Siuslaw Estuary Partnership

An Integrated Multiple Objective Approach To Watershed Protection and Restoration

April 7, 2011

TO: Water Quality and Quantity Team

FROM: Mike Miller, Florence Public Works Director

Subject: Status Report on Water Monitoring Program

The Surface Water and Groundwater Monitoring Program commenced in October 2010. City Public Works staff and consultants from GSI Water Solutions, Inc. have completed five rounds of groundwater sampling and water level measurements and four rounds of surface water chemical and microbiology testing. Future sampling events are planned and schedules for that sampling have been prepared.

The reports for the most recent groundwater and surface water monitoring are presented below. The reports for all other groundwater and surface water monitoring to date are attached; please see these reports for a detailed description of the program. The monitoring program provides technical data on water quantity and quality. When sufficient sampling data are available, staff will prepare a report that describes what the data mean, including any data trends detected. This should occur in the next six to eight months and the report will be posted to the web site: www.siuslawwaters.org.

The most recent lab analyses were not available in time for this report. The most recent sampling done at the end of February/first of March was for the full sampling, i.e., all constituents, and the full analyses were not available at the time this report was prepared. All of the lab work will be included in a full report by mid April that will include all of the most recent sampling, including the new monitoring wells.

Groundwater:

Water Quantity: Variation in Water Table Elevation.

In the past reports, we have been reporting the relationship between precipitation and water table elevation as a function of one of two measurement sites. Since February's report, we have acquired an additional five sites in the area for a total of 7 stations across the dunal aquifer (see Figure 1). The precipitation data in figure 1 reveals the extent of the variability during the month of February. Precipitation amounts varied from 5.58 to 7.5 inches, with an average of 6.58 inches, approximately an inch less than fell in January. Although there is an apparent decrease in precipitation amounts from south to north, these data are very preliminary and no conclusions can be reached at this time.

