

2001 Update to the Washington Coastal Geodetic Control Network

Developed in Support of the Southwest Washington Coastal Erosion Study

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The Washington Coastal Geodetic Control Network was reviewed by the National Geodetic Survey (NGS) and was adjusted by the NGS in December 1998. The stations in the network are currently part of the National Spatial Reference System. Individual data sheets (station descriptions) for stations in the network may be obtained via the Internet from the NGS at <http://www.ngs.noaa.gov/datasheet.html>.

This document contains coordinates and descriptions for stations that have been added to the network since the completion of Ecology Publication No. 99-103, *Washington Coastal Geodetic Control Network: Report and Station Index*. The stations described herein were surveyed or monumented by Ecology to densify the network, replace stations that have been destroyed, or to provide control points suitable for GPS training at Ecology's headquarters building in Lacey, Washington. The information contained in this document supplements, but does not replace, the information contained within Ecology Publication No. 99-103.

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2001 Update to the Washington Coastal Geodetic Control Network

Background

The Washington Coastal Geodetic Control Network was initially developed by the Washington Department of Ecology (Ecology) with the support of the U.S. Geological Survey (USGS) and the National Geodetic Survey (NGS). The field portion of the project was performed between July 20 and August 2, 1997 by Ecology and USGS personnel. NGS received the project report for the Washington Coastal Geodetic Control Network (Account Number GPS 1364) from Ecology in October 1997. NGS completed the final adjustment of the network on December 31, 1998.

The results of the 1997 survey were published by Ecology in Publication No. 99-103 (Daniels *et al.* 1999). Since that time the Coastal Monitoring & Analysis Program (CMAP) has surveyed and monumented several additional stations in a continuing effort to maintain the network and to support GPS surveying within Ecology and the coastal communities. This report documents the coordinates of these new stations. Please note that the information contained in this document supplements, but does not replace, the information contained within Ecology Publication No. 99-103, *Washington Coastal Geodetic Control Network: Report and Station Index*.

The surveys described herein were conducted (unless otherwise specified) to obtain first order horizontal coordinates, fourth order, class II, ellipsoidal height, and GPS derived orthometric height for each station. The datum used for deriving the ellipsoidal heights and horizontal coordinates is the North American Datum of 1983 (1991 adjustment) — NAD 83 (1991). Vertical orthometric heights are based on the North American Vertical Datum of 1988 (NAVD 88).

Existing Control

The Washington Geodetic Control Network is a vertical and horizontal control network located along the southwest Washington and northwest Oregon coast (Figure 1). The network was developed to support the Southwest Washington Coastal Erosion Study, a multidisciplinary effort aimed at understanding the natural and human factors that impact coastal behaviour within the Columbia River Littoral Cell (Kaminsky *et al.*, 1998 and Ruggiero *et al.*, 1999).

When possible, stations currently within the Washington Coastal Control Network were used to provide control to the surveys described in this document. The stations occupied during each survey were selected to conform to the requirement that each new station be traceable back to two control stations along independent paths, where the control stations must have known coordinates of the same or higher accuracy than required by the survey (Zilkoski *et al.* 1997). In cases where network stations were not located near the survey area, additional control stations were obtained from the NGS database.

Columbia River Littoral Cell Geodetic Control Network



Figure 1. Regional overview of the Washington Coastal Geodetic Control Network. The network covers coastal portions of Grays Harbor County and Pacific County, Washington, and Clatsop County, Oregon.

New Control

The coordinates for each new station were derived using published NGS standards as described in the *Guidelines for Establishing GPS-Derived Ellipsoid Heights (Standards: 2 cm and 5 cm)* (Zilkoski *et al.* 1997). Coordinates were calculated using adjustment software provided by Trimble Navigation Limited (i.e., GPSurvey, Trimble Geomatics Office) and the NGS program, Adjust.

Station PARK

Survey station PARK is located in Lacey, Washington (Figure 2). The mark is a 1.22 m long stainless steel rod mark set flush with the ground with an aluminum logo cap stamped PARK 2000. The station was surveyed to provide local control for use by Ecology personnel during training and as a base station site during GPS work within 50 miles of the Ecology HQ building.

