grease. Floatables are primarily an aesthetic problem, although some floatables, such as oil, can be harmful to marine life.

The MWRA has already ceased scum and sludge discharge, drastically reducing the amount of floatable material discharged from MWRA treatment plants. In addition, the new Deer Island Treatment Plant includes much better mechanisms for removing floatables, further reducing the discharge of floatables in effluent. CSOs are also a significant source of floatables. The MWRA is implementing a program to reduce the effect of CSOs which includes eliminating many CSOs and providing improved floatables control for any remaining CSO discharges.

It is important to note that there are other sources of floatables in the bays. Trash discarded on land and blown or washed into the bays is a very significant source of floatables, as is boat trash. Oil slicks come from land runoff and shipping traffic that travels through the bay, especially oil tankers.

5.62 Trigger parameters and thresholds

The MWRA will make regular observations of wastewater during treatment to determine whether floatables are removed as expected and whether oil and grease discharges are within the limits established by the NPDES permit.

Effluent parameters/ thresholds

Oil and Grease concentrations and floatables removal performance. The expected NPDES permit limits for oil and grease of petroleum origin, and expected treatment plant floatables removal performance have been incorporated into the contingency plan as warning thresholds. There are a series of devices to remove floatables, and low volumes of material collected in the final collection device indicates that upstream devices are effective at removal.

Table 5-6

Floatables Summary

Parameter Type/Location	Parameter	Caution Level	Warning Level
effluent	floatables	-	5 gallons/day in final collections device
effluent	oil and grease (petroleum)	-	15 mg/L weekly

Improved Floatables Removal. Should observations show that significant numbers of floatables are in the effluent after treatment, there are a number of remediation options that could be considered. Improved floatables removal can be achieved if wastewater is run through primary effluent screens. Space has been reserved for primary effluent screens should they need to be installed.

5.63 Potential corrective activities

Enhanced Educational Programs. MWRA could also make efforts through educational programs to stop floatables from entering the waste stream. Some possibilities are improved street sweeping; promoting the use of tampons with biodegradable, cardboard applicators or no applicators (both currently on the market); encouraging proper disposal of tampon applicators, cigarette filters, and condoms to solid waste facilities rather than the sewer system; and a variety of other public education programs.

5.7 Overall Treatment Plant Performance

5.71 Water quality issues

As described in the Contingency Plan Implementation Section, the first response to any threshold exceedance would be to determine whether plant operation could be altered to improve removal of the relevant pollutant. But even if thresholds have not been exceeded, the MWRA is committed to maintaining effective overall plant operation. A dedicated effort to maintain high quality effluent in all respects is the best way to prevent adverse impacts from any pollutant. The following trigger parameters and their thresholds will help identify overall acceptable operation of the treatment plant.

5.72 Trigger parameters and thresholds

EPA and the Association of Metropolitan Sewerage Agencies (AMSA) have established standards which define preferred and acceptable operational achievement practices. Through the NPDES permit, EPA requires that the MWRA "shall at all times properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) which are installed or used by the permittee to achieve compliance with the conditions of {the} permit" (EPA, in publication). EPA defines "significant noncompliance" to be failing the NPDES permit 5% of the time. AMSA has established God and Silver Awards to recognize achievement in meeting NPDES permit requirements. Gold Awards are presented for no NPDES permit violations during a calendar year and Silver Awards are presented for not more than 5 NPDES permit violations during a calendar year. If MWRA falls short of winning at least the Silver Award every year then a caution threshold will be triggered.

Effluent parameters/ thresholds

EPA Significant Noncompliance and AMSA Achievement Standard. MWRA caution and warning levels for plant performance are the AMSA standard and the EPA standard, respectively. Limits for pH and flow are also expected to be included in the new permit and will serve as warning levels for plant performance.

Table 5-7

Overall Plant Performance Summary

Parameter Type/Location	Parameter	Caution Level	Warning Level
effluent	plant performance	5 violations/year	noncompliance 5% of the time; pH <6 or >9 at any time; flow >436 for an annual average dry day

5.73 Potential corrective activities

Should the Deer Island Treatment Plant experience “significant noncompliance” with NPDES permit limits, MWRA would undertake to revise the Standard Operating Procedures described in the Underlying Pollution Control Strategies Section, the goal of the revision being to return the treatment plant to NPDES permit compliance. This revision would be presented for comment to the Operations Committee of the MWRA Advisory Board and the Wastewater Advisory Committee. The Water Environment Federation’s Manual of Practice would be used as a resource and a source of references for additional information on improving operations and maintenance.

