Technical Memorandum 1.1.1 – Survey
Fir Island Farm Restoration Feasibility Study
Fir Island, Washington

November 19, 2010

Submitted To:
Mr. Brian Williams
Washington Department of Fish and Wildlife
PO Box 1100
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By:
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21-1-12318-001

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GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

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November 19, 2010

Mr. Brian Williams
Washington Department of Fish and Wildlife
Natural Resources Building
1111 Washington Street SE
Olympia, WA 98501

RE: TECHNICAL MEMORANDUM 1.1.1 – SURVEY, FIR ISLAND FARM RESTORATION FEASIBILITY STUDY, FIR ISLAND, WASHINGTON

Dear Mr. Williams:

Data collection and analysis is being performed at the Fir Island Farm site by Shannon & Wilson, Inc. in conjunction with Washington Department of Fish and Wildlife (WDFW) and The Skagit Consolidated Diking District #22. The project proposes levee relocation to restore natural tidal exchange through the existing sloughs and reintroduce native tidal marsh habitat.

During this data collection phase, we are performing topographic surveys and geomorphic assessment of Fir Island Farm to gather information about current conditions to aid engineering evaluation and design for restoration alternatives.

The purpose of this technical memorandum is to summarize the data collected from the site in August and September 2010.

PROJECT BACKGROUND

Previous environmental studies have identified Fir Island Farm as a historic tidal marsh area that has been altered by the construction of levees. Natural tidal exchange has been eliminated by the presence of levees, which in turn has reduced tidal channel and marsh habitat. Existing culverts are outfitted with tidal gates to allow upland drainage, but are not designed for fish passage.

Shannon & Wilson, Inc. is performing a baseline study in conjunction with the WDFW to evaluate the feasibility of a coastal dike setback levee at the Fir Island Farm, Snow Goose Reserve. Survey datums, survey control points, and bathymetric and drainage infrastructure survey data collected for the study are presented below.

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PROJECT DATUMS

There are numerous reference datum for the project including NAD27/NGVD29, NAD83/NAVD88, and tidal mean lower low water (MLLW) datum. For the purposes of this study, we are utilizing the Washington State Plane North – 4601, NAD83, NAVD88 survey datum reference system. To compile various data, models, LiDAR, survey, and tidal information, horizontal and vertical datum transformations are necessary. Horizontal and vertical land geoid transformations for the project are performed using geographic information system (GIS) software (which can automatically transform and display NAD27 data in NAD83). We used the publically available software Corpscon to convert LiDAR data from state plane NAD27/NGVD29 to NAD83/NAVD88 (U.S. Army Corps of Engineers [USACE], 2004).

The project is located in a tidal environment. Tidal data available from NOAA is reported on the MLLW datum. To transform tidal MLLW datum to NAD83/NAVD88, we analyzed a number of sources to evaluate the MLLW datum for the project site including:

- Application of the Vdatum software was performed to estimate MLLW to NAVD88 datum transformation estimates. Vdatum is a publically available tidal datum transformation software (National Oceanic and Atmospheric Administration [NOAA], 2010). Transformations were made using the Geoid99 ellipsoid model and Washington Strait of Juan de Fuca, Version 01 grids. Vdatum provided a MLLW to NAVD88 transform estimate of -1.91ft. The Vdatum User's Manual describes potential uncertainty and errors as follows: "*larger model-data errors in any coastal domain were more likely to be seen in upstream river environments, marshes, and areas where the tides may change more rapidly*".

- Review of local tidal data references for MLLW to NAVD88 published transformations. For this project, the three closest tidal gaging locations with vertical datum and extreme tide information are listed below.

    - Crescent Harbor (Oak Harbor, Whidbey Island) – Station ID: 9447952. Difference between MLLW and NAVD88 = -2.21ft. (Note: extreme tides not available.)
    - Swinomish Channel (La Conner) – Station ID: 9448558. Difference between MLLW and NAVD88 not determined as NAVD88 reference is not available.

  - Sneeoosh Point (Fidalgo Island across from Hope Island) – Station ID: 9448576. Difference between MLLW and NAVD88 is -2.02ft.

- Review of other local project references to MLLW and NAVD88 transformations.

  - The Wiley Slough (WDFW, 2005) references a MLLW to NGVD29 transformation of -6.10ft. NGVD29 to NAVD88 conversions in the area are 3.70ft, which results in a MLLW to NAVD88 transformation of 2.40ft.