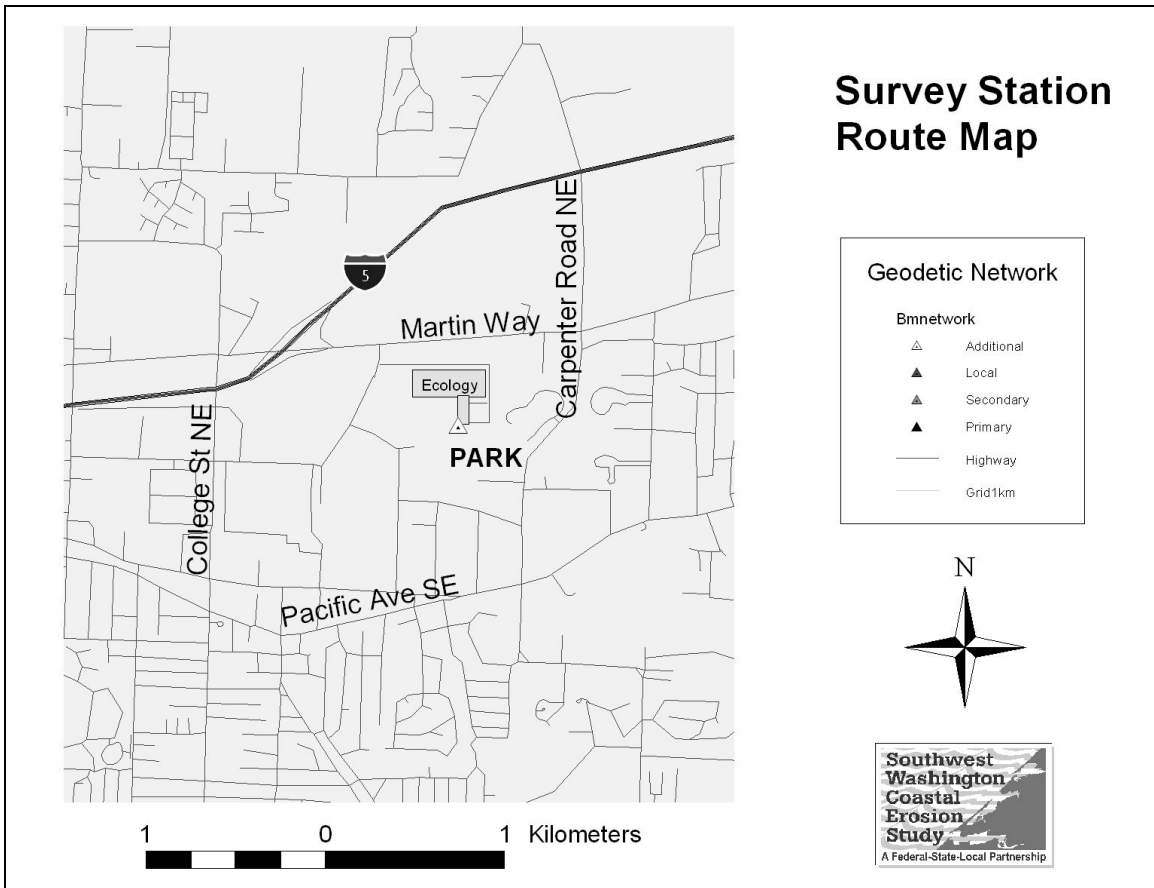


Figure 2. Approximate location of station PARK in Lacey, Washington.

The coordinates derived by Ecology for station PARK were obtained using the static observation method and followed NGS guidelines (Zilkoski *et al.* 1997). During the

survey six, forty-five minute GPS sessions were conducted over two days using Trimble 4400 series GPS receivers. The receivers were setup over stations PARK (at Ecology), Q 13, HOSP RM 4, and A 461 RESET 2.

NGS stations Q 13 (PID SY0708), A 461 RESET 2 (PID SY1600), and HOSP RM 4 (PID SY3193) provided control for the survey and ties to the national geodetic network. Station Q 13 served as the primary control for this survey and is part of the Washington High Accuracy Reference Network (HARN). The coordinates of Q 13 were held fixed during the final adjustment as the station had both a first order vertical elevation and a B order horizontal coordinate (the horizontal order, or accuracy, of a station may range from AA, A, B, 1, 2, 3 -with AA being the best). Stations HOSP RM 4 and A 461 provided additional secondary control to the survey.

The observation plan used for this survey is contained in Appendix A. The station description and coordinates are contained within Appendix D.

Stations NERR 2 and X 1 RM 1

The new survey stations, NERR 2 and X 1 RM 1, are located in Ocean Shores, Washington (Figure 3). Station NERR 2 consists of a 4.0-m long stainless steel rod mark with an NGS logo cover. Station X 1 RM 1 is a 3.15-m long stainless steel rod mark with an aluminum logo cap. These stations are being added to the Washington Geodetic Control Network to densify the network in the southern part of Ocean Shores, Washington. This is necessary as NGS station X 1 (PID AH7004) may be lost to erosion in the near future and station NERR NERR (PID AH7003) was destroyed by construction in 1999.

The coordinates derived by Ecology for station X 1 RM 1 and NERR 2 were obtained using the static observation method and followed NGS guidelines (Zilkoski *et al.* 1997). During the survey six two-hour GPS sessions were conducted over two days using Trimble 4400 and 4700 series GPS receivers. The receivers were setup over stations NERR 2, X 1 RM 1, GRAYS HARBOR E BASE 2, OMEN, and 94 1102 TIDAL 2 1952.

NGS stations GRAYS HARBOR E BASE 2 (SD0394), OMEN (AH6993), and 94 1102 TIDAL 2 1952 (SD0042) provided control for the survey and ties to the national geodetic network. Station OMEN served as the primary control for this survey. OMEN had been surveyed in 1997 by Ecology as part of observations conducted for the Washington Coastal Geodetic Control Network. The coordinates of OMEN were held fixed during the horizontal adjustment. In the final combined adjustment the coordinates for the three control stations were held fixed.