Appendix A

Sample “*Quarterly Wastewater Performance Report*”

CONTINGENCY PLAN STATUS REPORT

SAMPLE

Nutrients

Parameter Type/Location	Parameter	Caution Level	Warning Level	Baseline	Most Recent
effluent	total nitrogen	12,500 tons/year	14,000 tons/year		
water column nearfield bottom, Stellwagen bottom	dissolved oxygen	6.5 mg/L, 80% saturation for any one month during stratification (June-Oct.)	6 mg/L, 75% saturation for any one month during stratification (June-Oct.)		
water column, nearfield bottom	oxygen depletion rate	1.5 x baseline for any one month during stratification	2 x baseline for any one month during stratification		
water column, nearfield	chlorophyll	1.5 x baseline annual mean	2 x baseline annual mean		
water column, nearfield	chlorophyll	95th percentile of the baseline seasonal distribution	-		
water column, nearfield	nuisance algae	95th percentile of the baseline seasonal mean	-		
water column, nearfield	zooplankton	shift toward inshore community	-		
water column, farfield	PSP extent	new incidence	-		
sediments, nearfield	redox potential discontinuity	0.5 x baseline	-		

Toxic Contaminants

Parameter Type/Location	Parameter	Caution Level	Warning Level	Baseline	Most Recent
effluent	chlorine	-	631 ug/L average daily 456 ug/L average monthly		
effluent	PCBs	PCB (as Arochlors) limit 0.0045 ug/L			
lab test	effluent toxicity	-	acute: effluent LC50 < 50% for shrimp; chronic: effluent NOEC for fish growth and sea urchin fertilization < 1.5%		
water column, zone of initial dilution	initial dilution	-	effluent dilution predicted by EPA as basis for NPDES permit		
sediments, nearfield	toxics	-	NOAA Effects Range Median sediment guideline		
sediments, nearfield	toxics	90% EPA sediment criteria	EPA sediment criteria		
fish tissue, outfall	mercury	0.5 ug/g wet	0.8 ug/g wet		

Toxic Contaminants (Cont'd)

Parameter Type/Location	Parameter	Caution Level	Warning Level	Baseline	Most Recent
fish tissue, outfall	PCB	1 ug/g wet	1.6 ug/g wet		
fish tissue (mussel only), outfall	lead	2 ug/g wet	3 ug/g wet		
fish tissue, outfall	lipid-normalized toxics	2 x baseline	-		
fish tissue (flounder only)	liver disease incidence	greater than harbor prevalence over time	-		

Organic Material

Parameter Type/Location	Parameter	Caution Level	Warning Level	Baseline	Most Recent
effluent	cBOD	-	40 mg/L weekly 25 mg/L monthly		

Human Pathogens

Parameter Type/Location	Parameter	Caution Level	Warning Level	Baseline	Most Recent
effluent	fecal coliforms	-	1400 fecal coliforms/100 ml		

Solids

Parameter Type/Location	Parameter	Caution Level	Warning Level	Baseline	Most Recent
effluent	TSS	-	45 mg/L weekly 30 mg/L monthly		
sediments, nearfield	benthic diversity	appreciable change	-		

Floatables

Parameter Type/Location	Parameter	Caution Level	Warning Level	Baseline	Most Recent
effluent	floatables	-	5 gallons/day in final collections device		
effluent	oil and grease (petroleum)	-	15 mg/L weekly		

Overall Plant Performance

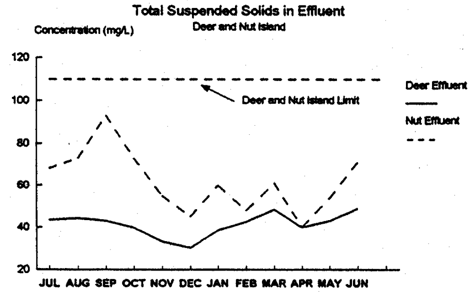
Parameter Type/Location	Parameter	Caution Level	Warning Level	Baseline	Most Recent
Effluent	plant performance	5 violations/year	noncompliance 5% of the time; pH <6 or >9 at any time; flow >436 for an annual average dry day		

