San Diego County Stormwater Copermittees
Coastal Storm Drain Monitoring Program
Adaptive Monitoring Proposal
March 20, 2003

1.0 CURRENT PROGRAM

The Copermittees initiated the Coastal Storm Drain Monitoring Program in November 2001. The current program design is a prescriptive approach that is based on elements of the AB 411 Recreational Water Monitoring Program and involves the collection of paired samples at flowing storm drain outlets and in the corresponding coastal or lagoon receiving water. Coastal receiving water samples are collected 25 yards downcurrent of the mixing zone, while lagoon samples are collected immediately in front of the storm drain outlet. Samples are collected monthly during the non-AB 411 period (November 1 – March 31), and every other week during the AB 411 period (April 1 – October 31), and are analyzed for total and fecal coliform, and enterococcus indicators (San Diego County Municipal Copermittees, 2001). Lagoons were incorporated into the program beginning November 2002.

The Revised Sampling Plan (San Diego County Municipal Copermittees, 2001b) states that, after one year of data collection the Copermittees will:

> '…. review the complete database to determine the appropriateness and applicability of an Adaptive Shoreline Monitoring matrix or any other available tools. Recommendations may include modifications to monitoring frequencies and locations in subsequent years.'

The Coastal Storm Drain Monitoring Workgroup began development of an adaptive strategy for the Coastal Storm Drain Monitoring Program in August 2002. The Workgroup decided not to follow the adaptive models developed by the State Water Resources Control Board or the USEPA. These guidance documents are designed to address recreational waters alone and do not necessarily accommodate paired sampling designs. The Workgroup discussed various adaptive approaches, conducted a comprehensive analysis of the paired sampling data collected from November 2001 to October 2002, and developed procedures to guide the implementation of an adaptive strategy.

2.0 COASTAL STORM DRAIN MONITORING RESULTS (NOV 2001 – OCT 2002)

The complete results of the data analysis are included in the San Diego Municipal Copermittees 2001 – 2002 Urban Runoff Monitoring Final Report, Attachment A, submitted to the San Diego RWQCB on January 31, 2003. The analysis included the development of a Coastal Storm Drain Monitoring database, plotting the data distributions for the 332 paired samples, identifying the samples that exceeded the receiving water AB 411 standards, calculating statistical values for the receiving water and storm drain data sets, and regression analyses.

The total and fecal coliform, and enterococcus bacterial indicators exceeded AB 411 standards 3, 5, and 15 times, respectively (23 total exceedances in 15 samples) (**Table 1**). This corresponds to overall exceedance rates of 0.9%, 1.5%, and 4.6% for the respective indicators. The higher rate of enterococci exceedance may be related to its ability to survive for comparatively longer periods in marine environments.

Table 1: Summary of Samples Exceeding AB 411 Receiving Water Standards (Nov 01 – Oct 02)

Site ID	Location Name	# of Paired Samples Collected			% of Sampling Attempts With Flowing Storm Drain	Storm Drain Flows To Ocean During Sampling?	AB 411 Exceedances		
		Wet	Dry	Total			TC	FC	Ent
Oceanside									
	Hayes	1	0	1	5	no	0	0	0
	Oceanside Blvd	1	1	2	10	no	0	0	0
EH-490	Wisconsin	0	1	1	5	no	0	0	0
OC-090	Surfrider	0	1	1	5	no	0	0	0
Carlsbad									
EH-470	Pine Ave	0	8	8	40	no	0	0	0
#2	Ocean St.	1	0	1	5	no	0	0	0
#3	Cypress Street	2	0	2	10	no	0	0	0
#5	Christiansen PBA	2	0	2	10	no	0	0	0
EH-475	Carlsbad Village Dr	1	2	3	15	no	0	0	0
Encinitas									
EH-403	North San Elijo SB	5	15	20	100	usually	0	0	0
EH-405	Swami's mid beach	5	15	20	100	yes	0	0	0
EH-410	Swami's Beach	5	15	20	100	yes	0	0	0
EH-420	Cottonwood Creek	5	15	20	100	yes	0	0	0
Solana Beach									
EH-390	Seascape Beach Park	5	12	17	85	no	0	0	0
SE-010	Fletcher Cove	5	10	15	75	sometimes	0	0	0
Del Mar									
EH-355	12th Street	4	15	19	95	yes	0	0	0
EH-360	15th Street	5	15	20	100	rarely	0	0	0
EH-370	17th Street	5	15	20	100	no	0	0	0
San Diego									
EH-250	Grand Ave	5	15	20	100	usually	0	0	0
FM-030	Tourmaline	4	4	8	40	sometimes	0	0	0
EH-255	PB Point	5	15	20	100	yes	**1**	**1**	**4**
EH-280	Playa Del Norte	5	15	20	100	yes	0	0	0
FM-050	Bonair	1	2	3	15	usually	0	0	0
EH-300	Ravina/ Horseshoes	2	9	11	55	yes	0	0	0
FM-060	Coast Blvd.	1	9	10	50	usually	0	0	0
EH-340	El Paseo Grande	3	8	11	55	sometimes	0	0	0
FM-080	Avenida De La Playa	0	1	1	5	yes	0	0	0
San Diego Unified Port District									
EH-070	Tidelands (bayside)	1	2	3	15	no	0	0	**1**
EH-120	Bayside Park (J St.)	4	6	10	50	at low tide	**1**	**2**	**3**
EH-160	Spanish Landing	1	3	4	20	sometimes	0	0	**1**
EH-200	Shelter Island	5	5	10	50	yes	**1**	**2**	**4**
EH-205	Bessemer Street	0	2	2	10	no	0	0	**1**
EH-210	Kellogg Street	5	2	7	35	usually	0	0	**1**
TOTALS:	**33 Sites**	**94**	**238**	**332**	**50.3%**		**3**	**5**	**15**

Approximately 37% of the storm drain samples had total coliform levels above the 10,000 MPN/ 100 mls receiving water standard. Similarly, approximately 35% and 62% of the storm drain samples exceeded the fecal coliform and enterococcus AB 411 standards, respectively. Dilution, filtration, and natural UV disinfection between the storm drain outlet and the receiving water sampling location contributed to the low number of AB 411 violations during the period of record.

One of the key findings of the data analysis was that storm drains that did not discharge directly to the receiving water (soaked into beach or ponded) typically had much higher bacteria levels than conveyances that flowed across the beach and directly into the ocean. Not surprisingly, storm drains that did not reach the receiving water had comparatively lower discharge rates than storm drains that conveyed runoff directly to the receiving water. The apparent difference in storm drain bacteria levels may be related to one or more characteristics of these two categories of storm drains. Low-flow storm drains may be characterized by a lack of flushing and dilution of bacterial contaminants, stagnation of runoff in the drain pipes due to ponding behind debris blockages, and the relative predominance of urban runoff over ground water discharge. Conversely, storm drain discharges that reach the receiving water typically originate from drains that are less stagnant than low-flow conveyances.

The 2001 – 2002 data also demonstrated that although storm drain flows that did not reach the ocean had comparatively higher bacteria levels, they were rarely associated with elevated concentrations in the receiving water. Several factors may contribute to the apparent absence of negative impacts of the low-flow storm drains.

1. Effective bacteria filtration of the storm drain discharge by beach sand and other substrate before it reaches the receiving water.
2. Bacteria mortality caused by exposure to UV radiation after the flow emerges from the drain outlet.
3. Comparatively low bacterial loadings from high concentration, low flow storm drains.
4. Dilution of storm drain discharges between the mixing zone and the site of receiving water sample collection (usually 25 downcurrent of the storm drain).

Elevated receiving water results that were paired with a low-flow storm drain sample were at least partially attributable to sources within the receiving water itself. For example, bird populations, which are significant natural sources of bacteria, were often observed in the vicinity of the receiving water sampling locations.

