

SECTION 6

Water Quality Monitoring Data Summary

In 2004, King County collected water column, sediment, butter clams, and the green alga *Ulva spp.* for a variety of analyses. Table 6-1 provides a summary of the matrices and parameters analyzed in 2004. As stated in Section 2, the monitoring program contains elements of baseline sampling to assess background conditions (ambient monitoring) and also sampling to assess conditions around King County’s marine outfalls (point source monitoring).

Table 6-1. Summary of Data Collected in 2004

Matrix	Number of stations	Frequency collected	Parameters analyzed
Water			
Offshore	11	Monthly	Fecal coliform, enterococci, temperature, salinity, diss. oxygen, turbidity, nutrients, plant pigments, suspended solids, and photosynthetically active radiation
Beach	8	Monthly	Fecal coliform, enterococci, temperature, salinity, and nutrients
	15	Monthly	Fecal coliform, enterococci, and temperature
Sediment			
Offshore	7	Once	Total solids, organic carbon, total sulfide, ammonia, grain size, 16 metals, chlorinated pesticides/PCBs, semi-volatile organics (includes PAHs), and butyltins
Beach	5	Once	Total solids, organic carbon, grain size, 14 metals, chlorinated pesticides/PCBs, and semi-volatile organics (includes PAHs)
Butter clam tissue			
	7	Once	Total solids, percent lipids, 14 metals, chlorinated pesticides/PCBs, and semi-volatile organics (includes PAHs)
<i>Ulva spp.</i> Tissue			
	8	Once	Total solids, 14 metals

A summary of data findings for 2004 is provided below for each matrix monitored, and also a summary of data trends over time if applicable.

6.1 Water Column

Fecal Indicator Bacteria

- Offshore sites met standards for fecal coliform bacteria, with the exception of Elliott Bay.

- A fecal contamination problem at Constellation Park, Alki Beach was identified. Possible cause includes station proximity to an identified freshwater source, which was not known previously.
- Statistical tests indicate that fecal coliform pollution at most beach stations has improved since 1997, but may be related to climate conditions and annual precipitation patterns.
- There was no difference between fecal coliform levels at outfall stations as compared to ambient stations.
- The beach stations located near Duwamish head and West Seattle on the eastern shoreline had the lowest fecal coliform levels.
- There appeared to be a relationship between rainfall and high fecal coliform counts at beach stations when at least 0.5 inches of rain fell preceding the day of sample collection.

Temperature

- Offshore water surface temperatures in 2004 peaked during July and August and reached minimum values in February.
- A seasonal thermocline developed at offshore stations in April and May and broke down in September in 2004.
- Statistically significant increasing trends in temperature over a 18-year period were detected off Point Jefferson (station KSBP01) in the Central Basin, at all depths analyzed.
- Statistically significant increasing trends in temperature over a 20-year period were identified at 13 beach stations.

Salinity and Density

- Offshore seasonal variations in salinity and density are apparent throughout the water column with minimums observed in winter and spring at the surface due to contributions from freshwater sources, and maximums seen from August to December.
- The cycle of coastal upwelling along the outer Pacific coast is seen as a deep, salty signal in late summer and fall of each year.
- No statistically significant trends in salinity were observed at KSBP01 over a 20-year period.
- Beach salinities varied spatially due to freshwater inputs.
- Statistically significant increasing trends in salinity were identified at Alki Point and Fauntleroy Cove.
- A high degree of water column stratification was observed in the summer of 2004.

Dissolved Oxygen

- Maximums in dissolved oxygen correspond with maximums in chlorophyll-*a* concentration, temporally and spatially, in the upper 35 meters of the water column.
- Seasonal variations throughout the water column indicate the entrance of low-oxygenated Pacific Ocean water and consumption of oxygen by bacterial respiration in the deep basin

over late summer and fall, with production of oxygen through primary production near and at the surface during late spring and summer.

- For most of the year at all stations, dissolved oxygen concentrations were above 5.0 mg/L. Many of the values below 5.0 mg/L were observed in Elliott Bay in late fall.
- Statistically significant decreasing trends in dissolved oxygen were observed at all depths analyzed at KSBP01 over an 18-year period.

