ATTACHMENT 1

January 2021 Unpermitted Wastewater Discharge Report

August 1, 2021

I. Contents

II. Motion Text

Motion 15832 is attached as Appendix A. [1]

Section A. The executive be directed to prepare a report that documents:

1. The causes of the discharge of untreated wastewater from the West Point Treatment Plant, and overflows at the Richmond Beach, Medina and East Pine pump stations on the morning of January 13, 2021;
2. The consequences of the discharges to the Puget Sound and Lake Washington ecosystems;
3. The potential impact to water-adjacent landowners and visitors to water-adjacent facilities;
4. The potential impacts to those utilizing the fishery and shellfish resources;
5. A summary of emergency bypass discharges at the West Point Treatment Plant and pump station overflows since February 2017, including causes, volumes and responses; and
6. The recent and projected future pattern and frequency of storms of a magnitude that can be expected to generate wastewater volumes that exceed the stated processing capacity of the West Point Treatment Plant and system pump stations.

Section B. The report shall also recommend a strategy to limit or eliminate recurrence of the January 13 discharges and overflows of untreated wastewater, and shall provide cost estimates associated with such a strategy and make suggestions on how a partnership with the King County Flood Control District might help improve these facilities.

III. Executive Summary

On January 12th and 13th, 2021, the Puget Sound region experienced a major winter storm with high winds. Those high winds resulted in power disruptions that temporarily shut down equipment at the West Point Treatment Plant (West Point). With high flows coming into the plant and equipment impacted by power outages, the control system at West Point automatically opened the emergency bypass gate and diverted incoming untreated wastewater directly to Puget Sound. West Point's control system operated as designed to protect the plant from flooding.

The power disruptions from this winter storm also resulted in discharges from East Pine Pump Station, Richmond Beach Pump Station, and Medina Pump Station.[2] At the three pump stations, high incoming wastewater flows also quickly exceeded storage capacity and overflowed into Puget Sound and Lake Washington. Further information is available in Appendix C: After Action Report Summary.

Since West Point resumed normal operations after the flood in February 2017, the plant has experienced two emergency bypass events prior to the emergency bypass on January 13th, 2021. One of these emergency bypasses, along with the January 13th bypass, was caused by power disruptions and the other brief bypass was caused by operator error. On April 29th, 2021, West Point experienced a short emergency bypass caused by the failure of a power switch. During this same timeframe, Richmond Beach

[1] Link to Motion 15832

[2] A pump station is a facility with a large tank that collects wastewater which is then pumped from a lower to a higher elevation to convey the wastewater to a treatment facility.

Pump Station experienced three overflows and the Medina Pump Station had two overflows. The last unpermitted overflow from East Pine Pump Station occurred in 1997.

Following the January 12th and 13th, 2021 storm event, the Wastewater Treatment Division (WTD) of the Department of Natural Resources and Parks (DNRP) worked with the Science and Technical Support Section (Science) of the Water and Land Resource Division (WLRD) of DNRP to study the impacts of the wastewater discharges into Puget Sound and Lake Washington. WLRD evaluated the environmental data based on water samples collected and analyzed by King County's Environmental Laboratory. This data, in conjunction with past studies on pollution discharge environmental impacts, indicates that there will be no lasting impacts to Puget Sound or Lake Washington waters. The data also shows minimal impacts to water-adjacent property owners or facilities, or to those using fishery or shellfish harvesting resources.

The future pattern and frequency of storms can be expected to influence West Point's wastewater treatment and the volume of wastewater flows to the pump stations. Wastewater flows to West Point are controlled by its conveyance system, which diverts excess flows to wet weather facilities for treatment to avoid exceeding West Point's capacity.[3,4] However, the anticipated increase in storm frequency due to climate change could increase the frequency of the plant operating at maximum capacity. In response to, and consistent with the Strategic Climate Action Plan goal of preparing for climate change, WTD is developing methods to incorporate data on climate change rainfall impacts into wastewater facility upgrade planning.

While the four facilities that experienced unpermitted discharges on January 13th, 2021, are not in areas overseen by the King County Flood District, WTD will continue to explore opportunities for further partnership with the District.

King County is implementing several strategies to prevent future emergency bypass and overflow events. At West Point, WTD is making electrical upgrades to increase reliability, in accordance with Washington State Department of Ecology (Ecology) Administrative Order 19477 and a County emergency declaration.[5] The current cost estimate for power reliability improvements at West Point is $64.6 million. WTD is also evaluating a strategy to adjust backup power when power disruptions are anticipated throughout the conveyance system. The estimated cost for evaluating and implementing this strategy is $500,000. The WTD Capital program includes multiple upgrades to the equipment at Medina Pump Station, including a standby generator upgrade estimated at $5.2 million.

IV. Background

Department Overview

The Department of Natural Resources and Parks (DNRP) works in support of sustainable and livable communities and a clean and healthy natural environment. Its mission is to foster environmental stewardship and strengthen communities by providing regional parks; protecting the region's water, air,

[3] WTD conveyance system is a series of sewers pipelines and pump stations that carry wastewater away from homes and businesses to the treatment plant.

[4] During large rain events, wet weather facilities are designed to treat combined sewage. More information on wet weather facilities is available on the treatment facility website.

[5] The Washington State Department of Ecology press release for Administrative Order 19477 includes a link to the order. The Emergency Declaration is available on the County Council Legislation website.

land, and natural habitats; and reducing, safely disposing of, and creating resources from wastewater and solid waste.

The Wastewater Treatment Division (WTD) of DNRP protects public health and enhances the environment by collecting and treating wastewater while recycling valuable resources for the Puget Sound region.

Key Historical Context

West Point Treatment Plant

The West Point Treatment Plant (West Point) is located on Puget Sound, next to Discovery Park in Seattle, Washington. The treatment facility is part of King County's regional wastewater treatment system serving Seattle, Shoreline, the north end of Lake Washington, north King County, and a portion of Snohomish County. Wastewater flows through the facility ranges from about 90 million gallons per day (mgd) to a peak of 440 mgd.

West Point has two permitted modes of operation. The combined capacity for primary and secondary treatment is 300 mgd. [6] The facility can provide only primary treatment for flows exceeding 300 mgd and up to 440 mgd, the plant's maximum permitted capacity. During flows below 300 mgd, all flows receive the primary and secondary treatment. During high-flow events, where flows to the plant are above 300 mgd, the flows above 300 mgd only receive primary treatment.[7]

West Point uses a series of treatment processes and pump stations to move and treat flows within the plant. Two pump stations of note for the January 13th unpermitted discharge event are the Intermediate Pump Station and the Effluent Pump Station. The Intermediate Pump Station at West Point is used to move flows to a higher elevation within the plant. West Point has three pumps at their Intermediate Pump Station, with two capable of pumping West Point's flows at maximum capacity. The Effluent Pump Station at West Point pushes treated wastewater to its discharge point in Puget Sound.

During high-flow events, flows that would exceed the plant's capacity are routed to other WTD facilities, such as Elliott West Wet Weather Treatment Facility. The upstream conveyance system is designed to protect West Point from being inundated and exceeding treatment plant capacity.

On February 9th, 2017, equipment failures during a storm event caused the treatment tanks at West Point to overflow, inundating electrical and mechanical equipment. This resulted in an emergency bypass of raw and partially treated sewage into Puget Sound. Because of the equipment damage caused by the flooding, West Point operated at a reduced treatment capacity from February 10th to May 9th, 2017. By May 10th, 2017, the plant was operating with fully restored capacity and met pollutant removal requirements. Following the restart of the plant, West Point instituted new Life Safety Management procedures to ensure health and human safety and protect plant equipment and treatment processes.

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[6] In wastewater, primary treatment uses physical processes to allow solids to settle and be removed. Secondary treatment uses biological and chemical processes to further treat wastewater. More information on wastewater treatment is available on the County treatment process webpage.

[7] More information on the West Point treatment process is available at the West Point Treatment Process web page.

Richmond Beach, Medina and East Pine Pump Stations
The Richmond Beach Pump Station located at 20001 Richmond Beach Drive NW in Seattle sends flows to the Edmonds Treatment Plant under an agreement between the City of Edmonds and King County. The maximum capacity of the four pump sets at the Richmond Beach Pump Station is 10 mgd.

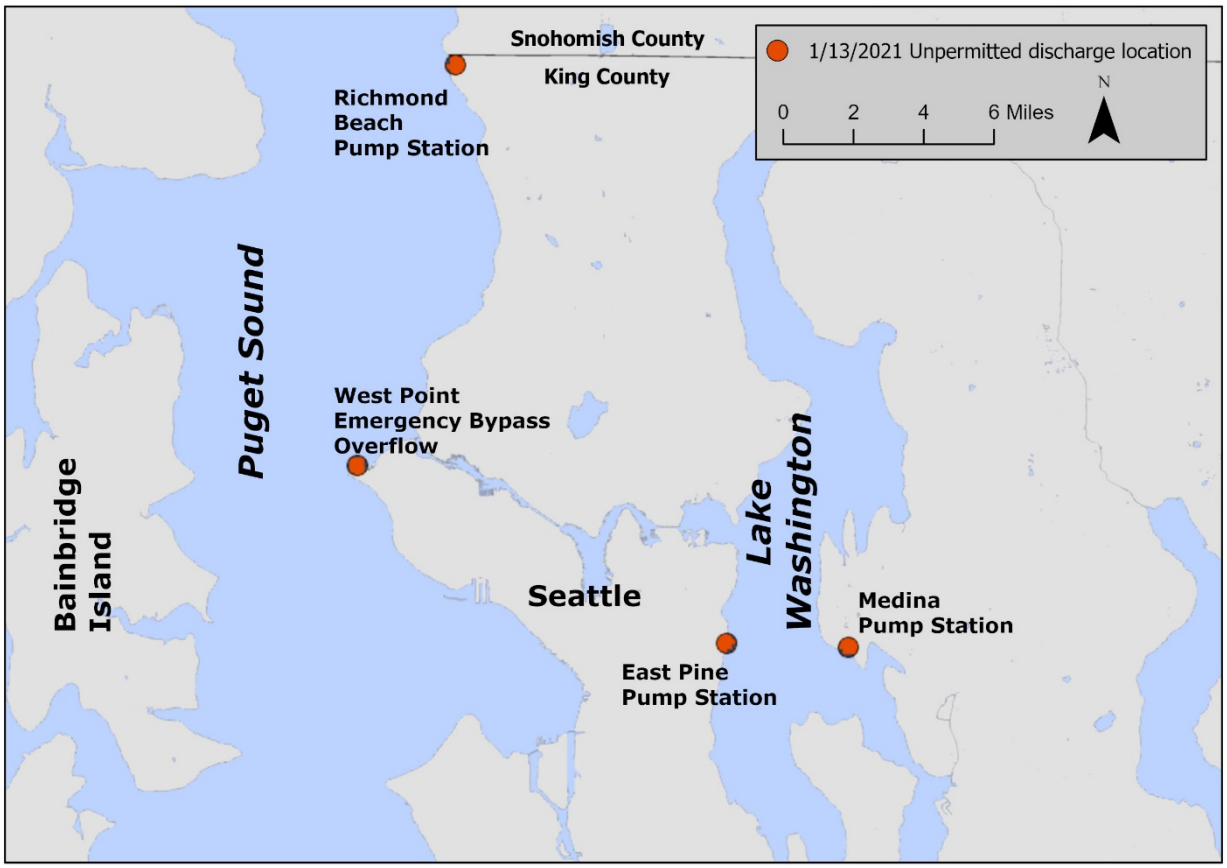
The East Pine Pump Station located in the Madrona neighborhood of Seattle on the shore of Lake Washington, sends flows from central Seattle to West Point for treatment. The capacity of East Pine Pump Station is 10 mgd.

The Medina Pump Station, located at the intersection of NE 8th Street and 81st Avenue NE in the City of Medina. It pumps flows to the Eastside Interceptor (a large sewer line), which runs south through Bellevue to King County's South Treatment Plant in Renton. The capacity of Medina Pump Station is approximately six mgd.

Key Current Context

Figure 1 below shows the four locations that experienced unpermitted discharges on January 13th, 2021.

Figure 1. Locations of Wastewater Treatment Division Unpermitted Discharges, January 13th, 2021



On January 12th and 13th, 2021, a significant winter storm hit the Seattle area with high winds, causing electrical power disruptions at several of King County's WTD facilities. These disruptions interrupted the power to the wastewater pumps at West Point and the East Pine, Richmond Beach, and Medina pump stations. As a result of the loss of power, wastewater could not be fully pumped out of the facilities and overflowed through outfalls into Puget Sound and Lake Washington.[8]

Since 2017, power disruption has resulted in several emergency bypasses and discharge of partially treated water from West Point. On February 2nd, 2021, Ecology issued a fine to King County and an administrative order prescribing actions WTD must take to meet Ecology's requirements and avoid unpermitted discharges due to power disruptions.[9] The prescribed actions include: changes to control strategy of West Point pumps; developing a strategic master plan for West Point's electrical system; and, implementing actions in the West Point strategic master plan by the end of 2025.

In February 2021, DNRP staff performed a comprehensive review of the events of January 12th and 13th, 2021. The staff interviewed operators and staff on duty during the event and conducted follow-up analysis with subject matter experts. Reconstruction and analysis of the events led the team to develop actionable recommendations designed to minimize the likelihood of future overflows and bypasses at King County WTD facilities, which are outlined in subsequent sections of this report.