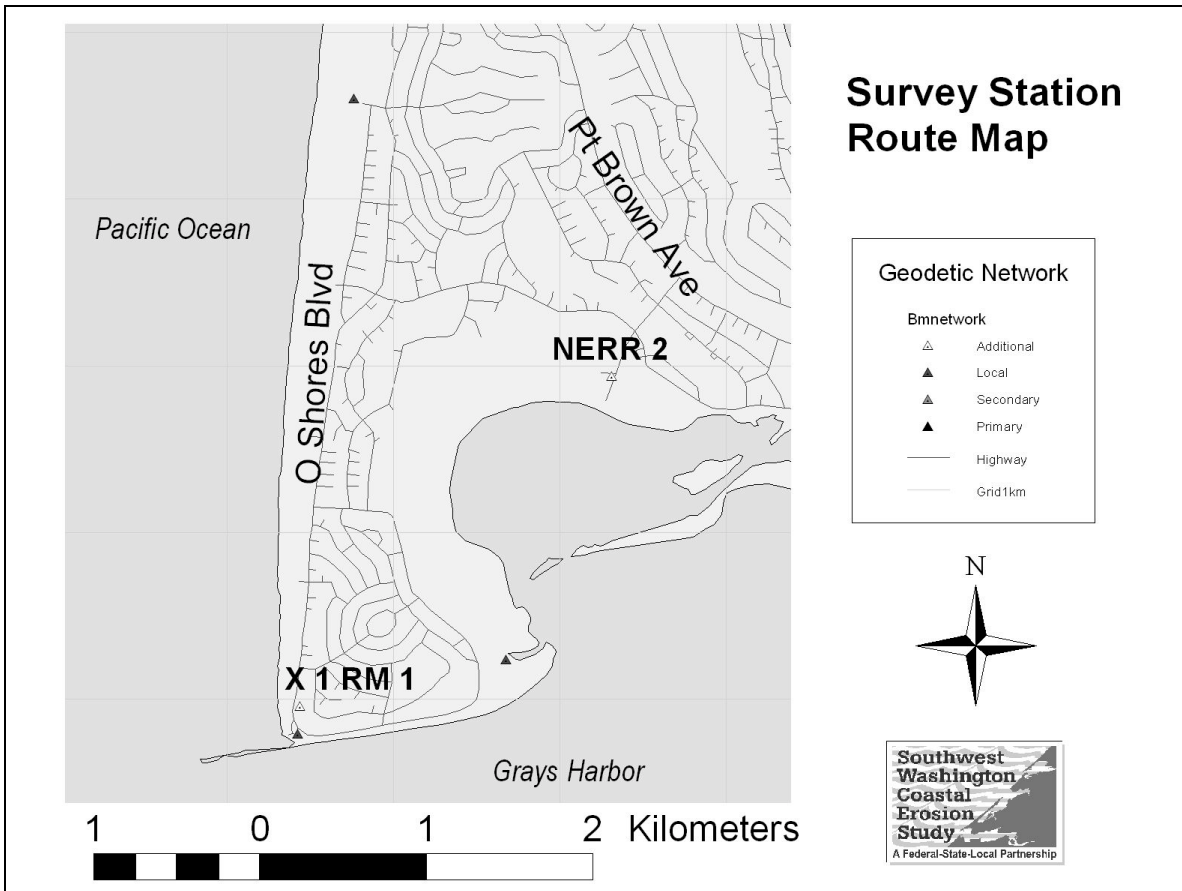


Figure 3. Approximate location of stations X 1 RM 1 and NERR 2 in Ocean Shores, Washington.

The observation plan used for this survey is contained in Appendix B. The station description and coordinates are contained within Appendix D.

Station 944 0574 C TIDAL

Survey station 944 0574 C TIDAL (PID SD0297) is located in Fort Canby State Park, Washington, near the North Jetty of the Columbia River (Figure 4). The station is a first order benchmark and consists of a 13.4 m stainless steel rod with a National Ocean Service brass logo cap. This survey was conducted to obtain first order horizontal coordinates and a fourth order, class II ellipsoid height for the station.

The coordinates derived by Ecology for station 944 0574 C TIDAL (SD0297) were obtained using the static observation method and followed NGS guidelines (Zilkoski *et al.* 1997). During the survey four two-hour GPS sessions were conducted over two days using Trimble 4400 and 4700 series GPS receivers. The receivers were setup over stations 944 0574 C TIDAL, 944 0574 A TIDAL, NORTH HEAD RM 4, and SMUR.

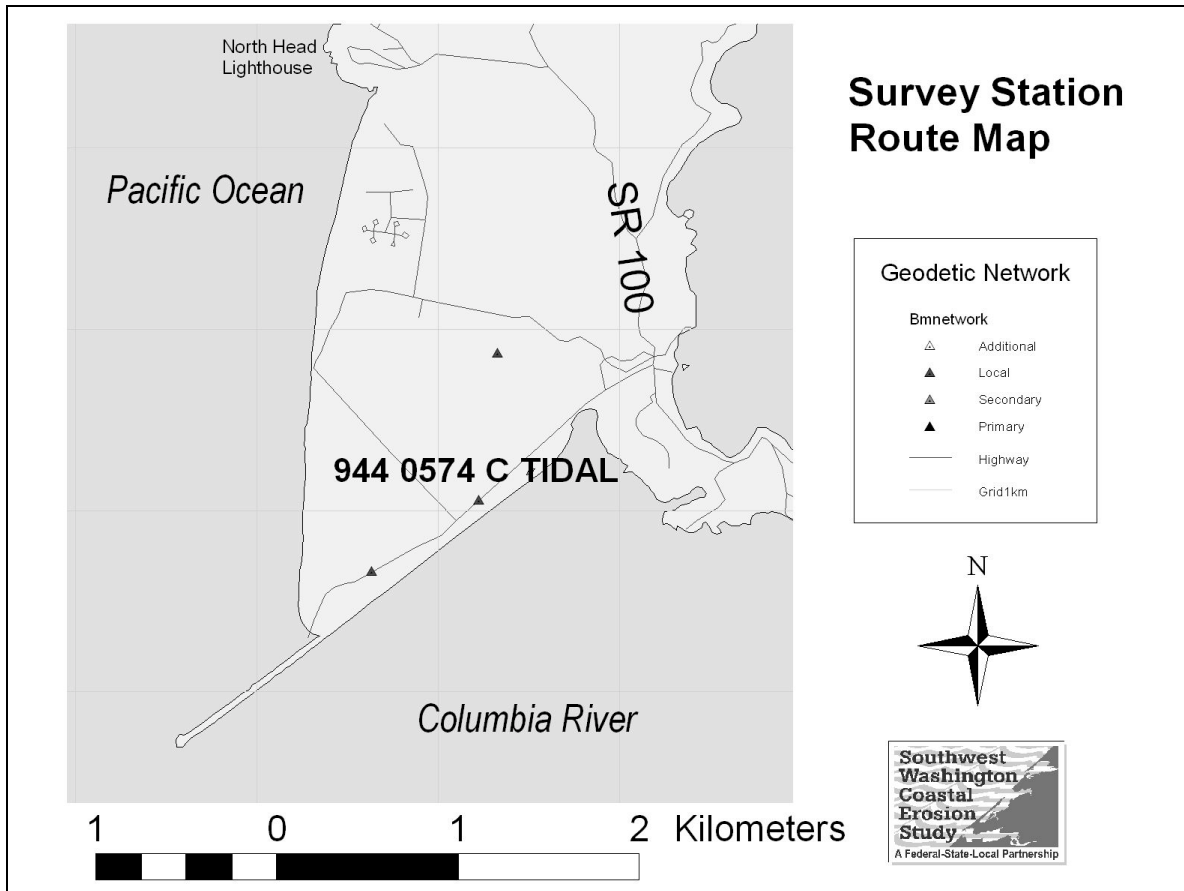


Figure 4. Approximate location of station 944 0574 C TIDAL in Fort Canby State Park, Washington.

NGS stations NORTH HEAD RM 4 (SD0854), SMUR (AB2106), and 944 0574 A TIDAL (SD0299) provided control for the survey and ties to the national geodetic network. Station NORTH HEAD RM 4 served as the primary control for this survey. NORTH HEADM RM 4 had been surveyed in 1997 by Ecology as part of observations conducted for the Washington Coastal Geodetic Control Network and is in the Washington HARN. The coordinates of NORTH HEAD RM 4 were held fixed during the horizontal adjustment. In the final combined adjustment the coordinates for the three control stations were held fixed.