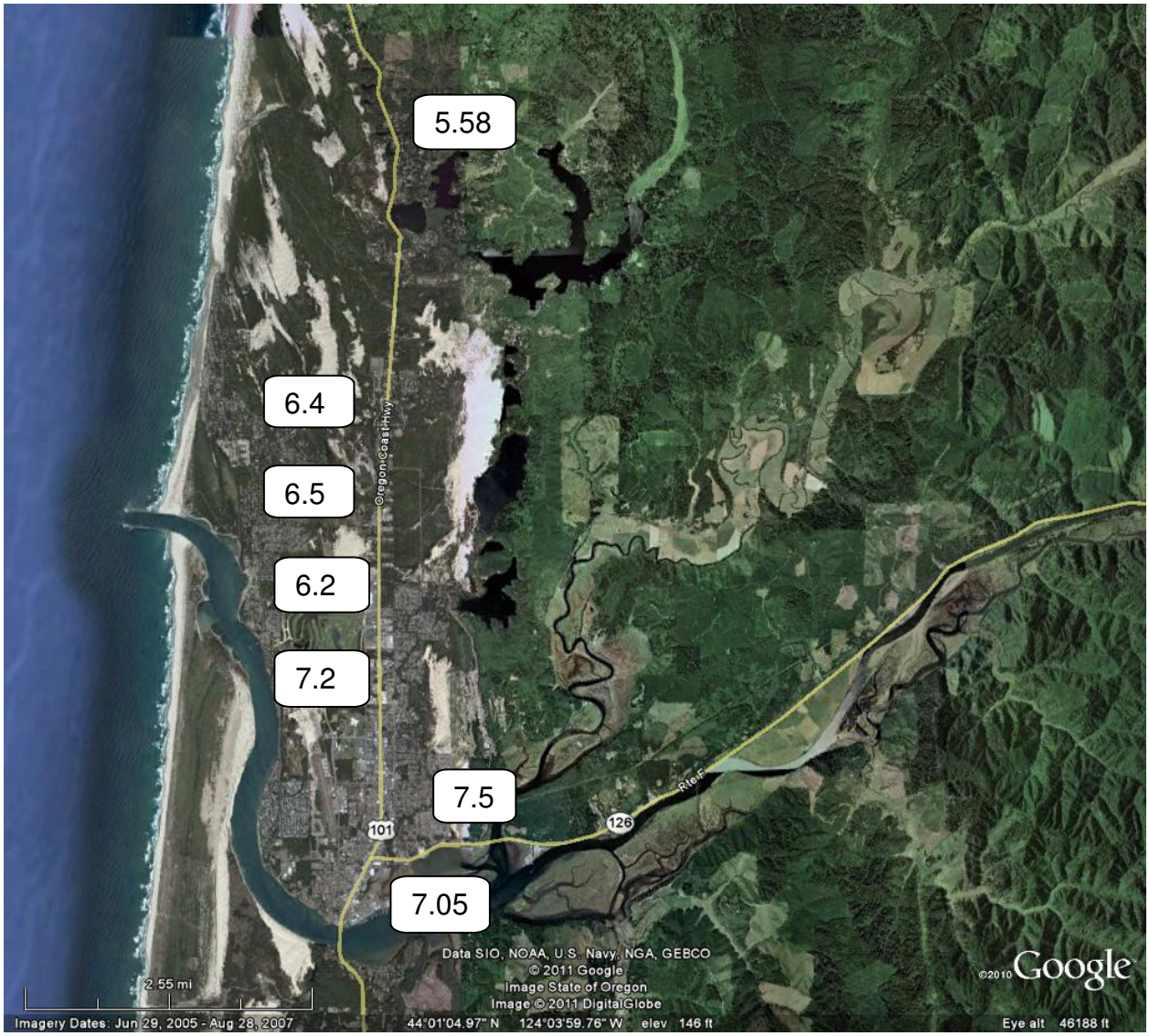

Figure 1. Florence area rainfall amounts in inches for the month of February, 2011.
Table 1 below provides the hydraulic head (elevation as feet above mean sea level) of the water table at monitoring well locations for four sampling events. The 9/29-10/1 set of samples were measured by the well constructors at the time the wells were installed. The remaining head levels were measured by City or GSI staff. Red indicates a decrease in hydraulic head, i.e., a decline in the water table, and the color blue indicates an increase in hydraulic head, i.e., a rise in the water table, since the previous measurement.

As described in previous reports, the water table dropped during the relatively dry period in late September to mid October, but, with the increased rainfall, and perhaps reduced pumping, it has been rising. The relation between water table rise and rainfall reported during the mid-October to late November interval was approximately 0.12 ft of rise per 1.0 in of rain. Between the early December and January measurement, ~14-15.5 inches of precipitation fell, resulting in hydraulic head increases varying from

<1foot (B-1) to >4 feet (see B-2) equivalent to 0.003 to 0.30 ft rise per inch of rain. With the exception of B-1, the infiltration rate and subsequent rise in water table was greatest along the shoreline, and less on the eastern side of the City (compare B-2 (shoreline) to B-7 (inland east) in Figure 1). Rainfall in the time elapsed between January and February sampling times varied from 7.2 to 7.95 inches and produced a change in the water table from -0.01 to 0.14 ft/in, in a similar pattern to that observed in the December-January interval. In February, the change in the water table varied from -0.129 to +0.073 ft/in of rain.

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Water Quantity: Hydraulic Head Distribution

The hydraulic head data is of fundamental importance with respect to achieving a better understanding of groundwater movement and its relationship with nearby surface water bodies. After six periods of measurement, the head data observed remains generally consistent with previous interpretations of groundwater movement. However, it would appear that, in contrast to the flattening of the water table observed in the last report, the gradient has actually steepened slightly towards the groundwater discharge areas, i.e., the Siuslaw River and the ocean. Heads have declined in the monitoring wells those areas while heads have increased in the more inland wells.