On February 25th, 2021, the King County Executive signed an emergency declaration to provide West Point with high-quality, reliable power in response to increasing power disruptions. In response to the emergency declaration, the County initiated projects to ensure plant equipment continues operating normally during utility power disruptions.[10]

Report Methodology

Staff from WTD developed this report, using analysis from WLRD Science and the WTD modeling group.[11] WTD discussed strategies to eliminate recurrences with the King County Flood Control District to determine opportunities for partnership.

V. Report

The identified actionable recommendations resulting from the comprehensive staff review noted above are the basis for outflow prevention strategies outlined in this report.

A.1. The causes of the discharge of untreated wastewater from the West Point Treatment Plant, and overflows at the Richmond Beach, Medina and East Pine pump stations on the morning of January 13, 2021

The winter storm that occurred on January 12th and 13th, 2021, had winds over 30 miles per hour that caused electrical utility power disruptions at West Point, Medina Pump Station, Richmond Beach Pump Station, and East Pine Pump Station. Area rainfall of 2.3 inches on January 12th caused high flows to the facilities that continued into January 13th.

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[8] The term "outfall" refers to a discharge point where wastewater enters a sea, lake, rivers, or the ocean.
[9] The Washington State Department of Ecology press release for Administrative Order 19477 includes a link to the order.
[10] The Emergency Declaration transmittal letter is available on the County Council Legislation website.
[11] WTD modeling group uses computer hydrology and wastewater flow models to support planning and capital project delivery.

As a result of the power disruptions and high flows, untreated wastewater could not be fully pumped out of the facilities and instead was discharged into Puget Sound and Lake Washington. Table 1 and the descriptions below provide details on each facility impacted by the January 12th and 13th storm events.

Table 1. Location, Duration, Volume and Receiving Water Body for Unpermitted Discharge Events in King County, King County Wastewater Treatment Division, January 13, 2021.

Facility	Event Duration (hours)	Bypass/Overflow Quantity (gallons)	Receiving Water
West Point Treatment Plant	1.7	11,000,000	Puget Sound
Richmond Beach Pump Station	0.8	160,000	Puget Sound
East Pine Pump Station	9.0	2,200,000	Lake Washington
Medina Pump Station	1.8	86,000	Lake Washington

West Point Treatment Plant Bypass

On January 13th, West Point was operating at its maximum capacity of 440 mgd. Power disruptions to the plant caused the pumps in the Intermediate Pump Station and the Effluent Pump Station to stop. When these pumps stop there is a domino effect of automated changes to the flow pattern within the plant. During high flows, this can cause process tanks to quickly fill and possibly overflow. As a safety measure to protect staff and equipment, flows can be automatically diverted out of the plant through the emergency bypass gate and outfall into Puget Sound, bypassing all treatment to avoid flooding the plant. On January 13th, the flows were automatically diverted out of the plant through the emergency bypass gate, resulting in the discharge of approximately 11 million gallons of untreated combined wastewater and stormwater into Puget Sound over the course of 103 minutes.

Richmond Beach Pump Station Bypass

On January 12th, 2021, the Richmond Beach Pump Station was running three of its four pump sets and was able to maintain wastewater levels as designed. The station's fourth pump set was undergoing maintenance and not available. During the January 12th and 13th storm event, the pump station experienced utility power disruptions which caused the variable frequency drives (VFDs) for the operating pumps to shut down and then go through an automated restart sequence. [12] Utility power was never fully interrupted for more than five seconds and as a result, the standby generator was not activated. Power disruptions continued and affected the performance of the pumps.[13] As wastewater flows increased, the pump station could no longer handle the flows which caused the outfall gate to open allowing the overflow into Puget Sound.

East Pine Pump Station Bypass

The East Pine Pump Station also experienced power disruptions on January 13th, 2021. Normally, an alarm indicating a high wastewater level would have been visible to the main control operations staff at West Point on their primary control panels. However, telemetry from the pump station was not available because the primary phone line was out of service. [14] A high level alarm was provided to West Point main

[12] A variable frequency drive or VFD is a device that protects and controls the speed of motors.

[13] The term "poor power quality" refers to any power supply that deviates from the ideal and can cause equipment to malfunction.

[14] Telemetry, in this case, allows the transmission of an alarm to a distant receiving station by radio or other electronic means.

control through an auxiliary phone line. This alarm was not immediately noticed by the operator because it came through the auxiliary alarm system.

Medina Pump Station
During the January 12th and 13th, 2021 storm event, the Medina Pump Station was running two, large pumps to pump all incoming wastewater into the downstream sewer as designed. However, utility power disruptions caused the large pumps to shut down and then go through an automated restart sequence. The disruption to utility power did not last more than five seconds, so the standby power generator was never activated. The two, large pumps attempted several automated restarts, but these pumps did not successfully restart. When the utility power returned to sufficient quality, the large pumps restarted automatically, ending the overflow event.

A.2. The consequences of the discharges to the Puget Sound and Lake Washington ecosystems

The WLRD Science group evaluated the environmental data based on water samples collected and analyzed by the DNRP Environmental Laboratory. After an unpermitted discharge event, beaches are closed and monitored to protect public health. Bacteria concentrations in the water, such as Enterococcus and E. coli, are important indicators of potential human health risks.[15] Public Health-Seattle & King County (Public Health) may authorize reopening Puget Sound and Lake Washington beaches once sampling indicates that bacteria are at safe levels. Marine beaches such as those of Puget Sound, can be reopened after two days at or below allowable bacteria limits.[16]

Sampling occurred at the locations of all four overflows on January 13th and January 14th. Sampling for the West Point and Richmond Beach discharges also occurred January 15th and January 16th. Except for a site near Point Wells, all Puget Sound beaches sampled following the discharges had elevated fecal indicator bacteria levels on January 13th, 2021. Because bacteria at Point Wells bacteria remained low, the bacteria were not expected to impact Snohomish County beaches to the north. Repeated sampling showed declining levels over the following three days to typical conditions. Carkeek and the south beaches at West Point exceeded the applicable bacteria levels only on January 13th.

Minimal ecosystem impacts are expected from these events in both Puget Sound and Lake Washington due to the relatively small magnitude and duration of the discharges that occurred. No fish die-offs were observed or reported by staff or the public. [17] Because of the relatively small volume discharged on January 13th, 2021, no long-term impacts are expected to sediments or to marine animals living on or in the surrounding seabed.[18] An expanded discussion of the impacts of discharges can be found in Appendix B.

[15] Enterococcus and E. coli levels are used as indicators of the presence of fecal material in recreational waters, indicating the possible presence of disease-causing bacteria, viruses, and protozoans that may pose health risks to people fishing and swimming in those waters.
[16] For more information on the Beach Action Value, state swimming standards and saltwater quality, reference the Ecology BEACH program.
[17] A fish die-off or fish kill refers to refers to a localized die-off of fish populations.
[18] More information on monitoring results is available on the West Point marine water quality monitoring website.

A.3. The potential impact to water-adjacent landowners and visitors to water-adjacent facilities

Table 2 presents the information on the beaches closed as a result of the unpermitted discharge events. All beaches listed in the table were closed for swimming and other water contact recreational activities on January 13th. Beach walkers and park visitors could safely use the upper beach/park areas during the closures, but not the areas close to the water. No impacts to adjacent landowners or visitors to Snohomish County beaches were expected based on the duration and amount discharged. An expanded discussion of the impacts to water-adjacent landowners can be found in Appendix B.

Table 2. Beach Openings for Wastewater Treatment Division unpermitted discharges, January 13th, 2021

Location	Date reopened
Madrona Beach and Madrona Park	January 15th
Howell Park	January 15th
Medina City Park	January 15th
Richmond Beach	January 16th
Saltwater Park	January 16th
Carkeek Park	January 16th
Golden Gardens	January 16th
Discovery Park Beach	January 18th

A.4. The potential impacts to those utilizing the fishery and shellfish resources

All beaches in King County along the eastern Puget Sound shoreline and their adjacent offshore waters are currently closed to recreational and commercial shellfish harvest by the Washington State Department of Health (WSDOH) due to general pollution concerns.[19] This closure stems from pollution concerns related to their proximity to urban areas with sewage treatment outfalls and stormwater runoff. As detailed in Appendix B, no additional impact to those shellfish resources along the King County shoreline occurred from the January 12th and 13th discharges. However, as a precautionary measure following the West Point discharges, WSDOH closed the Port Madison Shellfish Growing Area and the Kingston Shellfish Growing Area from the southern growing area boundary, north to Apple Cove Point in Kitsap County for all species on January 13th, 2021. The areas were opened to shellfish harvest on February 3rd, 2021. No impacts to those using fish or shellfish resources in Snohomish County beaches or offshore waters were expected based on the duration and amount discharged.

Based upon the relatively small amount discharged from the four facilities on January 13th, 2021, no impacts to those consuming marine fish or shellfish are expected. No WSDOH fish consumption advisory was issued.[20]

[19] Shellfish Harvest Map

[20] More information on monitoring results is available on the West Point marine water quality monitoring website.

A.5. A summary of emergency bypass discharges at the West Point Treatment Plant and pump station overflows since February 2017, including causes, volumes, and responses

Table 3 below summarizes the West Point Treatment Plant and pump station overflows from February 2017 through April 29th, 2021. Further information on strategies is available in Appendix C: After Action Report Summary.

Table 3. Emergency Bypass Discharges at the West Point Treatment Plant and Pump Station Overflows, May 2017-January 2021

Location	Event Date	Volume (gallons)	Cause of Overflow	Response/Corrective Actions
Richmond Beach Pump Station	12/14/2018	170,000	Loss of utility power followed by the feeder breakers tripping on all four pump sets.	Notification Letter to Ecology 12/21/2018. Implemented project to upgrade the electrical systems in 2021, scheduled for completion in 2022.
Richmond Beach Pump Station	2/04/2019	19,400	Power failure and pumps not automatically restarting.	Notification Letter to Ecology 2/11/2019. Replaced variable frequency drives in pumps in 2019.
West Point Treatment Plant	7/19/2019	Emergency bypass: 2,100,000	Power disturbance at an off-site utility power pole (Canal Street) caused multiple pump shutdowns.	Notification Letter to Ecology 7/25/2019. Ecology investigated incident; plant operated as designed and expected.[21]
Medina Pump Station	12/20/2019	40,000	Storm-induced high wastewater flows exceeded station capacity.	Notification Letter to Ecology 12/26/2019. Planned pump station upgrade to increase capacity.[22]
West Point Treatment Plant	12/2/2020	17,000	Operator error resulted in emergency bypass gate button pushed; gate opened 12.1% before closure.	Notification Letter to Ecology 1/21/21. Training on operating procedures for emergency bypass gate.
Richmond Beach Pump Station	12/21/2020	800,000	High incoming volumes and pump motor failure.	Notification Letter to Ecology 12/28/2020. Follow-up letter to Ecology 1/15/2021 describing repairs to one pump set to restore operation.

[21] Ecology's press release for Administrative Order 19477 includes a link to the order.
[22] Capacity constraints at Medina Pump Station have been identified in the Conveyance System Improvements 2017 Program Update. The timing and funding for conveyance capacity upgrades are being considered as part of WTD's Capital Portfolio Management Process.

Location	Event Date	Volume (gallons)	Cause of Overflow	Response/Corrective Actions
Medina Pump Station	12/21/2020	8,600	Storm-induced high wastewater flows exceeded station capacity.	Notification Letter to Ecology 12/28/2020. Planned pump station upgrade to increase capacity.[22]
West Point Treatment Plant	1/13/2021	11,000,000	Power disturbance led to intermediate pump Station and raw sewage pump shutdown.[23]	Notification Letter to Ecology 1/21/21. Performed After-Action Review to develop recommendations.[24]
East Pine Pump Station	1/13/2021	2,200,000	Power disturbance led to trip of pumps; pumps did not restart.[23]	Notification Letter to Ecology 1/21/21. Performed After-Action Review to develop recommendations.[24]
Richmond Beach Pump Station	1/13/2021	160,000	Power disturbance led to trip of pumps; pumps did not restart.[23]	Notification Letter to Ecology 1/21/21. Performed After-Action Review to develop recommendations.[24]
Medina Pump Station	1/13/2021	86,000	Power disturbance led to trip of pumps; pumps did not restart.[23]	Notification Letter to Ecology 1/21/21. Performed After-Action Review to develop recommendations.[24]
West Point Treatment Plant	4/29/2021	900,000	Failure of utility power switch during routine testing of electrical systems.	Correction of the failed utility power switch.

