

TECHNICAL MEMORANDUM



To: Kristen Homel – Oregon Department of Fish and Wildlife
From: Joe Parzych and Josh Epstein - Inter-Fluve
Date: June 3, 2019
Re: Sandy River Delta Chum Project: Year 2 Monitoring Data Summary



Sundial Island – Sandy River looking downstream with Sundial Island at right. Photo by Josh Epstein – InterFluve.

INTRODUCTION

The Oregon Department of Fish and Wildlife contracted Inter-Fluve in 2016 to assess the potential of Sundial Island for supporting a chum spawning channel. Sundial Island is located at the mouth of the Sandy River at the confluence with the Columbia River in Multnomah County, Oregon. This memorandum summarizes Year 2 (2017 - 2018) hydrology monitoring data for the Sandy River Delta Chum Project.

FIELD METHODS

A total of eight Hobo U-20L pressure and temperature sensors were deployed at groundwater and surface water monitoring stations in and around Sundial Island between October 2016 and October 2017 (Figure 1). Three sensors were placed in surface water stations in the Sandy River and south side channel (S1, S2, S3). Four sensors were placed in groundwater observation tubes that were installed roughly 12 feet beneath the ground (P1, P2, P3, P4), and one sensor was placed in a tree to correct other sensors for changes in atmospheric pressure. Sensors were surveyed using RTK GPS.

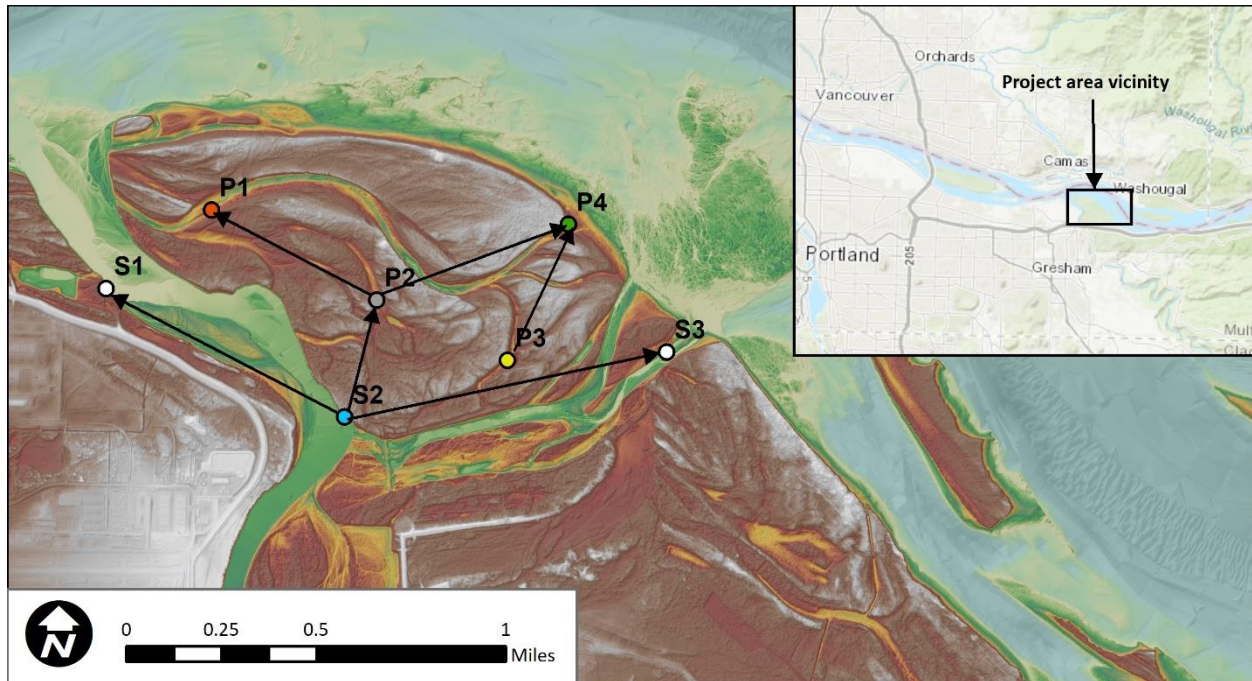


Figure 1. Groundwater and surface water monitoring stations in the study area. Lines between water level sensors were used to calculate water table slope.

