ASBS Concept Monitoring Design
Draft – 19 December 2007

Introduction

The coastal environment of California is an important ecological and economic resource. It is home to diverse and abundant marine life and has some of the richest habitats on earth including forests of the giant kelp, *Macrocystis pyrifera.* The State Water Resources Control Board (SWRCB) has created 34 Areas of Biological Significance (ASBS) in order to preserve and protect these especially valuable biological communities.

California's coasts are also a repository for waste discharges from the State's ever-increasing population. Treated municipal and industrial wastewaters, urban runoff, and power generating station discharges all represent a number of risks to aquatic life from human activities. As a result, the SWRCB, in the California Ocean Plan, has prohibited the discharge of waste to ASBS. All ASBS are State Water Quality Protection Areas that require special protection under state law.

Despite the prohibition against waste discharges to ASBS, a recent survey of ASBS has observed approximately 1,658 outfalls (SCCWRP 2003). As a result, the SWRCB has initiated regulatory actions, establishing special protections through the Ocean Plan's exception process. The intent of these regulatory actions is to maintain natural water quality of the ocean receiving water in the ASBS.

One large problem faced by both ASBS dischargers and regulators is a lack of information. The lack of information falls into at least three categories. First, it is uncertain what constitutes natural water quality. Second, it is uncertain which discharges exceed natural water quality limits. Finally, it is uncertain what the extent and magnitude of natural water quality impacts are on a statewide basis.

In response to the need for additional information, the SRWCB is working with ASBS dischargers to collaboratively conduct a statewide ASBS monitoring program. The goal of this monitoring program is to answer three questions:

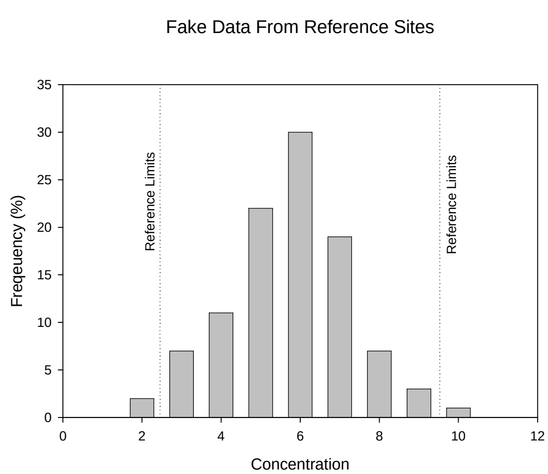
1) What is the range of natural water quality at reference locations?
2) How does water quality along ASBS coastline compare to the natural water quality at reference locations?
3) How does the extent of natural quality compare among ASBS with or without discharges?

Conceptual Approach

The conceptual study design is an integrated targeted and probabilistic survey of water chemistry and biological conditions in receiving waters along the coastline of California. A targeted design would be used for defining natural water at reference sites because significant effort will be required to establish criteria for reference locations. A targeted design would also be used for comparing individual ASBS to natural water quality for examining discharge specific impacts. The probabilistic design would be used for the third question as it pertains to ASBS as a whole. In all designs, samples for water chemistry will be collected during or immediately following wet weather. The biological samples should be collected during a preselected index period.

A series of four analytical steps will be required to answer the monitoring questions. These include: 1) providing information used to define natural water quality; 2) compare ASBS to natural water quality limits; 3) assess percent of shoreline-miles in ASBS that exceed natural water quality for chemistry; and 4) assess percent of shoreline-miles in ASBS that exceed natural water quality for biology. The first step is to generate information to help define natural water quality. In conjunction with the Natural Water Quality Committee[1], natural water quality will be defined as the ambient water quality in the vicinity of reference watersheds. A statistical approach (i.e., tolerance limits, reference envelope, population intervals, etc.) from this distribution of ambient water quality near reference watersheds will be used to define natural (See example Fig 1).

Fig 1. Developing a definition of natural water quality.