A.6. The recent and projected future pattern and frequency of storms of a magnitude that can be expected to generate wastewater volumes that exceed the stated processing capacity of the West Point Treatment Plant and system pump stations

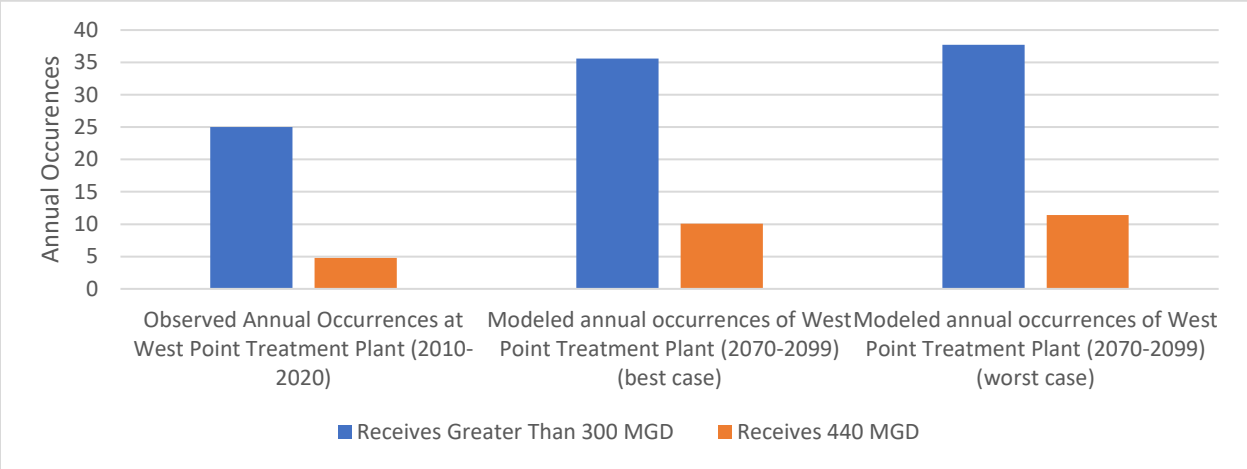
Recent research shows that climate change will likely result in higher intensity rainfall events in King County.[25,26] The larger rain events would increase the frequency of exceedance of the 300 mgd secondary treatment capacity at West Point.[27] Higher intensity storms due to climate change would also result in more flows being diverted away from West Point to WTD's upstream Combined Sewer Overflow (CSO)

[23] See Section V.A.1 of this report for more details on overflow causes.
[24] See Section V.B of this report for more details on recommendations and responses to prevent future events.
[25] The University of Washington published their projections of Changing Heavy Precipitation in King County.
[26] Seattle Public Utilities published updates to local rainfall patterns based on climate change.
[27] As described earlier in "Key Historical Context", 300 mgd is the capacity of primary and secondary capacity. More information on how West Point treatment process is available at the West Point Treatment Process web page.

facilities, such as the Elliott West facility, and more intense storms could lead to more frequent power disruptions.[28]

Figure 2 below shows the potential increases of flows to West Point associated with anticipated climate change impacts. The figure includes two different climate change projections, one with more conservative assumptions to the changes in rainfall (a best-case scenario), and one that assumes more extreme changes to rainfall patterns (worst-case scenario).

Figure 2. Observed (2010-2020) and Modeled Flows Exceeding or Meeting West Point Treatment Plant Processing Capacity, Accounting for Climate Change (2070-2099)



Increased frequency of high flows will increase the potential for unpermitted bypasses and discharges at West Point. Data shows that high flows are typically caused by storm events and accompanying wind-caused power disruptions can result in plant system failures. When high flows to West Point occur, there is an increased likelihood that a plant system failure will result in an unpermitted discharge because there is little time for staff to react and adjust operations before a discharge occurs. Discharges could increase during high flows because of the increased volumes coming to the plant. Developing flow-management strategies to account for climate change is an ongoing effort for WTD.

WTD is developing methods to incorporate potential climate impacts into planning and design at West Point and across the CSO system.[29] For example, the Ship Canal Water Quality Project will provide additional wastewater storage to accommodate anticipated increased rainfall based on climate change models. In addition to efforts specific to the CSO system, WTD is committed to the following actions to address climate change in its facilities, consistent with the Strategic Climate Action Plan:

- Develop guidance and recommendations to further incorporate climate change considerations within WTD programs, projects, and operations;

[28] Combined sewer overflows (CSOs) are relief points in older sewer systems that carry sewage and stormwater in the same pipe. When heavy rains fill the pipes, CSOs release sewage and stormwater into rivers, lakes, or Puget Sound.

[29] More research on climate change can be found on the WTD Climate Change site.

- Partner with the U.S. Geological Survey to aid in the development of their Puget Sound Coastal Storm Modeling System;
- Assess the hydraulic impacts of saltwater intrusion on the WTD conveyance system and develop a strategy for addressing them;
- Expand the use of recycled water[30] in the Sammamish Valley to help mitigate projected changes on summer low stream flows; and
- Expand the WTD assessment of how projected changes in rainfall intensity affect the wastewater system.

B. A strategy to limit or eliminate recurrence of the January 13 discharges and overflows of untreated wastewater, cost estimates associated with such a strategy, and suggestions on how a partnership with the King County Flood Control District might help improve these facilities

WTD assessed the West Point bypass and overflows from the Medina, Richmond Beach, and East Pine pump stations and identified actions that can be taken to reduce the likelihood of similar events in the future. Some of the recommendations are already being implemented, while others will require time to plan, budget, design, and implement.

WTD currently partners with the King County Flood Control District when the facilities are in a mapped coastal flood hazard area, such as Black River Pump Station. [31] The four facilities that experienced unpermitted discharges on January 13th, 2021, are not in mapped coastal flood hazard areas, and thus not currently subject to partnership with the Flood Control District. WTD will explore opportunities to partner with the King County Flood Control District to design projects that may help limit or eliminate the recurrence of unpermitted discharges where appropriate, provided actions are consistent with Revised Code of Washington (RCW) Chapter 86.15.[32]

Table 4 outlines the issues that contributed to the January 13th, 2021 overflows and strategies to limit recurrence of overflows at these facilities with available cost estimates.

Table 4. Summary of Strategies to Eliminate Recurrence of January 13, 2021 Discharges and Overflows

Location of Unpermitted Discharge	Strategies to limit recurrence	Cost estimate
West Point Treatment Plant	Implement requirements outlined in Ecology Administrative Order 19477 (issued 2/2/2021).	Work underway to design power improvements and identify reliability improvements for the West Point Treatment Plant. Emergency Declaration appropriation: $64.6M.

[30] Recycled water generally refers to treated domestic wastewater that is used more than once before it passes back into the water cycle.
[31] More information about the King County Flood Control District can be found on their website.
[32] RCW 86.15 defines the responsibilities of Flood Control Zone Districts.

Location of Unpermitted Discharge	Strategies to limit recurrence	Cost estimate
Offsite Facilities Richmond Beach, Medina and East Pine Pump Stations:	Evaluate pump station power and control strategy and the possibility of bringing the standby generator online when power disruptions are expected.[33]	Study and implementation estimate: $500,000.
East Pine Pump Station	Adjust maintenance schedule and tests for all offsite facilities, including testing the backup and standby system monthly to ensure that the systems can take over when called upon.	Negligible added cost outside staff time; absorbed by Operations budget.
East Pine Pump Station	Change user interface to display data on the operator screen at West Point Main Control system.	Cost estimate: $50,000. Project in progress, estimate completion Q4 2021.
East Pine Pump Station and Richmond Beach Pump Station	Increased data quality and capacity for telecommunications to communicate pump station data to main control operations staff.	In progress; Phase 1 (High Priority sites) estimate: $300,000.[34] Anticipated completion: Q3 2021. Phase 2 of upgrades (includes Richmond Beach and East Pine) anticipated completion: Q1 2022.[35] Ongoing operations cost for upgrades: $49,000/month ($600,000/year).
Richmond Beach Pump Station	Complete pumping system maintenance repairs required to bring standby pump set online. Maintenance items have been identified in ongoing work orders.	Pumping system maintenance completed, all pumping systems are back online and fully operational.

[33] Evaluation is needed to determine whether strategy to proactively run standby generator is feasible and fits WTD operational strategy.
[34] High priority includes fiber optic upgrades at all regional treatment plants and major facilities such as Interbay Pump Station, Georgetown Wet Weather Treatment Station, and Matthews Beach Pump Station.
[35] Cost information to be determined for Phase 2 upgrades.

Location of Unpermitted Discharge	Strategies to limit recurrence	Cost estimate
Medina Pump Station	Upgrade variable frequency drives (VFD) as part of VFD program.	Implementation for VFD upgrade is planned for Q3 2021. Cost estimate: $236,000.
	Upgrade standby generator at pump station.	Standby generator upgrade is scheduled for 2022. Cost estimate: $5.2M.

VI. Conclusion and Next Steps

Following the unpermitted discharge events of January 13th, 2021, WTD conducted a review of the events and began corrections and improvements to prevent a similar recurrence. Some action items, such as corrective maintenance at Richmond Beach, began immediately and have already been completed. Other items, such as replacing equipment at Medina Pump Station and improving control system communication systemwide, are scheduled to be completed in 2021. Improvements at West Point are part of an ongoing effort to fulfill requirements outlined in Ecology's Administrative Order 19477 and the February 25th, 2021, County emergency declaration. WTD will monitor and track progress of the recommendations to continue its commitment to protect public health and the environment.

VII. Appendices

Appendix A: Council Motion 15832
Appendix B: January 2021 Monitoring Results and Impacts Assessment
Appendix C: After Action Report Summary

1200 King County Courthouse
516 Third Avenue
Seattle, WA 98104

KING COUNTY

Signature Report

Motion 15832

Proposed No. 2021-0058.1 **Sponsors** Dunn

A MOTION requiring a report on the January 13, 2021, discharge of untreated wastewater into Puget Sound from the West Point Treatment Plant and several pump stations.

WHEREAS, on the morning of January 13, 2021, the King County West Point Treatment Plant discharged eleven million gallons of untreated wastewater into Puget Sound, and

WHEREAS, the discharge was directed through the emergency bypass system of the plant, during a heavy rainstorm that featured high winds and voltage fluctuations in the plant's power feed, and

WHEREAS, the discharge, while it did not result in plant flooding or injury to employees, nevertheless presented significant impacts to the marine environment and required the closure of public beaches at area parks, and

WHEREAS, in addition to the West Point Treatment Plant discharge, there were several other discharge events at pump stations located at various points along system conveyance lines, including the East Pine, Medina and Richmond Beach pump stations, resulting in additional overflows amounting to the spillage of 2.4 million gallons of untreated wastewater into local water bodies, and

WHEREAS, as much as 2.2 million gallons of wastewater overflowed into Lake Washington from the East Pine Pump Station resulting from a power outage. The flow

volume on the night of the storm also overwhelmed the pumping capacity at the Medina Pump Station, resulting in a spill of 100,000 gallons of wastewater into Lake Washington, and at the Richmond Beach pump station, which spilled 165,000 gallons of wastewater into Puget Sound, and

WHEREAS, other jurisdictions with waterfront bordering central Puget Sound also closed beaches and took actions to limit public access, and

WHEREAS, absent corrective action, there is no reason to expect that coming operational periods will witness any mitigation of the contributing factors to the discharges, such as heavy rainstorms, accompanied by high winds, and fluctuations in power feeds, and

WHEREAS, untreated wastewater contains human and pet sewage, pretreated industrial toxics and contaminants of emerging concern and stormwater runoff, and

WHEREAS, there is increasing evidence that Puget Sound marine life is facing challenges to their viability that may be due, in part, to these elements of untreated wastewater discharges, and

WHEREAS, King County has invested billions of dollars in building systems to avoid discharging untreated effluents into Puget Sound and Lake Washington, and

WHEREAS, such discharges are inconsistent with permit requirements under which county treatment plants are operated;

NOW, THEREFORE, BE IT MOVED by the Council of King County:

A. The executive be directed to prepare a report that documents:

1. The causes of the discharge of untreated wastewater from the West Point Treatment Plant, and overflows at the Richmond Beach, Medina and East Pine pump

stations on the morning of January 13, 2021;

2. The consequences of the discharges to the Puget Sound and Lake Washington ecosystems;

3. The potential impact to water-adjacent landowners and visitors to water-adjacent facilities;

4. The potential impacts to those utilizing the fishery and shellfish resources;

5. A summary of emergency bypass discharges at the West Point Treatment Plant and pump station overflows since February 2017, including causes, volumes and responses; and

6. The recent and projected future pattern and frequency of storms of a magnitude that can be expected to generate wastewater volumes that exceed the stated processing capacity of the West Point Treatment Plant and system pump stations.

B. The report shall also recommend a strategy to limit or eliminate recurrence of the January 13 discharges and overflows of untreated wastewater, and shall provide cost estimates associated with such a strategy and make suggestions on how a partnership with the King County Flood Control District might help improve these facilities.

C. The executive should electronically file the report, together with a motion that acknowledges receipt of the report no later than August 1, 2021, with the clerk of the council, who shall retain the original and provide an electronic copy to all

councilmembers, the council chief of staff and the lead staff for the regional water quality committee, or its successor.

Motion 15832 was introduced on 1/26/2021 and passed by the Metropolitan King County Council on 3/9/2021, by the following vote:

Yes: 9 - Ms. Balducci, Mr. Dembowski, Mr. Dunn, Ms. Kohl-Welles, Ms. Lambert, Mr. McDermott, Mr. Upthegrove, Mr. von Reichbauer and Mr. Zahilay

KING COUNTY COUNCIL
KING COUNTY, WASHINGTON

DocuSigned by:
Claudia Balducci
7E1C273CE9994B6...

Claudia Balducci, Chair

ATTEST:

DocuSigned by:
Melani Pedroza
8DE1BB375AD3422...

