West Point Treatment Plant

Ongoing Marine Water Quality Monitoring

King County
Department of
Natural Resources and Parks
Water and Land Resources Division

Water Quality Report – Update April 28th, 2017

OVERVIEW

As part of a long-term program, King County monitors water quality at 12 offshore and 20 beach locations (see Figure 1) to provide an understanding of water quality within the Puget Sound Central Basin, including at all treatment plant outfalls. The West Point Treatment Plant main outfall is the site labeled KSSK02 on the map, located 3,600 ft. offshore at approximately 230-ft deep. The county maintains a long-term dataset, over 50 years at some locations, which provides insight into natural variation. This monitoring program and dataset form the basis from which water quality conditions can be assessed that may be affected by the West Point wastewater discharge during its period of reduced treatment. Most recently, the restoration of treatment facilities has progressed with the restart of the secondary treatment process through March and early April. This included improved solids removal and improved control of the disinfection process for fecal bacteria reduction.

At the offshore sampling stations, dissolved oxygen, temperature, salinity, density (calculated), chlorophyll, and light intensity and transmission are measured throughout the entire water column from surface to bottom every two weeks. Additionally, nutrients, fecal indicator bacteria (FIB), suspended solids, and chlorophyll are measured at specific depths at each site, and phytoplankton composition and abundance are assessed at a subset of sites. Beach locations are monitored monthly for nutrients, FIB, temperature, and salinity.

Additional Monitoring: During reduced treatment at the West Point plant, the sampling frequency at a subset of four offshore monitoring stations has been increased to weekly. A new site was added at the emergency bypass outfall and is also sampled weekly. This frequency and variety of biological, chemical, and physical conditions can capture some impacts on ecosystem functions. Starting on April 10th, bacteria concentrations at a subset of six beach sampling stations are monitored weekly. Starting on April 11th, a new Submersible Ultraviolet Nitrate Analyzer (SUNA) sensor was loaned to King County from the Washington State Dept. of Ecology to support additional monitoring efforts. The SUNA sensor adds rapid measurements of nitrate, and provides more information on the variability of nitrate in the water column from the surface to bottom. Preliminary nitrate data are shown in the appendix (Figures A-1 to A-5).

Overall, the County's monitoring is sufficient to evaluate the most relevant water quality conditions that have the potential to result in any acute adverse effects to Puget Sound aquatic life.

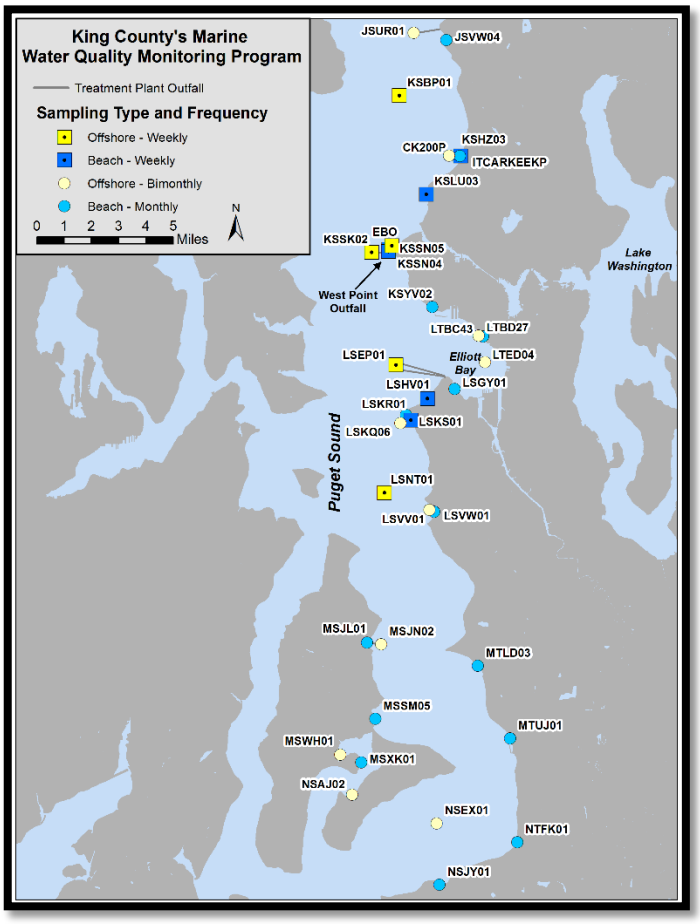

Figure 1. Map of King County's marine water quality monitoring stations.

The most recent data results available from April 3rd and 4th (offshore only) and April 10th and 11th (offshore and beaches) sampling events are summarized for three key water quality indicators below. More data results are available in the appendix.

BACTERIA

Fecal coliforms, along with *Enterococcus*, are a type of indicator bacteria that King County routinely monitors at freshwater and marine beaches, as well as offshore. These bacteria are found in the intestinal tracts and feces of humans and other warm-blooded animals, and can make their way into our waterways through various pathways. Although these bacteria are typically not pathogenic, they are important to monitor as an indicator that pathogens that make people sick may be present.

The State of Washington has a two part standard to protect human primary contact recreation and shellfish consumption in marine waters. The standard includes a 14 colony forming unit (CFU)/100 mL geometric mean average and a 43 CFU/100 mL peak concentration (the peak concentration is not to be exceeded in greater than 10% of samples). These standards are used for comparing data from multiple samples at a station rather than a single sample.

Comparing recent individual samples to the bacteria standards indicates that concentrations of fecal coliforms from surface waters at most offshore stations, including KSSK02 off of West Point, were at or below the geometric mean standard and all were below the peak standard during both sampling events in early April (Figure 2).