EFFLUENT QUALITY

Regulatory Limits Violations

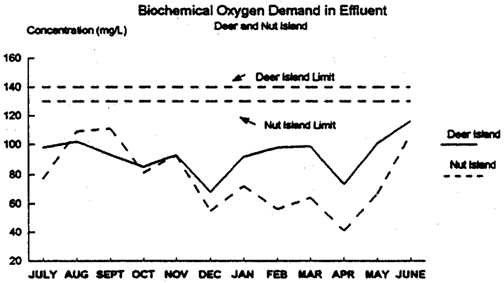
	Deer Island Interim Limits 4Q 97	Deer Island Interim Limits FY 97 12 Mo	Deer Island Interim Limits FY 96 12 Mo	Nut Island Interim Limits 4Q 97	Nut Island Interim Limits FY 97 12 Mo	Nut Island Interim Limits FY 96 12 Mo	Clinton NPDES Limits 4Q 97	Clinton NPDES Limits FY 97 12 Mo	Clinton NPDES Limits FY 96 12 Mo
BOD Monthly Average	0	0	0	0	0	0	0	0	0
Daily Maximum	0	0	0	0	0	2	0	0	0
Percent Removal	0	0	7	0	0	0	0	0	0
TSS Monthly Average	0	0	0	0	0	0	0	0	0
Daily Maximum	0	0	0	0	0	2	0	0	0
Percent Removal	0	0	0	0	0	0	0	0	0
Settleable Solids	0	0	0	0	0	0	0	0	0
Petroleum Hydrocarbons	0	0	5	0	0	3	NA	NA	NA
Fecal Coliform	0	0	0	0	0	0	0	0	0
Total Coliform	0	0	0	0	0	1	0	0	0
pH	0	0	0	1	4	2	0	1	0
Flow	NA	NA	NA	NA	NA	NA	1	3	8
Ammonia	NA	NA	NA	NA	NA	NA	0	0	2

Total Suspended Solids in Effluent



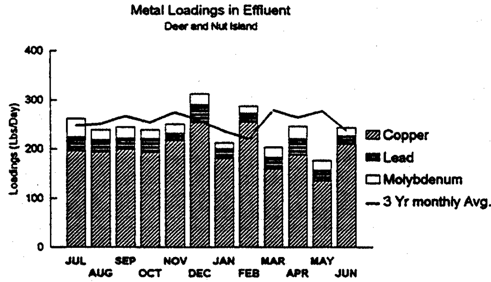
Total suspended solids were well below our Interim limit for Deer and Nut Island treatment plants.

Biochemical Oxygen Demand in Effluent



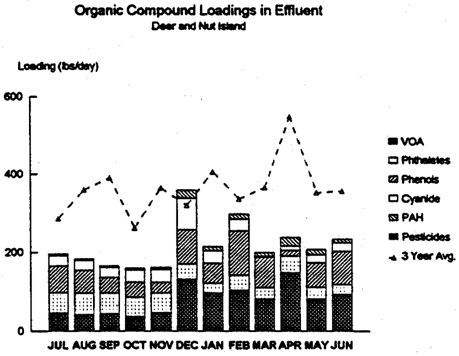
Biochemical Oxygen Demand was well below our Interim limit for Deer and Nut Island treatment plants.

Metal Loadings in Effluent

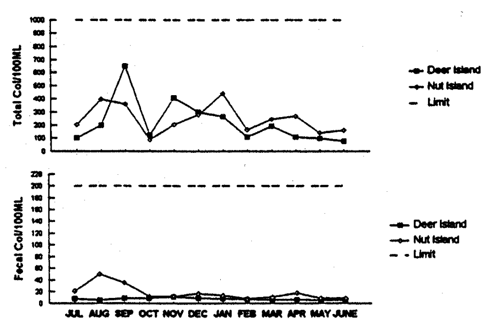


In the first quarter, Deer Island copper results were invalidated due to sampling line contamination. The Deer Island 3-year average monthly loadings were substituted for the bad data. High flow in February during one of the three sampling days resulted in high metal loadings.