Melani Pedroza, Clerk of the Council

Attachments: None

Certificate Of Completion

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Melani Pedroza melani.pedroza@kingcounty.gov Clerk of the Council King County Council Security Level: Email, Account Authentication (None)	DocuSigned by: Melani Pedroza 8DE1BB375AD3422... Signature Adoption: Uploaded Signature Image Using IP Address: 198.49.222.20	Sent: 3/16/2021 9:39:14 AM Viewed: 3/16/2021 9:50:15 AM Signed: 3/16/2021 9:50:22 AM
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In Person Signer Events	Signature	Timestamp

Editor Delivery Events	Status	Timestamp

Agent Delivery Events	Status	Timestamp

Intermediary Delivery Events	Status	Timestamp

Certified Delivery Events	Status	Timestamp

Carbon Copy Events	Status	Timestamp

Witness Events	Signature	Timestamp

Notary Events	Signature	Timestamp

Envelope Summary Events	Status	Timestamps

Envelope Summary Events	Status	Timestamps
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Payment Events	Status	Timestamps

1.0 JANUARY 2021 MONITORING RESULTS AND IMPACTS ASSESSMENT

This report provides a summary of fecal indicator bacteria measurements and impacts assessment following discharges from the emergency bypass at the West Point Treatment Plant (TP), Richmond Beach Pump Station, and Lake Washington pump stations on January 13, 2021. The locations sampled and volume discharged from the various facilities are shown in Figure 1. Beaches at multiple locations in the vicinity of the West Point TP emergency bypass outfall (EBO) and Lake Washington were sampled daily for fecal indicator bacteria until levels were safe for water contact and beaches re-opened.

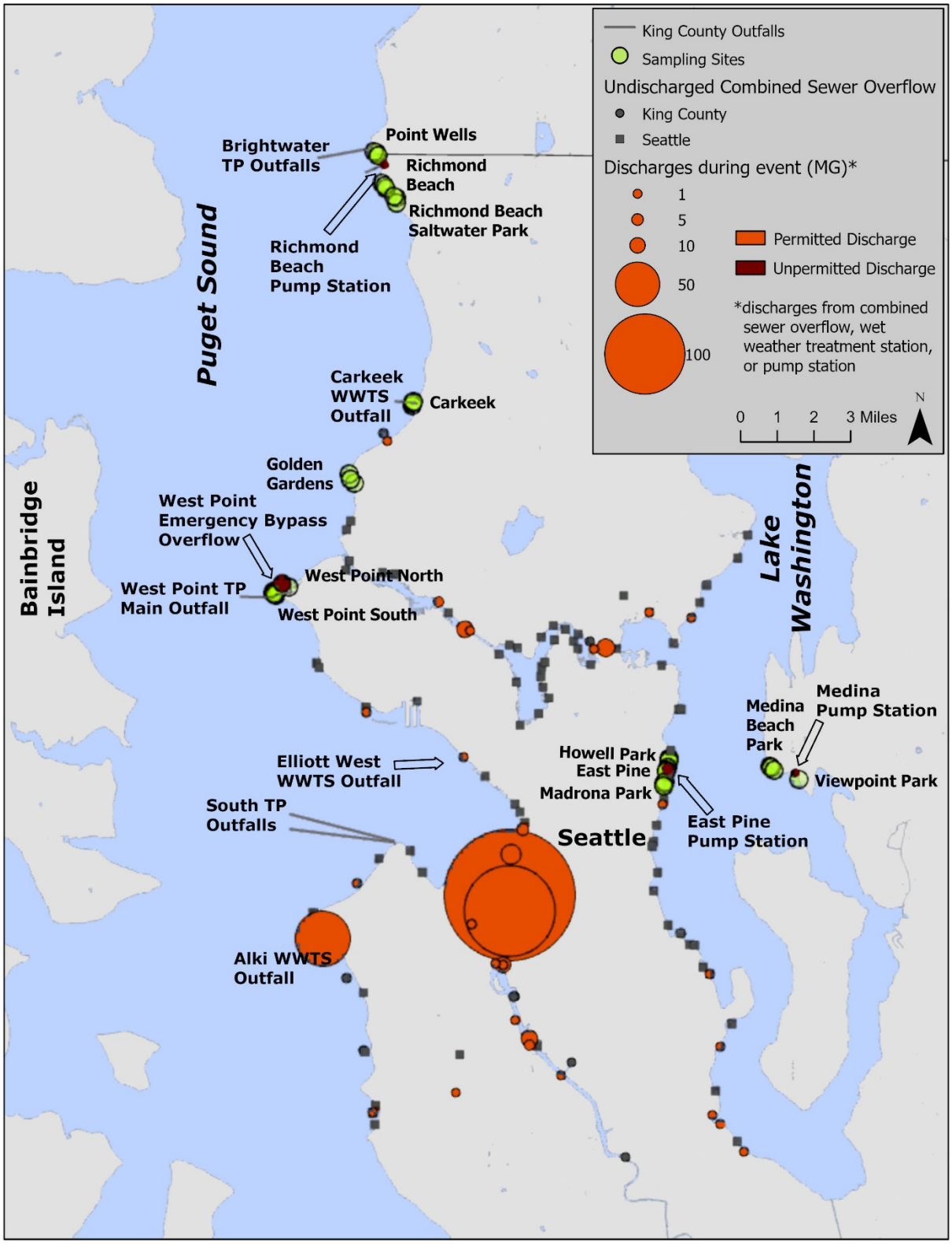

Figure 1. Bacteria sampling stations and location and volume of discharges (permitted and unpermited) from combined sewer overflows (CSOs), wet weather treatment stations (WWTS), pump stations, and the emergency bypass outfall.

2.0 MONITORING RESPONSE

King County monitored beaches for fecal indicator bacteria at several locations near the West Point TP Emergency Bypass Outfall (EBO), Richmond Beach Pump Station, East Pine Pump Station, and Medina Pump Station within hours after the overflows (see Figure 1). Fecal coliform and Enterococcus bacteria were measured in marine samples and fecal coliform and E. coli bacteria measured in freshwater samples. Samples were collected at multiple locations from each site for four (marine beaches) and two (Lake Washington beaches) consecutive days until bacteria levels demonstrated a return to typical values and all beaches reopened summary of samples collected. The following is a summary of samples collected:

- West Point (Discovery Park)—2 locations, 3 samples for 4 days, Jan 13-16, 2021
- Golden Gardens—1 location, 3 samples for 4 days, Jan 13-16, 2021
- Richmond Beach—3 locations, 3 samples each for 3 days, Jan 13-15, 2021
- Carkeek Park—1 location, 3 samples each for 3 days, Jan 13-15, 2021
- East Pine—3 locations, 3 samples each for 2 days, Jan 13-14, 2021
- Medina—1 location, 4 samples for 2 days, Jan 13-14, 2021.

Bacteria concentrations in the water column are important indicators of potential human health risks. Although not typically harmful on their own, fecal indicator bacteria are sampled as they are relatively easy to monitor and can be associated with viruses and other harmful pathogens that often occur in lower concentrations and are more difficult to detect. Fecal bacteria are found in the intestinal tracts and feces of warm-blooded animals and humans and high concentrations indicate a greater potential for the presence of harmful pathogens. After an unpermitted discharge event, beaches are automatically closed and monitored for indicator bacteria to protect public health. At marine beaches (Puget Sound), beaches can be reopened after two days if the average of three Enterococcus samples are below the Beach Action Value of 104 cfu/100 mL. For freshwater beaches (Lake Washington), reopening can occur two days after a discharge if the three E. coli samples are a below the single sample maximum of 1,000 CFU/100 ml and a 200 CFU/100 ml geometric mean.

3.0 PUGET SOUND AND LAKE WASHINGTON CIRCULATION AND GEOGRAPHIC CHARACTERISTICS

Puget Sound is a fjord-like estuary that consists of a series of underwater valleys and ridges (called basins) and submerged hills (called sills). Puget Sound consists of four major interconnected basins: Main (Admiralty Inlet and the Central Basin), Whidbey, Southern, and Hood Canal. A map showing the basins can be found at: https://en.wikipedia.org/wiki/Puget_Sound#/media/File:Map_pugetsound.png. All of King County's marine WWTP and CSO outfalls discharge to the Central Basin. The Central Basin has near-oceanic salinity throughout the year and is supplemented with cold, nutrient-rich, low-oxygenated deep oceanic water upwelled off the Washington coast during the late summer months.

Freshwater flows influence water circulation in the Central Basin because the amount of freshwater input varies seasonally and affects water temperature, salinity, and density, which, in turn, determines stratification of the water column. Freshwater input into rivers is mainly through rainfall; however, snowmelt also contributes a large source in late spring and early summer. The two main freshwater inputs to King County marine waters are the Green/Duwamish River, which enters Elliott Bay, and the Cedar River (Lake Washington drainage basin), which flows into the Sound through the Ship Canal.

Water circulation in the Central Basin is dominated by tidal currents and generally consists of a two-layered flow, with incoming, saltier oceanic water flowing along the bottom and a fresher, less dense water layer flowing out at the surface. Salty, cold, dense waters enter Puget Sound at depth in the bottom layer through Admiralty Inlet. A portion flows south in the Central Basin while the other portion flows northeast through Possession Sound to the Whidbey Basin. Water tends to flow faster on the eastern side of the Central Basin near Alki Point and Point Wells and along the western side near Point Monroe and north of Kingston, where major topographic features affect the currents. Amplitudes of tidal currents in the Central Basin are about 50 centimeters per second (cm/s). Estuarine circulation, which is important for transporting water masses, is typically up to about 10 cm/s, but can be higher during storms and bottom-water saltwater intrusion from Admiralty Inlet.

Lake Washington is the second largest lake by surface area in the state. Lake Washington's two major influent streams are the Cedar River at the southern end, which contributes about 60 percent of the total inflow, and Lake Sammamish via the Sammamish River from the north, which contributes about 30 percent of the total inflow. Most of the lake shoreline is highly developed, although as of 2011 approximately 40% of the basin was forested and 50% was classified as developed (King County, 2020a).

The basin of Lake Washington is a deep, narrow, glacial trough with steeply sloping sides. The lake is 20.6 feet above MLLW in Puget Sound and is connected to the Puget Sound Central Basin via Lake Union and the Lake Washington Ship Canal. Mercer Island lies in the southern half of the lake, separated from the east shore by a relatively shallow and narrow channel and from the west shore by a much wider and deeper channel. Lake Washington has one mixing and one stratification period per year. The lake undergoes complete mixing from the surface to the bottom during mid-December through early March. In late summer and fall, the weather becomes cooler, the epilimnion begins to cool, and the strength of stratification weakens. Wind begins to mix epilimnetic water with the shallowest hypolimnetic water and the thermocline deepens. Typically, late in the fall, a strong windstorm will almost completely mix the lake, resulting in uniform temperatures throughout the water column (King County, 2020a).

Beginning near the turn of the last century, Seattle began discharging raw sewage into the lake (Sylvester et al., 1956). Due to rising sanitary concerns, the construction of interceptor and trunk sewers was initiated in 1926 to divert the sewage to the South (formerly Renton) wastewater treatment plant. The removal of the last Seattle sewer outfall was completed in 1941, although CSOs then occurred from 32 previous sewer outfalls whenever there was appreciable rainfall. Beginning in that same year, secondary sewage treatment plants went into operation around the lake and by 1959 there were 11 secondary wastewater treatment plants discharging to Lake Washington (Edmondson and Lehman, 1981).

The paradox of secondary wastewater treatment is that the treatment process liberates phosphorus and nitrogen compounds in a form more readily available for promotion of algae growth. The effects of this eutrophication process on Lake Washington was recognized in the 1950s and the first wastewater diversion project was completed in 1963. By 1968, all treated wastewater inputs were diverted from the lake. However, inputs from CSOs continued. The recovery of Lake Washington from eutrophication and its continued stable trophic condition have been well documented (Edmondson and Lehman, 1981;King County, 2020a).

4.0 BACTERIA MONITORING RESULTS

This section provides a summary of bacteria monitoring results.

4.1 Puget Sound Bacteria

After the overflow at the Richmond Beach pump station, three water samples were collected daily for fecal indicator bacteria analysis from nearby Point Wells, Richmond Beach, and Richmond Beach Saltwater Park (samples collected January 13 to January 15). On January 13, concentrations of *Enterococcus* were slightly elevated in the Richmond Beach area with geometric mean concentrations at the three beaches ranging from 27 to 54 cfu/100 mL and arithmetic means ranging from 27 to 55 cfu/100 mL (maximum single value of 61 cfu/100 mL) (Figure 2 , Table 1). The geometric mean concentrations at Richmond Beach and Richmond Beach Saltwater Park initially exceeded the swimming beach geometric mean criteria of 30 cfu/100 mL. However, none of the sites exceeded the Beach Action Value of 104 cfu/100 mL, which is used to determine if the beach should reopen (Figure 2). For the next two days, samples remained above the geometric mean criteria at Richmond Beach, but below the Beach Action Value (Figure 2 , Table 1). Samples at Point Wells and Richmond Beach Saltwater Park were below both criteria after the first day of sampling. Fecal coliforms concentrations at all three beaches were slightly higher than *Enterococcus* concentrations, with geometric means ranging from 34 to 102 cfu/100 mL and arithmetic means from 34 to 140 cfu/100 mL (maximum single sample of 337 cfu/100 mL) and similarly declined over the three-day sampling period (Figure 3 , Table 1).