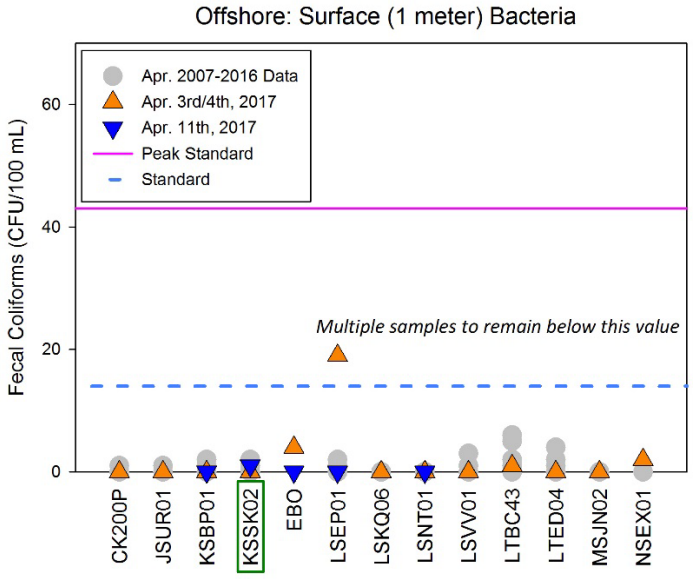

Figure 2. Bacteria levels of single samples collected near surface (1 meter) at a offshore stations in Central Puget Sound during the early April 2017 sampling events are illustrated with historical bacteria levels. Note: station KSSK02, West Point outfall, highlighted.

One exception is fecal coliforms were unusually elevated near King County's South Wastewater Treatment Plant (South Plant) outfall (LSEP01) on April 4th and exceeded the geometric mean standard. The source of this spike is unclear as fecal coliform concentrations measured from South Plant treated wastewater prior to discharge were low and typical for early April. Sub-surface bacteria concentrations were all below state water quality criteria as well. For data on subsurface and *Enterococcus* bacteria concentrations, see Appendix Table A-2.

Concentrations of bacteria at all beach monitoring stations, including near the West Point outfall, were similar to typical April concentrations. All beach bacteria concentrations were well below state water quality standards (see Appendix Figure A-6 and Table A-2).

NUTRIENTS

Nutrients, such as nitrogen compounds (ammonia and nitrate) and orthophosphate, are essential elements for aquatic plants and algae. Silica is a micronutrient needed by some algae and other organisms for skeletal growth. However, excess nutrients can cause a sudden increase in aquatic plants that can lead to unfavorable conditions. High ammonia concentrations can be toxic to aquatic organisms, including fish.

Most ammonia values measured across all depths in early April were low and well below the lowest (chronic) water quality criterion, which is based upon temperature, salinity, and pH factors (anticipated to be about 1.6 mg/L for April conditions). Surface ammonia levels, including at the West Point outfall, were low (Figure 3).

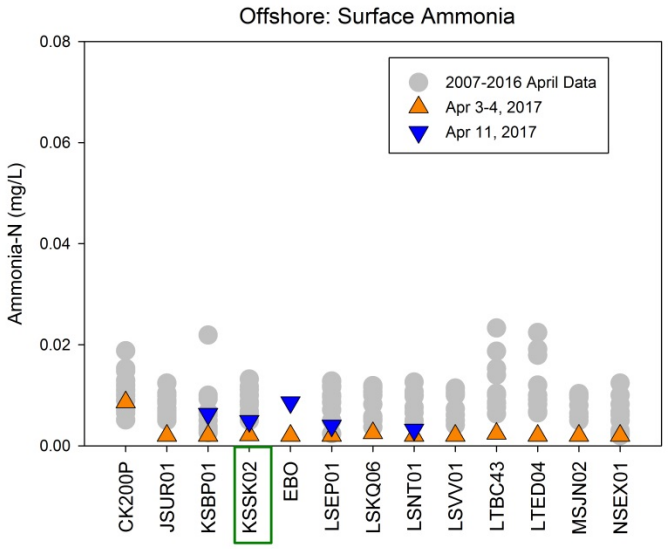

Figure 3. Ammonia levels of single samples collected near surface (1 meter) at offshore stations during the early April 2017 sampling events are shown with historical levels. Note: most April values were below detectable levels, therefore, the method detection limit value was used. Note: station KSSK02, West Point outfall, highlighted. The Emergency Bypass Station (EBO) had not been routinely sampled prior to March, so cannot be compared to prior years.

Although meeting the standard, the ammonia value at the deepest depth at the site near the South Plant outfall (LSEP01) on April 11th was higher than other stations and at the high range for historical levels (Figure 4). This higher-than-normal ammonia level may be associated with slightly higher South Plant discharge ammonia levels in April as a result of the plant treating additional solids from West Point during the restoration.

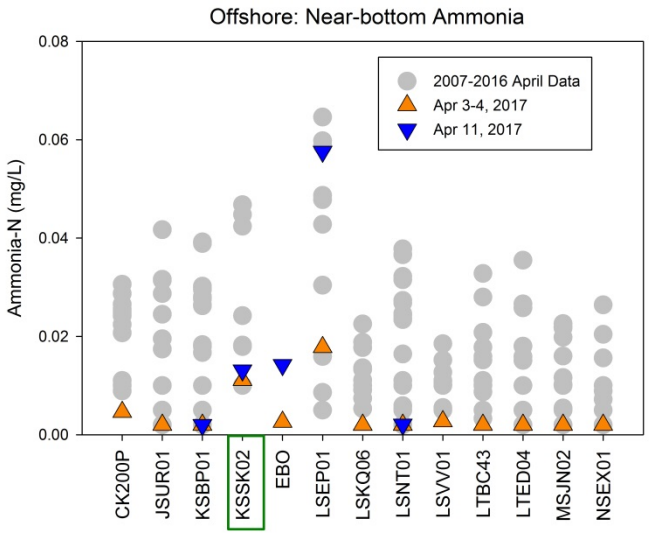

Figure 4. Ammonia levels for the deepest depth at each offshore station during the early April 2017 sampling events are shown with historical concentrations. Note: most April values were below detectable levels, therefore, the method detection limit value was used. Detection limits have changed from 0.01 to the current 0.005 mg/L with laboratory advancements. Note: station KSSK02, West Point outfall, highlighted.

Nitrate + nitrite, orthophosphate, and silica at offshore stations for all depths were within normal seasonal ranges for all sites. The results of the first use of the SUNA sensor (shown in the appendix) indicate patterns in nitrate concentrations that are comparable to water samples, and better capture the minimum nitrate levels. The lower nitrate, silica, and orthophosphate values in surface waters compared to previous weeks indicate the start of the spring phytoplankton (microalgae) bloom.