A regression analysis was performed on the log-transformed data to assess the relationship between the storm drain (independent variable) and receiving water (dependent variable) concentrations. The relationship between the two variables was statistically significant for all three indicators when the storm drain flow reached the receiving water and was essentially non-existent when the storm drain did not discharge directly to the receiving water. This supported the conclusion that storm drain flows that do not reach the receiving water do not negatively impact the receiving water, regardless of their bacteria concentrations.

In summary, there is very little evidence linking high bacteria levels in storm drains that do not discharge directly to the receiving water and elevated bacteria in the corresponding receiving water sample. *The adaptive program incorporates into its design the observation that storm drains that do not discharge directly to the receiving water pose a minimal threat to receiving* *water quality.* Conversely, storm drains that discharge directly to the receiving water have a greater potential to cause or contribute to elevated bacteria levels in the receiving water although this effect is moderated by the generally lower bacteria levels in these discharges.

3.0 ADAPTIVE MONITORING PROGRAM

The proposed adaptive program will pursue the following objectives:

1. Evaluate the impacts of ocean and lagoon storm drains on the recreational beneficial uses in coastal receiving waters
2. Identify and eliminate sources of highly elevated bacteria from coastal storm drains

In addition, the trend assessment and database development program objectives identified in the original Coastal Storm Drain Monitoring Program will continue to be pursued.

3.1 Program Design

The adaptive strategy is designed to address the storm drains that pose the greatest threat to recreational receiving waters most aggressively, while allocating a lower monitoring intensity to locations that exhibit consistently low bacterial levels. *Thus, the adaptive strategy is intended to make efficient use of Copermittee resources by identifying and addressing high priority storm drains first and reducing sampling intensity at low priority paired sampling locations.*

The Copermittees will perform follow up procedures and management actions depending on the results of the paired samples. Existing water quality criteria and other action levels developed by the Coastal Storm Drain Monitoring Workgroup will be used to trigger these sets of follow up procedures and actions. Contaminated storm drain discharges with sufficient flow to reach the receiving water will be assigned the highest priority for additional investigation and source elimination.

Established water quality objectives that can be employed as exceedance criteria are available for the ocean and lagoon receiving waters of coastal San Diego County. Established water quality criteria applicable to storm drain discharges are not available and have been developed as outlined below. Two other criteria were developed based on an analysis of the November 2001 – October 2002 paired sampling data: 1) action levels for each bacterial indicator that trigger storm drain investigations in the absence of a receiving water exceedance and, 2) a criteria that allows for a reduction in sampling frequency when bacteria results are consistently low. The development of these criteria are described in **Section 3.1.2** and **Section 3.1.3**, respectively.

3.1.1 Receiving Water Exceedance Criteria

The ocean receiving water exceedance criteria are the AB 411 standards established for the protection of public health. The lagoon criteria are established in the San Diego Basin Plan (1994).

	Coastal	Lagoon
Total Coliform (MPN/ 100 mls)	10,000	10,000
Fecal Coliform (MPN/ 100 mls)	400	400 (for REC-1areas)
Enterococcus (MPN/ 100 mls)	104	104 (designated beach); 276 (light-mod. used area); 500 (infrequently used area)

Each of the currently monitored coastal lagoons is designated with the REC-1 beneficial use; however the actual contact recreational activity within these lagoons varies considerably with location. Copermittees that are conducting coastal storm drain monitoring in lagoons will assess beach usage at each of the lagoon paired sampling locations to determine which of the three enterococci standards are applicable. Most of the lagoon areas monitored by the Copermittees are in infrequently used areas and will probably be subject to the 500 MPN/ 1000 mls standard. Selected lagoon areas may be categorized as designated beach and will be subject to the most stringent of the three enterococci criteria (104 MPN/ 100 mls).

3.1.2 Storm Drain Exceedance Criteria

Two separate sets of storm drain criteria or action levels were developed. These criteria are applied in the following circumstances:

1. When a receiving water bacteria concentration exceeds AB 411 or Basin Plan criteria given in **Section 3.1.1**, the storm drain criteria is identical to the receiving water criteria. This represents a conservative approach because it ignores the potential dilution of storm drain discharges as they mix with the receiving water however; this approach will provide assurance that storm drains that may have caused or contributed to a receiving water exceedance will be investigated.

2. When the receiving water *does not* exceed AB 411 or Basin Plan guidelines a different set of storm drain criteria are applied. The vast majority of the receiving water samples did not exceed the ocean AB 411 standards during 2001 – 2002. This included numerous receiving water samples that were paired with highly elevated storm drain samples. Despite the generally low threat to the receiving water posed by many high-bacteria storm drains, the Coastal Storm Drain Monitoring Workgroup agreed that a certain percentage of the high-bacteria drains should be investigated. Accordingly, the Workgroup established action levels for further storm drain investigation when highly elevated storm drain results are paired with compliant receiving water samples.

   There are several reasons for pursuing these highly contaminated drains, including the likelihood that they are sources of bacterial pollution during storms when the contents of the storm drain are flushed into the receiving water, the potential health effects of these discharges if they become ponded in accessible coastal areas, and the possibility that ongoing sources of pollution can be eliminated from coastal sub-watersheds by investigating these conveyances.

   The exceedance criteria for storm drains that are not paired with a receiving water sample that exceeded the AB 411 or Basin Plan criteria are based on the 95^{th} -percentile observations of the 2001 – 2002 total and fecal coliform, and enterococcus data. Storm drains that are not paired with a receiving water exceedance but exceed any of the following three 95^{th}-percentile action levels are subject to additional investigation.

Indicator	95^{th}-Percentile Storm Drain Criteria
Total Coliform	160,000 MPN/ 100 mls
Fecal Coliform	24,000 MPN/ 100 mls
Enterococcus	20,000 MPN/ 100 mls

Over time, addressing these highly contaminated storm drains will allow the Copermittees to identify and eliminate significant bacterial sources. As sources are eliminated, the 95th-percentile concentrations will decrease (the 95th-percentile concentration will be re-calculated on an annual basis) and the Copermittees will be tasked with investigating less and less contaminated storm drains.

3.1.3 Sampling Frequency

Paired sampling at all identified locations will typically be initiated at the ***base frequency***. The base frequency is identical to the sampling frequency implemented in the current Coastal Storm Drain Monitoring Program.

Time Period	**Base Frequency**
Nov 1 – March 31	once per month
April 1 – Oct 31	once every two weeks

An important characteristic of the adaptive sampling approach is an allowance for reduced sampling at locations with consistently low bacteria levels. Two factors will be assessed to determine locations where reduced sampling is appropriate: 1) a comparison of the analytical results of the three most recent paired sampling events to the sampling reduction criteria described below and, 2) a simple analysis of the previous one year (April – March) of paired sampling data. Storm drains whose samples satisfactorily meet these requirements can be collected at ½ the base frequency (once every four weeks in the summer, once every two months in the winter) as long as they continue to meet these requirements.

Sampling Frequency Reduction Criteria

As storm drain flows enter receiving waters, the discharge is quickly diluted by diffusion and wave action between the mixing zone and the sampling point 25 yards downcurrent. The method used to determine the Sampling Frequency Reduction Criteria (SFRC) involved calculating the storm drain-to-receiving water dilution factor using the slope of the regression line for each indicator's 2001-2002 data set. The slope of the paired sampling data regression line is an approximation of the dilution that occurs on a regional basis. A safety factor of 10:1 was applied to the calculated dilution factors to account for the possibility of lesser dilution rates between the storm drain and receiving water sampling points than is indicated by the slope of the regression line.

The numerical storm drain criteria for reducing the base sampling frequency are provided in **Table 2**.