Well	Head (ft-msl) 9/29-10/1/10	Head (ft-msl) 10/14-10/18/10	Head (ft-msl) 11/22-12/1/10	Head (ft-msl) 1/7/11	Head (ft-msl) 2/8/11	Head (ft-msl) 3/1/11
B-1	26.88	26.23	28.73	28.78	28.68	28.48
B-2	46.26	45.36	45.97	50.31	51.36	50.49
B-3	50.06	49.61	51.17	54.86	55.94	55.06
B-5	86.74	86.24	89.34	90.04	90.04	90.09
B-6	57.72	56.92	58.61	60.97	61.27	61.47
B-7	39.48	39.28	41.23	42.28	42.34	42.5
B-8	33.61	34.06	35.38	37.76	37.81	38.31
B-9	26.62	25.92	27.62	30.37	30.42	29.93
B-10	13.21	13.06	13.76	16.36	16.51	15.97
B-11	9.74	9.24	10.3	11.04	10.84	10.43

Table 1. Hydraulic head (elevation above mean seal level (msl)) of groundwater in the Florence Monitoring Wells. Heads have been rising, associated with increased precipitation and lower temperatures (less evaporation.

Figure 2. Approximate water table elevations in the Florence area. White numbers represent measurements in early March, 2011; yellow numbers represent data from new monitoring wells installed at the end of March, 2011. Water table contour elevations are feet above mean sea level. Groundwater gradient is much steeper to the west than to the south.

The distribution of hydraulic head or elevation of the water table is shown in Figure 2. Of note is that the data is mixed with respect to time with the white elevation numbers representing measurements collected in early March (Table 1) while the yellow data represents information collected when the new monitoring wells, B-12 to B-16, were drilled. If the pattern shown here holds up through subsequent measurements, the westwards slope of the water table is significantly greater than was earlier recognized (See figure 3 in the previous report).

Water Quality

City staff sampled groundwater on February 28th (B-1, B-2, B-3, B-5, and B-11) and March 1st (B-6, B-7, B-8, B-9, and B-10). Table 2 shows results from water quality data collected using the YSI probe.

Table 2. Water quality parameters collected from wells using the YSI probe.

SITE ID	WATER LEVEL BGS (FT)	TEMP (°C)	SpCond (uS/cm) adj. 25 °C	DO (mg/L)	pH (S.U.)	ORP (mV)	Comments
B-7	5.58	12	42.9	6.5	6.19	297.3	
B-6	9.15	11.8	82.2	0.8	5.56	52.7	
B-8	3.5	11.2	167.4	5.2	5.6	79.1	ODORS
B-9	5.59	11.2	105.2	0.1	5.27	204.2	ODORS/MILKY
B-10	16.74	12.7	139.3	2.8	5.68	239.9	
B-11	17.61	12	131.6	1.4	5.5	299.8	
B-11	17.61	12	131.5	1.4	5.46	280.6	
B-5	5.55	12.6	85.2	0.1	5.57	-72	
B-1	7.1	11.1	132.3	0.1	5.85	-144.8	ODORS/DIRTY
B-3	13.4	11.1	148.6	3.5	5.5	292.1	
B-2	18.17	11.8	194.8	9.5	5.84	313.9	DIRTY

As in January, dissolved oxygen (DO) in groundwater from the City's monitoring wells exhibits a considerable variation (Table 2). As suggested in the February 2011 report, the DO of precipitation at temperatures of approximately 12°C and atmospheric pressure is approximately 10.5 mg/L. Lower values seen here may reflect microbial activity as the water encounters organic matter, either indigenous or added by surface activities.

The lower pH values, less than 7.0, reflect typical values for precipitation which interacts with atmospheric CO_2 and forms carbonic acid (H_2CO_3). As precipitation/groundwater interacts with aquifer materials, the pH tends to increase to values of 6.5 to 8.0. Consistent with what we know about groundwater movement in the aquifer, the pH values suggest little such interaction.