DISSOLVED OXYGEN

Dissolved oxygen is important for marine life, and can control the presence or absence of species. Aquatic life requires a certain amount of oxygen dissolved in the water to live, and different species have different tolerances. Waters with high concentrations of dissolved oxygen are considered healthy for sustaining many species.

Plants and algae produce oxygen during the day. In deep waters, it can be too dark for plant growth and is separated from surface mixing with the air, so processes like decomposition by bacteria can result in low dissolved oxygen. Human inputs of organic materials and decay of sinking algae at depth may decrease oxygen levels. In addition, deep waters from the Pacific Ocean enter Puget Sound at depth and can result in naturally occurring low dissolved oxygen levels.

The State of Washington dissolved oxygen standard to protect aquatic life depends on the designated waterbody use. For Central Puget Sound, the one-day minimum dissolved oxygen standard is 7 mg/L for waters of extraordinary quality. At the dissolved oxygen level of 5 mg/L, biological stress can be induced on marine life. Dissolved oxygen levels below 3 mg/L can displace or potentially result in death of some marine species.

The most recent offshore near-bottom data from early April show typical oxygen conditions for sites across Central Puget Sound, and all sites show oxygen levels above the state water quality standard (Figure 5).

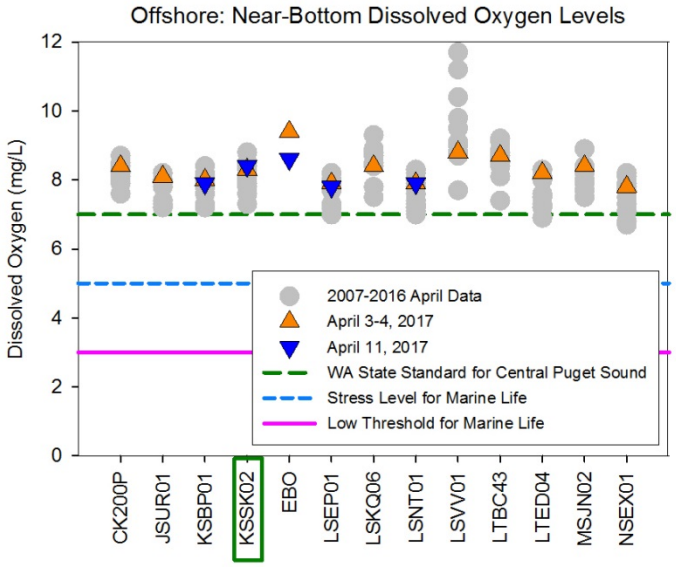

Figure 5. In Puget Sound, the lowest dissolved oxygen levels are typically found near the seafloor, so near-bottom oxygen levels are shown by site on top of historical oxygen conditions for the first half of April. Note: station KSSK02, West Point outfall, highlighted in green. The EBO site, Emergency Bypass Outfall, was added recently, so no historical data are available.

In addition, higher near-bottom concentrations of oxygen are observed at shallow sites, such as at the Emergency Bypass Outfall (EBO) and near the Fauntleroy ferry terminal (LSVV01). These sites are less than 15 meters deep where light can penetrate to the bottom, and algae can grow and produce oxygen. Higher oxygen conditions reflect spring growth of phytoplankton and other algae, which is typical for April.

SUMMARY

Water sample results collected between April 3rd-4th and April 10th-11th, 2017 are summarized below. Additional results are provided in the Appendix.

- Concentrations of fecal coliforms at offshore stations were at or below the geometric mean reference water quality standards and well below the peak standard for April, with the exception of the site near King County's South Plant outfall.
- Bacteria concentrations near the South Plant outfall were elevated and above the geometric mean standard. The cause of the high bacteria observed at this station is unknown, but does not appear to be due to the operation of the treatment plant.
- Beach bacteria concentrations were within the range of expected values for the month of April and none exceeded state water quality criteria.
- Surface ammonia levels were low at all sites.
- Although meeting the water quality criterion, the ammonia value at the deepest sampling depth was highest at the site near the South Plant outfall on April 11th and at the high end of the historical range. The results may reflect additional ammonia discharged from South Plant as a result of processing solids from West Point while restoration is underway at West Point.
- All other nutrients, which include nitrate/nitrite, orthophosphate, and silica results, were within expected values for offshore waters. The lower nutrient levels at the surface compared to the past few weeks indicate the start of the spring bloom of phytoplankton (microalgae).
- New nitrate sensor technology (Figure 6) was added on April 11th, and better captures the minimum and maximum nitrate levels in the water from the surface to bottom.
- Near-bottom dissolved oxygen values were at healthy levels and all sites were above the state water quality standard.
- Dissolved oxygen levels were higher at shallow locations where light can reach and aquatic plants and algae can grow and produce oxygen. This reflects typical conditions for April and spring growth.

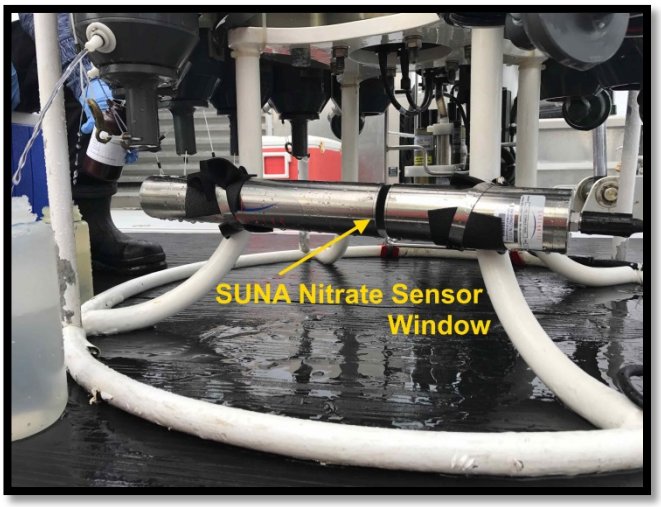

Figure 6. Washington State Dept. of Ecology's Submersible Ultraviolet Nitrate Analyzer (SUNA) pictured above attached to King County's water sample carousel frame. This new instrument rapidly measures changes in nitrate as the carousel is lowered through the water, and was recently added to provide more information on nutrient dynamics.