Several sensors were either dislodged from their position or stolen during year 1 monitoring (Table 1). Sensors S1 and S3 were re-deployed and have been included in this Year 2 analysis.

Table 1. Water level sensor installation history.

Sensor name	Sensor start	Sensor end	Notes
S1	10/25/2017	7/30/2018	Relocated 10/25/2017 due to sedimentation. Installation is under power lines.
S2	10/30/2016	2/1/2018	Hole from 6/13/17 to 7/19/17. Sensor vandalized in 2018.
S3	10/25/2017	7/30/2018	Relocated 10/25/2017 due to piezometer damage.
P1	10/30/2016	7/30/2018	
P2	10/30/2016	7/30/2018	
P3	12/13/2016	7/30/2018	Original sensor (P5) was stolen, replaced with P3 on 12/13/2017.
P4	10/30/2016	7/30/2018	

DATA SOURCES

Hydrology data were downloaded from the Columbia River gage at Vancouver (NOAA #9440083) and the Sandy River gage at Bull Run (USGS #14142500). LiDAR data from 2010 were downloaded from the Lower Columbia River Estuary Partnership. Water surface elevation and temperature data were obtained from Hobo U-20L pressure sensors, while RTK GPS were used to survey their location.

RESULTS

The period of interest is November 1 to April 1, which is when chum salmon are likely to be present in the area. The following section splits the time series into two periods for analysis and ease of viewing the data.

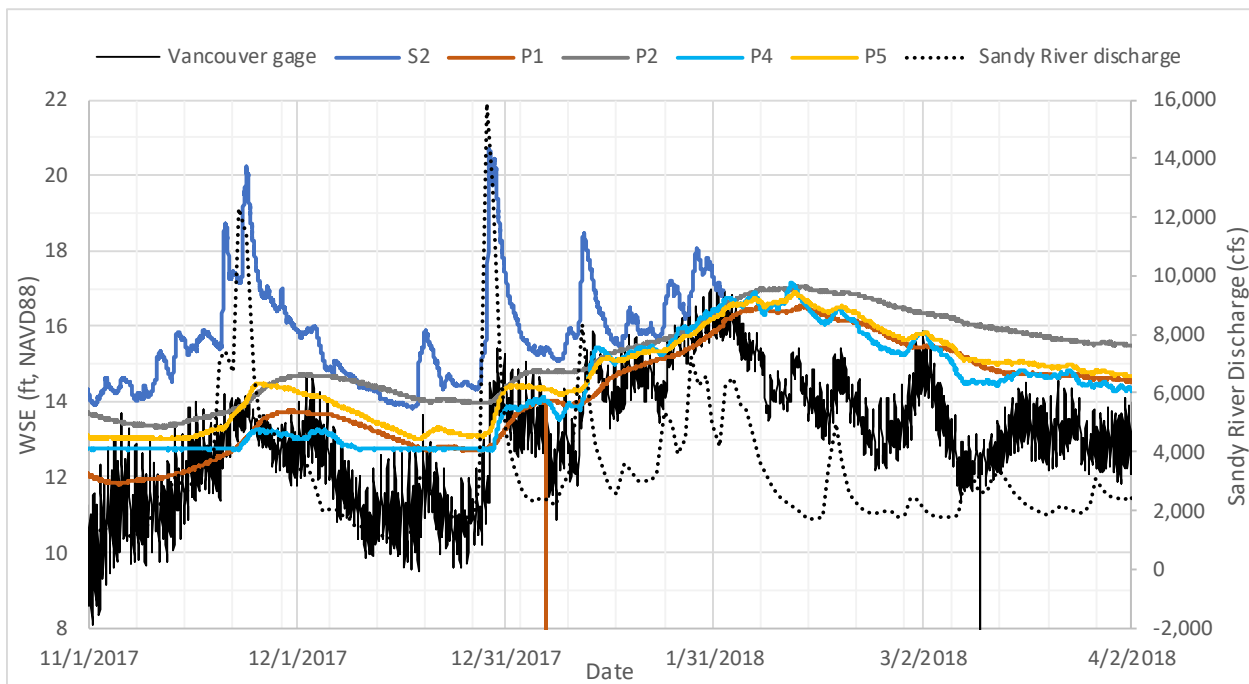


Figure 2. Water level sensor data from November 1, 2017 through April 1, 2018.