Table 2: Sampling Frequency Reduction Criteria

Indicator	Receiving Water Standard (MPN/ 100 mls)	Slope of Regression Line	Reduction Standard Without Safety Factor (MPN/ 100 mls)	Slope/Safety Factor	**Sampling Frequency Reduction Criteria (MPN/ 100 mls)**
TC	10,000	42	420,000	10:1	**42,000**
FC	400	18	7,200	10:1	**720**
Entero	104	165	17,160	10:1	**1,716**

Annual Data Assessment

Prior to April 1 of each sampling year, each municipality is required to review the previous year's data to assess the eligibility of their locations for sampling frequency reduction**. If > 20% of a**

location's storm drain samples were above any of the three Sampling Frequency Reduction Criteria during the previous year then that location is not eligible for a lower sampling frequency until the following year. For example, if there were 15 samples collected at a paired sampling site during the April 2002 – March 2003 period, then no more than three of the 15 storm drain samples may exceed any of the three Sampling Frequency Reduction Criteria provided in **Table 2**. If > 20% of the samples have at least one exceedance of an SFRC then sampling must be conducted at the base frequency during the entire sampling year.

The results of this annual assessment of April 1, 2002 – March 31, 2003 storm drain data will be a list of paired sampling locations that are eligible for sampling frequency reduction during that April – March sampling year. Each jurisdiction will provide that information to the chair of the Coastal Storm Drain Monitoring Workgroup who will subsequently provide that list of eligible locations to the RWQCB prior to the beginning of the sampling year.

At all storm drains that are determined eligible for sampling frequency reduction, *a minimum of three consecutive storm drain samples with bacteria levels below the Sampling Frequency Reduction Criteria* ***(Table 2)*** *for each bacterial indicator are required to reduce sampling to one-half base frequency.* The three consecutive samples must be paired with receiving water samples that do not exceed AB 411 or Basin Plan standards unless the receiving water exceedance can be reasonably attributed to a non-storm drain source or sources.

Samples collected immediately prior to the implementation of the program can be applied toward reducing sampling frequency. For example, if the Adaptive Program is implemented beginning April 2003, the January, February, and March 2003 samples may be applied to reducing sampling frequency if the results meet the Sampling Frequency Reduction Criteria in **Table 2**.

Additional Reduction of Sampling Frequency

The sampling frequency for storm drains that are confirmed to consistently discharge low bacteria levels may be further reduced to *quarterly* frequency pending additional supporting information collected by the municipality. This information may include existing or future storm drain source flow studies and detailed comparisons between storm drain and local groundwater bacteria levels. The San Diego RWQCB will evaluate the appropriateness of this additional sampling frequency reduction on a case-by-case basis. The municipality must submit the relevant paired sampling results and corroborating information to the RWQCB prior to April 1 of each sampling year to have that location considered for quarterly sampling during the April – March sampling year.

If a location sampled at ½ base frequency or quarterly experiences a receiving water bacteria result above the receiving water standard, and that exceedance cannot be reasonably attributed to a non-storm drain source(s) then the municipality must return to sampling that location at the base frequency. Likewise, if a location sampled at a reduced frequency experiences a storm drain bacteria result above the Sampling Frequency Reduction Criteria, a return to sampling at the base frequency is required.

3.1.4 Adaptive Monitoring Diagrams

A series of scatter plots, referred to as adaptive monitoring diagrams**,** were developed to illustrate the relationships between receiving water and storm drain bacteria levels, AB 411 and Basin Plan regulatory drivers, the storm drain criteria developed by the Coastal Storm Drain

Monitoring Workgroup, and potential contamination sources. The adaptive monitoring diagrams stratify the paired sampling data into categories, or Regions, for management purposes and are essential tools in the implementation of the proposed Adaptive Monitoring Program. The diagrams are also extremely useful visual tools for summarizing the results of the 2001 – 2002 paired sampling program.

The adaptive monitoring diagrams for total and fecal coliform for both coastal and lagoon sampling are presented in **Figures 1 and 2**. The adaptive monitoring diagram for enterococcus for coastal and *designated beach* areas within lagoons is presented in **Figure 3**. The diagrams for enterococcus in light to moderate and infrequently used lagoon areas are provided in **Figures 4 and 5**. Each adaptive monitoring diagram is divided into five regions and one subregion that are formed by superimposing a line of slope = 1 (indicative of equal receiving water and storm drain bacteria concentration), two perpendicular lines that delineate the receiving water regulatory standards summarized in **Section 3.1.1**, and the 95^{th} percentile storm drain criteria outlined in **Section 3.1.2**. **Table 3** describes the regions of the scatter plots as they relate to the applicable bacterial standards and criteria and the required follow up actions.

The regions of the adaptive monitoring diagrams are color shaded to indicate the level of risk associated with the storm drain discharge. Green shaded areas (Regions I and II) are associated with the lowest storm drain bacteria concentrations and represent the lowest risk. Paired samples falling within Region II exceed the receiving water standard but are probably dominated by non-storm drain sources. The paired samples within this region are characterized by receiving water results that are higher than the corresponding storm drain results. Very few paired samples collected during 2001 – 2002 fall within Region II.

Table 3: Adaptive Monitoring Diagram Regions

Region	Receiving Water Concentration	Storm Drain Concentration	Description:
I	< AB 411 or Basin Plan	< AB 411 or Basin Plan	Both the storm drain and receiving water are below the receiving water standard. No follow up action necessary. Continue sampling at BF unless Sampling Frequency Reduction Criteria are met. If met, sample at ½ BF.
I-A	< AB 411 or Basin Plan	> AB 411 or Basin Plan and < 95^{th} percentile	Storm drain is above the receiving water regulatory standard but the receiving water is below. Storm drain is also below the 95^{th} percentile criteria. No action necessary. Continue sampling at BF unless Sampling Frequency Reduction Criteria are met. If met, sample at ½ BF.
II	> AB 411 or Basin Plan	< AB 411 or Basin Plan	Receiving water is above standard but storm drain is below. Unlikely that storm drain contamination caused the receiving water exceedance. Non-storm drain sources are likely present. Resample ASAP to confirm scenario and address potential non-storm drain sources.
III	> AB 411 or Basin Plan	> AB 411 or Basin Plan	Both the storm drain and receiving water are above the receiving water standard but RW level is greater than storm drain level. This indicates that storm drain contamination may contribute to exceedance but that non-storm drain sources may predominate. Resample ASAP to confirm scenario and address both storm drain and non-storm drain sources.
IV	> AB 411 or Basin Plan	> AB 411 or Basin Plan	Both the storm drain and receiving water are above the receiving water standard. Storm drain appears to be a dominant contributor. Resample ASAP to confirm scenario and conduct IC/ID investigation.
V	< AB 411 or Basin Plan	> AB 411 or Basin Plan and > 95^{th} percentile	Receiving water is below the standard however; the storm drain is highly contaminated. Resample and conduct IC/ID investigation.

Region I-A is yellow shaded to indicate a moderately high storm drain concentration that is paired with a receiving water sample within regulatory limits. Follow up action is not required in response to paired samples within Region I-A however; the high between-sample variability that characterizes storm drain samples suggests that these storm drains have a reasonable probability of exceeding the 95^{th} percentile criteria at some point.

Region III is pink shaded to indicate that both the storm drain and receiving water samples are above receiving water criteria however; Region III lies above the slope = 1 (equal concentration) line indicating that non-storm drain sources likely predominate. Possible sources include birds, other marine wildlife, discharges from watercraft, and ocean bathers. It is important to consider these sources and their potential contribution to observed receiving water bacteria levels to avoid wasted effort when the paired sampling results fall within Regions II or III.

Bacteriological analyses of coastal and storm drain water samples are often characterized by high variability, a factor that should be considered when the paired sampling results are within Regions II and III and slightly above the slope = 1 line. In this situation, the bacterial contribution from the storm drain cannot be assumed to be insignificant. Municipal staff must use their Best Professional Judgment to assess the follow up actions that are appropriate to identify and address potential storm drain and non-storm drain sources. This is especially important when the paired sample results fall slightly above the slope = 1 line within Region III. If the storm drain discharges directly to the receiving water a more conservative approach, similar to the procedures followed in Region IV is appropriate. This would involve an immediate resample and follow up investigation of the storm drain. If the flow does not reach the receiving water a storm drain investigation is the proper course of action if the storm drain concentration exceeds the 95^{th} percentile criteria.