FOR MORE INFORMATION

- **King County Marine & Sediment Assessment Group:** http://green2.kingcounty.gov/marine
- **Download Water Column Data:** http://green2.kingcounty.gov/marine/Download
- **West Point Marine Monitoring:** http://www.kingcounty.gov/depts/dnrp/wtd/system/west/west-point-restoration/marine-monitoring.aspx
- **Wastewater Incidence Response:** http://kingcounty.gov/depts/dnrp/wtd/response/incident-response.aspx

Appendix: April, Part 1, Marine Water Quality Data

The following graphs and tables display data from the April 3rd/4th and April 11th marine monitoring events. General water quality data are shown by site. For the offshore sites, parameters shown include water temperature, salinity, dissolved oxygen, relative chlorophyll fluorescence, total suspended solids, percent light transmission, nutrient concentrations, and fecal indicator bacteria. Nutrients include nitrate and nitrite, ammonia, orthophosphate, and silica water samples. Starting April 11th, nitrate concentrations were also measured rapidly through the water column from top to bottom with the new Submersible Ultraviolet Nitrate Analyzer (SUNA). For this report, SUNA nitrate data are preliminary, and subsequent review may result in revisions to final data. For the beach sites sampled in the second half of the month, parameters shown include fecal indicator bacteria, nitrate and nitrite, and ammonia. For this sampling event, only bacteria data were collected for the weekly beach sites. For more explanation of parameters and sampling methods, see the marine monitoring program website: http://green2.kingcounty.gov/marine/

Description of station locators from the map on the first page (Figure 1) are given in the table below. Data from a subset of stations from the routine monitoring program are displayed to provide context for data collected near the West Point Treatment Plant and Treatment Plant Outfall. For more details on all monitoring stations, see the marine monitoring plan.

Table A-1. Sampling stations that include data in this summary report. The following data graphs and tables in the Appendix are from the stations highlighted in blue.

Offshore Stations

Locator	Description
JSUR01	Brightwater Treatment Plant Outfall
KSBP01	Point Jefferson
CK200P	Carkeek CSO Treatment Plant Outfall
KSSK02	West Point Treatment Plant Outfall
EBO	Emergency Bypass Outfall for West Point
LTBC43	Elliott West CSO Treatment Plant Outfall
LTED04	Central Elliott Bay
LTXQ01	Henderson/MLK CSO Treatment Plant Outfall
LSEP01	South Treatment Plant Outfall
LSKQ06	Alki CSO Treatment Plant Outfall
LSNT01	Mid-Passage between Fauntleroy/Vashon
LSVV01	Barton CSO Outfall
MSJN02	Vashon Treatment Plant Outfall
NSEX01	East Passage

Beach Stations

Locator	Description
ITCARKEEKP	Carkeek Park
KSLU03	Golden Gardens
KSSN04	West Point North, Discovery Park
KSSN05	West Point South, Discovery Park
LSHV01	Alki Beach
LSKS01	Constellation Park