The observation plan used for this survey is contained in Appendix C. The station description and coordinates are contained within Appendix D.

Station Coordinates

Table 1 contains adjusted coordinates for the four stations described in this document. These coordinates are consistent with those contained in the Washington Coastal Geodetic Control Network. The station identification numbers used here were assigned to allow these coordinates to be appended to those shown in Ecology Publication No. 99-103 (Daniels *et al.* 1999).

Table 1. Coordinates for four new stations tied to the national network but not adjusted by the NGS. Coordinates are in the Washington State Plane, NAD 83 coordinate system, with values in meters.

Station Number	County	NGS PID	Station Designation	NAD 83 (1991)		NAVD 88 Elevation
				Easting (m)	Northing (m)	(m)
79	Pacific	SD0297	944 0574 C TIDAL	225,226.997	111,061.382	4.678
80	Grays Harbor		X 1 RM 1	220,440.491	183,959.508	5.66
81	Grays Harbor		NERR 2	222,313.201	185,939.810	4.29
96	Lacey		PARK	324,710.351	192,957.682	49.78

Table 2 contains coordinates for all stations that were described in Daniels *et al.* 1999. They are presented again here as the station numbers may have changed from those previously published. Note, however, that the coordinates contained in Table 2 have not been revised since the original report. Horizontal coordinates in Table 2 are in Washington State Plain, NAD 83, meters, and vertical coordinates are in NAVD 88, meters.

Table 2. Coordinates for the stations contained within the Washington Coastal Geodetic Control Network in the Washington State Plane, South, meters, NAD 83 and NAVD 88 coordinate systems.

Station Number	County	NGS PID	Station Designation	Station	NAD 83 (1991)		NAVD 88 Elevation (m)
				Type	Easting (m)	Northing (m)	
01	Grays Harbor	SD0794	GRENVILLE	Local	214355.081	225915.358	37.63
02	Grays Harbor	SD0132	SOUTH	Secondary	216603.847	225290.033	4.643
03	Grays Harbor	SD0129	L 443	Local	217632.452	223555.901	6.86
04	Grays Harbor	SD0780	PIER RM 1 AZ MK	Local	218706.174	218480.556	7.13
05	Grays Harbor	SY5644	HATCHERY	Primary	236150.840	216822.073	36.537
06	Grays Harbor	AH6996	GKAM	Local	219509.529	214862.915	7.16
07	Grays Harbor	SD0117	R 443	Secondary	225227.546	212765.386	32.988
08	Grays Harbor	AH6997	BHUX	Local	220002.033	211327.432	5.96
09	Grays Harbor	AH6998	GP 14109-31	Local	220961.222	204470.295	7.34
10	Grays Harbor	AH6999	DIANA	Local	221227.901	199520.997	6.01
11	Grays Harbor	SD0720	MOTULIPS	Secondary	232060.108	198880.826	15.49
12	Grays Harbor	AH7000	DAMONS	Local	221436.304	193625.612	5.55
13	Grays Harbor	AH7001	ET	Local	221016.816	191040.669	8.55
14	Grays Harbor	AH7002	BUTTER	Local	220765.202	187608.277	5.50
15	Grays Harbor	SC2824	CENTRAL	Primary	256336.103	187168.504	38.31
16	Grays Harbor	AH6993	OMEN	Secondary	225495.170	185461.276	4.59
17	Grays Harbor	AH7003	NERR NERR (Destroyed)	Local	221682.225	184240.742	7.42
18	Grays Harbor	AH7004	X 1	Local	220427.159	183793.925	7.10
19	Grays Harbor	SD0042	944 1102 TIDAL 2	Local	224937.418	181306.423	4.652
20	Grays Harbor	AH7005	HD 1	Local	223445.898	180809.016	8.04
21	Grays Harbor	SD0394	GRAYS HARBOR E BASE 2	Secondary	225837.656	180705.800	5.06
22	Grays Harbor	AH7006	WORM	Local	223748.246	179169.649	9.90
23	Grays Harbor	AH7007	SPICE	Local	224091.455	177805.208	10.93
24	Grays Harbor	SD0020	GUNVILLE	Secondary	227653.074	176052.922	4.934
25	Grays Harbor	AH7008	RDAN	Local	224751.964	174824.006	6.05
26	Grays Harbor	AH7009	PRUG	Local	225147.769	171889.637	8.33
27	Pacific	AH7010	PC 068	Local	225461.984	168616.114	7.80
28	Pacific	SD0453	PC 064	Local	225502.985	165743.021	8.14
30	Pacific	AH7011	GELF	Local	225512.109	163324.692	5.74
31	Pacific	AH7012	CSW 2	Local	228200.073	161801.350	91.40
29	Pacific	AH6994	CSW 1	Secondary	228207.248	161750.215	96.91
32	Pacific	AH7013	GP 25105-13	Local	229654.821	161131.872	4.33
33	Pacific	SC0916	FLAG	Local	234674.370	158293.909	4.095
34	Pacific	SC2806	SOUTH BEND	Primary	246765.528	153108.439	25.193
35	Pacific	AH7014	LB 1	Local	227437.439	152509.793	3.88
36	Pacific	AH7015	PC 055 RM2	Local	227077.024	150868.728	4.58
37	Pacific	SD0533	PC 051	Local	226884.585	148626.156	8.69
38	Pacific	AH6995	BONE	Secondary	237206.298	148161.257	3.76
39	Pacific	SD0358	MESS	Local	229982.397	144909.939	4.209
40	Pacific	AH7016	PC 044	Local	227016.756	144587.456	7.26
41	Pacific	AH7017	PC 057	Local	227065.847	142639.147	7.76
42	Pacific	AH7018	GOULTER 3	Local	229766.295	141522.662	4.63
43	Pacific	SD0531	OYSTER 3	Local	227103.068	141090.565	8.29
44	Pacific	AH7019	PC 037	Local	227115.905	138871.463	9.79
45	Pacific	AH7020	PC 035	Local	227095.614	137662.732	9.76

Table 2. (Continued)

