Who Will Participate in the Lateral Bay Campaigns (**please fill-in / correct**):

PI	Participants?	Task(s)
Lerczak	Lerczak Lemagie Haugland Thomas	Forerunner cruise leader CTD with: DO, FLNTU, PE, CDOM, altimeter; ADCP measurements; will need assistance with water sample pumping system. Bottom lander measurements: ADCP, microcat, other sensors; assist in planning, deploying, maintaining ADCP at SAT-04
Levine	Langner	help with R/V Forerunner preparations and cruises
Needoba	Needoba Gilbert Ben Li 3 Grad Stds	Biogeochemical sampling aboard R/V Forerunner (2 people, working one 12 hr shift per day). Time series sampling at SAT04 for nutrients, chlorophyll and CDOM (4 people to cover the shifts at MERTS, 2 people per 12 hour shift)
Peterson	Nyerges 2 Undergrads	Coordinate interaction with Pacific University (Gyorgi Nyerges)
Prahl	Prahl Zirbel Shumway	Running / maintenance of FMA; SPM – POC/PN – Pigments – Methane – dissolved Mn^{+2} sampling at SAT-04 GC/FID analysis of methane samples at MERTS
Simon	Simon Hayes	ESP? still in development – with fingers crossed; DNA / RNA sampling during Neap / Spring hourly time series
Tebo	Matthew Jones Anthony Rigoni	Mn(II), Mn(III), particulate Mn at SAT-04 Sampling aboard R/V Forerunner (Mn speciation) Help w/ time series sampling at SAT04, sampling processing/archival
Crusius	???	Equilibrator work for Rn measurement (USGS collaboration)
Others	???	