November 1, 2017 to February 1, 2018

The first period of interest is between November 1, 2017 and February 1, 2018. S2 has the highest water surface elevations, followed by P2, P3, P1, and finally P4. S2 is primarily influenced by Sandy River discharge, as would be expected given its position in the delta, and relatively moderate Columbia River stages during this time (Figure 3). S2 is always at a higher stage than the Columbia River.

P2 typically has higher stages than other groundwater sensors. Sandy River hyporheic flows travel through Sundial Island, recharging groundwater at P2, which slowly “leaks out” after the peak has passed. P4 has the highest fluctuations of any groundwater sensors, and is most closely related to the Columbia River tidal cycle, even showing daily fluctuations in stage related to the Columbia River. This may be due to close proximity to the Columbia River, or due to higher subsurface hydraulic conductivity at P4. P4 has groundwater elevations that are lower than P1 during low Columbia River stages because P1 receives more hyporheic flow from the Sandy River. P4 does have higher water surface elevations than P1 during high Columbia River stages.

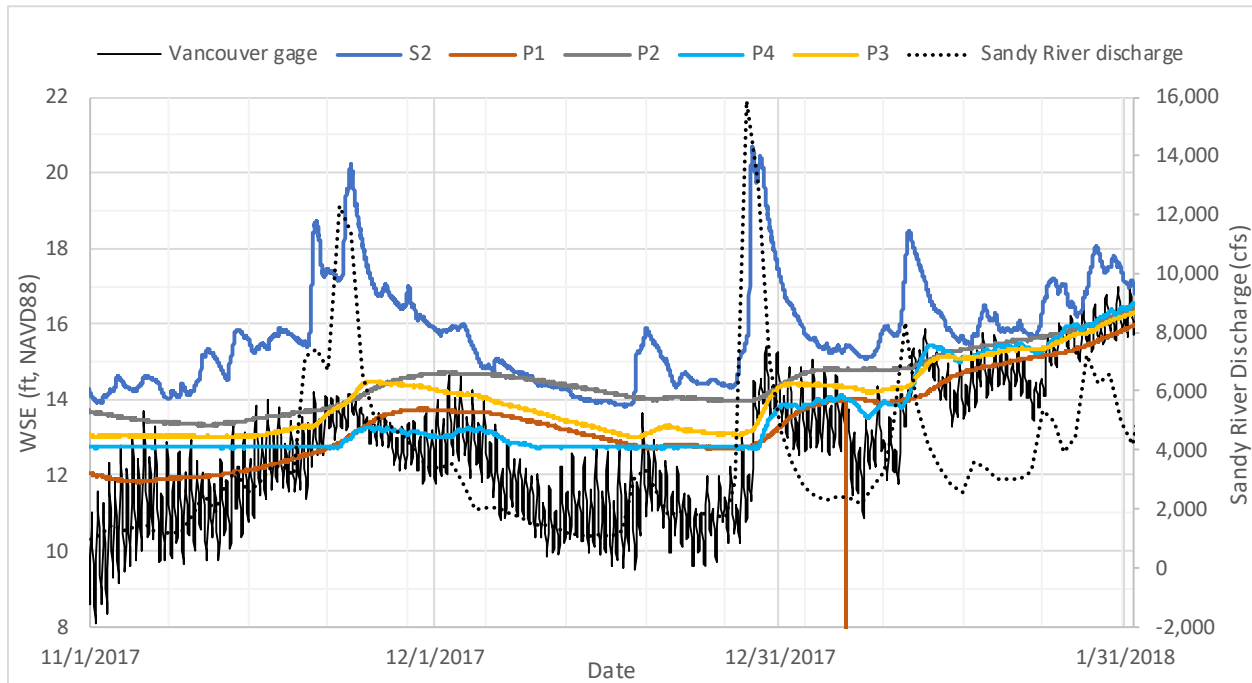
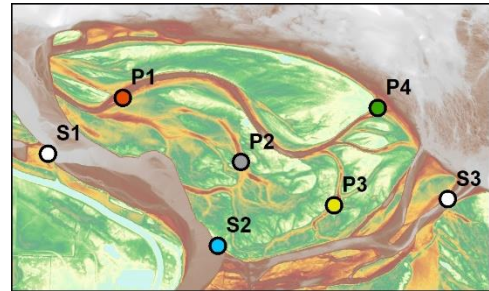


Figure 3. Water level sensor data from November 1, 2017 through February 1, 2018.