Offshore Water Quality: KSSK02 – West Point Outfall

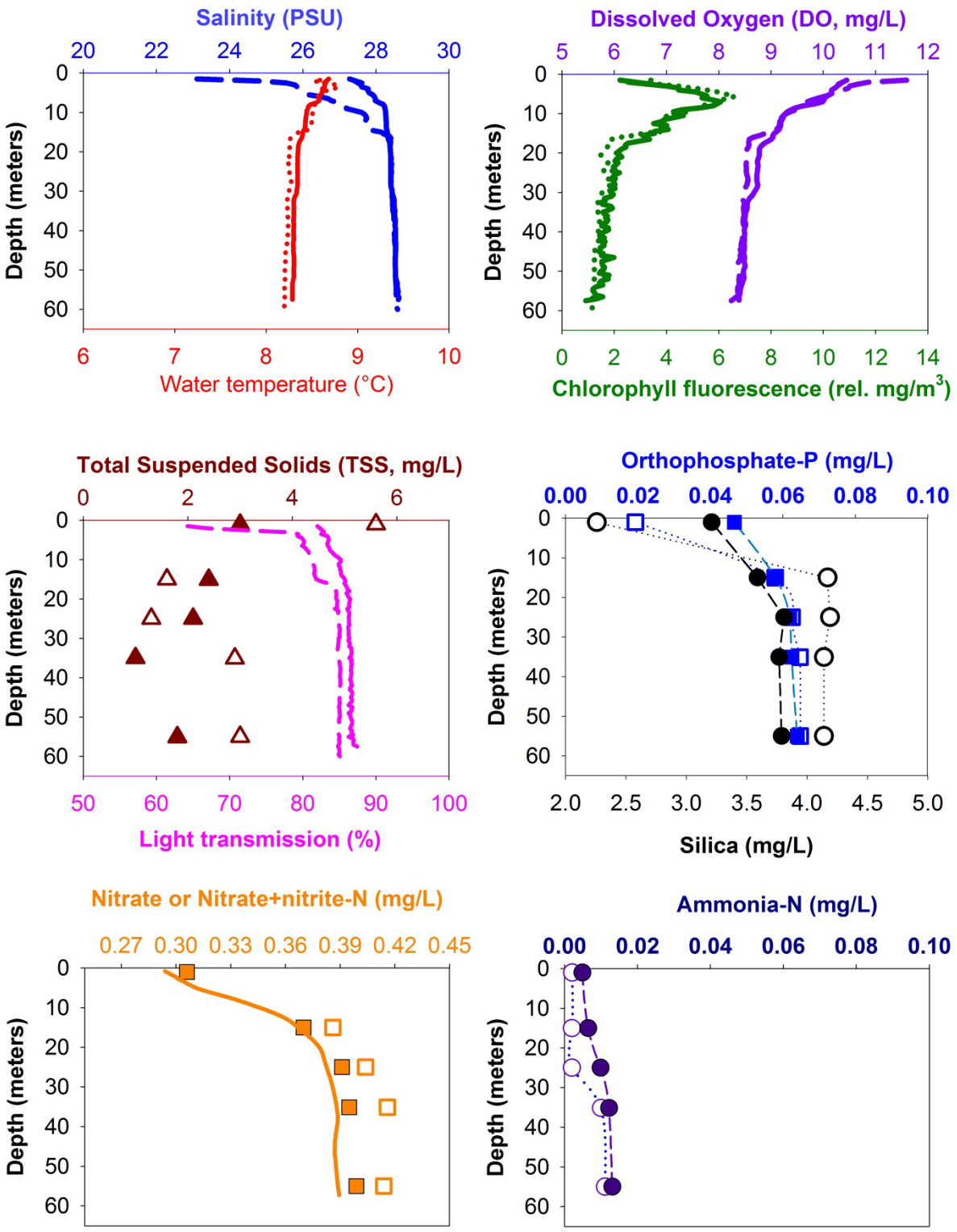

Figure A-1. Offshore water column profile (lines) and discrete water quality results (points) from the first two weeks of April 2017 at the West Point Outfall. Dashed lines and open symbols represent the April 3rd/4th sampling event and solid lines and solid symbols represent the April 11th sampling event. For the plot on the lower left, preliminary averaged SUNA nitrate data are shown with the solid line, while the water sample results (squares) are combined nitrate and nitrite concentrations.

Offshore Water Quality: KSBP01 – Point Jefferson

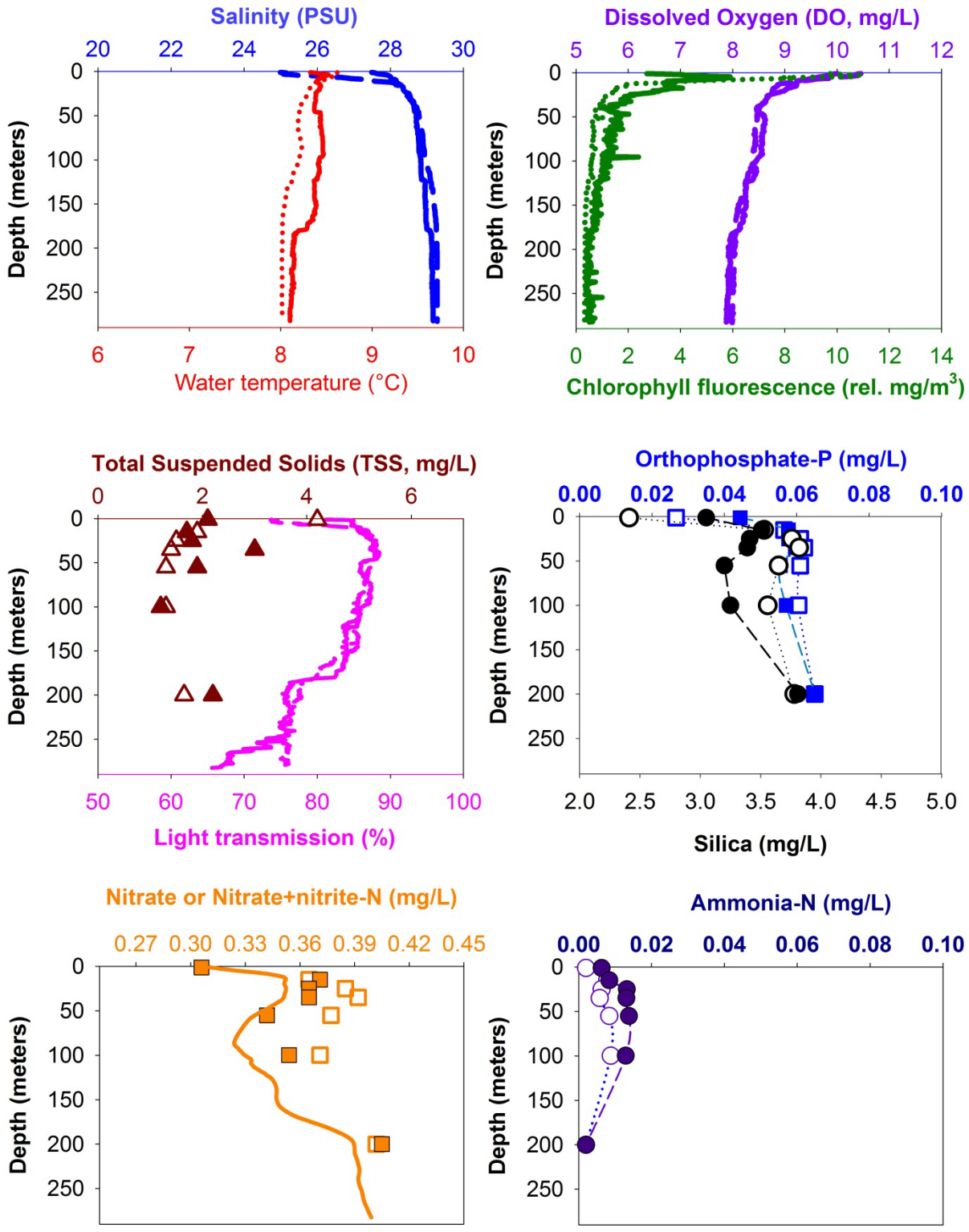

Figure A-2. Offshore water column profile (lines) and discrete water quality results (points) from the first two weeks of April 2017 at Point Jefferson. Dashed lines and open symbols represent the April 3rd/4th sampling event and solid lines and solid symbols represent the April 11th sampling event. For the plot on the lower left, preliminary averaged SUNA nitrate data are shown with the solid line, while the water sample results (squares) are combined nitrate and nitrite concentrations.