Region IV is red shaded to indicate that the combination of elevated receiving water and storm drain bacteria levels is most likely a result of storm drain contributions. The extent of the storm drain's contribution depends largely on whether the storm drain flow reaches the receiving water. This scenario represents the highest priority for follow up action according to the adaptive monitoring approach. The storm drain's influence is expected to decrease significantly if the discharge does not reach the receiving water. Regardless of the flow conditions, an immediate follow up investigation is warranted to further assess the situation.

Region V is pink shaded to delineate that the storm drain concentration is above the 95^{th} percentile criteria. Although the paired receiving water sample is within regulatory limits, the storm drain is discharging highly elevated bacteria levels and must be investigated.

In summary, additional sampling and/or investigation is required when the results of paired samples fall within one of three categories:

1. The storm drain sample is below and the receiving water is above the receiving water AB 411 or Basin Plan standard for the indicator in question (**Region II**). Follow up actions other than prompt resampling, if necessary, are likely to focus on controllable non-storm drain sources (boat discharges, pet waste on beach, etc.).
2. The storm drain and receiving water samples both exceed the receiving water AB 411 or Basin Plan standard for the indicator in question (**Regions III and IV**). The **Region IV** scenario is considered the highest priority especially if the storm drain discharge reaches the receiving water. Follow up actions may include resampling, source identification and

elimination, and BMP implementation. Follow up actions for the Region III scenario may focus on eliminating both storm drain and controllable non-storm drain sources.

3. The receiving water sample is below the AB 411 or Basin Plan standard and the storm drain sample is above the 95-percentile action level (**Region V**). Follow up actions may include resampling, source identification and elimination, and BMP implementation.

4.0 IMPLEMENTATION

The Copermittees will begin implementing the Adaptive Program on April 1, 2003. Samples will continue to be collected and analyzed in accordance with the procedures described in the prescriptive Coastal Storm Drain Monitoring Program (San Diego County Municipal Copermittees, 2001). Paired samples will be collected at frequencies outlined in **Section 3.1.3**. Upon receipt of the analytical results, staff will promptly refer to the respective adaptive monitoring diagrams for the three bacterial indicators to determine the status of each of the paired samples. Appropriate management actions will be implemented based on the guidelines provided on the adaptive monitoring diagram and the Coastal Storm Drain Adaptive Monitoring Matrix (**Table 4**).

The management strategies in **Table 4** are intended to be general instructions in the event that receiving water and /or storm drain results exceed the established criteria. The Coastal Storm Drain Monitoring Workgroup believes that the individual jurisdictions must retain a sufficient degree of flexibility to develop specific follow up approaches to address the situation at hand. The Copermittees are encouraged to employ their Best Professional Judgment and field experience when developing the details of their follow up actions.

Table 4: Coastal Storm Drain Adaptive Monitoring Matrix

Region of Adaptive Monitoring Diagram	Receiving Water Status: (Ocean or Lagoon)	Storm Drain Status: (Ocean or Lagoon)	Follow Up Procedures
I	< AB 411 or Basin Plan	< AB 411 or Basin Plan and < 95-percentile	1. Continue sampling at base frequency (BF) unless results indicate change to 1/2 BF.
Notes: Receiving water and storm drain criteria are not being exceeded. Reducing sampling frequency is warranted if storm drain results meet reduction criteria.			
I-A	< AB 411 or Basin Plan	> AB 411 or Basin Plan and < 95-percentile	1. Continue sampling at base frequency unless results indicate change to 1/2 BF.
Notes: Receiving water and 95th percentile storm drain criteria are not being exceeded. Reducing sampling frequency is warranted if storm drain results meet reduction criteria.			
II	> AB 411 or Basin Plan	< AB 411 or Basin Plan < 95-percentile	1. Notify DEH of exceedance immediately. Resample ASAP to confirm receiving water and storm drain status. Collect detailed observations to assess the presence of other bacteria sources in the area (birds, bather, boats, etc.)
			2. If resample confirms results, continue sampling at BF. Eliminate non-storm drain sources if appropriate.
			3. Do not reduce sampling frequency to 1/2 BF if receiving water exceeds criteria, regardless of storm drain status.
<u>Notes:</u> The analytical results do not link the receiving water exceedance to a contaminated storm drain discharge. The receiving water contamination is likely due to non-storm drain sources.			
III	> AB 411 or Basin Plan	> AB 411 or Basin Plan and > or < 95-percentile	1. Notify DEH of exceedance immediately. Resample ASAP to confirm receiving water and storm drain status. May include sample at point zero to assess storm drain as cause/ contributor of exceedance and dilution effects. Assign highest priority if storm drain discharges directly to receiving water. If original or follow up storm drain sample exceeds 95th percentile, conduct IC/ID as in Reg V.
			2. If resample is above Basin Plan storm drain and AB 411 receiving water criteria, initiate IC/ID investigation ASAP. Eliminate storm drain and non-storm drain sources as appropriate. Assign highest priority if storm drain discharges directly to rec. water.

			3. If resample is above 95th percentile storm drain criteria and below receiving water criteria then conduct IC/ID investigation in the storm drain (proceed as in Region V).
			4. If resample is below storm drain criteria and above receiving water criteria proceed as in Region II. Assess the presence of non-storm drain bacteria sources in the area.
			5. If resample is below receiving water and storm drain criteria then return to paired sampling at BF (Regions I and I-A).
Notes: *Responses to paired samples falling within Region III are similar to those outlined for Region IV. An important distinction between Regions III and IV is that receiving water indicator levels are higher than storm drain levels in Region III. This indicates that non-storm drain sources (birds, bathers, boats, etc.) may predominate in Region III. If resample is below limits, use BPJ to guide follow up. Contaminated discharges may be sporadic and require investigation.*			
IV	> AB 411 or Basin Plan	> AB 411 or Basin Plan and > or < 95-percentile	1. Notify DEH of exceedance immediately. Resample ASAP to confirm receiving water and storm drain status. May include sample at point zero to assess storm drain as cause/ contributor of exceedance and dilution effects. Assign highest priority if storm drain discharges directly to receiving water. If original or follow up storm drain sample exceeds 95th percentile, conduct IC/ID as in Reg V.
			2. If resample is above Basin Plan storm drain and AB 411 receiving water criteria, initiate IC/ID investigation ASAP. Eliminate storm drain and non-storm drain sources as appropriate. Assign highest priority if storm drain discharges directly to rec. water.
			3. If resample is above 95th percentile storm drain criteria and below receiving water criteria then conduct IC/ID investigation in the storm drain (proceed as in Region V).
			4. If resample is below storm drain criteria and above receiving water criteria proceed as in Region II. Assess the presence of non-storm drain bacteria sources in the area.
			5. If resample is below receiving water and storm drain criteria then return to paired sampling at BF (Regions I and I-A).
Notes: *The scenario outlined in Region IV represents the greatest risk of continuing receiving water impacts and therefore, requires the most aggressive response. As a first course of action, it is important to resample ASAP after receiving the initial results. Sampling at point zero will allow the assessment of dilution effects between the mixing zone and 25 yards downcurrent, and will help indicate whether sources other than the storm drain are causing the receiving water exceedance.*			
V	< AB 411 or Basin Plan	> 95-percentile	1. Conduct IC/ID investigation in storm drain. Assign highest priority if storm drain discharges directly to receiving water.
			2. Eliminate sources as appropriate. Assess the success of IC/ID investigation by monitoring at BF.
			3. If IC/ID does not identify source(s), implement BMPs and monitor at BF to assess BMP effectiveness
Notes: *The analytical results do not indicate that the storm drain is causing a bacterial exceedance in the receiving water. However, the storm drain discharge is highly contaminated (> 95 percentile observation) and it should be investigated as soon as practicable. If the storm drain flow discharges directly to the receiving water the investigation should be assigned highest priority. Additional paired sampling during the IC/ID investigation is warranted to verify that the storm drain discharge does not contaminate the receiving water.*			

4.1 Field Observations

The Coastal Storm Drain Monitoring Workgroup has worked closely with the Copermittees' Dry Weather Monitoring Workgroup to develop consistent guidelines for collecting and recording qualitative and quantitative field observations. These data collection standards are designed to ensure that important measurements and observations are collected during all field visits. Additional required data collection includes bird and bather counts, storm drain flow measurements, and tidal information (**Figure 6**).