Organic Compound Loadings in Effluent



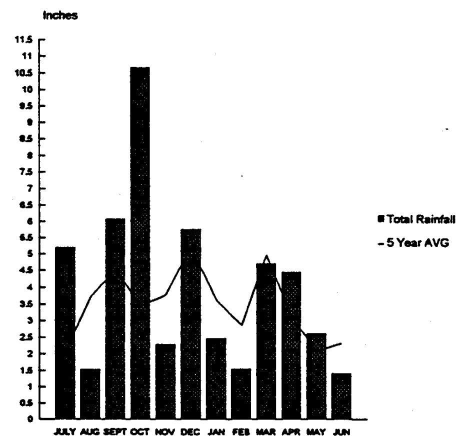
Total & Fecal Coliform Monthly Geometric Mean
Deer and Nut Islands



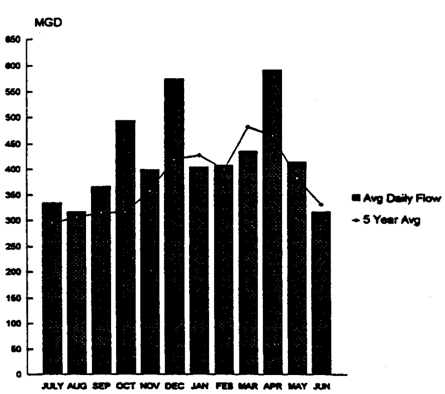
WASTEWATER FLOW

CSO Facilities (CAPACITY IN MGD)	Volume (MG)	Number of Activations FY 97 12 Mo	FY 96 12 Mo	4Q Activations
Cottage Farm (233)	12.79	27	27	3
Prison Point (385)	34.75	27	25	3
Fox Point (119)	10.92	18	12	7
Somerville Marginal (245)	8.999	29	28	6
Constitution Beach (20)	0.941	17	13	5
Commercial Point (194)	7.06	22	12	7
TOTAL	75.46	140	117	31

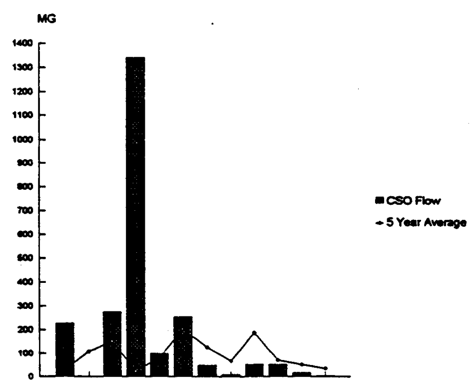
Monthly Rainfall Compared with 5 Year Average



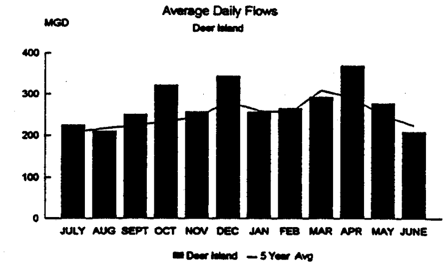
Combined Deer and Nut Island Average Flows

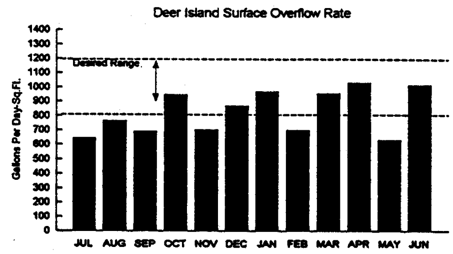


Total Treated Flow at CSO Facilities

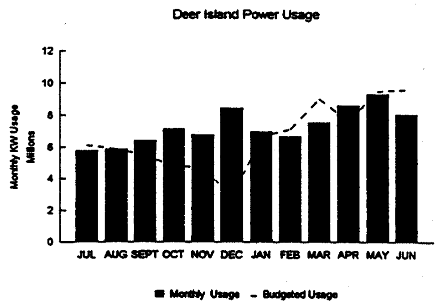


DEER ISLAND TREATMENT PLANT OPERATIONS

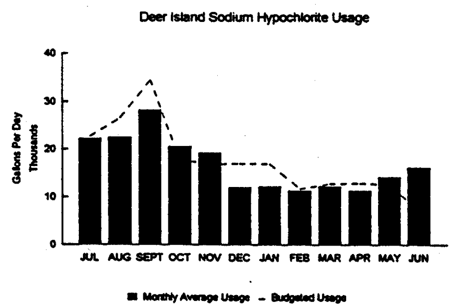




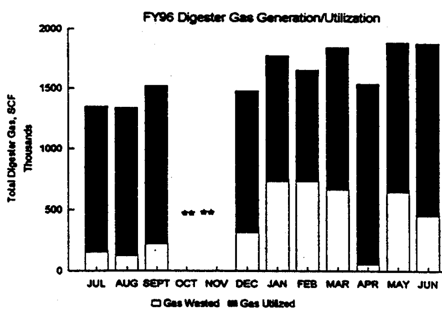
The Surface Overflow Rate is a measure of gallons per day moved through the primary clarifiers per square foot of the surface area of the clarifiers in service. Operating the plant at a low overflow range is a conservative operating regimen which will maximize the settling capability of the clarifiers. Plant staff target the lower end of the desired range. Achieving slightly below the range is indicative of a high percentage availability of battery C and D sedimentation tanks. The plant is also meeting its peak hourly design criteria of 2000 gallons per day per square foot.