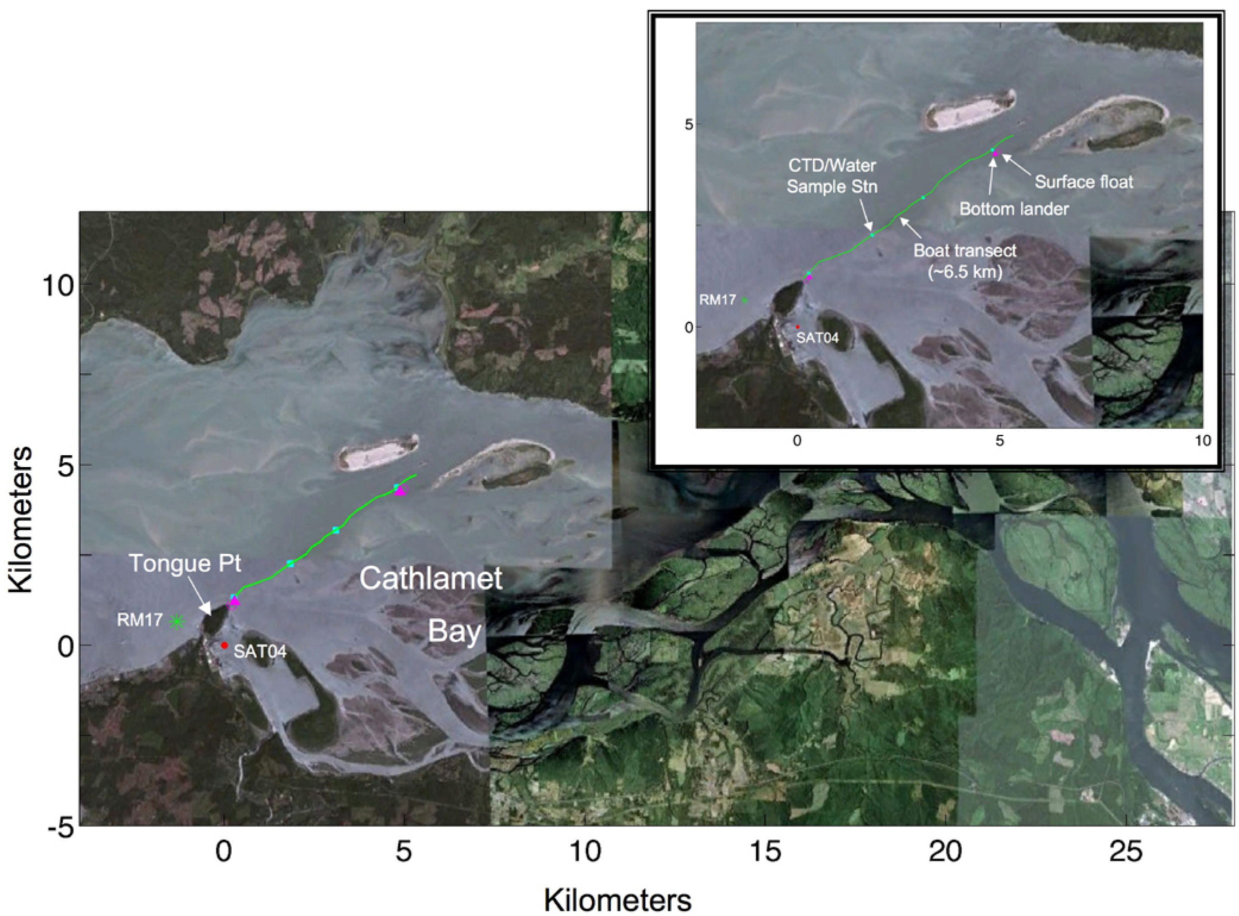
General Perspective

The overarching goal of this initiative is to establish the contribution of Columbia River Estuary lateral bay ecosystems to the biogeochemical and ecological function of the coastal margin. Our working hypothesis is that the lateral bays of the Columbia River estuary are biological and biogeochemical 'hotspots' due to their (1) increased residence time relative to the estuary proper and (2) their significant interaction with the land margin through tidal 'pumping'. Distinct and diagnostic transformations of dissolved and particulate biogeochemical constituents inherited from downstream flow of the river occur within the lateral bay environments. Moreover, since lateral bays are found within both the lower marine-influenced and upper freshwater-influenced reaches, they provide an excellent opportunity for comparative biogeochemical study.

Material flux is controlled by organic matter production / remineralization in the lateral bays and a tidal pumping phenomenon. An overarching goal of this initiative is to answer the following two questions: 1) What are the major transformations of nutrients and particulate carbon in the lateral bays? And, 2) to what extent do these settings contribute to the total flux of carbon (POC, DOC, DIC), dissolved oxygen, reduced chemical species (Mn, Fe, CH_4, NH_4^+), and nutrients (dissolved inorganic and organic N and P) into the lower CR estuary?

Our initial investigations in 2012 into the biogeochemistry of lateral bays will focus on Cathlamet Bay, the major freshwater intertidal region at the head of the Columbia River Estuary. The investigations will be done as two campaigns: 1) a high river flow, spring freshet (May 29 – June 5) and 2) a low river flow (September 9-19) forcing of the estuary. The first campaign has been completed. The second campaign is now imminent and this organizational document is focused on its planning.

Fig. 1. Google Map image of Cathlamet Bay showing locations of measurement stations to be occupied during the lateral bay initiative field campaign in the spring of 2012. Intensive biogeochemical and physical sampling will occur at the SAT-04 observatory and on a transect along the boundary between Cathlamet Bay and the main Columbia River channel (green line) on the R/V Forerunner. Water samples and CTD profiles will be collected at stations along this transect (cyan squares) every hour for two twelve hour periods during neap tide (September 10-11) and spring tide (September 17-18) conditions. Bottom landers (magenta triangles) with upward looking acoustic Doppler current profilers (ADCPs) and conductivity, temperature, depth instruments (CTDs) and surface floats (magenta circles) with surface CTDs will be deployed for the duration of the spring campaign (September 9 - 18) at the mouths of channels that drain Cathlamet Bay during ebb tides.



Low Flow, Late Summer Campaign (see Tongue Point tide and current charts – Fig. 2)

When?