Also showing marked variation is the specific conductance, i.e., conductivity, a measure of the total dissolved ions in solution (TDS = ~0.5 Specific Conductance). Fresh water typically has specific conductance values of <100 uS/cm, e.g., see Munsel Creek data in Table 3 below. Average specific conductance values observed in Florence's groundwater from October, 2010 to March, 2011 are shown in Figure 3.

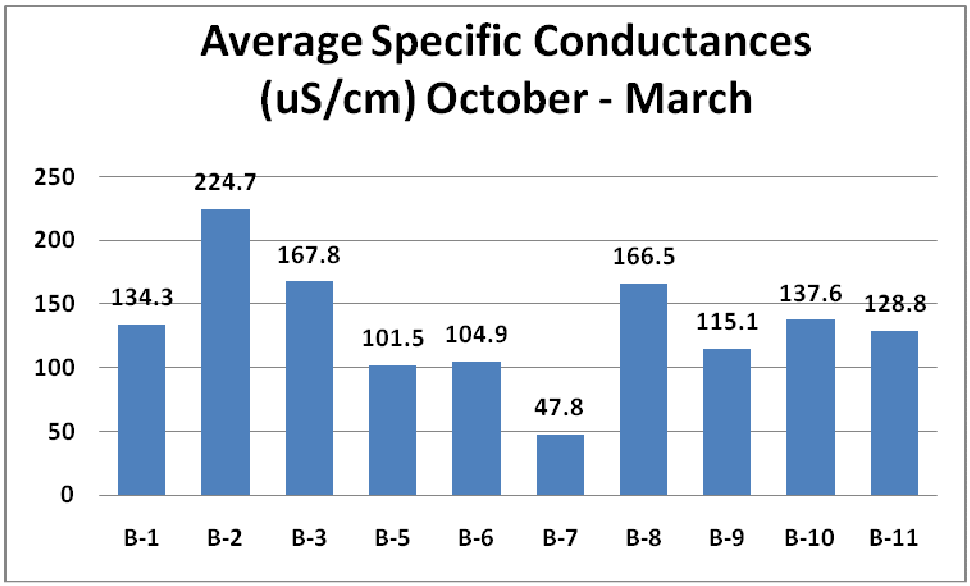

Figure 3. Average specific conductance values (uS/cm) for the 10 monitoring wells active over the period October, 2010 to March, 2011. Average values over the period are shown above each data column.

Specific conductance values tend to be higher near discharge areas (B-1, B-2, B-3 B-8, B-10, B-11) and lower further away from the discharge areas (B-5, B-7). Exceptions do occur, e.g., B-6 and B-9. Variations are observed over the time period with most being less than 100 uS/cm. B-7 shows the smallest variation (42.9 – 80.5 uS/cm) while B-2 shows the greatest variation (117.8 – 407.5 uS/cm). Even considering these individual variations, the relationship between conductivity and position relative to discharge areas remains unchanged.

It is considered unlikely that the higher specific conductance values closer to the discharge areas indicate a mixing of brackish waters in the estuary or with the ocean (specific conductance > 50,000 uS/cm). It is assumed that the increase in conductivity along groundwater flow paths represents interactions between groundwater and aquifer matrix and/or influence from surface activities.

Surface Water

Water Quantity: Streamflow

Streamflow was greater on March 3rd than February 2nd, a difference ranging from nearly 4 cfs near Munsel Lake Road up to approximately 9 cfs at the Public Works site. The notable water quality differences (see below) at the Munsel Lake Road site may be associated with the change in streamflow and an influence of Munsel Lake that does not reach sites farther downstream.

Figure 4 indicates the variation in stream flow rate (cfs) from the “headwaters” (upstream from Munsel Lake Rd) to near the outflow (near the Public Works site) over

the period from late October-early November to early March. From December to March, we observe, in general, an increase in flow rate in Munsel Creek as we proceed downstream. The exception is the late October-early November sampling.