Station Number	County	NGS PID	Station Designation	Station	NAD 83 (1991)		NAVD 88 Elevation
				Type	Easting (m)	Northing (m)	(m)
46	Pacific	SD0323	X 537	Secondary	227176.554	137586.974	5.763
47	Pacific	AH7021	PC 032	Local	227056.809	135788.931	9.67
48	Pacific	SD0554	COTTA	Local	228989.637	135555.140	2.80
49	Pacific	SD0560	KLIPSAN 2	Local	226941.030	131888.571	8.85
50	Pacific	AH7022	PC 021	Local	226778.994	128970.830	8.69
51	Pacific	SD0538	SNAKE 2	Local	229550.786	128681.474	3.03
52	Pacific	SC1020	M 536	Secondary	238304.176	127434.240	7.789
53	Pacific	SD0563	RICH	Local	226581.743	126285.947	7.48
54	Pacific	SD0536	LIME 2	Local	229630.549	125706.828	3.32
55	Pacific	AH7023	PC 014	Local	226345.349	123150.053	7.40
56	Pacific	AH7024	PC 008	Local	225822.964	118601.072	7.42
57	Pacific	AH7025	PC 025	Local	225473.758	116431.952	6.32
58	Pacific	SD0287	TURN RM 4	Local	226897.696	116248.932	5.376
59	Wahkiakum	SC2756	GP 35004-3	Primary	257618.624	116055.406	27.89
60	Pacific	AH7026	PC 004	Local	225210.806	115181.161	7.23
61	Pacific	SD0854	NORTH HEAD RM 4	Secondary	224613.617	113727.382	77.69
62	Pacific	SD0090	MCKENZIE HEAD	n/a	Bad GPS Visibility		
77	Pacific	AH7027	MCKENZIE HEAD RM 3	Local	225330.915	111871.682	58.99
63	Pacific	SD0640	BETTY M	Local	227089.549	110920.242	6.55
64	Pacific	SD0299	944 0574 A TIDAL	Local	224638.597	110670.308	4.872
65	Clatsop	SD0651	EAST JETTY 2	Local	229432.797	105168.514	9.8
66	Clatsop	AB2106	SMUR*	Secondary	233158.444	102901.091	7.6
67	Clatsop	SC2198	MIT	Local	232150.030	100432.955	28.7
68	Clatsop	AH7028	IREDALE (Destroyed)	Local	231520.392	99783.876	8.3
78	Clatsop	AH8187	IREDALE RESET	Local	231520.396	99783.896	8.6
69	Clatsop	AH7029	KIM	Local	233109.080	96639.806	28.3
70	Clatsop	SC0554	UU 282*	Secondary	239326.392	95561.858	4.4
71	Clatsop	AH7030	RILEA	Local	233676.170	92569.623	13.0
72	Clatsop	SC1033	X 711*	Local	235757.129	88256.226	9.6
73	Clatsop	AH7031	DELRAY	Local	234763.667	85204.106	11.5
74	Clatsop	SC0617	MEADOW RESET*	Secondary	235240.572	82967.391	11.7
75	Clatsop	RD1141	SEASIDE RM 2*	Local	234404.488	79328.263	7.2
76	Clatsop	RD4216	CANN	Primary	231371.929	64617.918	30.5
79	Pacific	SD0297	944 0574 C TIDAL	Local	225226.997	111061.382	4.678
80	Grays Harbor		X 1 RM 1	Local	220440.491	183959.508	5.66
81	Grays Harbor		NERR 2	Local	222313.201	185939.810	4.29
90	Clatsop		ASTOR (a.k.a. ASTO)	Local	238953.073	97089.346	3.02
91	Pacific		BC TIDAL	Local	236074.214	149158.719	4.23
92	Pacific		NC TIDAL	Local	229622.823	135895.987	6.01
93	Pacific		NR TIDAL	Local	238296.162	127535.464	2.96
94	Pacific		SB TIDAL	Local	246578.968	153728.636	4.33
95	Pacific	SC0980	T 540	Local	240118.114	138893.909	31.47
96	Lacey		PARK	Special	324710.351	192957.682	49.78

*Leveled NAVD 88 orthometric height differed from GPS derived height by more than one decimeter.

Due to these errors GPS derived NAVD 88 orthometric heights for Oregon are shown to the nearest decimeter.

References

- Daniels, R.C., P. Ruggiero, and L. Weber, 1999. *Washington Coastal Geodetic Control Network: Report and Station Index, Developed in Support of the Southwest Washington Coastal Erosion Study*. Publication No. 99-103, Coastal Monitoring & Analysis Program, Washington Department of Ecology, Olympia, WA, 268 p.
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Appendix A. Observation Plan (PARK)

Goal of the Survey: The new survey mark, PARK, is a four-foot stainless steel rod mark set flush with the ground with an aluminum logo cap stamped PARK 2000. The survey is being conducted to obtain a GPS ellipsoid elevation, GPS derived NAVD 88 height, and second order horizontal coordinates for the new station. The station is being surveyed to provide local control for use by Ecology personnel during training and as a base station site during GPS work within 50 miles of the Ecology HQ building.

Location of the Station: Survey station PARK is located in Lacey, Washington on the grounds of the Department of Ecology Headquarters Building.

The following ties will be made to obtain a GPS ellipsoid elevation, GPS derived NAVD 88 height, and second order horizontal coordinates for the new station.

27 March 2000

Session	Receiver	Station	Type	Time
101	R1	Q 13	Primary	1310 to 1425
	R2	PARK	New Station	
102	R1	HOSP RM 4	Secondary	1450 to 1535
	R2	PARK	New Station	
103	R1	A 461 RESET 2	Secondary	1615 to 1705
	R2	PARK	New Station	

28 March 2000

Session	Receiver	Station	Type	Time
201	R1	Q 13	Primary	0945 to 1030
	R2	PARK	New Station	
202	R1	HOSP RM 4	Secondary	1100 to 1145
	R2	PARK	New Station	
203	R1	A 461 RESET 2	Secondary	1215 to 1300
	R2	PARK	New Station	

UTC date for paper work and job names: UTC on 27 March is 087. UTC time is +8 hours from Pacific Standard Time. Note: sessions are 45 minute sessions with 5 second epoch intervals, 15 degree masks, and QA 1 and 2 on.

The new stations are being tied to three control points that are currently in the NGS database. Details on these stations are shown below.