The low river flow, late summer campaign will be conducted over the time frame from September 9-18, 2012. September 9 will be used for purposes of experimental setup, both at the fixed sampling site (SAT-04) and for the R/V Forerunner cruise. In this window of time, two periods of observation / sampling will be emphasized: 1) neap tide (September 10-11) and spring tide (September 17-18) forcing of Cathlamet Bay. Predicted tidal height and current velocity conditions proximate to SAT-04 for each of these observation / sampling periods are shown the Fig. 2.

Where?

SAT-04: This established CMOP site (see Fig. 1) will be equipped so that a large number of concerted physical, chemical and optical measurements can be made either autonomously or by discrete manual means over the time periods of interest. The collective set of measurements will be interpreted in the context of the role that biogeochemical exchange with this intertidal, peripheral largely freshwater bay plays in the grand scheme of carbon cycling in this river-dominated, estuarine ecosystem. Much of the infrastructural requirements for set-up were accomplished during the first campaign in May-June 2012. These requirements will be identified below along with a brief explanation of their importance to the campaign goals.

R/V Forerunner: Measurements aboard this vessel will be made to quantify net biogeochemical fluxes between Cathlamet Bay and the Columbia River channel and their dependences on tidal amplitude (Fig. 2). Surveys will be made along a transect at the boundary flank between the Bay and the river channel and runs from Tongue Pt. and runs 6.5 km up estuary along the flank. Time series measurements of currents, temperature, salinity and stratification will be made at two locations along the flank at drainage channels of Cathlamet Bay.

What?

SAT-04: This fixed monitoring site is (or soon will be) equipped with sensors for measurement of T, S, DO, pCO2 / pH, ISUS nitrate, Chl-Fl, NTU and CDOM at two depths (surface and near bottom). Continuous measurements of these dissolved and particulate properties of water at this tidal outlet from Cathlamet Bay will be made on a duty cycle of once every ~15 min at each depth over the ~10 day time period of the low flow, late summer campaign. Effort has been (or is being) made to assure that the calibration for each sensor is up-to-date and the data acquired will be of highest quality.

The same set of sensors have been or are being installed at SAT-05, the fixed monitoring site located up river and managed through collaboration of CMOP (headed by Joe Needoba) with the USGS, Portland Water District. pCO2 / pH will be the only water column attribute that is not monitored at SAT-05 during the low flow, late summer campaign (see Infrastructural Needs below).

In addition to the remote measurements just mentioned, SAT-04 will be equipped in a way that will allow us to make a variety of additional measurements over the ~week-long time period of the low flow, late summer campaign.

- Our cavity ringdown IR spectrometer for methane analysis (FMA) was successfully interfaced in late spring 2012 with a showerhead equilibrator. This instrumental design accomplishment allowed us during the first high flow, spring freshet campaign to monitor at high temporal resolution (1 Hz) changes in methane concentration in the tidally modulated outwash for surface waters from Cathlamet Bay at SAT-04. Development of the showerhead equilibrator interface has eliminated the detrimental problems of operating the FMA in waters of relatively high particle load that were presented when this methane detector was interfaced with a membrane contactor and previous used in proximity to Cathlamet Bay. The greatest operational impediment in this development effort was one of evaluating instrument response time. Does the instrument respond to changes in methane concentration sufficiently fast for our study purposes? Results from our first campaign yielded a resounding YES! to this question. In the upcoming campaign, we will make an effort to collect data using this device throughout the weeklong campaign, not just during the 24 hr neap and spring tide sampling periods.

  Just before the first campaign, a dialogue with John Crusius (USGS) was started to put a device in SAT-04 that would allow us to evaluate, through analysis of dissolved radon, whether or not significant groundwater input was present in the tidal outwash from Cathlamet Bay. This device could not be brought on-line quick enough to use during the first campaign, however John Crusius will participate during the upcoming second campaign. The instrument for dissolved radon measurement, like the FMA, also uses a showerhead equilibrator interface. There is room in the shed at SAT-04 to accommodate this instrument.