  - The Skagit Conservation District (SCD, 2009) survey report references the Wiley Slough vertical datum transformation of -6.10ft.

- Review and average of measured MLLW elevations in NAVD88 datum using the project system of downstream surface water tide gages.

  - Dry Slough tide gage data from 9/1/2010 through 10/7/2010 – MLLW (NAVD88 datum) = 2.69ft

  - Claude O Davis Slough tide gage data from 9/1/2010 through 10/7/2010 – MLLW (NAVD88 datum) = 2.72ft

  - Browns Slough tide gage data from 9/1/2010 through 9/17/2010 – MLLW (NAVD88 datum) = 2.48ft

Our current recommendation for a project tide datum is to use the averages of existing tidal data at the project site (MLLW – 2.63ft = NAVD88). The rationale for this recommendation is as follows:

- Vdatum uses large sets of gage networks and hydrodynamic models to statistically estimate the MLLW to NAVD88 transformation at a give location. The model documentation acknowledges errors and uncertainties for tidal datums in riverine areas, for which the Skagit Delta has both tributary interior drainage and localized influences from the Skagit River. We therefore do not recommend using the Vdatum software output.

- The Wiley Slough data transformation were made from MLLW data analysis using data from the Crescent Harbor tide gage data. The Crescent Harbor gage is approximately 11.6 miles away from the project site, and is strictly tidal gage without riverine influence.

- The Sneeoosh Point gage is approximately 10.0miles away from the project site, is a tidal gage, it is not influence by river levels, and is likely influenced by unique tidal hydrodynamics through Deception Pass.

We recommend application of a MLLW – 2.63ft = NAVD88. The current period of data collection is short, and we therefore recommend to continue to collect site specific data for inclusion in future engineering studies and designs. It will be important to finalize the project MLLW and tidal datum as this will ultimately relate to dike design criteria and required heights of the structures.

The second aspect of evaluating tidal datums is to determine the typical tidal conditions including Mean Lower Low Water (MLLW), Mean Sea Level (MSL), Mean Higher High Water (MHHW), and extreme low and high tides. Tidal datums for the three local tide gages (Crescent Harbor, Swinomish, Sneeosh) are presented in Table A-1 (Appendix A). NOAA tide gage datum sheets used to generat Table A-1 are included in Appendix B.

Table A-2 summarizes the transformation between each of the Crescent Harbor gages datum from MLLW to NAVD88 and NGVD29, for reference. The following vertical transformations were used:

- MLLW – 2.63ft = NAVD88

- MLLW – 6.33ft = NGVD29

SURVEY DATA COLLECTION

Survey Control

Survey control for the project was provided by WDFW, Al Hammond, PLS. Survey control benchmarks surrounding the project site were used as reference control points for infrastructure, topographic, and bathymetric surveys performed in support of the project. Survey control maps are provided in (Appendix C, Figure C-1). A summary of survey control information is listed in Table A-3.

Topographic, Bathymetric, and Infrastructure Surveys

Shannon & Wilson, Inc. performed surveys using survey grade RTK-GPS equipment referencing the WDFW survey control points. The surveys included a number of elements that are used to support hydrologic, hydraulic and hydrodynamic modeling for the project. Survey points are shown in Figure C-2 and include the following:

- Three thalweg profile surveys on Dry Slough, Claude O'Davis/No-name and Brown's Slough downstream from the dike tidegates along the bay front channels to provide additional bathymetric data already stated above (profile Figures D-1 through D-4).
- Twenty cross section surveys at channel locations both downstream and upstream from the dike and tidegates in Browns Slough, Dry Slough, No-name and Claude O' Davis Sloughs (Figure B-3, Tables D-1 through D-21).
- Suface water, groundwater monitoring well gage survey locations (Figure C-4, Table A-4). Surface water gages were originally deployed in early August 2010 and then redeployed in September 2010 to account for potential sedimentation in the bottom of the wells, and to correct water surface elevation datum errors which were observed at the initial installation.
- Geoprobe exploration locations were established using Global Positioning System (GPS) surveys. A total of 12 geoprobe locations were established as shown in Figure C-5, Table-A-5.
- Culverts surveys were performed on a number of culverts within the project study area and are shown in Figure C-6 and summarized in Table A-6. Culvert surveys are considered to be accurate within ± 1.0 foot, when the actual position of the culvert was located and surveyed, per the type of GPS survey unit accuracy for this project.