Water table slopes between sensors were calculated to evaluate water table dynamics and head gradients in the study area (Figure 4). Slopes between S2 and P2 are most variable, due to high variability in S2 surface water elevations. P2 to P4 slope is consistently high, and is higher than P2 to P1 except when Columbia River stages meet or exceed Sandy River stages. This is because P1 is more strongly connected to Sandy River hyporheic water, while P4 is more heavily influenced by Columbia River. P2 to P1 has consistently high slope, and is more consistently positive than P2 to P4 due to higher connectivity to Sandy River hyporheic flows. P3 to P4 slope fluctuates with a similar shape as P2 to P4, but at a typically lower slope. Slope between P1 and P4 was analyzed but not shown in figures, and averaged around zero. S2 to S1 showed consistently positive slope, indicating that the Columbia River did not backwater the Sandy River between these two sensors for the period of interest.

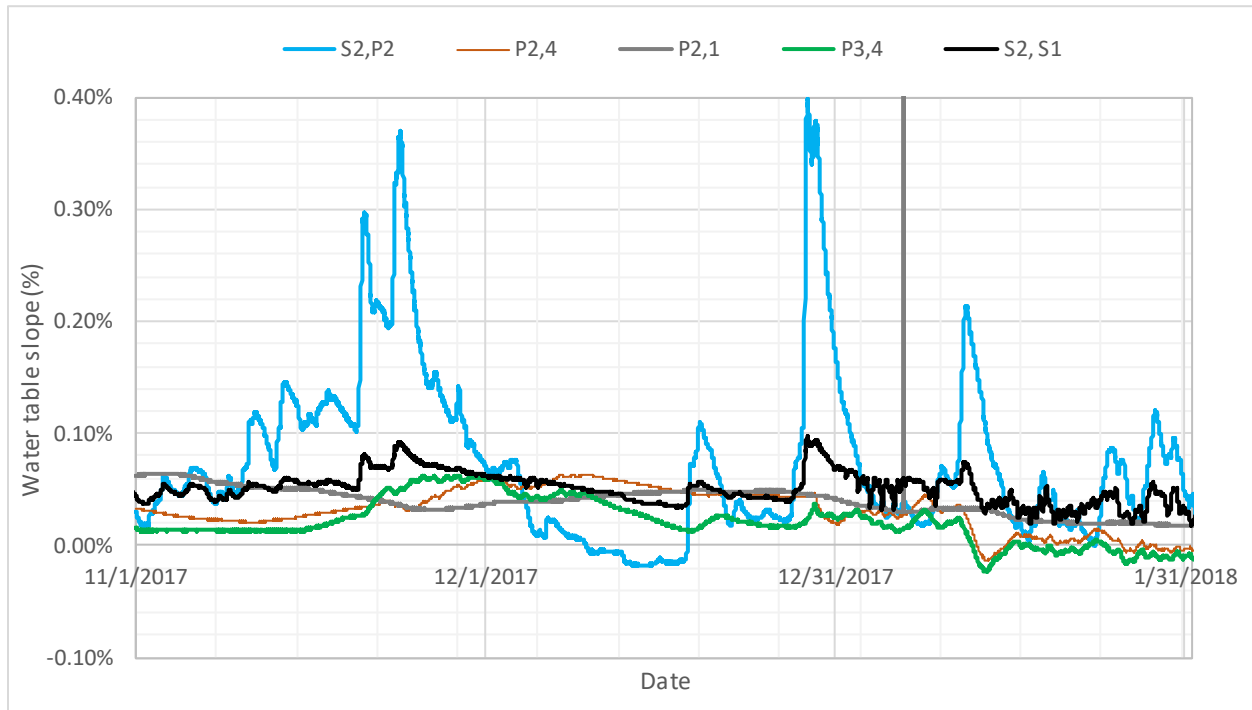
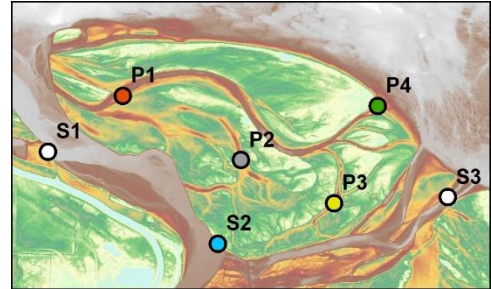


Figure 4. Water table slope between sensor locations from November 1, 2017 through February 1, 2018. Horizontal distance measured on a straight line between points.