- Our autonomous profiling nutrient analyzer (APNA) will not be used during this second campaign. It was setup and run unsuccessfully during the first campaign. The cause for its failure to perform remains under investigation. (NOTE: Joe/Missy – if this prognosis is not correct, please replace my prose with a more explicit description of status.)

  Collaboration with Wetlabs was done during the first campaign. A Cycle-Ammonia analyzer, currently under development by Cory Koch, was set up at SAT-04. The instrument did not successfully run and the reason for its failure to perform remains under investigation. At this time, there is no intention to try again with the Cycle-Ammonia in the second campaign (NOTE: Cory – if this prognosis is not correct, please replace my prose with a more explicit description of status.)

- Water samples from both a surface and bottom depth will be taken hourly over 24 hr time periods during both the neap tidal and spring tidal forcing observational periods (see Fig. 2). The water will be obtained using the existing pump that now supplies water to sensors permanently running at SAT-04 (see Infrastructural Needs below). The samples to be taken include: 1) nutrients, 2) CDOM, 3) dissolved methane, 4) dissolved manganese, 5) SPM from gravimetric weight and total manganese / aluminum determination by ICP-MS, 6) POC and PN content, 7) HPLC pigments (chlorophyll a and carotenoids), and microbiological / molecular biological measurements (DNA and RNA). As soon as possible after the samples are obtained, they will be taken to MERTS and processed for storage and later analysis back in the lab or immediate analysis (methane by gas chromatography – flame ionization detection) at MERTS.

In the high flow, spring freshet campaign, water samples were also collected for pCO2/TCO2 analysis. Results from analysis of these samples revealed a problem for which we currently have no clear solution. Mercuric chloride preservation of these freshwater samples yields an artifact on the carbonate chemistry that renders the data completely unreliable. The only clear solution at the moment is to run all samples for pCO2/TCO2 as soon as they are collected. We are not prepared in this second campaign to take on such a task and so no pCO2/TCO2 samples will be collected.

Infrastructural Needs at SAT-04

1. Install a valve on the outlet to the SAT-04 pump so that discrete water samples can be taken. The plumbing of this outlet should be done to assure that the gas content of samples is not compromised. Suitable plumbing was accomplished in the first campaign. During the course of that work, a sink and other improvements to the design were made. If this set-up is assured for the second campaign, then the second campaign will proceed smoothly in this regard.

   Just before the start of the first campaign, all lines from the pump intake through the set of sensors on SAT-04 were replaced. This action was done since biofouling in the lines could compromise some of the biogeochemical measurements taken as a critical, integral part of the Lateral Bay Campaign. We need assurance again that all plumbing from the pump intakes through the SAT-04 sensor package is clean and 100% clear of biofouling.

2. AC (120V / 230V) power at instrument shack. This requirement was accomplished just before the first campaign. If this set-up is assured for the second campaign, then all will proceed smoothly in this regard.

3. A plywood shelf (~20" wide x 60" long) was attached inside the shed for the first campaign so that the fast methane analyzer (FMA), the showerhead equilibrator and associated plumbing could be set-up. Availability of this shelf for the second campaign is required. As discussed with Michael Wilkin, the size of this shelf can be scaled down somewhat to provide more clearance and better access to the shed for on-demand maintanence. Also, a smaller plywood shelf (~15" wide x 24" long) could be attached above to provide more options for instrument setup and economy of space in the shed.

4. Install a well pump to deliver water to the shed for operation of the FMA and Rn – showerhead equilbrators. Put some sort of particle screen on the pump intake to filter out large particulate debris and thereby prevent plugging. Use 1" o.d. x 7/8" i.d. plastic tubing for the supply line to the shed. In the shed, install two 'tees" and ball valve for each so that a controlled flow rate can be diverted to the FMA – equilibrator (thru on 'tee') and another possible equilibrator (ground water discussion / potential collaboration with John Crusius, USGS). The plastic supply line for the FMA – equilibrator is 1/2" o.d. x 3/8" i.d. and so, we will need to accommodate this step-down in diameter by some sort of reducing union.

This requirement was successfully met for the first campaign. If this set-up is assured for this second campaign, all is good to go in this regard.