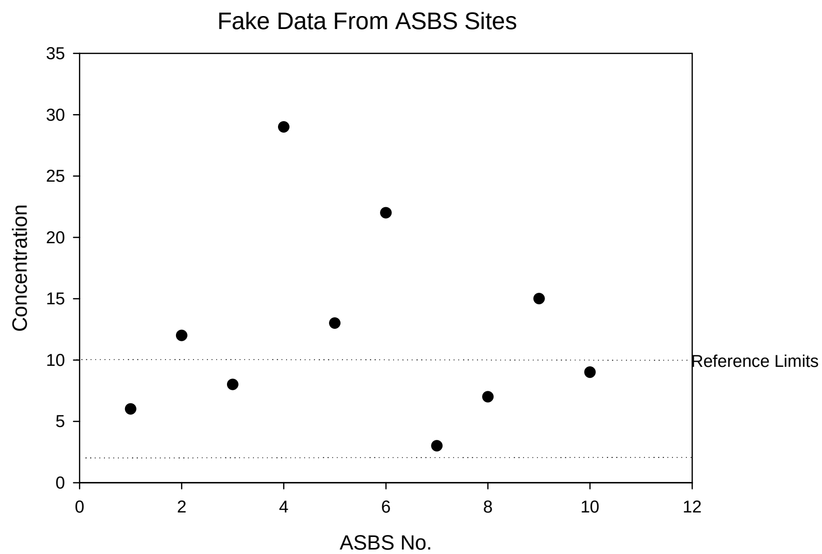


The second analytical step is to compare ASBS to natural water quality limits (Question 2). This can be done by simply comparing receiving water concentrations within individual ASBS to our definition of natural water quality (Fig 2). Maps are also convenient data analysis tools for stakeholders. The goal of this monitoring is to sample

[1] The ASBS Natural Water Committee is a team of scientists commissioned by the State Water Resources Control Board.

at locations in the immediate vicinity of the discharge to determine if natural water quality limits are exceeded in the presumed location of greatest impact.

Fig 2. Comparing ASBS water quality to natural



The third analytical step is an assessment of percent of shoreline-miles in ASBS that exceed natural water quality (Fig 3). If ASBS with and without discharges were stratified, then a comparison among the two would be useful. This would take into account discharges outside of the ASBS that are impacting water quality inside the ASBS (such as a large river plume from upcoast or downcoast). A variation on the design would be to assess the magnitude of impact for discharges in ASBS. This could be accomplished by designing a gradient approach into the sample frame (Fig 4). In this way, the targeted sampling in question 2 could be integrated into question 3.

Fig 3. Extent of impact at ASBS

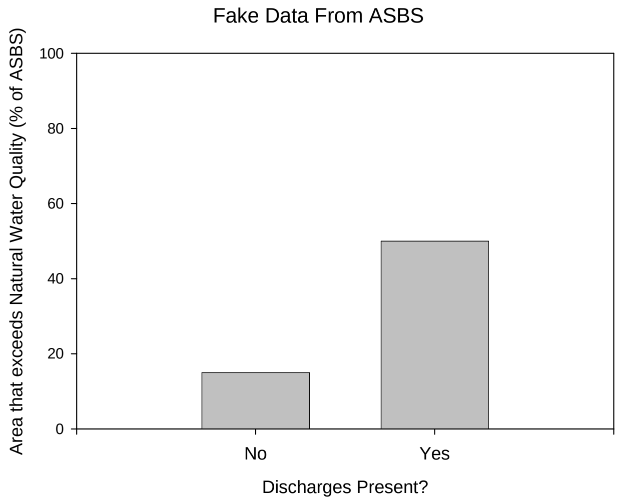
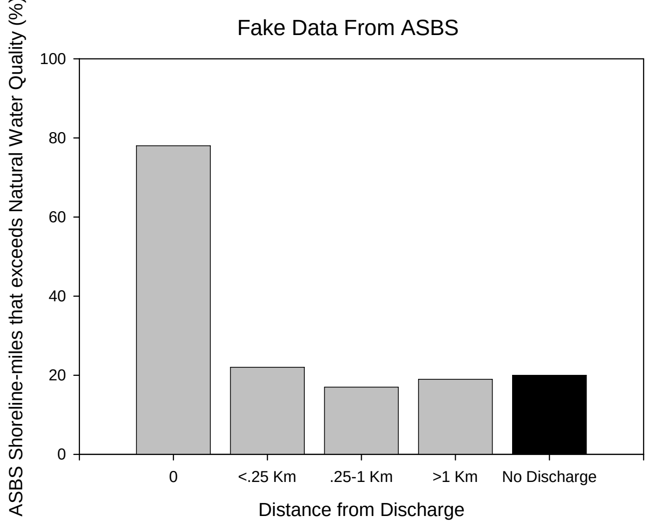