Station	PID	Horizontal Order	Vertical Order	Ellipsoid Order
Q 13	SY0708	B	First, I	Fourth, I
HOSP RM 4	SY3193	Second	n/a	n/a
A 461 RESET 2	SY1600	Second	First, II	Fourth, I

Equipment:

R1 Tripod: Saco, 2m fixed, HT + PCO = 205.6455 cm
 Antenna: Trimble L1/L2 Compact W/GP, PN 220220-00, SN 0220079730
 Receiver: Trimble 4400, PN 29887-11, SN 3652A18127

R2 Tripod: Omni, 2m fixed, HT + PCO = 204.2625 cm
 Antenna: Trimble L1/L2 Compact W/GP, PN 220220-00, SN 0220079600
 Receiver: Trimble 4400, PN 29887-11, SN 3652A18099

Appendix B. Observation Plan (NERR 2 and X 1 RM 1)

Goal of the Survey: Station NERR 2 is a new station consisting of a standard stainless steel rod mark with NGS logo cover. Station X 1 RM 1 is a standard stainless steel rod mark with an aluminum logo cap. This survey is being conducted to obtain first order horizontal coordinates, a fourth order (or better) ellipsoid height, and a GPS derived NAVD 88 height for the stations. These stations are being added to the Washington Geodetic Control Network to densify the network in the southern part of Ocean Shores, Washington. This is necessary as NGS station X 1 (PID AH7004) may be lost to erosion in the coming year and station NERR NERR (PID AH7003) was destroyed by construction in 1999.

Location of Survey: Survey station NERR 2 and X1 RM 1 are located in Ocean Shores, Washington, near the Grays Harbor North Jetty.

Based on NGS GPS-derived ellipsoid height standards station X1 RM 1 and NERR 2 will be classified as local network stations. The new marks must be tied into the old secondary base station network (order of network was CORS Control Stations→ Primary Base→ Secondary Base→ Local Network) to provide sufficient ties to the Washington Coastal Geodetic Control Network. As such, two-hour sessions on two different days will be needed (per conversation with Gary Perasso, NGS).

The following ties will be made to derive the required information for stations NERR 2 and X1 RM 1.

June 26, 2000

Session	Receiver	Station	Type	Time
301	R1	NERR 2	New local	12:30 to 1430
	R2 met	OMEN	Secondary Base	
	R3 met	944 1102 TIDAL 2	Local Network	
302	R1	NERR 2	New local	1515 to 1715
	R2 met	OMEN	Secondary Base	
	R3 met	GRAYS HARBOR E BASE 2	Secondary Base	
303	R1	X1 RM 1	New local	18:00 to 20:00
	R2 met	OMEN	Secondary Base	
	R3 met	GRAYS HARBOR E BASE 2	Secondary Base	

June 27, 2000

Session	Receiver	Station	Type	Time
301	R1	NERR 2	New local	0930 to 11:30
	R2 met	OMEN	Secondary Base	
	R3 met	944 1102 TIDAL 2	Local Network	
302	R1	NERR 2	New local	1215 to 1415
	R2 met	OMEN	Secondary Base	
	R3 met	GRAYS HARBOR E BASE 2	Secondary Base	
303	R1	X1 RM 1	New local	15:00 to 17:00
	R2 met	OMEN	Secondary Base	
	R3 met	GRAYS HARBOR E BASE 2	Secondary Base	

Note that the term “met” in the table above indicates that wet and dry bulb temperatures, humidity, and barometric pressure will be taken prior to and after each session at the given station.

UTC date for paper work and job names: UTC on June 26 is 178. UTC time is -7 hours from Pacific Daylight Time. Sessions are two hours each and will have 15-second epoch interval, 10 degree masks, and QA 1 and 2 on.

The new stations are being tied to three control points that are currently in the NGS database. Details on these stations are shown below.

Station	PID	Horizontal Order	Vertical Order	Ellipsoid Order
OMEN 944 1102	AH6993	First	GPS OBS	Third, II
TIDAL 2 GRAYS HARBOR	SD0042	First	First, II	Third, II
E BASE 2	SD0394	A	GPS OBS	Third, II

Equipment:

Station observations were performed by three crews using Trimble 4400 and 4700 receivers with L1/L2 Compact antennas w/ground plains or L1/L2 Microcentered antennas w/groundplains.. Each receiver was paired with the same equipment throughout the survey.

Name	Receiver ID	Receiver Information	Antenna Information	Tripod Information	Height (cm)
Richard Daniels Etienne D. Kingsley	1	Trimble 4400 P/N: 29887-11 S/N: 3652A18099 10 m cable	Compact L1/L2 w/GP P/N: 22020-00 S/N: 0220079730	2-m Seco Collapsible	HT=205.43 PCO=0.69 Total=206.12
Diana C. McCandless	2	Trimble 4400 P/N: 29887-11 S/N: 3652A18127 5 m cable	Compact L1/L2 w/GP P/N: 22020-00 S/N: 0220079600	2-m Omni Collapsible	HT=203.73 PCO=0.69 Total=204.42
Robert H. Huxford	3	Trimble 4700 P/N: 35846-12 S/N: 0220154311 10 m cable	Compact Microcenter L1/L2 w/GP P/N: 33429-00 S/N: 0220132235	2-m Seco Collapsible	HT=205.80 PCO=0.69 Total=206.49

Uncorrected antenna height (HT) is measured to bottom of notch on ground plain from surface. Value shown is the average of three measurements taken to the ground plain from each side of the tripod.

Appendix C. Observation Plan (944 0574 C TIDAL)

Goal of Survey: Station 944 0574 C TIDAL is a first order benchmark consisting of a stainless steel rod with a brass logo cap. This survey is being conducted to obtain first order horizontal coordinates and a fourth order (or better) ellipsoid height for the station. Nearby station 944 0574 A TIDAL, is currently part of the Washington Coastal Geodetic Control Network, may be lost to erosion or covered by drifting sand in the near future. This survey is being conducted to allow C TIDAL to be used as a replacement for A TIDAL.

Location of Survey: Survey mark 944 0574 C TIDAL (PID SD0297) is located in Fort Canby State Park, Washington, near the North Jetty of the Columbia River.