After the January 13 bypass through the EBO, bacteria samples were collected from each of four nearby beaches (West Point north beach, West Point south beach, Golden Gardens, and Carkeek Park) through either January 15 or January 16. Bacteria concentrations were elevated on January 13 at all beaches with *Enterococcus* geometric means ranging from 57 to 264 cfu/100 mL and arithmetic means ranging from 62 to 267 cfu/100 mL (maximum single sample of 300 cfu/100 mL). Fecal coliform geometric means ranged from 35 to 413 cfu/100 mL with arithmetic means of 37 to 1,364 cfu/100 mL (max single sample of 4,000 cfu/100 mL) (Figure 2 and Figure 3 , Table 1). Generally, the highest initial concentrations of bacteria were at West Point south beach. A flood tide with a large tidal exchange (>15 feet) occurred at and following the time of the discharge, which would likely have initially moved water south around West Point, explaining the higher values in those samples. There was a single very high sample of fecal coliforms at Carkeek (4,000 cfu/100 mL) on January 13 (Figure 3). Routine creek samples collected at Carkeek Park that day had high concentrations of bacteria with fecal coliform concentrations ranging from 16 to 11,000 cfu/100 mL (mean of 4,129 cfu/100 mL). The single high sample from Carkeek was likely due to high concentrations in Piper's creek, which discharges near the location where the high sample was collected. Similarly, elevated concentrations were not seen at other marine sites or Carkeek locations indicating a source other than the EBO. For all four beaches, bacteria concentrations quickly declined, and all beaches were below the Beach Action Value on January 14.

Table 1. Puget Sound bacteria monitoring results.

		Enterococcus samples (cfu/100 mL)					Fecal Coliforms samples (cfu/100 mL)				
Beach	**Date**	**#1**	**#2**	**#3**	**Geometric Mean**	**Mean**	**#1**	**#2**	**#3**	**Geometric Mean**	**Mean**
Point Wells	1/13/2021	25	28	28	27	27	31	44	28	**34**	34
	1/14/2021	20	27	23	23	23	25	30	15	**22**	23
	1/15/2021	22	11	14	15	16	5	9	21	10	12
Richmond Beach	1/13/2021	61	47	56	**54**	55	97	100	110	**102**	**102**
	1/14/2021	27	38	38	**34**	34	57	24	26	**33**	36
	1/15/2021	16	42	140	**45**	66	6	14	44	**15**	21
Richmond Beach Saltwater Park	1/13/2021	39	38	32	**36**	36	45	37	337	**82**	**140**
	1/14/2021	22	23	19	21	21	43	7	22	**19**	24
	1/15/2021	8	10	14	10	11	6	5	3	4	5
Carkeek	1/13/2021	26	25	290	**57**	**114**	28	63	4000	**192**	**1364**
	1/14/2021	12	30	33	23	25	11	17	24	**16**	17
	1/15/2021	18	10	25	17	18	6	8	13	9	9
Golden Gardens	1/13/2021	81	83	90	**85**	85	170	67	57	**87**	**98**
	1/14/2021	72	57	44	**57**	58	110	110	50	**85**	**90**
	1/15/2021	28	26	23	26	26	14	20	5	11	13
	1/16/2021	--	--	--	--	--	14	12	18	14	15
West Point North Beach	1/13/2021	63	61	62	**62**	62	50	38	23	**35**	37
	1/14/2021	47	51	51	**50**	50	69	62	69	**67**	**67**
	1/15/2021	9	14	12	11	12	3	4	5	4	4
	1/16/2021	--	--	--	--	--	3	9	5	5	6
West Point South Beach	1/13/2021	220	300	280	**264**	**267**	430	400	410	**413**	**413**
	1/14/2021	110	60	44	**66**	71	110	100	88	**99**	**99**
	1/15/2021	24	37	14	23	25	1	16	8	5	8
	1/16/2021	--	--	--	--	--	14	13	14	14	14

*Red text and highlighted cells indicate a value above either the geometric mean criteria (30 cfu/100 mL) or the beach action value of 104 cfu/100 mL.

Elevated bacteria concentrations after a release of wastewater, similar to the results seen, is expected. Dilution and dispersion (from mixing, tidal and wind driven currents, etc.) aid in the reduction of bacteria concentrations. Additionally, the survival rate of these bacteria in aquatic environments is also dependent on physical factors such as salinity, temperature, solar irradiance, nutrient availability, presence of organic matter, and predation (Gameson and Gould, 1975; McCambridge and McMeekin, 1981; Davies-Colley et al., 1994; Alkan et al., 1995; Rozen and Belkin, 2001; and Noble et al., 2004) with many of these factors working together to rapidly reduce bacteria concentrations through natural die off.

In addition to dilution, dispersion, and natural die off, the volume of the discharge has a large effect on measured bacteria concentrations. While elevated above ambient values,

beach bacteria concentrations after the January 13 discharge event were much lower than those measured after the larger EBO release in February 2017. After the discharge of 185 MG of stormwater and wastewater in 2017, West Point north beach *Enterococcus* samples averaged a much more substantial 15,333 cfu/100 mL with a single sample maximum of 22,000 cfu/100 mL (King County, 2018a). While samples were initially higher in 2017 than after the 2021 discharge, mean bacteria concentrations at all sites in 2017 also declined rapidly, with State water quality criterion being met within three days or less following each discharge event (King County, 2018a).

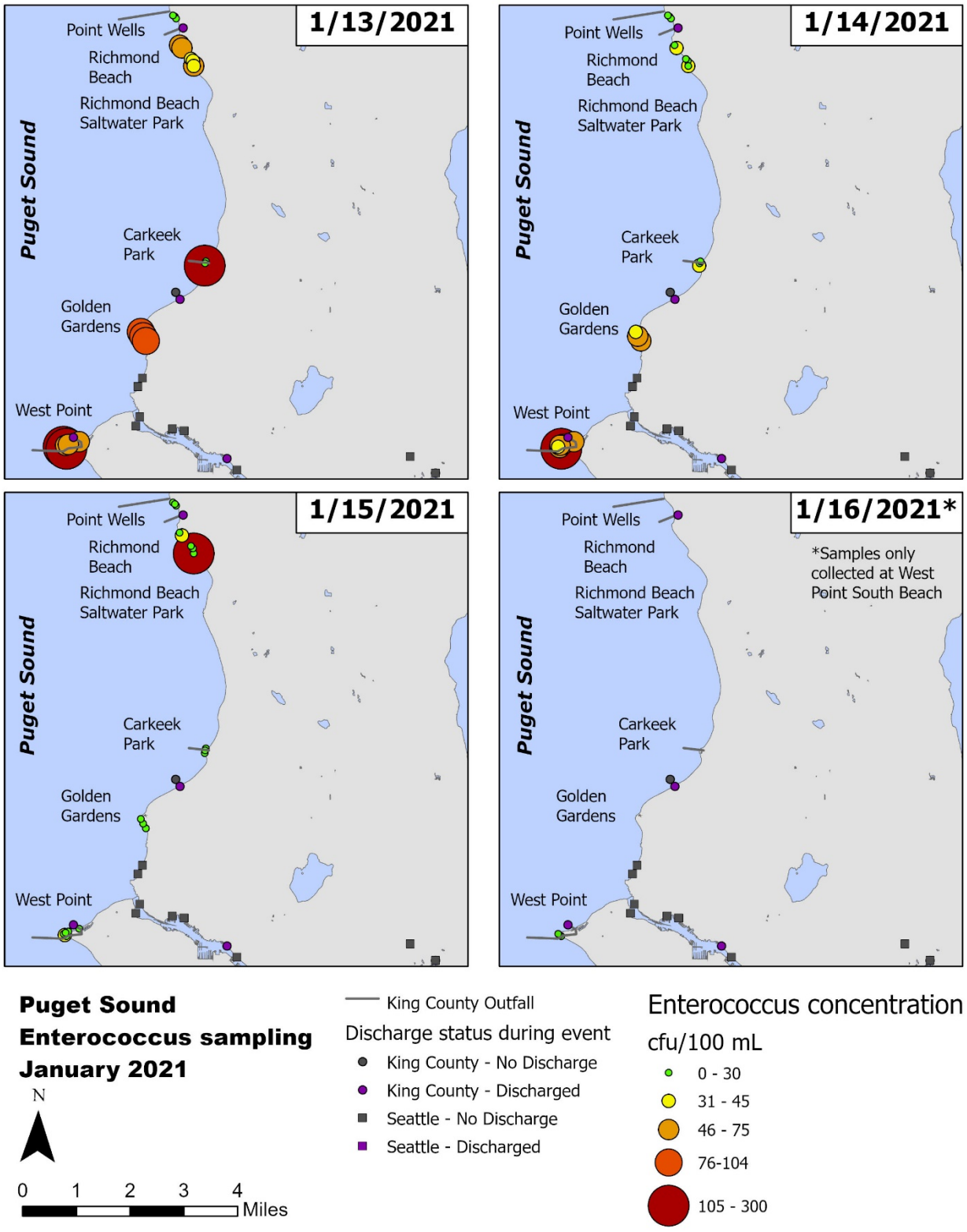

Figure 2. ***Enterococcus*** **concentrations measured in Puget Sound from January 13 to January 16, 2021.**

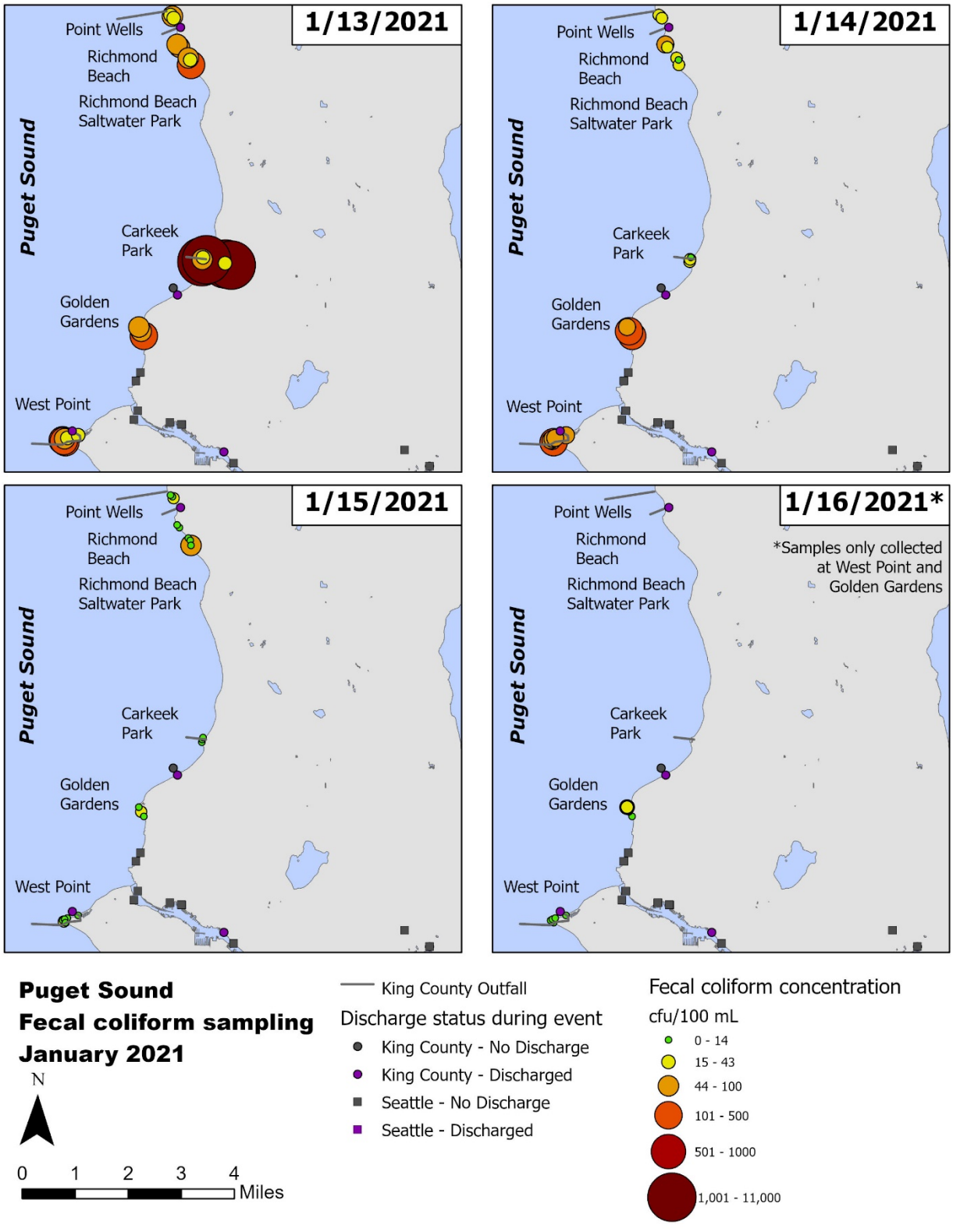

Figure 3. Fecal coliform concentrations measured in Puget Sound from January 13 to January 16, 2021.