5. Arrange for space at MERTS to process and analyze samples taken at SAT-04. Nothing special is required of this space other than counter top, access to AC power and tap water. (NOTE: no toxic chemicals are required or will be used). The storage / utility room that Michael Wilkin provided the CMOP group for the first campaign would work perfectly.

6. Do not install new Sunburst flow-thru pCO2 sensor. The waste introduced to the flow-thru water by this instrument is in conflict with other biogeochemical sampling that will be done during this campaign. Keep the existing SAMI-pCO2 deployed at the surface for this campaign. At present, we cannot provide any data assurance for pCO2 results since it is unclear how calibration samples can be taken and stored reliably for later analysis (see earlier comments).

7. Deploy bottom-mounted ADP proximate to SAT-04 so that flux measurements can be derived from monitored chemical / optical properties in time series. This request was met soon after the first campaign began. If this set-up is again assured for the second campaign, then all will proceed smoothly in this regard.

8. Provide the Lateral Bay Campaign Leader (Fred Prahl) with the name of a contact person at Job Corps so that a call can be made to arrange a viable plan for transport of samples / sampling gear back-on-forth between SAT04 pier and MERTS lab. This back-and-forth activity must occur hourly over two 24hr periods (i.e. Neap and Spring tide series) if this second campaign is to be successful.

R/V Forerunner: The R/V Forerunner will be used to deploy and recover bottom landers and surface floats during the field campaign and conduct tidal (12 hr) surveys along the flank between Cathlamet Bay and the Columbia River channel. Bottom lander/surface float pairs will be deployed at two locations along the boundary between the bay and the river channel to make continuous time series measurements of current profiles and surface and bottom temperature and salinity and will be located at two side channels that likely funnel water off the intertidal regions of the bay during ebb tides (Fig. 2). The landers and surface instruments will be deployed for the duration of the low flow, late summer campaign (September 9-18).

Measurements along a 6.5 km transect that borders the bay and the river channel (Fig. 1) will also be made aboard the R/V Forerunner to quantify spatial and temporal variations in currents, temperature and conductivity and biogeochemical concentrations. Repeat surveys of the transect will be made hourly over a 12 hour period for two days during neap tide (September 10-11) and spring tide (September 17-18) conditions.

Continuous measurements of current profiles will be made using a hull-mounted 1200 kHz ADCP as well as a 1200 kHz ADCP mounted to a pole off the side of the boat. The side-mounted ADCP will be deployed close to the surface so that the first current bin will be about 1 m below the surface. Continuous surface measurements of temperature, salinity and chlorophyll fluorescence will also be made utilizing the boats flow through system.