The increase in flow rate observed from December to March indicates that Munsel Creek is gaining as it flows downstream. At present it is not known how much contribution comes from tributaries, groundwater, or storm water outflow. With respect to groundwater, as discussed previously, the increased rainfall resulted in an increase in the elevation of the water table, particularly seen in monitoring wells 5, 7, and 11, those closest to Munsel Creek, and inflow to the stream is certainly possible.

The decrease observed in the November flow rate between the upstream and midstream sites may reflect the lack of significant rainfall in October, and falling water table elevations in most monitoring wells (see Table 1 above).

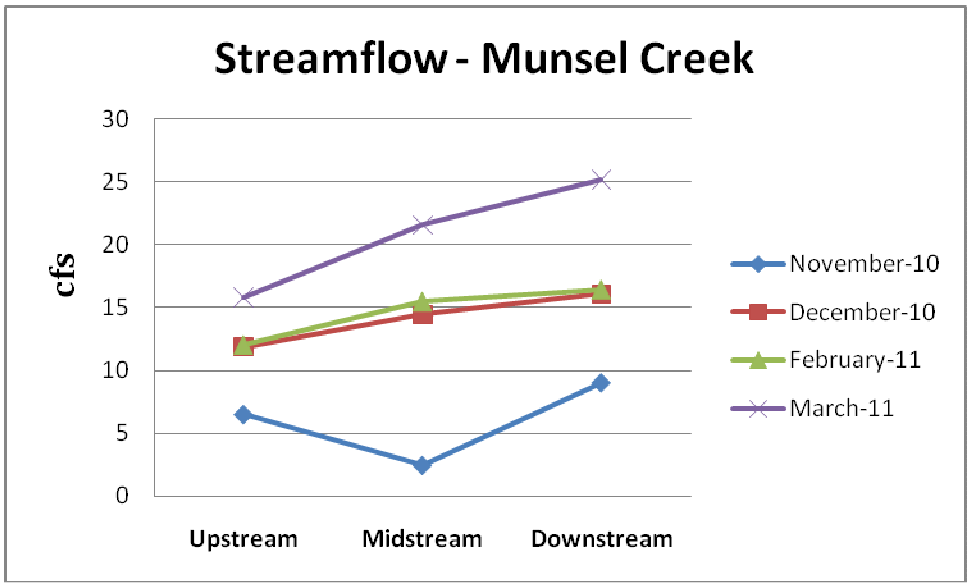

Figure 4. Stream flow (cfs) measured in Munsel Creek during the period from November, 2010 to March, 2011. Upstream site is above Munsel Rd, midstream site is at Greenway Park, and downstream site is near the Public Works facility.

Water Quality

Sampling of Munsel Creek and Ackerley Creek occurred on March 2nd. The March readings shown in Table 3 have a similar range to the Jan 31st readings, except that the temperature dropped a full degree Celsius and dissolved oxygen increased almost 1 mg/L at the site near Munsel Lake Road.

Table 3. Water quality parameters collected from surface water using the YSI probe.

Site	Water Temp (°C)	pH	DO (mg/L)	DO (%)	SpCond (uS/cm), adj. 25 °C	Turbidity (NTU)	ORP (mV)	Streamflow (cfs) (3-3-11)
Munsel Creek at Public Works on Spruce St.	8.7	7.03	10.6	92	72.8	2.05	156.4	25.21
Munsel Creek at Munsel Greenway Park	8.4	6.66	10.7	92	69.8	1.56	150.1	21.58
Munsel Creek upstream of Munsel Lake Road	7.6	7.15	11.8	99	61.9	0.69	172.8	15.82
Ackerley Creek upstream of Martin Road	7.8	7.18	11.3	95	60.5	0.73	194	-

In March, OWRD and GSI staff installed two pressure transducers, one in Munsel Creek near Munsel Lake Road on March 3rd and the other in Ackerley Creek on March 14th. The pressure transducers are now recording water level every 15 minutes.