4.2 Lake Washington Bacteria

Three locations in the vicinity of the East Pine CSO were sampled on January 13 and January 14, 2021. Concentrations of *E. coli* were relatively elevated at two locations in the vicinity of the East Pine CSO on January 13 (maximum of 75 cfu/100 mL), although all observed concentrations were well below the geometric mean and single sample swimming beach criteria of 200 and 1,000 cfu/100 mL, respectively (Figure 4, Table 2). On the following day, *E. coli* concentrations had declined to typical levels; observed concentrations were all below 25 cfu/100 mL (Figure 4, Table 2). Although the state bacteria criterion changed from fecal coliform to *E. coli* at the end of 2020, samples were also analyzed for fecal coliform.[1] Fecal coliform concentrations and trends reflected the observed *E. coli* patterns. Relatively elevated fecal coliform concentrations as high as 170 cfu/100 mL were observed near the East Pine CSO on January 13 (Figure 5, Table 2). Fecal coliform concentrations declined to typical levels on January 14 at all locations; the highest concentrations measured was 23 cfu/100 mL (Figure 5, Table 2).

Table 2. Lake Washington bacteria monitoring results.

		***E. coli* samples (cfu/100 mL)**					**Fecal Coliforms samples (cfu/100 mL)**				
Beach	**Date**	**#1**	**#2**	**#3**	**Geometric Mean**	**Mean**	**#1**	**#2**	**#3**	**Geometric Mean**	**Mean**
Medina Swim Beach	1/13/2021	5	6	0	3	4	8	21	2	7	10
	1/14/2021	4	5	4	4	4	5	9	5	6	6
Medina Viewpoint Park	1/13/2021	16	--	--	16	16	19	--	--	19	19
	1/14/2021	1	--	--	1	1	10	--	--	10	10
Howell Park	1/13/2021	32	23	75	38	43	21	19	170	41	70
	1/14/2021	3	4	1	2	3	6	8	10	8	8
East Pine	1/13/2021	61	42	34	44	46	110	46	62	68	73
	1/14/2021	14	10	22	15	15	15	20	23	19	19
Madrona	1/13/2021	2	2	2	2	2	7	3	4	4	5
	1/14/2021	11	13	4	8	9	7	5	8	7	7

*No results exceeded either the geometric mean criterion (200 cfu/100 mL) or the single maximum value of 1,000 cfu/100 mL.

Four samples near the Medina pump station were collected on January 13 and 14. The highest concentration of *E. coli* measured on January 13 was 16 cfu/100 mL; all concentrations were at typical levels and well below the swimming beach bacteria criteria (Figure 4, Table 2). Concentrations on January 14 did not exceed 5 cfu/100 mL (Figure 4, Table 2). Fecal coliform concentrations and trends again reflected the observed *E. coli* patterns. The highest concentration observed January 13 was 21 cfu/100 mL (Figure 5,

[1] The fecal coliform criterion expired on December 31, 2020 (WAC 173-201A-200).

Table 2). The maximum concentration on January 14 was 10 cfu/100 mL (Figure 5, Table 2).

Observation of elevated concentrations following CSO or sanitary sewer overflow (SSO) events are not unexpected and the measured concentrations generally depend on the magnitude of the discharge, the initial dilution/dispersion of the discharge, the prevailing currents, and the proximity of sampling locations to the discharge. Following the event, a rapid decline in bacteria concentrations is expected due to continued dilution/dispersion, settling, and die-off (Brookes et al., 2004; Nelson et al., 2018).

Beyond the specific observations of bacteria concentrations during and after the January 2021 events, some general historical background on bacteria levels in Lake Washington are provided for context. Although King County's routine bacteria monitoring efforts in Lake Washington terminated at the end of 2008, samples for *E. coli* and fecal coliform analysis were routinely collected at eight nearshore and five offshore stations from 1999-2008 and analysis of samples for fecal coliform at some of these same stations extend back to 1981.[2] *E. coli* concentrations were consistently below the current State ambient water quality geometric mean criterion (100 cfu/100 mL), except for two nearshore stations. A total of four exceedances were recorded at a location near the Henderson CSO in Seattle and two exceedances at location off the mouth of the Cedar River over the 10-year monitoring period (King County, 2020a). Although *E. coli* concentrations were relatively low, concentrations were typically higher at nearshore stations and concentrations at all stations were generally highest January-March (King County, 2020a).
Trend analyses have indicated that bacteria concentrations were generally declining over the periods of available records with the greatest rates of decline were observed at two nearshore locations (a nearshore station in Meydenbauer Bay off Bellevue and the station near the Henderson/MLK CSOs) (King County, 2020a).

The relatively low concentrations may be partly explained by the management of the collection and conveyance system during storms that prioritizes the protection of freshwater bodies like Lake Washington when and where possible. The occurrence of elevated bacteria levels in nearshore relative to offshore areas is due in part to the occurrence of CSOs, but stormwater is also a source of elevated bacteria inputs, particularly in highly urbanized areas (Embry, 2001; King County, 2019a). Declining trends in Lake Washington bacteria concentrations is likely due to progress that has been made to control CSOs (there is currently only one uncontrolled King County CSO that discharges to Lake Washington - Belvoir in Union Bay) and improvements in stormwater management. Evidence for both factors might be found in the declines in *E. coli* concentrations observed at the station near the Henderson\MLK CSOs and the Meydenbauer Bay station near Bellevue where there are no CSOs.

[2] King County's swimming beach monitoring program is a separate effort from the routine ambient lake monitoring effort. The freshwater swim beach monitoring program was initiated in 1998 and continues to monitor bacterial quality at public swimming beaches along Lake Washington during the summer swimming season.

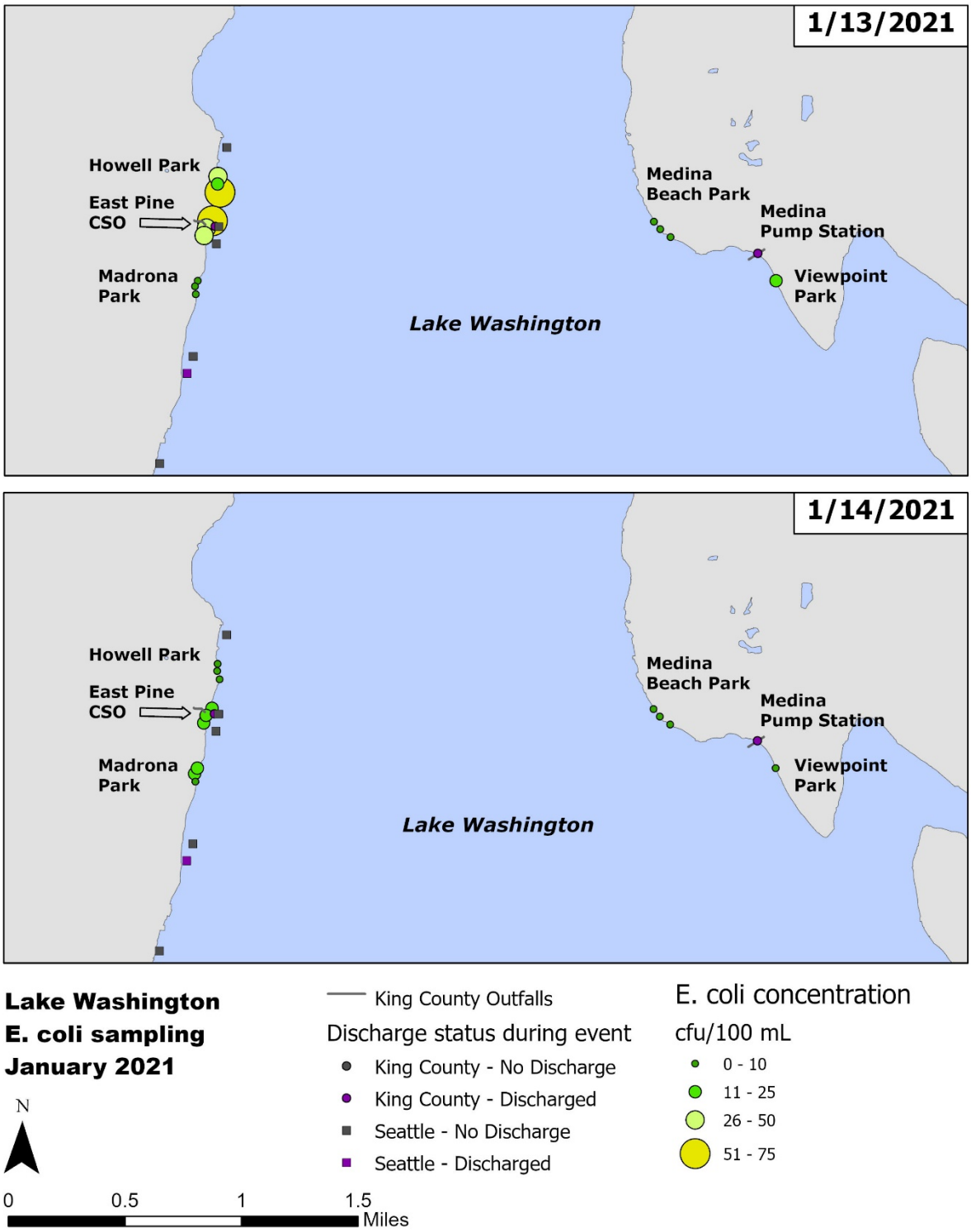

Figure 4. **E. coli concentrations measured in Lake Washington on January 13 and 14, 2021. Note: Stormwater outfall locations were not available for the City of Medina.**

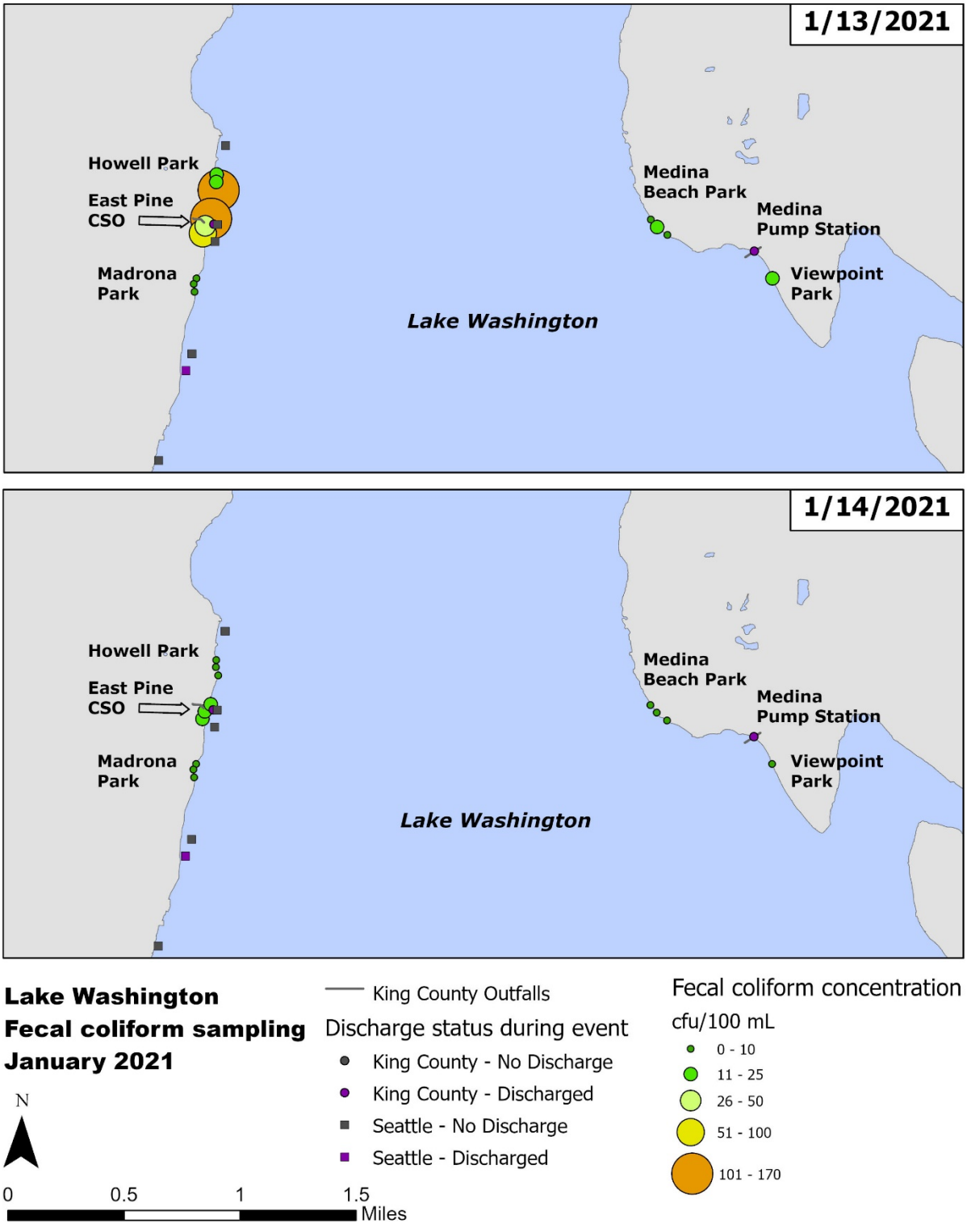

Figure 5. Fecal coliform concentrations measured in Lake Washington on January 13 and 14, 2021. Note: Stormwater outfall locations were not available for the City of Medina.

5.0 IMPACTS ASSESSMENT

This section addresses the following Council Motion items:

- Item #2 - consequences of the discharges to Puget Sound and Lake Washington ecosystems,
- Item #3 - the potential impact to water-adjacent landowners and visitors to water-adjacent facilities, and
- Item #4 - the potential impacts to those using fishery and shellfish resources.