Transparency and Light Intensity

- Seasonally, Secchi transparency was highest in fall and winter and lowest in spring and summer.
- In general, low Secchi depths occurred during periods of high chlorophyll-*a* values indicating that phytoplankton biomass contributes significantly to the decrease of transparency in central Puget Sound.
- Light attenuation is highly variable throughout the year and between locations and is affected by primary productivity rates.

Nutrients

- Seasonal variations in nitrate+nitrite concentrations in the photic zone correspond to phytoplankton production in the water column.
- Ammonia concentrations near treatment plant outfalls were consistently higher than ambient sites, however, were well below the water quality standard.
- Nitrate+nitrite concentrations in beach waters were slightly higher than those at offshore stations.
- Silica concentrations in offshore waters were highest in Elliott Bay during winter months and lowest in surface waters during phytoplankton blooms.
- Offshore waters are not silica limited as indicated by nitrogen: silica ratios throughout the year.
- The highest silica values at beach stations were noted for those sites near a freshwater input, and a source of silica.
- No statistically significant trends were found in dissolved silica at KSBP01 over an 18-year period.
- Statistically significant increasing trends in nitrate+nitrite were detected at KSBP01 over an 18-year period at all depths except for 1 meter.

6.2 Sediment

- Fourteen of the 16 metals and 30 of the 102 trace organic compounds analyzed were detected in the 7 samples collected in 2004. Detected concentrations of all Sediment Management Standards regulated parameters were below their respective chemical criteria with the exception of mercury.

- The mercury concentration of 0.511 mg/Kg DW, detected at the Seattle Waterfront Station (LTDF01), exceeded the Sediment Quality Standard (SQS) chemical criterion of 0.49 mg/Kg DW. Mercury concentrations detected between 1995 and 2004 at Station LTDF01 have all been above the SQS, however, seem to show a possible downward trend. Mercury concentrations at Station LTDF01 are significantly higher than at the other three Elliott Bay stations and also higher than those found in the three Central Basin stations.
- PCBs have never been detected at the three Central Basin stations and have been detected sporadically at three of the Elliott Bay stations. PCBs have been detected consistently at the Seattle Waterfront Station, with the total PCB concentration in 1996 exceeding the SQS chemical criterion. All total PCB concentrations detected at the Seattle Waterfront station subsequent to 1996, however, have been below the SQS chemical criterion.
- Metals and organics analyzed in beach sediment samples in 2004 were well below their respective chemical criteria. Metals and organics generally do not accumulate in very sandy sediments, which represents the substrate at all beach monitoring stations.
- A total of 81 beach sediment samples were collected from 10 monitoring stations between 1995 and 2004 for analysis of 14 metals. Metals concentrations showed little variation, either spatially or temporally.
- A total of 102 beach sediment samples were collected from 33 monitoring stations between 1995 and 2004 for analysis of trace organic compounds. These samples were collected both as part of the routine sediment monitoring program as well as the County's response to a fuel spill near Dalco Passage in 2004. All detected concentrations of trace organic compounds were well below their respective SMS chemical criteria. The most commonly detected trace organic compounds over the 10-year monitoring period were PAHs. PAH concentrations have shown some spatial variation, generally attributable to the proximity of a particular monitoring station to creosote-treated pilings or stormwater input.

6.3 Shellfish

- Arsenic concentrations in butter clams were higher than those found in corresponding beach sediments.
- Arsenic levels in butter clams at Station MTL03 (Normandy Park) in 2004 were significantly higher than those found at other stations, however, the highest value was well below the level of concern recommended by the FDA.
- Overall metal concentrations found in butter clams were low when compared to regulatory limits and other studies in both 2004 and in previous years.
- Other than benzoic acid, a metabolic byproduct, organic compounds are rarely detected.

6.4 Macroalgae

- Arsenic levels in macroalgae increased from 2000-2003 and decreased in 2004.

- Aluminum, arsenic, cadmium, copper, iron, lead, manganese, nickel, and zinc were detected in all samples collected in 2004.
- Selenium, beryllium, and mercury were not detected in 2004, nor in past years.
- Analysis of data between 1996 and 2004 indicated high variability in metal concentrations, with the exception of arsenic.
- An analysis of metal ratios of both macroalgae and beach sediments indicated that fine sediment particles may have adhered to macroalgae tissues and biased the metals data. The arsenic data may be less biased.

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