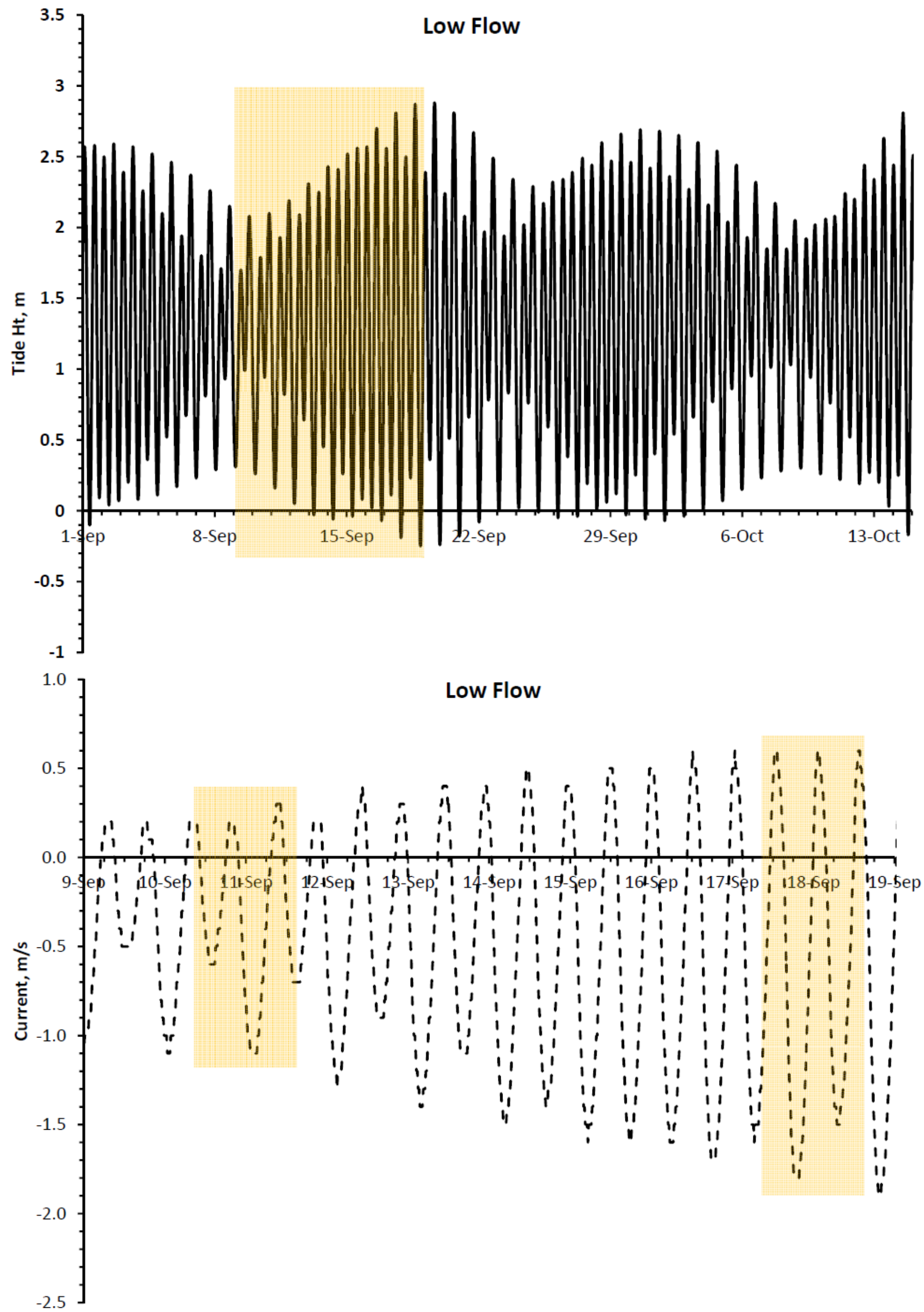
Hourly CTD profiles and water samples will be collected at four stations along the transect (**we could do more if the work load for the biogeochemical sampling can be accomodated**).

Profile measurements will include conductivity, temperature, pressure, dissolved oxygen, chlorophyll fluorescence, turbidity, CDOM, phycoerythrin fluorescence and height above bottom. Pumped water samples will be collected at two depths (surface and near bottom) and will be analyzed for concentrations of nutrients, methane, dissolved Mn/Fe, and CDOM.

Infrastructural Needs for R/V Forerunner Work

1. Deploy bottom mounted ADCP (another outlet from Cathlamet Bay, see Fig. 1)
2. Equip w/ pole-mounted ADCP (in addition to unit mounted in hull) w/display
3. Equip w/ CTD (T, S, Chl-Fl, NTU, DO, altimeter) and real-time display
4. Establish a water sampling capability using the CMOP pump system (to obtain nutrient, methane, dissolved Mn/Fe, CDOM, POC/PN?, chlorophyll? samples)
5. Ability to log ship’s navigational data

Figure 2. Tidal height and current predictions for Tongue Point obtained using Nobeltec Tides & Currents software (www.nobeltec.com). The highlighted portions of each indicate the period of time when observations / sampling will be made remotely / discretely during the low river flow, late summer campaign.