Surface water slopes were also analyzed relative to the groundwater table slope between S2 and P2. S2 to S1 fluctuates similarly to S2 to S3 but with lower variation and consistently positive slopes. The negative slope from S2 to S3 shows that the Columbia River backwatered the south side channel for a period of time. The water table slope between surface and groundwater (S2 to P2) has greater variability than surface water slopes because S2 responds rapidly to stage changes, while P2 responds more slowly after water has percolated through the ground.

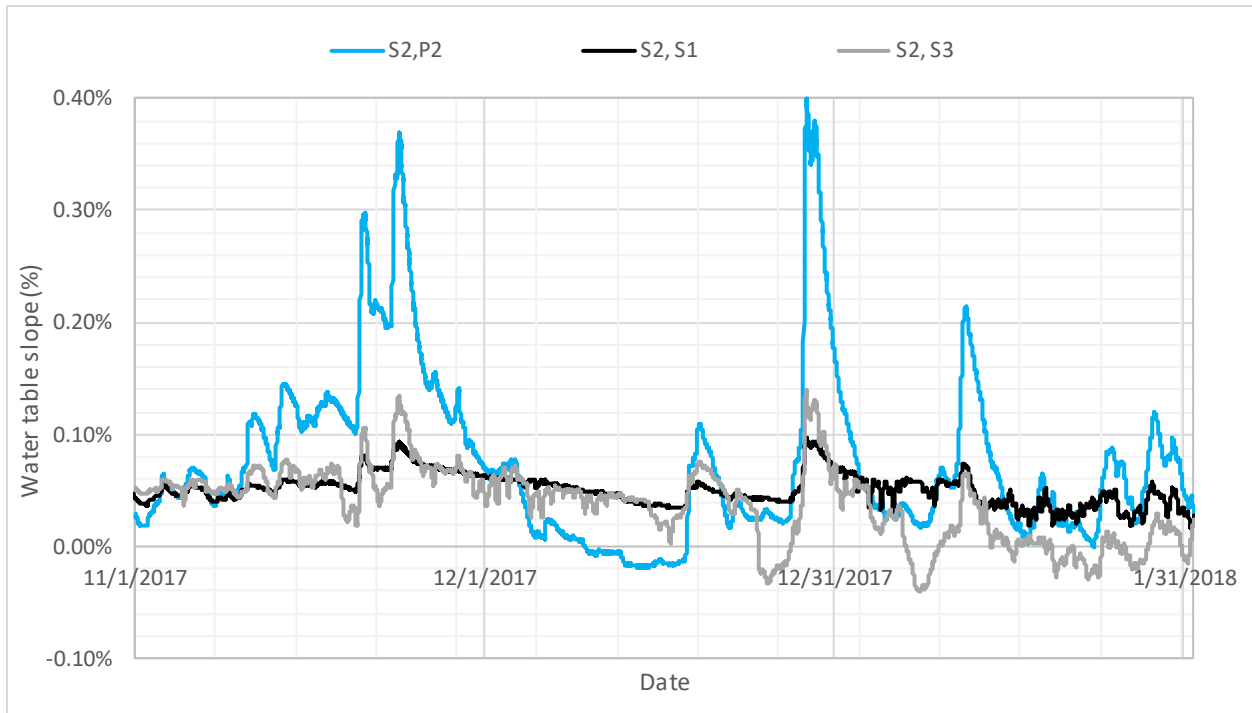


Figure 5. Water table slope between sensor locations from November 1, 2017 through February 1, 2018. Horizontal distance measured on a straight line between points.

February 4, 2018 to April 1, 2018

The second period of interest is between February 1, 2018 and April 1, 2018. Water surface elevations during this period are higher and dropping in magnitude over time. P2 has the highest elevation, followed by P3, P1, and S2. The relative elevation of P2 is variable, depending on Sandy River discharge and Columbia River stage. P2 appears to be least sensitive to changes in Columbia River stage, as it has the longest lag time relative to changes in the Columbia River. This may be due to lower hydraulic conductivity compared to other sensors, or the greater distance from this sensor to surface water.