5.1 Puget Sound

Elevated levels of fecal indicator bacteria occurred at West Point (Discovery Park), Richmond Beach, and Golden Gardens beaches for two days following the discharges and returned to typical levels by the third day. Beaches near Carkeek Park had high bacteria levels on the first day near the outflow of Piper's Creek but then returned to typical levels. Warning signs were posted on January 13 and beaches closed for swimming and recreational activities for an additional three days, except at West Point (closed for five days), following the discharges until bacteria values returned to typical levels. This action minimized potential for human contact, but did not allow full recreational use of these beaches. Beach walkers and park visitors could safely use the upper beach area above the high tide line, but not lower on the beach where water occurs at high tide. Water activities were also disrupted during this time.

All King County beaches along the eastern shoreline, and their adjacent offshore waters, are closed indefinitely to recreational and commercial shellfish harvest by the Washington State Department of Health (WDOH) due to pollution concerns related to their proximity to urban areas with sewage treatment outfalls and stormwater runoff. Therefore, no impact to those using shellfish resources along the King County shoreline occurred due to the discharges.

The discharges to Puget Sound occurred with winds from the south and during a flood tide with a large tidal exchange that likely resulted in initial transport of the discharges in a southerly direction while being mixed with seawater and diluted. The bacteria results showing that the highest values were south of the discharge points at Richmond Beach and West Point confirm this transport. Kitsap County posted warning signs and closed several beaches following the discharges as a precautionary measure. This action did not allow full recreational use of these beaches. Beach walkers and visitors could safely use the upper beach area above the high tide line, but not lower on the beach where water occurs at high tide.

A modeling study to assess transport of untreated discharges from the West Point EBO under different scenarios suggested that bacteria levels would not exceed the State water quality standard at beaches in either Snohomish or Kitsap Counties based on the duration of the EBO discharge (< 2 hours) and wind direction (south)(King County, 2020b). That

same modeling study did suggest, however, there was potential to exceed the shellfish harvest criterion which is based on the amount of bacteria in the water at some beaches in Kitsap County (Kingston, Port Blakely, and Port Madison). When an upset condition from untreated wastewater discharges is expected to result in water column fecal coliform values above 14 CFU/100 ml, WDOH closes the shellfish harvest areas for 21 days, or until test results on "full-body" shellfish for male specific coliphage (MSC) indicate values are less than 50 PFU/100 g tissue (King County, 2020b).

In Kitsap County, Point No Point (northeastern tip of the Kitsap Peninsula) south to Bainbridge Island, including Port Madison and Miller Bay, was closed to butter and varnish clam harvest by WDOH in January due to Paralytic Shellfish Poison (PSP) biotoxins from a phytoplankton bloom that occurred in late 2020. However, WDOH closed the Port Madison Shellfish Growing Area and the Kingston Shellfish Growing Area from the southern growing area boundary north to Apple Cove Point for all species on January 13 due to the EBO discharges. The areas opened to shellfish harvest on February 3. It is unknown if Tribal shellfish harvest other than that listed above occurred at or was scheduled to occur following the discharges on January 13. Based upon the small amount discharged and assessment of impacts from the 2017 flooding event, negative impacts to the biota or those consuming them would not be expected. However, it is unknown at this time if Tribal harvest was temporarily suspended.

An additional previous modeling study that assessed transport of untreated discharges from the Richmond Beach Pump Station over a 24-hour period and under different scenarios showed that there was potential for the discharge to reach southern Edmonds beaches within 4 hours and north to Meadowdale within 12 hours. The modeled discharges did not reach Kitsap County beaches (King County, 2019b). This study did not assess likelihood to exceed water quality standards, only transport. Based on the duration (<1 hour) and amount of the Richmond Beach discharge on January 13, there was likely no impact to people visiting or using beach resources in either Snohomish or Kitsap Counties from this discharge.

Water quality indicators, such as nutrients (ammonia and nitrate) and dissolved oxygen, that can affect organisms were likely not negatively impacted by the discharges on January 13 due to the small amount discharged. Ammonia can be toxic to fish at high levels, however, no fish kills were observed by staff or reported by the public. It is presumed that any fish in the vicinity of the discharges relocated to other areas until the discharges ceased. Ammonia and nitrate in the discharges would not cause an algae bloom as water temperatures were too cold for significant algae growth in January and there was insufficient light. Furthermore, nutrients are not limiting in January so additional nutrients from the discharges would not have caused excess algal growth. High amounts of organic matter can lower the amount of dissolved oxygen in the water, but the duration and amount of the discharges would not be sufficient to cause dissolved oxygen to decrease to levels that would cause stress or mortality to marine organisms.

Beach sediments and butter clam tissues sampled at multiple beaches following the 2017 flooding event showed that both sediment and clam tissues near the West Point EBO had

elevated concentrations of copper and clam tissue also had elevated lead based on historical values. Beach sediments met the Washington State Sediment Management Standards (SMS) for all metals, including copper (King County, 2019c). The SMS were developed for the protection of biological resources from sediment contamination. The increase in copper appeared to be short-term and were within normal ranges in sediment based on subsequent sampling. Metals were also sampled in sediments around the main outfall in 2017, which also met SMS. Organic contaminants were also sampled in offshore sediments near West Point following the 2017 event and met SMS except for two compounds: benzyl alcohol at one site, and its metabolized byproduct, benzoic acid at four of eight sites. Benzoic acid was found to be elevated Puget Sound-wide in 2017 (King County, 2019d).

Benthic invertebrates that live in/on sediments are an indicator of sediment health, and benthic communities at the main outfall remained robust and similar to historical data following the 2017 event (King County, 2019d). An underwater video survey near the EBO shortly after the 2017 event showed no obvious adverse effects to the benthic community or surrounding habitat. Based on the 2017 monitoring results and because of the small volume discharged on January 13, 2021 from the TP and CSO facilities compared to the 2017 event, no long-term impacts to sediments, benthic invertebrates, or butter clams are expected. Potential short-term impacts could have included displacement of mobile organisms due to disturbance from the physical force of the discharges. Those impacts would be short-term (< 2 hours) until cessation of the discharges.

Dungeness crab, zooplankton, and English sole tissues were sampled for metals and organic contaminants following the 2017 flooding event at various locations and compared to pre-event historical data when available. English sole were also sampled for hormones and vitellogenin (a female fish protein). Only English sole were sampled in close proximity to the West Point outfall.

An increase in organic contaminants in Dungeness crab tissues compared to prior results was not observed following the 2017 event and while an increase in some metal concentrations may have been influenced by West Point discharges, overall data variability and the limited historic data made it difficult to conclude definitively. The crab tissue data following the 2017 event would not have resulted in a change to the existing seafood consumption advisory for crab anglers established by WDOH (King County, 2020c). Based upon these results and the smaller volume discharged on January 13, 2021, no long-term impacts to crabs or those utilizing this resource are expected. A potential short-term impact (< 2 hours) could have been temporary displacement of Dungeness crabs in the vicinity of the outfalls due to disturbance from the physical force of the discharges. Dungeness crabs are more likely to be found near the Richmond Beach and Carkeek outfalls, than near the West Point EBO based on known distribution patterns.

Due to challenges associated with the zooplankton sampling following the 2017 flooding event, including lack of historical data for comparison, the limited data were insufficient to evaluate seasonal, interannual, or spatial variability of contaminant concentrations in zooplankton tissues (King County, 2020d). However, based upon the smaller volume

discharged on January 13, 2021, no long-term impacts to zooplankton abundance or distribution or to those organisms consuming them are expected. Short-term impacts (< 2 hours) could have included displacement in the water column to avoid the lower salinity water which could result in increased predation. However, many types of zooplankton have diel vertical migrations and would have been in deeper water at the time of the discharges so this potential impact would be negligible.

Comparison of metals and hormones concentrations in English sole sampled in 2015, 2017 and 2019 near West Point and other Puget Sound locations suggested these fish were not impacted by the 2017 flooding event (King County and WDFW, 2021a and 2021b). Differences in concentrations of vitellogenin in male fish and organic contaminants in either gender between locations or over time were not attributed to the flooding event. The existing fish consumption advisories for English sole would not change based on the observed 2017 or 2019 tissue concentrations. Based upon the smaller volume discharged on January 13, 2021 compared to 2017, long-term impacts to English sole and other fish or to those consuming them are not expected. An undocumented but potential short-term impact (< 2 hours) could have been temporary displacement in the vicinity of the outfalls due to disturbance from the physical force of the discharges.

Based upon the small amount discharged on January 13, 2021, no long-term impacts are expected to other marine organisms at all food web levels, including fish. Although some contaminants may bioaccumulate up the food chain, the discharge was very small relative to other inputs into Puget Sound. The most likely short-term impact to marine organisms not mentioned above would be temporary displacement of mobile organisms if they were in the vicinity of the outfalls during the discharges.

5.2 Lake Washington

Somewhat elevated levels of fecal indicator bacteria occurred in the vicinity of the East Pine CSO and at Howell Park to the north of the CSO on January 13, 2021 the day of the event. Warning signs were posted, and Madrona and Howell parks were closed. Samples collected the following day indicated that levels had declined sufficiently for Public Health to reopen the parks and beaches on January 15. Typical levels of bacteria were found in the vicinity of the Medina pump station on January 13 and levels remained low on January 14 and 15. Warning signs were posted at Medina Beach Park in Medina on January 13 and the park and beach were reopened on January 15. Although the warnings and closures deterred the use of parks and shoreline areas for two days, these actions minimized potential for human contact with any contaminated water.

No *E. coli* concentrations measured at any site approached the geometric mean or single value criteria of 100 and 320 cfu/100 mL, respectively (WAC 173-201A-200). The maximum *E. coli* concentration of 75 cfu/100 mL was measured at south Howell Park station on January 13, 2021. The bacteria sampling results were consistent with the relative magnitude of the overflows at East Pine and Medina (2.2 and 0.086 MG, respectively) and the prevailing strong winds from the south on January 13. Winds from the south would have tended to transport the discharge from the East Pine CSO toward

Howell Park to the north. Detailed studies of CSO discharges to Lake Washington have indicated that in the absence of thermal stratification (typical condition in January), discharge plumes rise through the water column and form an observable surface lens (Tomlinson et al., 1980). This lens might remain intact for as much as a day following an overflow. Larger particulates in the discharge settled near the CSO, but particulates in CSO discharges were relatively fine indicating a high potential for transport away from the outfall. The influence of inputs from nearby stormwater outfalls was also recognized (Tomlinson et al., 1980).

The ecosystem impacts of these events in Lake Washington is presumed to be limited due to the relatively small magnitude and duration of the discharges that occurred. No fish kills were observed by staff and none were reported by the public. Impacts that have been observed in the past are limited to uncontrolled CSO discharge and stormwater outfall locations with more frequent and relatively large releases (Tomlinson et al., 1980; King County, 2018b). East Pine is a controlled CSO. There are currently 41 CSOs along the Seattle shoreline. Of these CSOs there are 6 controlled and 1 uncontrolled King County CSO and 20 controlled and 14 uncontrolled Seattle CSOs that have discharged an average of approximately 32.4 MG annually to Lake Washington from 2015 to 2019.[3] In addition, a great deal of progress has been made in controlling Lake Washington CSOs. The annual average Seattle and King County CSO discharge to Lake Washington from 1995-1999 was approximately 176 MG.

On an annual average basis, CSOs typically contribute a relatively small portion of the overall contaminant loading to Lake Washington (Cerco et al., 2004; King County, 2013). For example, CSOs were estimated to contribute approximately 2 percent of the total PCB loading to Lake Washington (King County, 2013).

The primary concern with respect to CSOs has been for the potential for the accumulation of contaminated sediment in the immediate vicinity of CSOs affecting the health of invertebrates that live in the sediment. These organisms provide food for fish that forage along the shoreline. King County has sampled sediments in the vicinity of their CSOs and the most recent investigations have not found any contaminant concentrations above cleanup screening levels that would require further investigation (King County, 2018b). Analysis of contaminant levels in dated sediment cores from deeper, offshore locations in Lake Washington indicate that contaminant inputs to the lake and hence sediment contamination have declined substantially since the 1960s and 1970s (King County, 2020). However, concentrations of most contaminants remain above pre-industrial background levels.

Further evidence of limited ecosystem impacts of these CSO events may be found in the results of quarterly sampling of nearshore and offshore Lake Washington waters for trace metals and organic contaminants from 2006-2008. Although concentrations of metals such as copper, lead, and zinc were typically higher at nearshore locations, no trace metal

[3] A CSO is considered controlled when there is less than an average of one overflow event per year over the latest 20-year averaging period.

concentrations exceeded applicable water quality criteria for the protection of aquatic organisms, including fish and shellfish (King County, 2020a). Organic contaminants were rarely detected, and the observed concentrations did not exceed applicable water quality criteria for the protection of aquatic life.

These events also likely had negligible impact on those using fishery or shellfish resources. Washington Department of Health (WDOH) human fish consumption advisories exist for polychlorinated biphenyl compounds (PCBs) in common carp (do not eat), northern pikeminnow (do not eat), cutthroat trout (≤1 meal per month), and yellow perch (≤4 meals per month).[4] The manufacture of PCBs was banned in the U.S. in 1979, but a legacy of inputs and some continued authorized uses result in Lake Washington fish contaminant levels that pose a risk for human consumption. There is also a statewide WDOH advisory for mercury in northern pikeminnow (do not eat) and largemouth and smallmouth bass (≤2 meals per month). The Washington Department of Ecology (Ecology) has also listed Lake Washington as impaired (following Clean Water Act Section 303(d)) for mercury, PCBs, and a list of additional chlorinated organic compounds, including compounds related to the banned pesticide DDT (King County, 2020a).