- Spot checks to compare GPS survey data with known survey control and random tests to compare GPS data with existing ground LIDAR (Table A-7). In general, the GPS surveys matched ground control surveys with quality accuracy ± 0.3 foot horizontal and vertical. Comparison of test areas in open field and bare earth showed relatively acceptable accuracy (± 0.4 foot vertical on roads and structures) and in light vegetation areas (± 1.0 foot in levees and farm fields), and poorer LIDAR accuracy in vegetated channels (± 3.0 feet at a single point in a vegetated channel thalweg) and very poor accuracy in unvegetated and deep channels (± 6.0 feet observed at a thalweg point in No Name with a LIDAR water surface elevation of 4.78 feet). Users of the LIDAR data should be aware of these accuracies when applying the data to engineering analyses, models, and designs.
- Compile and prepare other available survey data:
  - Dry Slough Survey data were made available by the Skagit Conservation District (SCD) for Dry Slough bathymetric and cross section surveys (SCD, 2009) (Figures C-7 through C-9**)**.
    - These data were gathered in support of ongoing studies by the SCD to investigate the replacement of tidegates on Dry Slough with Self Regulating Tidegates (Moffatt & Nichol, 2008). This work is being performed by SCD to assist Diking District No. 22 in complying with the conditions of an Endangered Species Act, Section 7 Consultation Biological Opinion that relates to impacts to juvenile Chinook Salmon caused by DD22 work on the tidegates in 2003.
    - Processing was performed to transform SCD survey data into NAVD88 data for use in future hydraulic modeling studies for the Fir Island Farm Restoration project. SCD provided survey report and data files to Shannon & Wilson for use in this studies hydraulic models. We consulted Tom Slocum (Slocum, 2010) regarding survey report datums to confirm our datum transform efforts.
    - SCD Report conversion of MLLW – 6.20 feet = NGVD29. The SCD report references the Wiley Slough Report (WDFW, 2005). The Wiley Slough report lists a vertical transformation of -6.10 feet. This report uses MLLW – 6.33 feet = NGVD29. Additional steps will be necessary to compile survey data into the project datum.
    - SCD survey data is tied to local vertical datum and references the Wiley Slough MLLW as a reference. The survey data uses relative positions for all horizontal data. If the data are to be used for work other than the SCD hydrologic and hydraulic modeling, the SCD survey data will need to be adjusted and tied to a

horizontal datum, which is beyond the scope of the Fir Island Farm feasibility study.

- Thirteen cross sections from the SCD Dry Slough surveys are included in Tables D-22 through D-34**.** These tables match the survey report from downstream to upstream, and are not in alpha-numeric order. The survey file provided by SCD has an additional six survey cross sections, but they are not shown on the report figure and, therefore, not included in this report as the reviewer was not able to determine the location of these cross sections.

— The Rawlins Road study channel survey data were made available by Battelle, Pacific Northwest National Laboratory (PNNL) for Rawlins Road and Browns Slough bathymetry (PNNL, 2006) (Figure C-10**)**. Cross sections along Browns Slough, upstream from Fir Island road are shown as part of the data set. Cross section locations were provided in an Excel file. Cross section profile figures showing station and elevation data were also provided and can be incorporated into future modeling efforts as necessary. The report references that 91 cross sections were surveyed by WDFW. The data for these WDFW survey cross sections was not provided and could prove useful in compiling and assembling hydraulic models, if they are extended upstream from Fir Island Road. There is no additional information on survey datum in the report. We assumed that the survey data has been post-processed into NAD83, NAVD88 considering the Puget Sound 3d Hydrodynamic Model uses a NAVD88 datum.

Electronic Data Files

We developed a number of electronic data files as part of the survey data collection and post-processing work. These survey files are available to the project team. Changes or updates to the files should be superceded and redistributed to the team. The following files are posted on the Shannon & Wilson client site for the Fir Island Farm Project with Technical Memo 1.1.1:

- SURVEY_INFO_TABLES_20101122.xlsx
- XS_TRANSFORM_20101111.xlsx
- FIF_SRVY_PTS_110910.shp

We are using the survey data to develop a digital surface model to represent the downstream Bay Front channels to be used with the 3D hydrodynamic model. These electronic files will be

distributed upon completion of the hydrodynamic model and quality control review of the data collection and post-processing.