Copermittee staff may initiate an investigation based solely on field observations, prior to obtaining analytical results. This approach is similar to investigating a problem observed during dry weather field screening. Field staff does not need the validation of high bacteria results to pursue an immediate source investigation if observations of abnormally high flows, sewage releases, restaurant discharges, excessive foam, or other evidence of potential bacterial contamination or illicit discharge is present.

One of the most important field observations recorded during paired sampling and investigative work is whether or not the storm drain discharges directly to the corresponding receiving water. Municipal staff should also be aware of the storm drains within their jurisdiction that flow intermittently and may actually reach the receiving water for short periods of time. Field staff will record any evidence of intermittent flows and act accordingly when conducting follow up investigations. Qualitative observations of debris, trash, flow lines, or local knowledge may be helpful when assessing the threat that a storm drain poses to the receiving water.

Certain storm drains may represent a potential health risk to children because of their accessibility and tendency to pond on the beach. Staff will record observations of coastal visitors contacting storm drain discharges and will consider these special circumstances when assessing the urgency of follow up action. Receiving water exceedances and elevated bacteria levels discharging from these storm drains will be considered high priority events and aggressively investigated.

4.2 Resampling After Receiving Water Criteria Are Exceeded

The first management action to follow any exceedance of the receiving water criteria outlined in **Section 3.1.1** is prompt resampling of the paired sampling location. The resample must be collected as soon as possible after the results are received and must not be delayed until the next regularly scheduled sampling event. The Coastal Storm Drain Monitoring Workgroup believes that the follow up confirmation sample is very important tool to assess whether the initial contamination is a transient event or a chronic condition. A repeatable exceedance suggests that the problem should be considered a high priority and addressed immediately and aggressively.

The experience of Workgroup members with IC/ID investigations has shown that unless the contamination is either followed upstream immediately or confirmed by resampling, there is little chance of identifying sources. Investigating these transient discharges often leads to wasted effort that could be better used elsewhere. Nevertheless, a certain amount of judgment must be employed when interpreting the resampling results. For example, if a regularly scheduled sample exceeds the receiving water criteria and the corresponding resample is within limits, it is reasonable to attribute the initial receiving water exceedance to a transient occurrence. However, if this pattern repeats then a more detailed follow up investigation is warranted to address an intermittent discharge of bacteria from the storm drain in question.

4.3 Exceedance of 95th Percentile Storm Drain Criteria

Some storm drains may regularly exceed the 95th percentile storm drain criteria (**Region V**), despite ongoing efforts to identify and eliminate causative bacterial sources. If a chronically contaminated storm drain is already under investigation it is not necessary to immediately resample the storm drain if a high result occurs. The fact that the IC/ID investigation is underway and moving ahead is sufficient to demonstrate progress and action. In contrast, receiving water exceedances should always be resampled in a timely manner.

These chronically contaminated storm drains may be addressed using a range of investigative tools as determined by the jurisdiction until the source(s) of contamination is identified. The methods of eliminating identified discharges or the appropriateness of eliminating such discharges will be left to the discretion of the jurisdiction involved.

4.4 Program Evaluation

The Coastal Storm Drain Monitoring Workgroup will re-evaluate the Adaptive Coastal Storm Drain Monitoring Program on an ongoing basis. At a minimum, the following issues will be reviewed:

1. Changes in regulatory requirements and applicable water quality criteria for bacterial indicators.
2. Sharing of successful source identification techniques and procedures.
3. Results of other relevant bacteriological studies in local waters.

The Workgroup may also discuss necessary changes and clarifications to the program. The Copermittees will also recalculate the Sampling Frequency Reduction Criteria and 95th Percentile Storm Drain Criteria on an annual basis. These calculations should be based on the most recently tabulated year of paired sampling data.

5.0 REFERENCES

San Diego County Municipal Copermittees, 2003. San Diego County Municipal Copermittees 2001 – 2002 Urban Runoff Monitoring Report, Final Report, Attachment A, January 31, 2003.

San Diego County Municipal Copermittees, 2001. San Diego Region: Previous Monitoring and Future Recommendations, Final Report, August 20, 2001.

San Diego County Municipal Copermittees, 2001b. San Diego Stormwater Copermittees Coastal Storm Drain Outfall Monitoring Program, October 19, 2001. Revisions to August 20, 2001 Submittal.

Water Quality Control Plan for the San Diego Region (9), 1994. California Regional Water Quality Control Board, San Diego Region.

6.0 FIGURES

Figure 1:

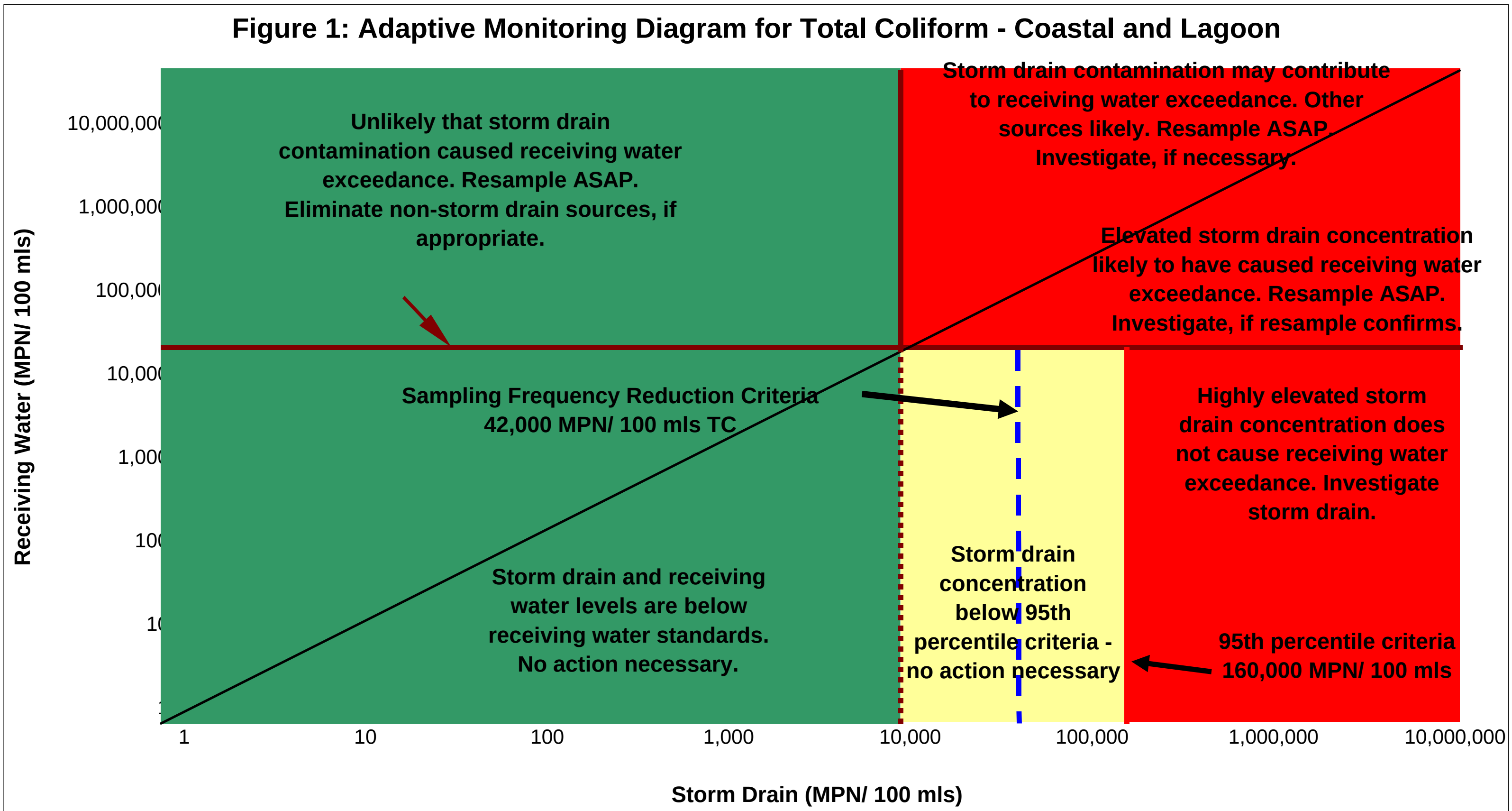

Figure 1: Adaptive Monitoring Diagram for Total Coliform - Coastal and Lagoon

Figure 2:

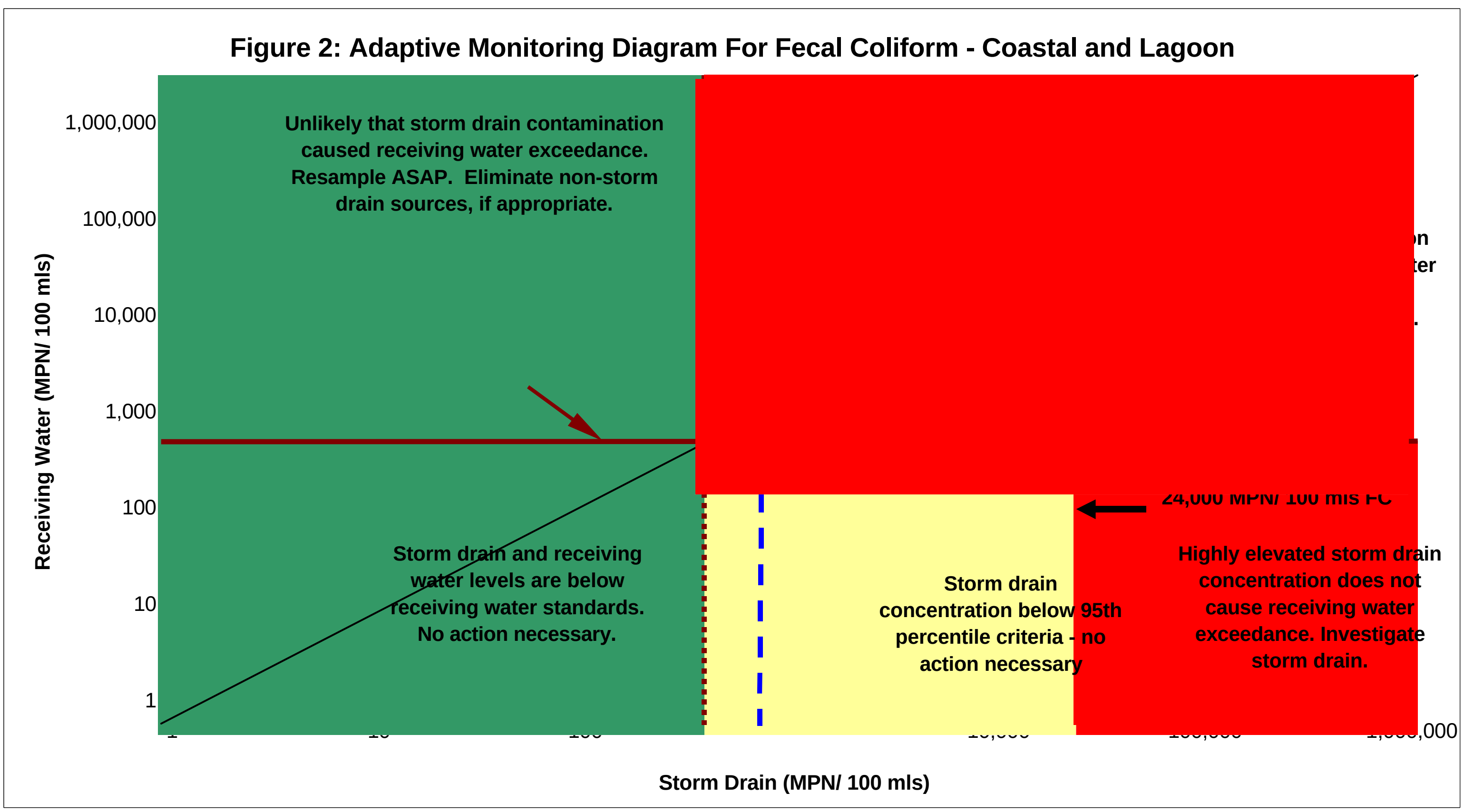

Figure 2: Adaptive Monitoring Diagram For Fecal Coliform - Coastal and Lagoon

Figure 3:

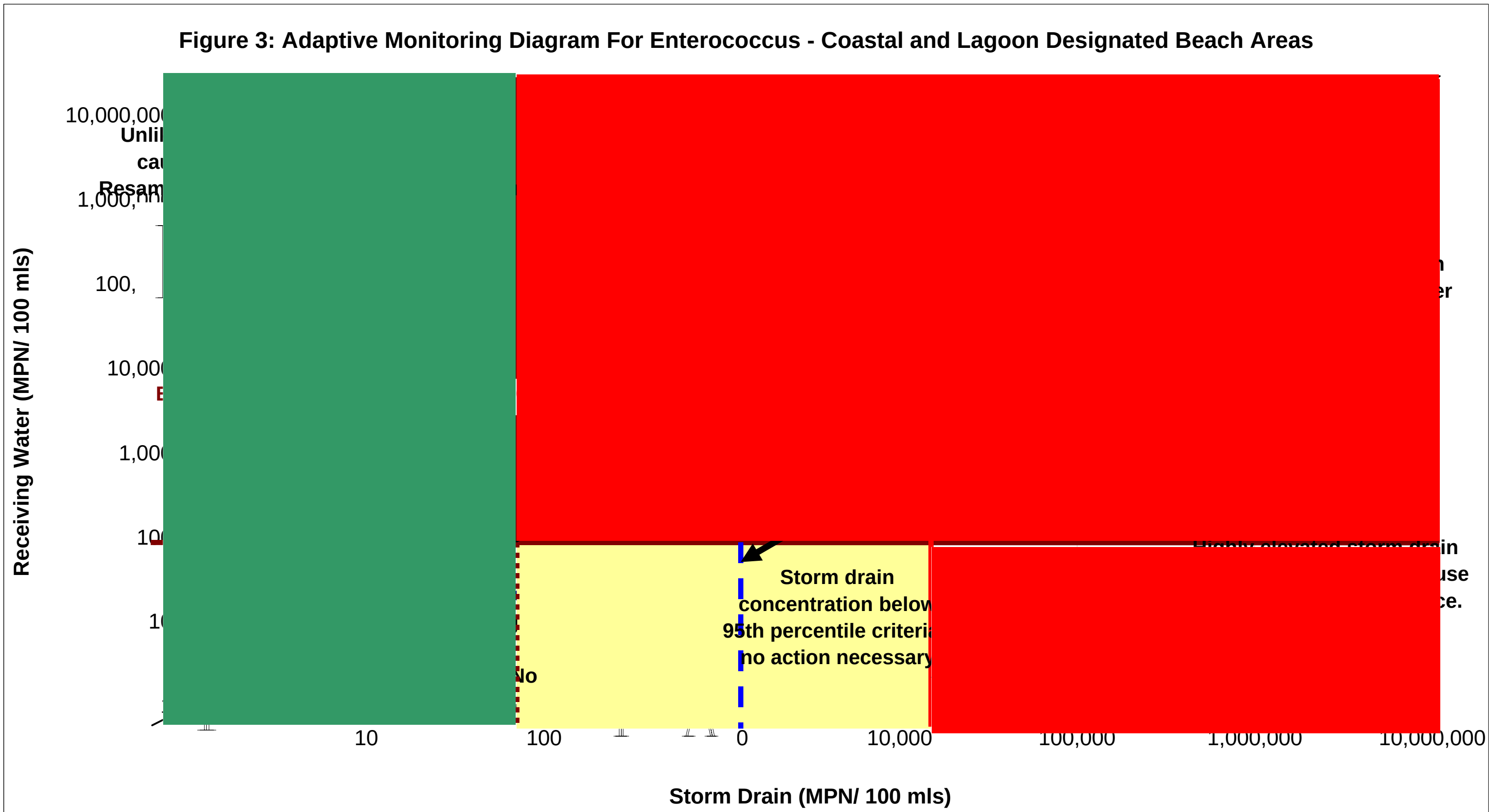

Figure 4:

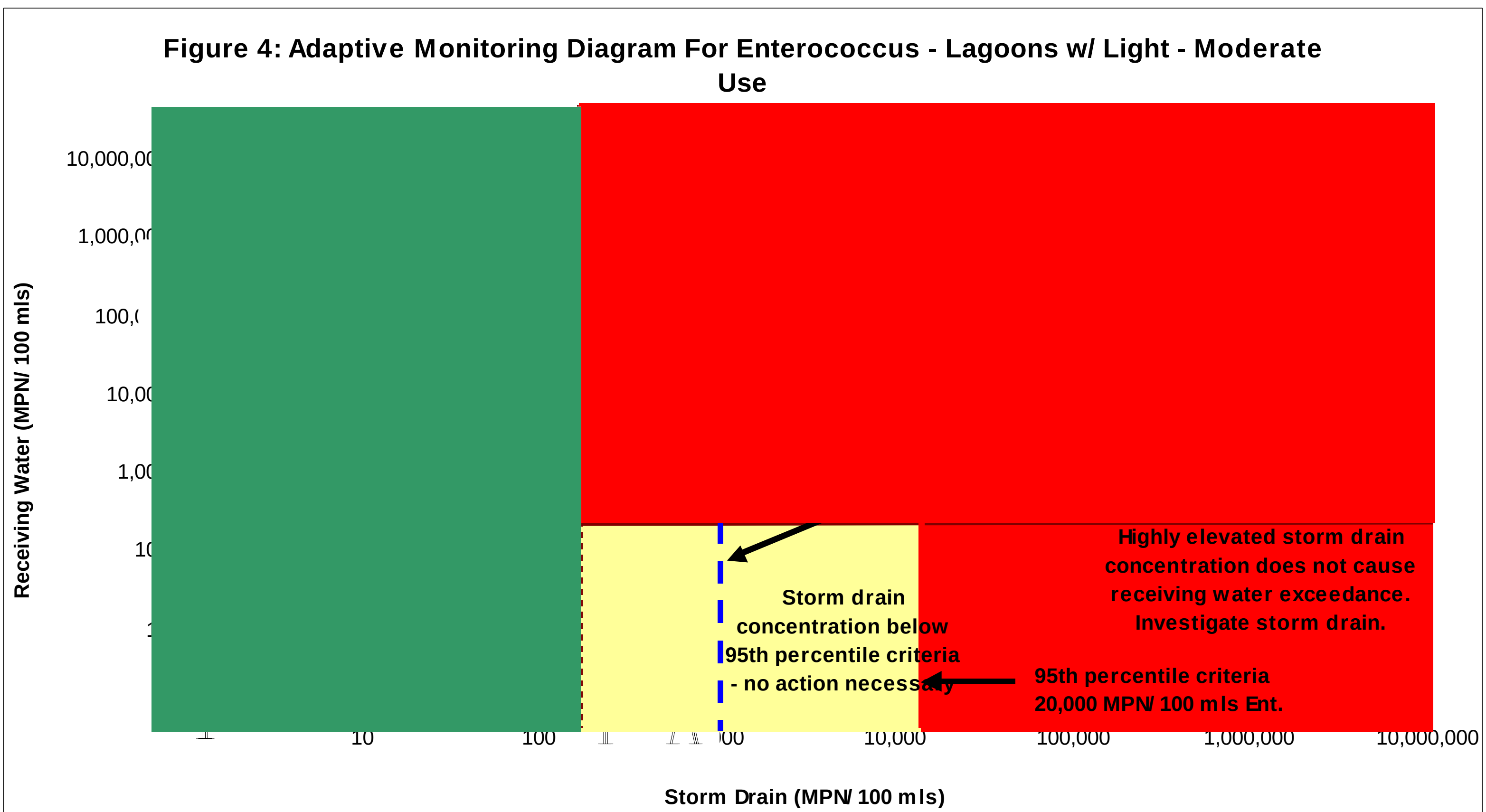

Figure 5:

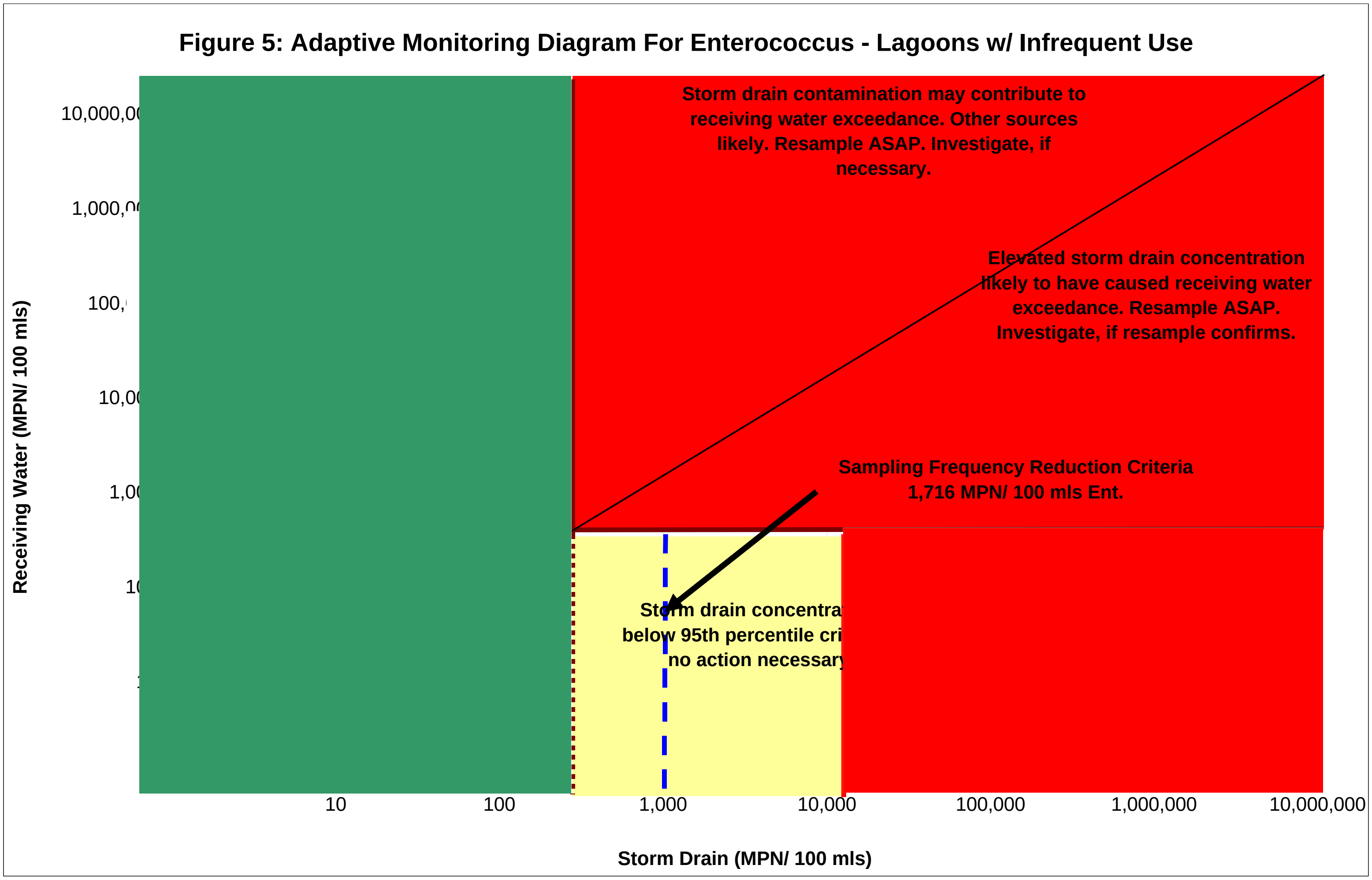
Figure 5: Adaptive Monitoring Diagram For Enterococcus - Lagoons w/ Infrequent Use
Storm drain contamination may contribute to receiving water exceedance. Other sources likely. Resample ASAP. Investigate, if necessary.
Elevated storm drain concentration likely to have caused receiving water exceedance. Resample ASAP. Investigate, if resample confirms.
Sampling Frequency Reduction Criteria 1,716 MPN/ 100 mls Ent.
Storm drain concentra
below 95th percentile cri
no action necessar
10
100
1,000
10,000
100,000
1,000,000
10,000,000
Storm Drain (MPN/ 100 mls)
Receiving Water (MPN/ 100 mls)