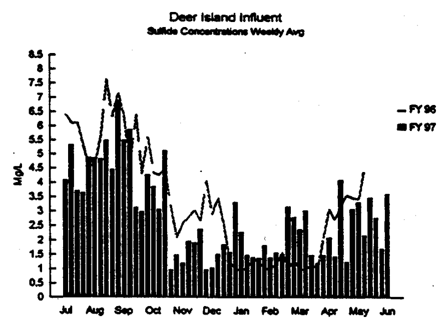
The power usage at Deer Island is flow dependent, as the flow increases . so does power usage. The FY97 budget for electricity also assumed that Deer Island would be able to reduce its reliance on purchased power through use of the STGs to generate power, an expection now delayed until October 1997.



Sodium hypochlorite usage in the fourth quarter exceeded the budget due to the delay in secondary start up. In FY98, cleaner secondary effluent will allow for decreased hypochlorite usage.



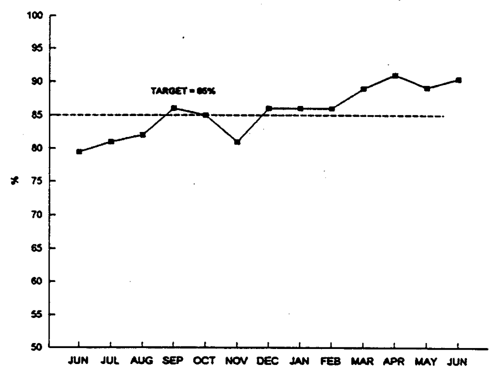
**The gas meters did not send reliable data for part of the month of October and November. The meters had to be replaced. Staff is in the process of specifying and procuring the meters. For the past 7 months, while the gas meters were not working, staff calculated the gas generated and used based on sludge meter and lab analysis results.



Aqueous sulfide concentrations higher then 3 mg/L range will require corrosion control. 3 to 5 mg/L aqueous sulfide correlates with greater than 50 ppm hydrogen sulfide in head space above wastewater in primary sedimentation tanks. High sulfide conc. can cause corrosion. High sulfide concentrations experienced in August were the result of normal dry weather conditions.

DEER ISLAND TREATMENT PLANT
MAINTENANCE

DITP Major Process Equipment Availability

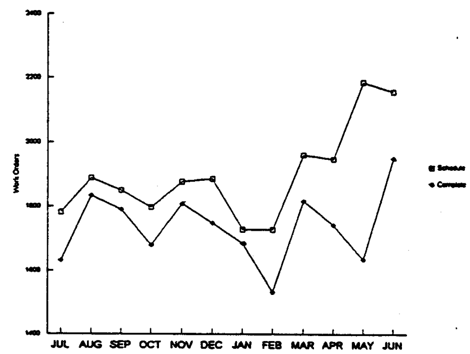


559 major pieces of equipment turned over to date. 491 pieces of equipment available this month 383 are considered critical equipment and are required by operations to be continuously available. Having 87.7% of the major pieces of equipment available allows the equipment redundancy necessary to assure daily availability of the 383 critical equipment.

"Critical equipment" includes pieces of equipment throughout all process areas (pumping, primary, residuals, etc.) which must be available daily to provide adequate plant operation. Daily joint O&M meetings assure attention to critical equipment availability.

There were no exceptions to the availability of the 383 critical equipment items in June.

Monthly PM Work Order Performance

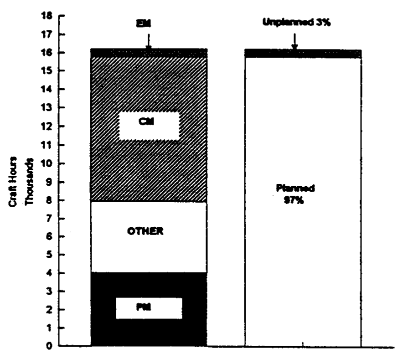


2158 Preventive Maintenance Work Orders Issued in June
1949 Preventive Maintenance Work Orders Completed in June
555 Rescheduled for next month, these PM's have a lower priority
Due to secondary startup efforts.