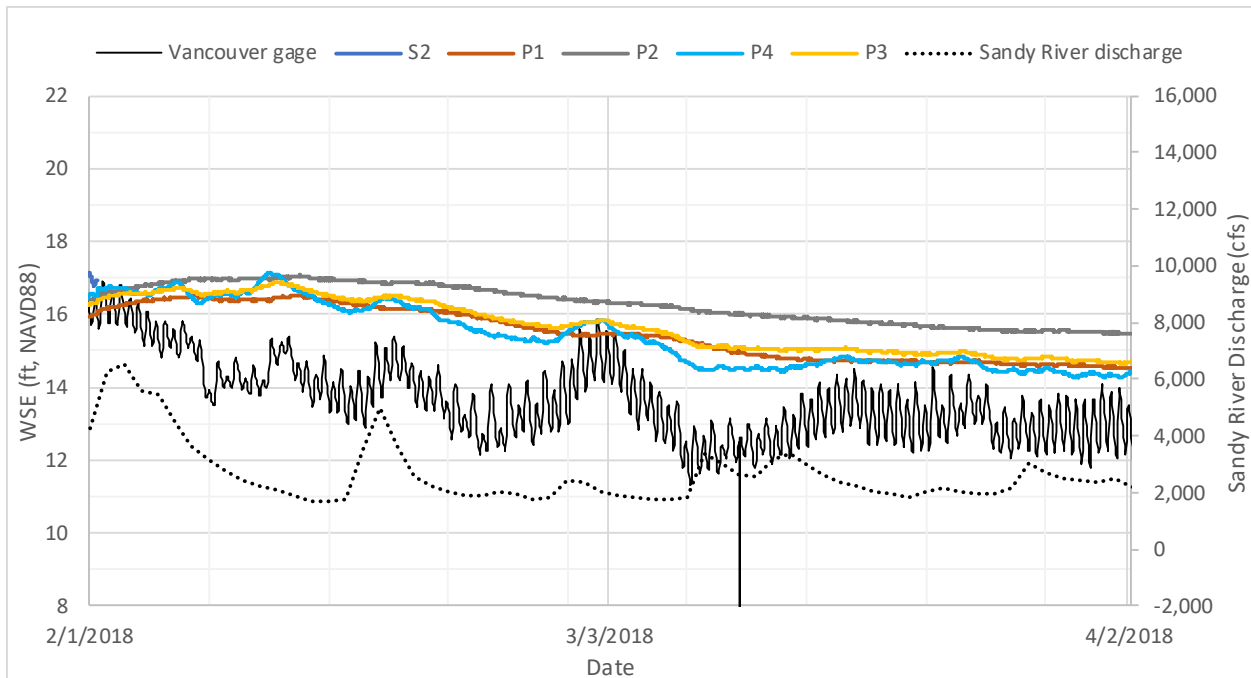
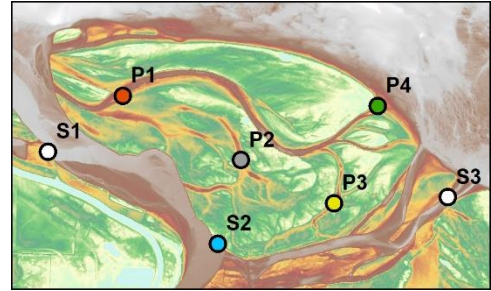


Figure 6. Water level sensor data from February 1, 2018 to April 1, 2018.

Sensor S2 was vandalized before data were downloaded for this period, therefore it is not included in this February through April time series analysis. Slopes from P2 to P1 are most stable, while P2 to P4 and P3 to P4 are more variable, and exhibit negative slopes for a portion of the period. P2 to P1 has the most time with a positive slope compared to the other sensors. Hydraulic conductivity may be lower at P1, or it is more dampened from surface water fluctuation due to greater distance from surface water.