DISCUSSION

The contents of this technical memorandum are provided so that project team members have access to various survey data for their elements of work. We remind the team and survey data users that the current project is being performed in Washington State Plane North – 4601, NAD83, NAVD88 coordinates. We also remind users of this data and report to check which data source they are referencing and to understand the relative accuracy of these sources. Data provided by others are only reported in this technical memorandum for the purpose of providing recommendations on possible data corrections to carry forward in the investigation; we did not independently verify the data.

LIMITATIONS

The data presented in this survey memorandum were developed by Shannon & Wilson staff and Dave Cline, P.E. The GPS survey data collected by Shannon & Wilson references and checks were made to the survey control provided by WDFW, Al Hammond, PLS. Data provided by others are made available through this report. Shannon & Wilson does not certify nor make claims regarding the correctness or accuracy of these other survey data.

Facts and conditions referenced in this technical memorandum may change over time. Facts and conditions set forth here are applicable as described only at the time this technical memorandum was written. We believe that the conclusions stated here are factual, but no guarantee is made or implied.

This technical memorandum was prepared for the exclusive use of WDFW and its representatives and in no way guarantees that any agency or its staff will reach the same conclusions as Shannon & Wilson, Inc.

SHANNON & WILSON, INC.

Sincerely,

SHANNON & WILSON, INC.

David R. Cline, P.E.
Associate

DRC/drc

Enc: References
Appendix A – Survey Data Tables
Appendix B – National Oceanic and Atmospheric Administration (NOAA) Tidal Datum and Extreme Event Data Sheets
Appendix C – Survey Figures
Appendix D – Survey Profiles and Cross Sections Figures and Tables

REFERENCES

Moffatt & Nichol, 2008, Dry slough tidegate replacement, hydraulic and geomorphic assessment.

National Atmospheric and Oceanic Administration, 2010, Vdatum users guide: http://vdatum.noaa.gov/docs/usersguide.html#step2

Pacific Northwest National Laboratory (Battelle), 2006, Hydrologic and hydrodynamic modeling of the Skagit River estuary, Rawlins Road restoration feasibility study, PNWD-3692.

Skagit Conservation District, 2009, A survey of channel profile and cross sections of dry slough, Fir Island, Skagit County, Washington.

Skagit Conservation District, November 2010, Personal communication with Tom Slocum regarding SCD 2009, channel cross section survey datum in NAVD88 in Appendix 1.

U.S. Army Corps of Engineers (USACE), 2004, Corpscon version 6.x, technical documentation and operating instructions.

Washington Department of Fish and Wildlife, 2005, Wiley Slough estuarine restoration design report.

APPENDIX A

SURVEY DATA TABLES

APPENDIX A

SURVEY DATA TABLES

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TABLE A-1
FIR ISLAND FARM, TIDAL DATUM REFERENCES

Datum[1]	Swinomish	Sneeoosh	Crescent Harbor[2]	Average
Extreme High (Observed)	13.0	12.0	15.6	13.6
MHHW	10.4	11.1	11.7	11.0
MHW	9.4	10.2	10.8	10.1
MTL	6.1	6.4	6.8	6.4
MSL	6.0	6.4	6.8	6.4
MLW	2.7	2.6	2.8	2.7
MLLW	0.0	0.0	0.0	0.0
Extreme Low (Observed)	-2.5	-3.3	-	-2.9

Notes:
1. Datum references mean lower low water (MLLW) vertical datum.
2. Extreme high references local DD22 observations of overtopping using known LiDAR elevation of 13ft (NAVD88) +2.63ft = 15.6ft (MLLW).