WDOH advisories would not likely change in response to these single relatively small events. Like sediment contaminant levels, contaminant levels in fish also appear to be on the decline in Lake Washington. For example, large cutthroat trout total PCB, DDT, and mercury concentrations decreased by 55-75, 54, and 40%, respectively, between 2005 and 2015 (Seiders and Deligeannis, 2018).

[4] Washington Department of Health Fish Consumption Advisories: https://www.doh.wa.gov/CommunityandEnvironment/Food/Fish/Advisories, accessed March 22, 2021.

6.0 SUMMARY

A summary of Puget Sound and Lake Washington water quality following the discharges from the West Point Treatment Plant and several pump stations on January 13, 2021 is provided below.

Item #2. The consequences of the discharges to Puget Sound and Lake Washington ecosystems. All Puget Sound beaches that were sampled following the discharges, except near Pt. Wells, had elevated fecal indicator bacteria levels on January 13, 2021. Levels then declined over the next three days to typical conditions. Carkeek and the West Point south beaches exceeded the Beach Action Value bacteria levels only on the 13th. A Beach Action Level exceedance triggers a beach closure by King County DOH. Fecal indicator bacteria levels in Lake Washington in the vicinity of the East Pine CSO were slightly elevated on January 13, but declined by January 14. Bacteria were at typical levels near the Medina Pump Station all days sampled. Bacteria were not expected to impact Snohomish County beaches.

The ecosystem impacts of these events in both Puget Sound and Lake Washington are expected to be minimal due to the relatively small magnitude and duration of the discharges that occurred. No fish kills were observed by staff and none were reported by the public. Although some contaminants may bioaccumulate up the food chain, the discharge was very small relative to other inputs into both ecosystems. The most likely short-term impact to organisms would be temporary displacement (< 2 hours) of mobile organisms if they were in the vicinity of the discharges.

Item #3 The potential impact to water-adjacent landowners and visitors to water-adjacent facilities. Several Puget Sound beaches in King County were closed for swimming and recreational activities on January 13, 2021 and did not reopen until the 16th: Richmond Beach Saltwater Park, Carkeek Park, and Golden Gardens. The beach areas at Discovery Park did not reopen until January 18. Madrona Beach, Madrona Park, Howell Park, and Medina City Park along Lake Washington reopened on January 15. This action minimized potential for human contact but did not allow full recreational use of these beaches and/or waters during the beach closures. Beach walkers and park visitors could safely use the upper beach/park areas, but not close to the water. Water activities such as swimming, kayaking, and paddle boarding were disrupted during these days. No impacts to landowners or visitors to Snohomish County beaches were expected.

Item #4 The potential impacts to those using fishery and shellfish resources. All King County beaches along the eastern shoreline, and their adjacent offshore waters, are closed to recreational and commercial shellfish harvest by WDOH due to pollution concerns related to their proximity to urban areas with sewage treatment outfalls and stormwater runoff. Therefore, no impact to those using shellfish resources along the King County shoreline occurred due to the discharges. However, WDOH closed the Port Madison Shellfish Growing Area and the Kingston Shellfish Growing Area from the southern growing area boundary north to Apple Cove Point in Kitsap County for all species on January 13,

2021 due to the West Point discharges as a precautionary measure. The areas opened to shellfish harvest on February 3. No impacts to those using fish or shellfish resources in Snohomish County beach or offshore waters were expected based on the duration and amount discharged.

Based upon the small amount discharged on January 13, 2021 no impacts to those consuming marine fish or shellfish are expected. WDOH fish consumption advisories in Lake Washington would not likely change in response to the relatively small amount discharged in relation to other inputs, but sediment and fish contaminant levels appear to be on the decline in Lake Washington.

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After Action Report Summary

The King County Wastewater Treatment Division (WTD) has examined the events that led to unpermitted sewage discharges on January 13, 2021, from West Point Treatment Plant (West Point) and overflows from three WTD facilities. Table ES-1 lists the WTD facilities, the quantities overflowed, and the receiving waters.

Table ES-1. January 13, 2021, Unpermitted Discharges by Facility.

Facility	Bypass/Overflow Quantity (gallons)	Receiving Water
West Point Treatment Plant	11,000,000	Puget Sound
Richmond Beach Pump Station	160,000	Puget Sound
East Pine Pump Station	2,200,000	Lake Washington
Medina Pump Station	86,000	Lake Washington

This After Action Review (AAR) Self-Assessment Report provides a record of WTD's examination and resultant findings, staff actions, and lessons learned to avoid future similar overflows at these and other WTD facilities. The report also provides recommendations and near- and long-term actions to be taken by WTD to improve resiliency of its operating strategies.

During the late night and early morning of January 12 and 13, 2021, the Seattle area experienced significant winter storm conditions. Winds over 30 miles per hour caused electrical utility power disruptions at several WTD facilities, and rainfall of 2.33 inches on January 12, in particular, caused high flows to the facilities. As a result, wastewater could not be adequately pumped out of the facilities and instead discharged into Puget Sound and Lake Washington.

The bypass at West Point and overflows from the pump stations were precipitated by automated electrical protective devices turning off the variable frequency drives (VFDs) that power the large wastewater pumps and control their speeds. It has been determined that these automated pump shutdowns were caused by power disruptions, likely due to the high winds of the night's storm affecting transmission lines. The protective devices monitor the quality of power supplied by the electrical utility and protect the VFDs and pump motors by shutting down if voltage fluctuates beyond predetermined limits.

Once the power is again of sufficient quality, some VFDs will automatically attempt to restart the pump while others require an operator to manually initiate a restart. If a VFD fails to automatically restart a pump, an operator must verify that there is no other reason for that failure and restart the pump by manually activating the VFD. The standby generators at the pump stations did not operate during these events because the power disruptions were very brief. The generators only start when utility power is exceeded for more than 5 seconds.

ES-1: West Point Treatment Plant Bypass

Just after midnight on January 13, West Point was operating at its maximum capacity of 440 million gallons per day (MGD). Power disruptions to the plant caused both running pumps in the intermediate pump station (IPS) to stop. This resulted in the diversion of flow leaving the primary treatment process (primary effluent) to be re-directed to the chlorine mix structures for disinfection, bypassing the plant's secondary treatment processes. At the chlorine mix structures, the bypassed primary effluent mixed with fully treated effluent still draining from the secondary clarifiers. This large volume of combined flow then passed to the effluent pump station (EPS). This flow caused the level in the EPS wet well to rise, lifting float switches that caused the primary sedimentation tank effluent gates to close, preventing more flow from inundating the EPS.

Because flow from the primary sedimentation tanks was prevented from being released, their levels began to rise and lifted float switches that caused the shutdown of the raw sewage pumps and the closure of the plant's wastewater influent control structure (ICS) gates. This, in turn, caused levels to rise in the ICS and the emergency bypass gate to partially open, beginning the bypass of approximately 11 million gallons of untreated combined sewage (wastewater and stormwater) into Puget Sound for about 103 minutes. This time was required for the plant operators to reestablish flows within the plant, coordinate the resetting of equipment, and bring the IPS and EPS pumps back online in a coordinated manner to end the bypass.

It should be noted that this event could have resulted in an outcome similar to the plant flooding event of February 2017. Since that time, West Point has performed more frequent equipment maintenance and operator training for emergency situations. During the January 13 event, flooding of the plant was avoided by stationing operators at critical positions in the plant, enabling the facility's systems to be operated properly. The control system operated as designed to protect the plant from flooding.

ES-2: Richmond Beach Pump Station Overflow

Just before midnight on January 12, the Richmond Beach Pump Station was running three of its four pump sets and was able to maintain levels in the wet wells as designed. The station's fourth pump set was undergoing maintenance and not available. Minutes before midnight, the pump station experienced utility power disruptions, which caused the operating pumps' VFDs to go through an automated restart sequence. Utility power was never fully interrupted for more than 5 seconds, and the standby generator was not activated. Interruption in pump operation caused the wet well level to rise, and a float switch was lifted, switching the station control logic to its standby fill-and-draw mode.

Poor power quality persisted, and two of the three operational pump sets failed to restart after several attempts. One pump set remained running, but was not able to keep up with the high inflows. The wet well level rose, causing the outfall gate to open and overflow to Puget Sound. An operator was dispatched and arrived at the pump station just before 1:00 a.m. They were able to reset the two pump sets that had stopped and reset the station's wet well level control to its primary level control mode, ending the overflow event.

ES-3: East Pine Pump Station Overflow

Just after midnight on January 13, the East Pine Pump Station experienced utility power disruptions which caused the station's control logic to switch to its standby fill-and-draw mode. In this mode, the wet well level control depends on a preselected set of bubbler system pressure switches to control the wet well water level. Unfortunately, the valves that isolate the wet well level sensing pressure switches from the station's instrumentation and control system had been improperly left closed after recent maintenance. In this position, the pressure sensors could not provide a proper signal, so the pumps that had stopped remained offline.

Normally, a high wet well alarm would have been visible to the main control operators at West Point on their primary control panels. However, telemetry at the pump station was not available due to service restrictions with communication lines at the time of the event. A backup signal (Metrotel) of the high wet well alarm was provided through different lines to MC on a different monitor (Metrotel console). At 12:07 a.m., the Metrotel console recorded a wet well high-level alarm in text format that was not immediately noticed by the operator due to their high volume of work. At approximately 9:00 a.m. on the morning of January 13, an operator arrived at the pump station and recognized that the pump system was not operating normally and that an overflow was occurring. They manually switched the pumps on, thereby lowering the wet well level and ending the overflow event.

ES-4: Medina Pump Station Overflow

Just after midnight on January 13, the Medina PS was running two large VFD pumps and was able to maintain level in the wet well as designed. Minutes after midnight, the pump station experienced utility power disruptions that caused the large VFD pumps to go through an automated restart sequence. Interruption in pump operation caused the wet well level to rise and a float switch was lifted, switching the station control logic to its standby fill-and-draw mode. The disruption to utility power was not an interruption that lasted more than 5 seconds so the standby power generator was never called on to power the station.

For the next several minutes, two large VFD pumps and two small constant speed pumps attempted several automated restarts. The two smaller pumps successfully started. However, the larger pumps' VFDs are older and less tolerant of voltage variances; therefore, they failed to restart and remained offline. The two smaller pumps were unable to maintain the wet well level due to heavy incoming flows. The wet well level rose and began to overflow at 12:15 a.m. Poor utility power quality persisted until about 12:50 a.m. When the large pumps' VFDs detected utility power of sufficient quality they successfully restarted the pumps, which lowered the wet well level and ended the overflow event.

ES-5: Post-event Activities

Following the bypass and overflow events, WTD's AAR team examined historical digital data (trends, alarm logs, etc.) and interviewed operators and other staff to verify the sequence and timing of events that led to the wastewater discharges. The team also reviewed reports on past events to develop this report and to make recommendations for near- and long-term improvements.

AAR meetings were also held with WTD Operations and Maintenance staff to discuss the events to determine what should have happened, what actually happened, what went well and what did not go well, and what needed to be improved upon to lessen the likelihood of future

events and/or reduce their severity. Information from these meetings helped to accurately characterize details related to the events and to develop the following list of recommended action items.

Table ES-2. Actionable Recommendations from Unpermitted Discharge Events of January 13, 2021.

Item	Actionable Recommendation
West Point 1	Study and recommend power reliability improvements for West Point. Implement requirements outlined in Washington State Department of Ecology Administrative Order 19477 (2/1/2021) and King County emergency declaration related to West Point power reliability.
West Point 2	Determine root cause of emergency bypass gate not opening entirely. Determine risk to health and human safety if gate does not open entirely.
Off-site Facilities 1	Evaluate the possibility of bringing the standby generator online when utility power quality or reliability is questionable. Investigate VFD limits to undervoltage and standby generator call parameters to ensure the generator is online before VFDs reach their undervoltage limits and protective devices cause pump shutdowns.
Off-site Facilities 2	Review and bring up-to-date East Pine, Richmond Beach, and Medina Pump Station operations manuals, control descriptions, and pumping system mechanical layouts and instrumentation diagrams for consistency with the current pump station conditions.
East Pine Pump Station 1	Provide the bubbler system check and purge during weekly site inspections. Test the backup and standby systems monthly to ensure that the systems can take over when called upon. Provide external indication of backup level control system components by installing a window on the panel.
East Pine Pump Station 2	Change Metrotel data to appear on the Ovation screen at West Point Main Control.
East Pine Pump Station 3	Become a priority customer of Lumen Communications, and work closely with them to solve service and telemetry problems.
Richmond Beach Pump Station 1	Complete pumping system maintenance repairs required to bring standby pump set online. Maintenance items have been identified in ongoing work orders.
Richmond Beach Pump Station 2	Add alarms to the SCADA system to indicate when VFDs operate in the bypass mode (bypassing temperature and vibration alarms on pumps and motors).

Medina Pump Station 1	Near-term, dispatch an electrician to be on-site to handle any electrical issues during significant wind/storm events. In the long-term, upgrade VFD and standby generator. Currently, implementation for VFD upgrade is planned for quarter 3 of 2021 and standby generator upgrade is planned for 2022.