Offshore Water Quality: EBO – Emergency Bypass Outfall

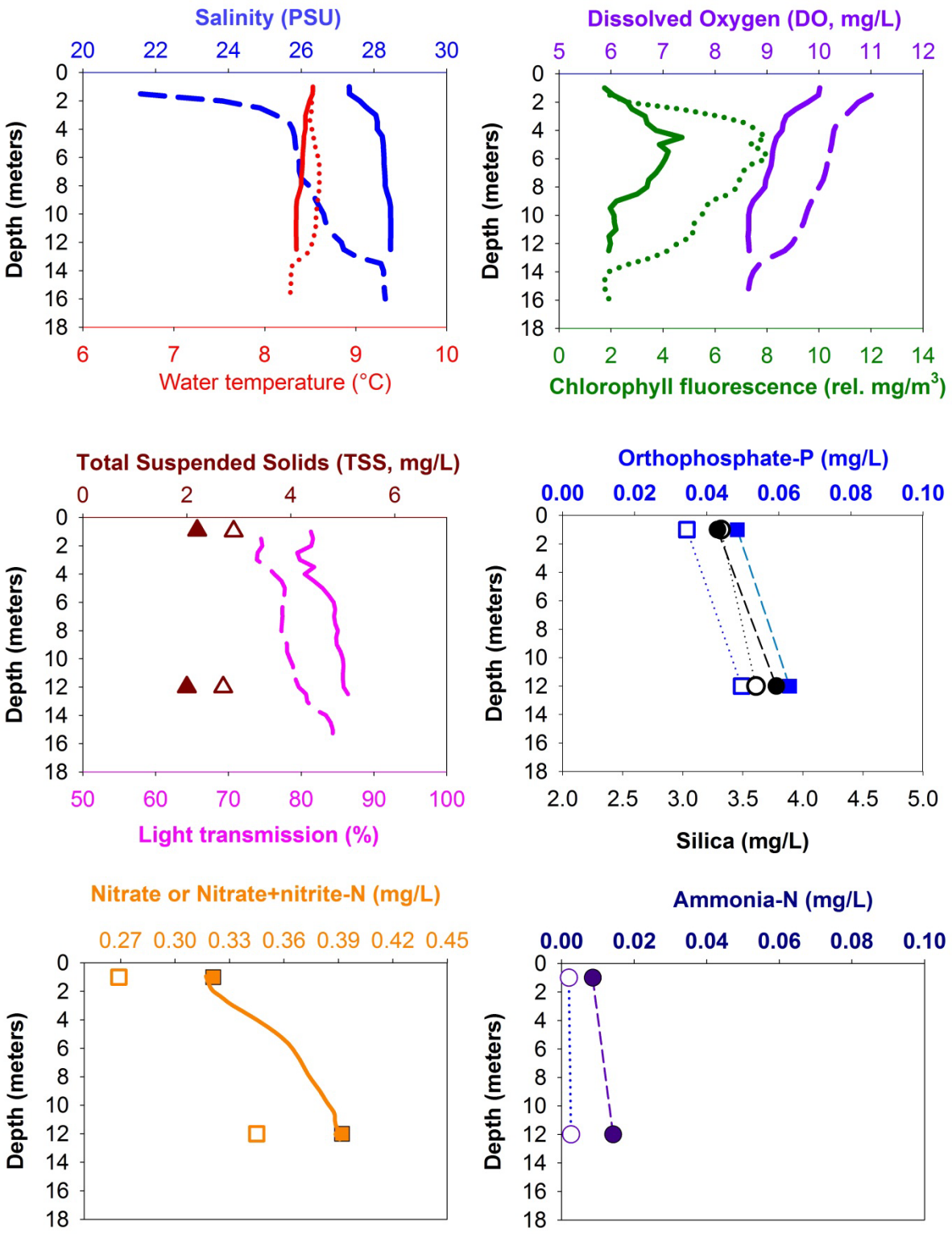

Figure A-3. Offshore water column profile (lines) and discrete water quality results (points) from the first two weeks of April 2017 at West Point's emergency bypass outfall. Dashed lines and open symbols represent the April 3rd/4th sampling event and solid lines and solid symbols represent the April 11th sampling event. For the plot on the lower left, preliminary averaged SUNA nitrate data are shown with the solid line, while the water sample results (squares) are combined nitrate and nitrite concentrations.