Neap Tide Forcing (LFN#-Asc#, B or S)

					Who/Where									
					OSU	OSU	OSU	OHSU	OHSU	OHSU	OHSU	OHSU	Tebo	Forerunner
Date	Tidal Ht, m	Sample Code	Bottom, Asc#	Surface, Asc#	#1	#2	#3	#1	#2	#3	#4	Jones	Rigoni	'Crew'
9/10/2012 10:00	1.78	LFN1	1	2		Zirbel	Shumway	Missy	Taunya	Sheree	Leslie			Joe, Estefania
9/10/2012 11:00	1.77	LFN2	3	4		Zirbel	Shumway	Missy	Taunya	Sheree	Leslie			Joe, Estefania
9/10/2012 12:00	1.62	LFN3	5	6		Zirbel	Shumway	Missy	Taunya	Sheree	Leslie			Joe, Estefania
9/10/2012 13:00	1.39	LFN4	7	8		Zirbel	Shumway	Missy	Taunya	Sheree	Leslie			Joe, Estefania
9/10/2012 14:00	1.16	LFN5	9	10		Zirbel	Shumway	Missy	Taunya	Sheree	Leslie			Joe, Estefania
9/10/2012 15:00	0.99	LFN6	11	12		Zirbel	Shumway	Missy	Taunya	Sheree	Leslie			Joe, Estefania
9/10/2012 16:00	0.95	LFN7	13	14		Zirbel		Missy	Taunya	Sheree	Leslie			Joe, Estefania
9/10/2012 17:00	1.08	LFN8	15	16		Zirbel		Missy	Taunya	Sheree	Leslie			Joe, Estefania
9/10/2012 18:00	1.35	LFN9	17	18		Zirbel		Missy	Taunya	Vena	Mouzhong			Joe, Estefania
9/10/2012 19:00	1.65	LFN10	19	20		Zirbel		Michelle	Rachel	Vena	Mouzhong			Joe, Estefania
9/10/2012 20:00	1.91	LFN11	21	22		Zirbel		Michelle	Rachel	Vena	Mouzhong			
9/10/2012 21:00	2.06	LFN12	23	24		Zirbel		Michelle	Rachel	Vena	Mouzhong			
9/10/2012 22:00	2.09	LFN13	25	26		Zirbel		Michelle	Rachel	Vena	Mouzhong			
9/10/2012 23:00	1.93	LFN14	27	28	Prahl		Shumway	Michelle	Rachel	Vena	Mouzhong			
9/11/2012 0:00	1.61	LFN15	29	30	Prahl		Shumway	Michelle	Rachel	Vena	Mouzhong			
9/11/2012 1:00	1.22	LFN16	31	32	Prahl		Shumway	Michelle	Rachel	Vena	Mouzhong			
9/11/2012 2:00	0.83	LFN17	33	34	Prahl		Shumway	Michelle	Rachel	Vena	Mouzhong			
9/11/2012 3:00	0.49	LFN18	35	36	Prahl		Shumway	Michelle	Rachel	Vena	Mouzhong			
9/11/2012 4:00	0.24	LFN19	37	38	Prahl		Shumway	Sheree	Leslie	Vena	Mouzhong			
9/11/2012 5:00	0.16	LFN20	39	40	Prahl			Sheree	Leslie	Joe	Estefania			Missy, Taunya
9/11/2012 6:00	0.27	LFN21	41	42	Prahl			Sheree	Leslie	Joe	Estefania			Missy, Taunya
9/11/2012 7:00	0.56	LFN22	43	44	Prahl			Sheree	Leslie	Joe	Estefania			Missy, Taunya
9/11/2012 8:00	0.93	LFN23	45	46	Prahl			Sheree	Leslie	Joe	Estefania			Missy, Taunya
9/11/2012 9:00	1.33	LFN24	47	48	Prahl			Sheree	Leslie	Joe	Estefania			Missy, Taunya
9/11/2012 10:00	1.69	LFN25	49	50	Prahl			Sheree	Leslie	Joe	Estefania			Missy, Taunya
9/11/2012 11:00	1.91	LFN26	51	52	Prahl			Sheree	Leslie	Joe	Estefania			Missy, Taunya