Fig 4. Comparison of impacts at different distances from discharges at ASBS.



The fourth analytical step is for assessment of biological monitoring. The biological monitoring component could take on several design elements, which are probably best conceptualized by habitat. However, the focus of this design is on the rocky intertidal habitat. A sampling design to address this could be very similar to the chemistry design (except for rocky shoreline only). The analysis would also look similar (substitute concentration on the y-axis for biodiversity or other biological endpoint on Fig 2). Percent of shoreline miles could also be estimated (similar to Fig 3). Comparisons between chemistry and biological responses could be conducted, such as frequency of cooccurrence, correlations, or regressions. Additional designs could be created for rocky- and soft-bottom subtidal habitats if sufficient interest and resources allow.

Specific Approach

Site Selection

Since there is little or no historic water quality data available at ASBS sites prior to anthropogenic discharges, reference sites will be selected that will be used to determine natural water quality and natural condition of marine life. The following primary criteria were established for reference sites:

- Located at the mouths of watersheds with limited anthropogenic influences and with no offshore discharges in the vicinity. Limited anthropogenic influence is defined as a minimum of 95% open space. Preferably, the few anthropogenic sources in a reference watershed will be well attenuated (e.g., natural space buffers between a highway and the high tide line).
- There should be no 303(d) listed waterbodies either in the reference watershed or in the coastal zone.

There are additional secondary criteria that are deemed important, but may not lead to complete exclusion:

- A range of reference watershed sizes that are inclusive of the ranges observed in watersheds that discharge to ASBS.
- A range of reference watershed geologies that are inclusive of the geologies observed in watersheds that discharge to ASBS
- A range of reference beach substrate that includes sand, cobble, and rock.
- Reference watersheds that include channel island and mainland sites.

(Insert GIS maps here….)

Sample Size and Storm Selection

A total of five sample events will be collected during the wet season (Table 1). The goal will be to capture a range of storm event types including one large and one small event early in the wet season and another large and small event late in the wet season. Large storm events will be defined as those events greater than the long-term average (at least 10 years) at the closest rain gage. Small storms will be defined as those less than the long-term average. Early season storm events are defined as those before January 1st. Late season storm events are defined as those after January 1st. This will help to assess the impact of non-storm flows. In addition to the four storm events, there will be one more sample event during the winter season. This event should occur in between storm events, but while the creek or stream is still flowing. Storm event sampling must be done less than 24 hours after the cessation of rainfall. Targeting nonstorm flows in the late season will help maximize the potential

Table 1. Matrix of storm event sampling.