Based on NGS GPS-derived ellipsoid height standards C TIDAL will be classified as a local network station. However, the new mark must be tied into the old secondary base station network (order of network was CORS Control Stations→ Primary Base→ Secondary Base→ Local Network) to provide sufficient ties to the Washington Coastal Geodetic Control Network. As such, two-hour sessions on two different days will be needed (per conversation with Gary Perasso, NGS). This survey will make C TIDAL a local network station.

The following ties will be made to derive the required information for C TIDAL.

June 20, 2000

Session	Receiver	Station	Type	Time
101	R1	C TIDAL	New local	14:00 to 1600
	R2 met	NORTH HEAD RM 4	Secondary Base	
	R3 met	944 0574 A TIDAL	Local Network	
102	R1	C TIDAL	New local	1700 to 1900
	R2 met	NORTH HEAD RM 4	Secondary Base	
	R3 met	SMUR	Secondary Base	

June 21, 2000

Session	Receiver	Station	Type	Time
201	R1	C TIDAL	New local	0900 to 11:00
	R2 met	NORTH HEAD RM 4	Secondary Base	
	R3 met	944 0574 A TIDAL	Local Network	
202	R1	C TIDAL	New local	1200 to 1400
	R2 met	NORTH HEAD RM 4	Secondary Base	
	R3 met	SMUR	Secondary Base	

UTC date for paper work and job names: UTC on June 19 is 171. UTC time is -7 hours from Pacific Daylight Time. Sessions are two hours each and will have 15-second epoch interval, 10 degree masks, and QA 1 and 2 on.

The station (C TIDAL) is being tied to three control points that are currently in the NGS database. Details on the stations to be occupied are shown below.

Station	PID	Horizontal Order	Vertical Order	Ellipsoid Order
NORTH HEAD RM 4	SD0854	B	GPS OBS	Third, II
944 0574 A TIDAL	SD0299	First	First, II	Third, II
SMUR	AB2106	A	First, II	Third, II
944 0574 C TIDAL	SD0297	n/a	First, II	n/a

Equipment:

Station observations were performed by three crews using Trimble 4400 and 4700 receivers with L1/L2 Compact antennas w/ground plains or L1/L2 Microcentered antennas w/groundplains. Each receiver was paired with the same equipment throughout the survey.

Name	Receiver ID	Receiver Information	Antenna Information	Tripod Information	Height (cm)
Richard Daniels Etienne D. Kingsley	1	Trimble 4400 P/N: 29887-11 S/N: 3652A18099 10 m cable	Compact L1/L2 w/GP P/N: 22020-00 S/N: 0220079730	2-m Seco Collapsible	HT=205.43 PCO=0.69 Total=206.12
Diana C. McCandless	2	Trimble 4400 P/N: 29887-11 S/N: 3652A18127 5 m cable	Compact L1/L2 w/GP P/N: 22020-00 S/N: 0220079600	2-m Omni Collapsible	HT=203.73 PCO=0.69 Total=204.42
Robert H. Huxford	3	Trimble 4700 P/N: 35846-12 S/N: 0220154311 10 m cable	Compact Microcenter L1/L2 w/GP P/N: 33429-00 S/N: 0220132235	2-m Seco Collapsible	HT=205.80 PCO=0.69 Total=206.49

Uncorrected antenna height (HT) is measured to bottom of notch on ground plain from surface. Value shown is the average of three measurements taken to the ground plain from each side of the tripod.

Appendix D. Station Descriptions

The coordinates shown in the Appendix derived by the Washington Department of Ecology and are not currently available from the National Geodetic Survey. NAVD 88 elevations were derived from GPS observations. NAVD88 elevation accuracy is estimated to be ± 0.02 m.

DESIGNATION: PARK
STATE/COUNTY: WA/THURSTON
USGS QUAD: LACEY (1986)

STAMPING: PARK 2000
UPDATE: OCTOBER 16, 2000

COORDINATES

WA STATE PLAIN SOUTH (NAD 83, M)	192,957.682 N 324,710.351 E	ADJUSTED
WA STATE PLAIN SOUTH (NAD 83, FT)	633,062.00 N 1,065,320.54 E	ADJUSTED
NAD 83 (1991)	47° 02 46.47702 N 122° 48 25.87235 W	ADJUSTED
WA STATE PLAIN SOUTH (NAD 27, FT)	1,425,198.65, 633,115.79	NADCON
NAD 27	47° 02 47.13049 N 122° 48 21.38606 W	NADCON

HORIZONTAL COORDINATES MEET SECOND ORDER STANDARDS
ELLIPSOID HEIGHTS MEET FOURTH ORDER, CLASS II STANDARDS

ELEVATIONS

NAVD 88	49.78 M	GPS OBS
NGVD 29	159.90 US FT	VERTCON
NAD 83 ELLIPSOID	27.948 M	GPS OBS
GEOID	-21.839 M	GEOID99
GEOID	-21.630 M	GEOID96

REFERENCE STATION	DISTANCE (M)	WA STATE PLAIN SOUTH (NAD 83, M)	ELEVATION (NAVD 88, M)
PARK RM 1	101.48	193,035.100 N 324,644.708 E	49.439

DESCRIPTION

STATION MONUMENTED ON MARCH 22, 2000 AND IS LOCATED IN THE CITY OF LACEY AT THE WASHINGTON DEPARTMENT OF ECOLOGY BUILDING. TO REACH FROM INTERSTATE 5 AND MARTIN WAY HEAD EAST ON MARTIN WAY 0.4 MILES TO A STOP LIGHT AND INTERSECTION WITH DESMOND DRIVE ON RIGHT. TURN RIGHT (SOUTH) ON DESMOND DRIVE AND FOLLOW SIGNS TO THE ECOLOGY BUILDING. CONTINUE PAST THE MAIN ENTRANCE TO VISITORS PARKING ON LEFT AND PARKING GARAGE ON RIGHT. TURN RIGHT AND PROCEED SOUTH ABOUT 150 M TO THE SOUTHERN MOST PARKING LOT AT ECOLOGY. THIS LOT IS ADJACENT TO THE SOUTH WING OF THE ECOLOGY BUILDING.

PROCEED TO THE SOUTH END OF THE SOUTH WING OF THE ECOLOGY BUILDING. THE STATION IS 39.85 M (138 DEGREES MAGNETIC) FROM THE SOUTHWEST CORNER OF A 29.5 BY 9.7 M CEMENT PATIO, 22 M SOUTH OF A GATED ACCESS ROAD, 2.4 M SOUTH OF AND CENTERED ON A BENCH, AND 8.5 M WEST AND 1.22 M HIGHER THAN THE WEST CURB OF A PARKING LOT.