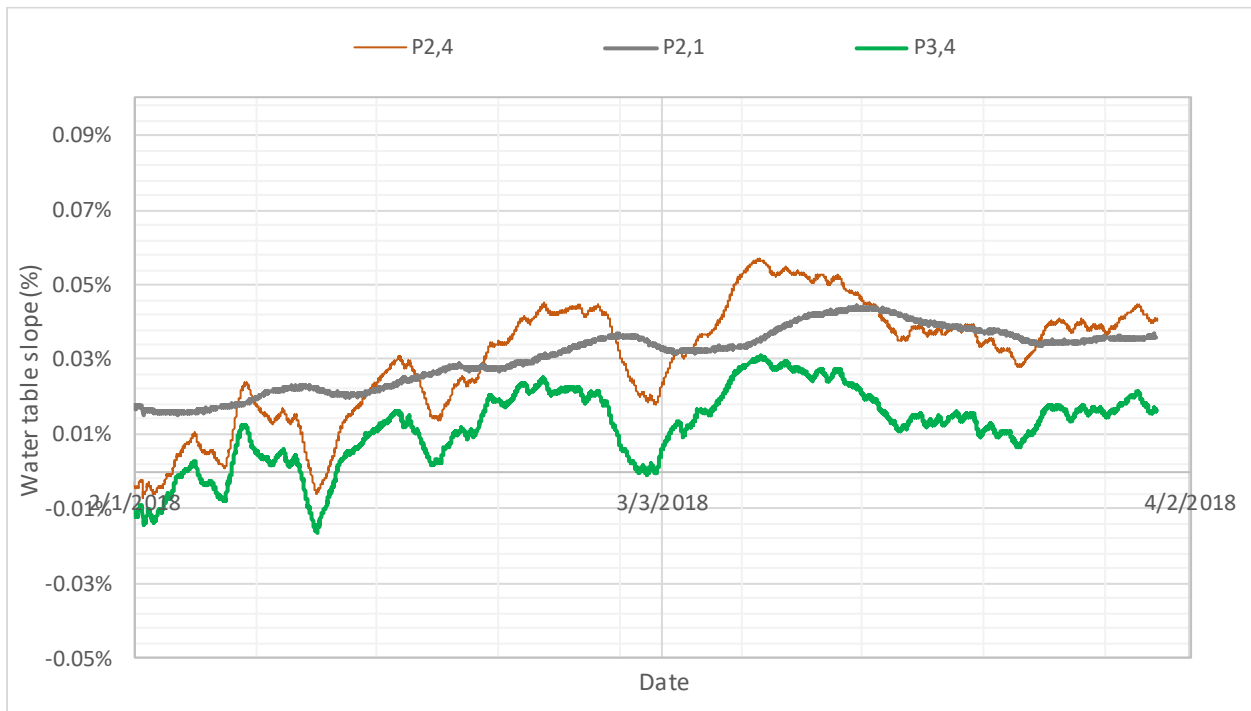
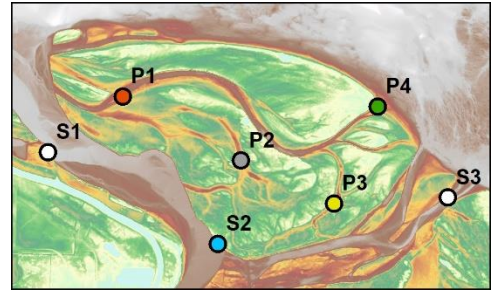


Figure 7. Water table slope between sensor locations from February 1, 2018 through April 1, 2018. Horizontal distance measured on a straight line between points. Sensor S2 not included because it was vandalized before data from this period were downloaded.

CONCLUSIONS

This analysis presents preliminary findings from year 2 surface water and groundwater monitoring at Sundial Island. Local water table slopes between sensors ranged during the period of interest (November through April) from to 0.05% to -0.02%, with the majority of slopes between 0.04% and 0.0%. The water table is sloped in a primarily north-south direction, with groundwater stages controlled by both Sandy River stage and Columbia River stage. Sensors P1 and P2 appear to be most influenced by Sandy River hyporheic water, while P4 is more strongly regulated by the Columbia River. The groundwater slopes between P2 and P4 were relatively high, and least affected by Columbia River stage compared to other relationships analyzed. This is either due to higher connectivity with Sandy River hyporheic flow, lower hydraulic conductivity of subsurface material, or greater distance between the sensors and surface water. A more thorough feasibility analysis of a potential chum spawning channel at the site is included in a separate memorandum.