Precipitation	**Early Season** (< Jan 1)	**Late Season** (> Jan 1)
Small storm (< long term average)	X	X
Large storm (> long term average)	X	X
No rainfall (flow between storms)		X

Target Analytes

The target analytes for this program focus on constituents that have natural and anthropogenic sources. Nine different analyte classes are targeted for analysis including:

- salinity
- total suspended solids (TSS)
- total and dissolved organic carbon
- total and dissolved trace metals
- nutrients (N, P)
- polynuclear aromatic hydrocarbons (PAHs)
- chlorinated and organophosphorus pesticides
- dioxin
- toxicity

Salinity and TSS are not necessarily toxic, but can serve as excellent markers of the stormwater plume as the turbid freshwater runoff mixes with ambient seawater. Total organic carbon has natural sources such as terrestrial debris including vegetation. Because of its relatively high concentrations in runoff, total organic carbon is also a potential marker of the plume. There are also potential anthropogenic sources such as oil, grease, or gasoline spilled on roadways. Dissolved organic carbon, which also has natural and anthropogenic sources, can serve as a sequestering agent binding trace metals and reducing their bioavailability. Trace metals are a natural component of the earth's crust and can be found in varying quantities in every geological formation. Anthropogenic sources such as tire and break wear debris are also commonly found in urban stormwater runoff. While the total fraction is what's required for comparison to Ocean Plan thresholds, dissolved trace metals are what's considered bioavailable to marine life. It is also this bioavailable dissolved fraction that can potentially bind with dissolved organic carbon. PAHs have natural sources such as plants waxes or can be generated during wildfires. However, PAHs are abundant in fuel and are a common signature of combustion byproducts from vehicular traffic. Most pesticides, including dioxin, are synthetic chemicals and by definition are man-made. However, the ubiquity of many persistent organic pesticides has led to their worldwide distribution including such remote areas as the Antarctic. We will attempt to measure these compounds to observe their distribution in ASBS. Toxicity serves a dual function. First toxicity is a tool to check for unmeasured constituents that could result in marine life impacts. Second, toxicity serves as a negative control reinforcing our selection of reference locations.

Sampling Protocols
Sampling will performed from shore (grab samples) in the surf zone at the mouth of a reference watershed stream (point zero). Additional options still under consideration are:

- comparison with offshore samples immediately outside of the surfzone, if resources allow
- several grab samples collected over the length of a storm to determine intra storm variability, if resources, logistics and safety allow
- comparison with discharge samples

Leverage Against Existing Programs

Bioaccumulation

Bioaccumulation is a preferred indicator because it provides a measure of biological exposure. For ASBS, bioaccumulation information is going to be collected in collaboration with NOAA's Status and Trends Program using mussels. Coordination with NOAA's status and trends program allows not only for information in ASBS, but also a comparison with samples taken in other locations throughout California, other locations throughout the country, and with samples taken over the last two decades.

Add in detail about NS&T methods…..

Rocky Subtidal

Biological assemblage data is a desirable indicator because it can provide information on potential impacts to the beneficial use trying to be protected; marine life. However, obtaining these data are difficult both in terms collection and interpretation. As a result, this program will collaborate with the Southern California Bight 2008 Regional Monitoring Program (Bight'08). Bight'08 will be conducting surveys of biological assemblages in rocky subtidal habitats from 2 to 30 m depth from Pt Conception to the US-Mexico international border. Coordination with Bight'08 allows for information in

ASBS, but also a comparison with samples taken in other locations throughout southern California.

Add in detail about Bight'08 methods…..

Timeline

This project will take at least 24 months to complete (Table 2). The first task is planning, which includes tasks such as this conceptual workplan. The second task is a pilot study that will be used to test potential approaches, methods, and new technologies or address unknown questions. The third task will be sampling. Sampling will be conducted during the last quarter of 2008 and first quarter of 2009 concurrent with the wet season. Lab analysis will be completed within one quarter of the last sample event. Reporting will be completed by the end of the 2009 calendar year. Reporting will include a final assessment report as well as a compiled database with metadata.

Table 2. Timeline for project activities.

Task	2008				2009			
	1st Qtr	2nd Qtr	3rd Qtr	4th Qtr	1st Qtr	2nd Qtr	3rd Qtr	4th Qtr
Planning								
Pilot								
Sampling								
Lab Analysis								
Reporting								