THE STATION IS A 1.22 M LONG STAINLESS STEEL ROD DRIVEN INTO THE GROUND WITH A WASHINGTON DEPARTMENT OF ECOLOGY 2.5-INCH ALUMINUM SURVEY DISK. THE MARK IS CEMENTED IN PLACE WITH SIXTY POUNDS OF CONCRETE. THE STATION IS STAMPED PARK 2000.

REFERENCE MARK NUMBER 1 (NO STAMPING) IS THE CENTER OF A ½ INCH BOLT ATTACHED WITH A PK NAIL TO THE PAVEMENT OF A FIRE ACCESS ROAD AND IS ABOUT 3 M SOUTH OF A FIRE HYDRENT, ABOUT 0.4 M NORTH OF THE SOUTH EDGE OF PAVEMENT, AND 0.1 M NORTHWEST OF A WATER VALVE ACCESS COVER (PAINTED RED). THE MARK IS 77.42 M NORTH, 65.643 M WEST, 0.34 M LOWER, AND AT A BARRING OF 319 DEGREES 42' 18" (GRID) FROM THE STATION.

DESIGNATION: NERR 2
STATE/COUNTY: WA/GRAYS HARBOR
USGS QUAD: POINT BROWN (1983)

STAMPING: NERR 2 2000
UPDATE: JUNE 13, 2000

COORDINATES

WA STATE PLAIN SOUTH (NAD 83, M) 185,939.810 N 222,313.201 E ADJUSTED
NAD 83 (1991) 46° 56 54.18020 N 124° 08 56.80315 W ADJUSTED

HORIZONTAL COORDINATES MEET FIRST ORDER STANDARDS
ELLIPSOID HEIGHTS MEET FOURTH ORDER, CLASS II STANDARDS

ELEVATIONS

NAVD 88	4.287 M	GPS OBS
NAD 83 ELLIPSOID	-20.399 M	GPS OBS
GEOID	-24.715 M	GEOID99
GEOID	-24.526 M	GEOID96

DESCRIPTION

THE STATION IS LOCATED AT THE OYHUT WILDLIFE AREA (OWNED BY THE WASHINGTON DEPARTMENT OF FISH AND WILDLIFE) IN THE CITY OF OCEAN SHORES. FROM THE INTERSECTION OF CHANCE ALAMER ROAD AND POINT BROWN AVENUE IN OCEAN SHORES PROCEED SOUTH ON POINT BROWN AVENUE FOR 3.8 MILES TO THE INTERSECTION WITH TONQUIN AVENUE. TURN RIGHT (SOUTHWEST) ONTO TONQUIN AVENUE AND PROCEED 0.4 MILES OVER BRIDGE AND THROUGH THE INTERSECTION WITH MARINE VIEW DRIVE SW. CONTINUE SOUTHWEST ON TONQUIN AVENUE TO A 50 BY 50 M GRASS PARKING AREA WITH WOOD FENCE ON SOUTH SIDE OF LOT AND GATE. THE GRAVEL ROAD LEADING SOUTH FROM THE PARKING AREA LEADS TO THE HOQUIAM FAA VORTAC STATION (RADIO BEACON).

THE STATION IS LOCATED 17.5 M WEST OF THE CENTERLINE OF THE GRAVEL ACCESS ROAD AND 16 M SOUTH OF THE GATE OR 146 M, 350 DEGREES MAGNETIC, FROM THE DOOR (PAINTED GREEN) ON THE NORTH FACING SIDE OF THE VORTAC STATION. AN ORANGE WITNESS POST IS 1 M NORTH OF THE STATION.

THE STATION IS A STAINLESS STEEL ROD DRIVEN 4.15 M. ACCESS TO THE DATUM POINT IS HAD THROUGH A STANDARD 5-INCH NGS LOGO CAP THAT IS STAMPED NERR 2 2000.

DESIGNATION: 944 0574 C TIDAL **STAMPING:** 0574 C 1982
STATE/COUNTY: WA/GRAYS HARBOR **UPDATE:** JUNE 29, 2000
USGS QUAD: CAPE DISAPPOINTMENT (1984) **NGS PID:** SD0297

COORDINATES

WA STATE PLAIN SOUTH (NAD 83, M) 111,061.382 N 225,226.997 E ADJUSTED
NAD 83 (1991) 46° 16 35.91561 N 124° 03 59.09172 W ADJUSTED

HORIZONTAL COORDINATES MEET FIRST ORDER STANDARDS
ELLIPSOID HEIGHTS MEET FOURTH ORDER, CLASS II STANDARDS

ELEVATIONS

NAVD 88	4.678 M	LEVELED (FIRST ORDER, CLASS II)
NAD 83 ELLIPSOID	-19.651 M	GPS OBS
GEOID	-24.411 M	GEOID99
GEOID	-24.199 M	GEOID96

DESCRIPTION

THE STATION IS LOCATED IN FORT CANBY STATE PARK NEAR THE NORTH JETTY OF THE COLUMBIA RIVER. FROM THE CITY OF ILWACO PROCEED SOUTH ON SR 100 TO THE ENTRANCE TO FORT CANBY STATE PARK ON RIGHT (100 M NORTH OF THE ENTRANCE TO THE CAPE DISAPPOINTMENT COAST GUARD STATION). TURN SOUTHWEST ON TO JETTY ROAD AND PROCEED 1.12 KM (0.70 MILES) TO STATION ON LEFT.

THE STATION IS 3.35 M SOUTHEAST OF THE SOUTH EDGE OF ROAD. A ORANGE WITNESS POST IS LOCATED 1 M EAST OF THE STATION. A STEEL WITNESS POST IS 0.6 M SOUTH OF THE MARK.

THE STATION IS A 13.4 M STAINLESS STEEL ROD WITH A NATIONAL OCEAN SERVICE BRASS SURVEY CAP. ACCESS TO THE STATION IS THROUGH A 4-INCH PVC PIPE WITH CAP SET IN CONCRETE. THE SURVEY DISK IS STAMPED 0574 C 1982. THIS IS A NGS STATION.