Offshore Water Quality: LSEP01 – South Plant Outfall

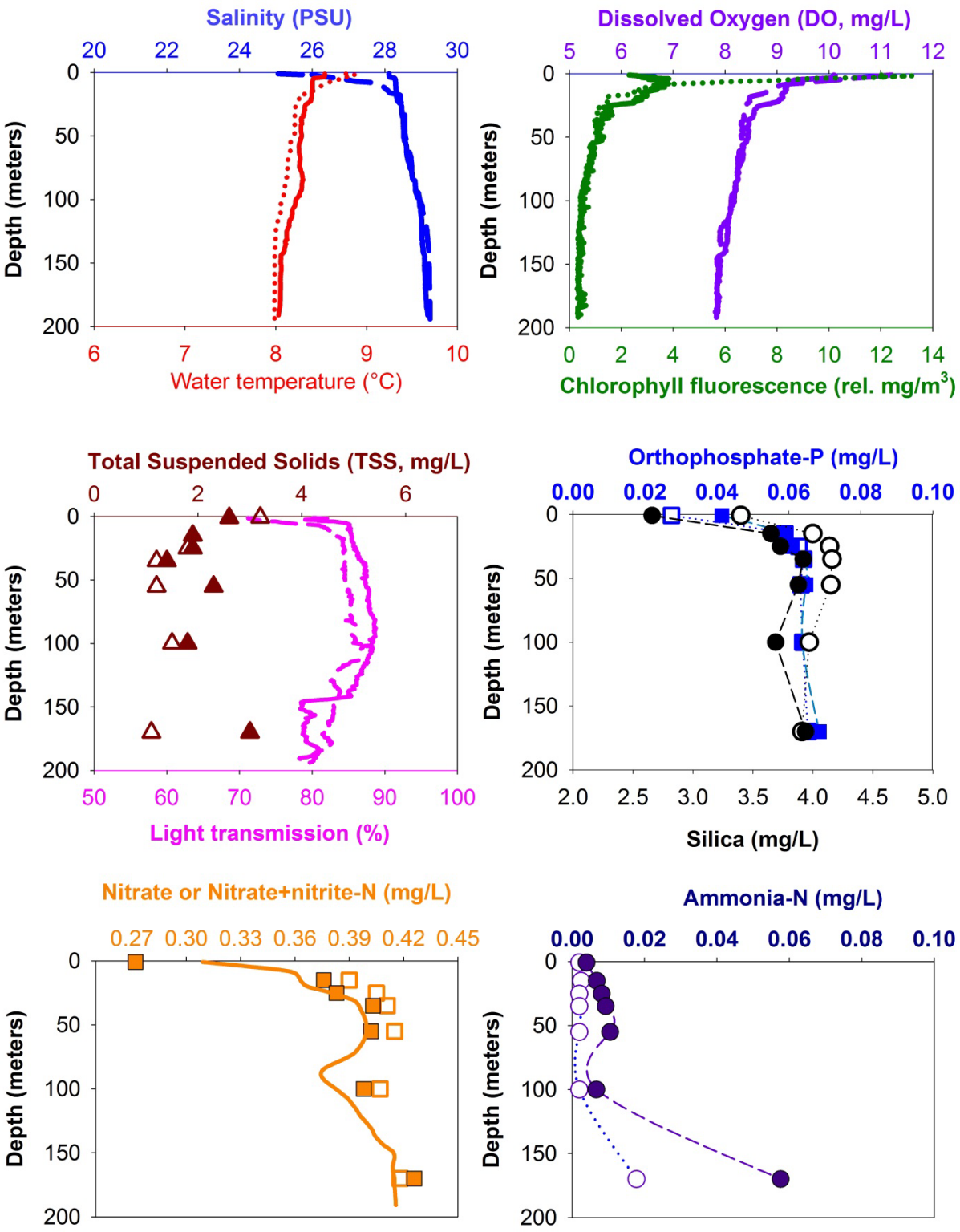

Figure A-4. Offshore water column profile (lines) and discrete water quality results (points) from the first two weeks of April 2017 at the South Plant Outfall. Dashed lines and open symbols represent the April 3rd/4th sampling event and solid lines and solid symbols represent the April 11th sampling event. For the plot on the lower left, preliminary averaged SUNA nitrate data are shown with the solid line, while the water sample results (squares) are combined nitrate and nitrite concentrations.

Offshore Water Quality: LSNT01 – Point Williams

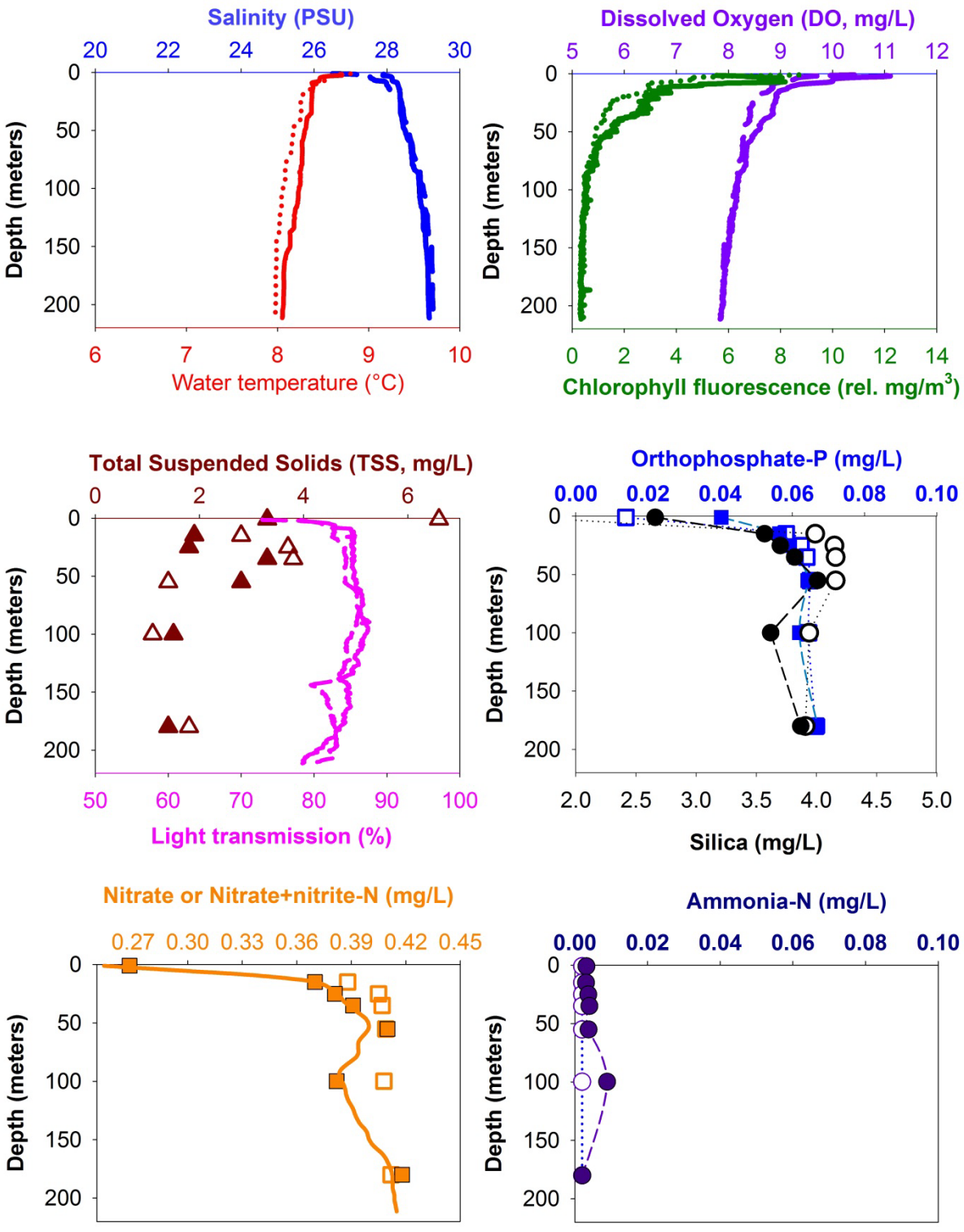

Figure A-5. Offshore water column profile (lines) and discrete water quality results (points) from the first two weeks of April 2017 at Point Williams. Dashed lines and open symbols represent the April 3rd/4th sampling event and solid lines and solid symbols represent the April 11th sampling event. For the plot on the lower left, preliminary averaged SUNA nitrate data are shown with the solid line, while the water sample results (squares) are combined nitrate and nitrite concentrations.