Spring Tide Forcing (LFS#-Asc#, B or S)

					Who/Where									
					OSU	OSU	OSU	OHSU	OHSU	OHSU	OHSU	OHSU	Tebo	Forerunner
Date	Tidal Ht, m	Sample Code	Bottom, Asc#	Surface, Asc#	#1	#2	#3	#1	#2	#3	#4	Jones	Rigoni	'Crew'
9/17/12 14:00	2.70	LFS1	53	54		Zirbel	Shumway	Joe	Rachel	Missy	Leslie			Ben, Michelle
9/17/12 15:00	2.80	LFS2	55	56		Zirbel	Shumway	Joe	Rachel	Missy	Leslie			Ben, Michelle
9/17/12 16:00	2.56	LFS3	57	58		Zirbel	Shumway	Joe	Rachel	Missy	Leslie			Ben, Michelle
9/17/12 17:00	2.16	LFS4	59	60		Zirbel	Shumway	Joe	Rachel	Missy	Leslie			Ben, Michelle
9/17/12 18:00	1.48	LFS5	61	62		Zirbel	Shumway	Joe	Rachel	Missy	Leslie			Ben, Michelle
9/17/12 19:00	0.78	LFS6	63	64		Zirbel	Shumway	Joe	Rachel	Missy	Leslie			Ben, Michelle
9/17/12 20:00	0.21	LFS7	65	66		Zirbel		Joe	Rachel	Missy	Leslie			Ben, Michelle
9/17/12 21:00	-0.13	LFS8	67	68		Zirbel		Joe	Rachel	Vena	Mouzhong			
9/17/12 22:00	-0.16	LFS9	69	70		Zirbel		Joe	Rachel	Vena	Mouzhong			
9/17/12 23:00	0.17	LFS10	71	72		Zirbel		Estefania	Taunya	Vena	Mouzhong			
9/18/12 0:00	0.77	LFS11	73	74		Zirbel		Estefania	Taunya	Vena	Mouzhong			
9/18/12 1:00	1.45	LFS12	75	76		Zirbel		Estefania	Taunya	Vena	Mouzhong			
9/18/12 2:00	2.04	LFS13	77	78		Zirbel		Estefania	Taunya	Vena	Mouzhong			
9/18/12 3:00	2.41	LFS14	79	80	Prahl		Shumway	Estefania	Taunya	Vena	Mouzhong			
9/18/12 4:00	2.49	LFS15	81	82	Prahl		Shumway	Estefania	Taunya	Vena	Mouzhong			
9/18/12 5:00	2.24	LFS16	83	84	Prahl		Shumway	Estefania	Taunya	Vena	Mouzhong			
9/18/12 6:00	1.73	LFS17	85	86	Prahl		Shumway	Estefania	Taunya	Vena	Mouzhong			
9/18/12 7:00	1.13	LFS18	87	88	Prahl		Shumway	Estefania	Taunya	Ben	Michelle			
9/18/12 8:00	0.61	LFS19	89	90	Prahl		Shumway	Missy	Leslie	Ben	Michelle			Joe, Rachel
9/18/12 9:00	0.29	LFS20	91	92	Prahl			Missy	Leslie	Ben	Michelle			Joe, Rachel
9/18/12 10:00	0.25	LFS21	93	94	Prahl			Missy	Leslie	Ben	Michelle			Joe, Rachel
9/18/12 11:00	0.54	LFS22	95	96	Prahl			Missy	Leslie	Ben	Michelle			Joe, Rachel
9/18/12 12:00	1.13	LFS23	97	98	Prahl			Missy	Leslie	Ben	Michelle			Joe, Rachel
9/18/12 13:00	1.83	LFS24	99	100	Prahl			Missy	Leslie	Ben	Michelle			Joe, Rachel
9/18/12 14:00	2.44	LFS25	101	102	Prahl			Missy	Leslie	Ben	Michelle			Joe, Rachel
9/18/12 15:00	2.80	LFS26	103	104	Prahl			Missy	Leslie	Ben	Michelle			Joe, Rachel