June PM's completed are at 90%.

There were 108 new PM's developed into Maximo and 77 existing PM's were updated. There is a total of 12,052 preventive maintenance programs.

Monthly Craft Hours by Work Order Type



Definitions

PM = Preventive Maintenance is performed work on operational equipment that contribute to uninterrupted operation of equipment within design characteristics.

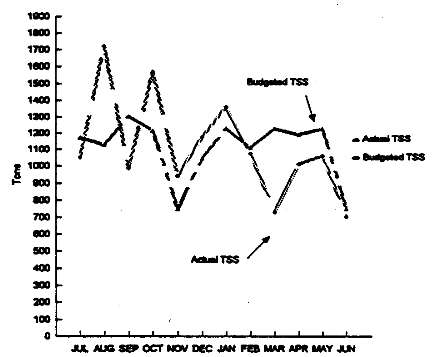
CM = Corrective Maintenance are the actions required to restore equipment to an operational condition within predetermined tolerances/limitations.

EM = Emergency Maintenance are critical repairs needed to restore a system or equipment to operational service within a minimum amount of downtime due to personnel hazards or process system failure.

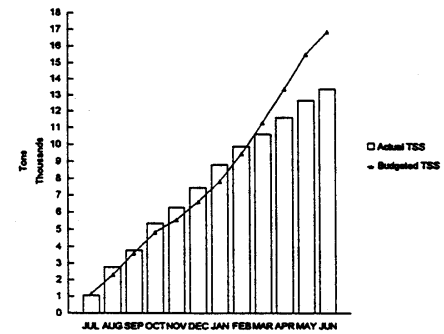
OTHER = Special projects, facility maintenance and startup related issues.

RESIDUALS PROCESSING

Tons of Solids Barged to FRSA - Monthly

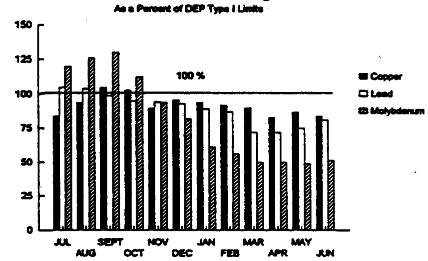


Tons of Solids Barged to FRSA - Cumulative



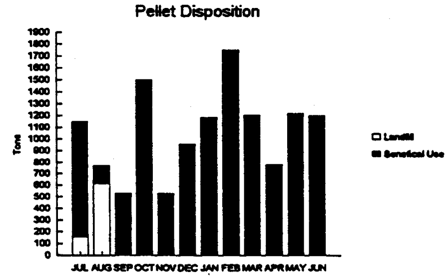
Startup of secondary treatment has been delayed, resulting in high budgeted TSS. The revised numbers reflect secondary being delayed.
Budgeted TSS officially revised as of January 97.

Metals Concentrations in Sludge Pellets
As a Percent of DEP Type I Limits



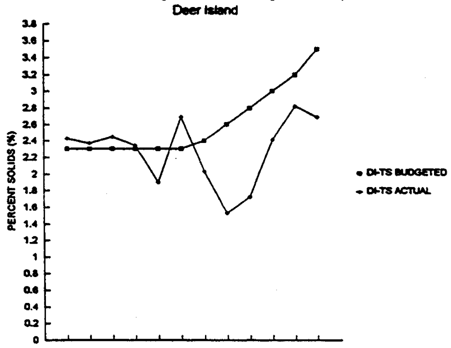
All metals continue to meet DEP Type I limits

Pellet Disposition



Liquid sludge from Nut Island and Deer Island are both being pelletized.
All pellets landfilled in August were derived from poor quality Nut Island sludge.
Beneficial use includes both use in unrestricted settings as well as use at permitted land applications sites.

Solids Content of Sludge to FRSA vs Budgeted assumptions
Deer Island



The solids content of Deer Island digested sludge improved dramatically during the 4th quarter. The lower solids content earlier in the year was due in part to an operational problem related to filling and starting additional digesters. Since then, plant staff have been able to use newly available sludge transfer pipelines to provide additional thickening in one of the digesters. The reason for the large difference between the budgeted and actual total solids concentration is that the budgeted amount assumed the availability of the new digested sludge centrifuges (which are now scheduled to be available in August pending resolution of construction issues).

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