Fecal Indicator Bacteria: Offshore and Beaches

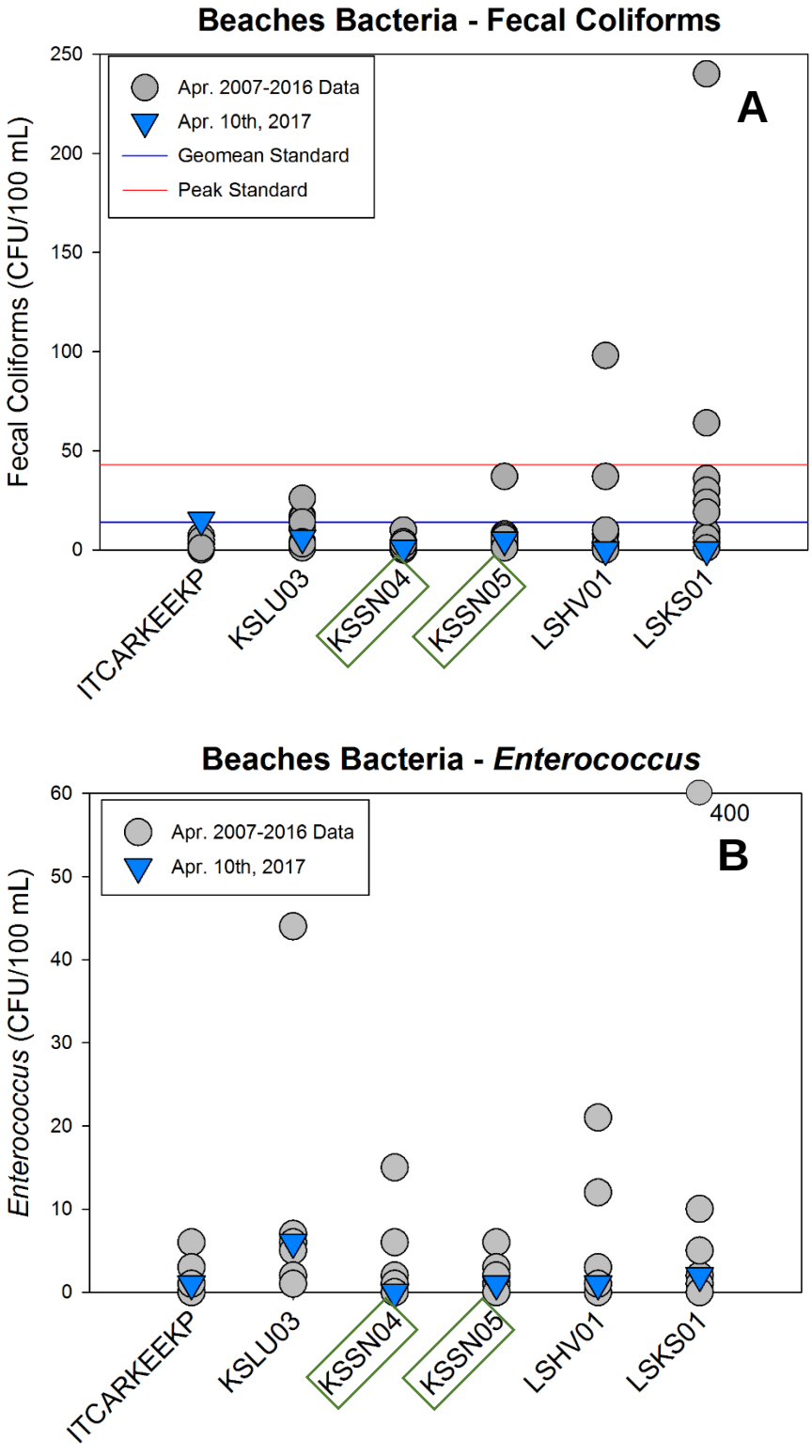

Figure A-6. Bacteria concentrations (**A.** Fecal coliforms; **B.** *Enterococcus*) of single samples collected at a subset of beach stations during the April 10th, 2017 sampling event are illustrated with historical bacteria concentrations. Although not appropriate to compare single samples to Washington State water quality criteria, the state's geometric mean and peak standards for primary contact recreational and shellfish harvesting uses are provided for reference. Note: KSSN04 and KSSN05, near the West Point outfall are highlighted.

Table A-2. Offshore fecal indicator bacteria concentrations at select monitoring sites during the first two weeks of April, 2017. Stations near West Point Treatment Plant Outfall are highlighted.

	Station	Date	Depth (m)	Fecal Coliform (CFU/100 mL)	*Enterococcus* (CFU/100 mL)
Offshore	KSBP01	4/3/2017	1.1	0	0
	KSSK02	4/3/2017	1.0	0	0
	KSSK02	4/3/2017	25	0	0
	KSSK02	4/3/2017	55	0	2
	EBO	4/3/2017	1.0	4	0
	EBO	4/3/2017	12	0	1
	LSEP01	4/4/2017	0.8	19	6
	LSEP01	4/4/2017	100	0	1
	LSEP01	4/4/2017	170	1	1
	LSNT01	4/4/2017	1	0	0
	KSBP01	4/11/2017	1	0	0
	KSSK02	4/11/2017	0.9	1	0
	KSSK02	4/11/2017	12	0	2
	KSSK02	4/11/2017	1.1	0	0
	EBO	4/11/2017	25	0	2
	EBO	4/11/2017	55.1	0	1
	LSEP01	4/11/2017	1.1	0	0
	LSEP01	4/11/2017	100	0	0
	LSEP01	4/11/2017	170	0	0
	LSNT01	4/11/2017	0.9	0	0
Beaches	ITCARKEEKP	4/10/2017	--	15	1
	KSLU03	4/10/2017	--	6	6
	KSSN04	4/10/2017	--	1	0
	KSSN05	4/10/2017	--	5	1
	LSHV01	4/10/2017	--	0	1
	LSKS01	4/10/2017	--	0	2