Figure 6:

COASTAL STORM DRAIN MONITORING

Routine Investigation **Resample** **IC/ID Follow-Up** (Select One)

GENERAL SITE DESCRIPTION

Site ID:	______	**Latitude:**	______	(GPS coordinates recorded in NAD 83 decimal deg)
Location:	______	**Longitude:**	______	
Date/Time:	______	**Watershed:**	______	(Watershed Management Area as defined in Permit)
Observer:	______	**TB Page:**	______	

Observed Land Use:	Residential	Commercial	Industrial	Agricultural	Parks	Open (check all applicable)
Conveyance Type:	Manhole	Catch Basin	Outlet	Open Channel	Other	______
Construction:	Concrete	Steel	Plastic	Natural		

ATMOSPHERIC CONDITIONS

Weather	Sunny		Partly Cloudy	Overcast	Fog	
Tide	N/A	Low	Incoming	High	Outgoing	**Tide Height:** ______ft.
Last Rain	> 72 hours		< 72 hours			
Rainfall	None		< 0.1”	> 0.1”		

BEACH APPEARANCE **Composition:** Sandy Rocky/Gravel

Clean Trash Kelp/Grasses Organic Matter Other: ____________

Potential Fecal Sources Within 75 ft.

- Wildlife: #______
- Pets: #________
- Birds: #________
- Children (Diapers): _____
- Other Bathers: #_______
- Encampments: #_______

RUNOFF CHARACTERISTICS

Odor	None	Musty	Rotten Eggs	Chemical	Sewage	Other ______
Color	None	Yellow	Brown	White	Gray	Other ______
Clarity	Clear		Slightly Cloudy	Opaque		Other ______
Floatables	None	Trash	Bubbles/Foam	Sheen	Fecal Matter	Other ______
Deposits	None	Sediment/Gravel	Fine Particulates	Stains	Oily Deposit	Other ______
Vegetation	None	Limited	Normal	Excessive		Other ______
Biology	None	Insects	Algae	Snails/Fish	Mussels/barnacles	Other ______

Flow Observed Yes No Ponded Tidal (If yes, record conductivity below)

Flow Rate:__________ gpm (*See worksheets below) ____________mS/cm or mhos/cm

Does the storm drain flow reach the Receiving Water? Yes No N/A

Evidence of Overland Flow? Yes No Irrigation Runoff Other: ________________________

Photo Taken Yes No **Picture #** __________

Stormdrain Sample Collected Yes No Bottle ID# __________ **Collection Time** ____________

Storm Drain	T. Coliform		F. Coliform		Enterococcus	

Receiving Water Sample Collected Yes No Bottle ID# __________ **Collection Time** __________

Sample Location (From storm drain, facing receiving water) 75’ Left 75’ Right Mixing Zone Other ______

Receiving Water	T. Coliform		F. Coliform		Enterococcus	

*** FLOW ESTIMATION WORKSHEETS**

Flowing Creek or Box Culvert*

Width		ft
Depth		ft
Velocity		ft/sec
Flow		gpm

Filling a Bottle or Known Volume*

Volume		mL
Time to Fill		sec
Flow		gpm

Flowing Pipe*

Diameter		ft
Depth		ft
Velocity		ft/sec
Flow		gpm

COMMENTS: ____

____

____

____

* See formula and conversions on back of page

SAE / Metric Unit Conversion

0.083 ft	=	**1 in**	=	**2.54 cm**						
0.1337 ft^3 **3,785 mL**	=	**1 gal**	= =	**128 oz** **3.785 L**		**1ft^3/S**	=	**448.8 gal/min**		
0.0078 gal	=	**1 oz**	=	**.0011 ft^3**		**1mL/S**	=	**0.0159 gal/min**		
1000 cm^3	=	**1 L**	=	**1000 mL**		**1728 in^3**	=	**1ft^3**		
		ppt	=	**g/L**						
		ppm	=	**mg/L**						
		ppb	=	**µg/L**						

Calculating the Area (a) of the Cross Section of a Circular Pipe Flowing Partially Full

D = Depth of water

a = area of water in partially filled pipe

d = diameter of the pipe

Ta = Tabulated Value

Then a = Ta*d^2

D/d	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	0.0000	0.0013	0.0037	0.0069	0.0105	0.0147	0.0192	0.0242	0.0294	0.0350
0.1	0.0409	0.0470	0.0534	0.0600	0.0668	0.0739	0.0817	0.0885	0.0951	0.1039
0.2	0.1118	0.1199	0.1281	0.1365	0.1440	0.1535	0.1623	0.1711	0.1800	0.1890
0.3	0.1982	0.2074	0.2187	0.2280	0.2355	0.2450	0.2540	0.2642	0.2780	0.2836
0.4	0.2934	0.3032	0.3130	0.3220	0.3328	0.3428	0.3527	0.3627	0.3727	0.3827
0.5	0.3980	0.4030	0.4130	0.4230	0.4330	0.4430	0.4520	0.4620	0.4720	0.4820
0.6	0.4920	0.5020	0.5120	0.5210	0.5310	0.5400	0.5500	0.5590	0.5690	0.5780
0.7	0.5870	0.5960	0.6050	0.6140	0.6230	0.6320	0.6400	0.6490	0.6570	0.6660
0.8	0.6740	0.6810	0.6890	0.6970	0.7040	0.7120	0.7190	0.7250	0.7320	0.7360
0.9	0.7450	0.7500	0.7560	0.7610	0.7660	0.7710	0.7750	0.7790	0.7820	0.7840

AREA x VELOCITY (CREEK/CHANNEL METHOD)

1. Measure the width, depth, and velocity of the water.
2. Convert each value to a common unit (i.e. all measurements converted to cm, ft, or in.)
3. Multiply the width * depth * velocity to determine flow.
4. Multiply the flow by 0.8 for creek measurements –or-- 0.9 for concrete channel measurements to account for channel roughness.
5. The results if measured in
   - Ft = Ft^3/sec
   - cm = cm^3/sec (mL/sec)
   - in = in^3/sec
6. Convert to desired value.

<u>TIME REQUIRED TO FILL A KNOWN VOLUME</u> (FILL A BOTTLE METHOD)

1. Determine volume/capacity of the sample bottle.
2. Measure time required to fill the bottle.
3. Divide time by seconds
4. Flow will be determined by initial volume units:
   - mL/s
   - oz/s
5. Convert to desired value

AREA x VELOCITY (PARTIALLY FILLED PIPE)

1. All measurement must be converted to a common unit before calculation (ft, in, or cm).
2. Let D = water depth
3. Let d = *inside* pipe diameter
4. Calculate D/d
5. Find the tabulated (Ta) value on the partially filled pipe formula chart above using the D/d value. (i.e. if D/d = 0.263 then Ta . 0.1623)
6. Find the area using the formula a = Ta*d^2.
7. Multiply area (a) by the water velocity.
8. Convert to desired value