MHW = mean high water
MHHW = mean higher high water
MLW = mean low water
MSL = mean sea level
MTL = mean tide level

TABLE A-2
FIR ISLAND FARM, VERTICAL DATUM TRANSFORMATIONS

Datum	MLLW (ft)[1]	NAVD88 (ft)[2]	NGVD29 (ft)[3]
Extreme High (Observed)	15.6	13.0	9.3
MHHW	11.7	9.0	5.3
MHW	10.8	8.1	4.4
MTL	6.8	4.2	0.5
MSL	6.8	4.2	0.5
MLW	2.8	0.2	-3.5
MLLW	0.0	-2.6	-6.3
Extreme Low (Observed)	-	-	-

Notes:

[1] Crescent Harbor mean lower low water (MLLW) datum from Table 1

[2] Vertical transformation MLLW to NAVD88 (-2.63 feet)

[3] Vertical transformation MLLW to NGVD29 (-5.61 feet)

MHW = mean high water

MHHW = mean higher high water

MLW = mean low water

MSL = mean sea level

MTL = mean tide level

TABLE A-3
FIR ISLAND FARM, SURVEY CONTROL POINTS

Survey Control Point ID	Northing (ft)	Easting (ft)	Latitude	Longitude	Elevation (NAVD88-ft)	Description
TBM SWA GPS-3	493,110.45	1,259,287.62	48˚20'20.265"	-122˚24'02.046"	7.12	¾-inch rebar with 2 ½-inch aluminum cap
TBM SWA GPS-4	493,135.02	1,256,828.24	48˚20'28.012"	-122˚24'38.451"	8.85	¾-inch rebar with 2 ½-inch aluminum cap
TBM 6	488,370.32	1,258,102.12	48˚19'41.259"	-122˚24'18.158"	10.96	¾-inch rebar with 2 ½-inch aluminum cap
TMB 7	491,734.89	1,256,443.51	48˚20'14.120"	-122˚24'43.719"	8.40	¾-inch rebar with 2 ½-inch aluminum cap
TMB 8	491,081.04	1,256,174.11	48˚20'07.614"	-122˚24'47.507"	8.79	¾-inch rebar with 2 ½-inch aluminum cap

TABLE A-4
FIR ISLAND FARM, SURFACE WATER GAUGE SUMMARY

Station	Location	Type of Logger / Serial Number	Owner	TOC Elevation[1]	Depth to Logger[1]	Logger Elev[1]	Depth to Logger[2]	Logger Elev[2]	Northing[4]	Easting[4]
SW-DS-1.0-LTC	Outside dike at Dry Slough	Levelogger - LTC /0121052302	SCL	5.58	7.75	-2.17	7.1	-1.52	1,258,173.39	488,279.75
SW-DS-1.1-LTC	Inside dike near Dry Slough tide gates	Levelogger - LTC /0121053905	SCL	8.4	10.07	-1.67	9.39	-0.99	1,258,200.62	488,415.79
SW-DS-1.2-LT[5]	North of Fir Island Road in Dry Slough	HOBO /9672875 (874175)	SCD (WDFW)	9.18	6.61	2.57	6.2	2.98	1,261,565.04	493,189.37
SW-DSw-1.4-LT[5]	North of Fir Island Road in west branch Dry Slough	HOBO /9669739 (8534941)	SCD (WDFW)	6.79	7.84	-1.05	6.98	-0.19	1,259,576.68	493,208.15
SW-COD-2.0-LTC	Outside levee at No-Name Slough	Levelogger - LTC /0121049572	WDFW	8.79	10.07	-1.28	9.71	-0.92	1,256,444.01	489,419.07
SW-COD-2.1-LTC	Inside dike near No-Name Slough tide gates	Levelogger - LTC /0121049564	WDFW	5.94	8.11	-2.17	6.86	-0.92	1,256,534.13	489,504.64
SW-NNS-2.2-LT	North of Fir Island Road in east branch No-Name Slough	HOBO /2238189	SCL	8.26	9.49	-1.23	9.44	-1.18	1,256,424.91	493,241.39
SW-BS-3.0-LTC	Outside dike at Brown's Slough	Levelogger - LTC /0121053902	SCL	7.81	10.06	-2.25	9.27	-1.46	1,255,928.67	491,085.30
SW-BS-3.1-LTC	Inside dike near Brown's Slough tide gates	Levelogger - LTC /0121049563	WDFW	6.89	8.74	-1.85	7.83	-0.94	1,255,980.76	491,138.85
SW-BS-3.2-LT	North of Fir Island Road in west branch Brown Slough	HOBO /2238186	SCL	7.22	8.45	-1.23	7.25	-0.03	1,256,025.43	493,256.27
BARO-HOBO[5]	Installed near No-Name Slough at the levee	HOBO /2451185 (2451185)	SCD (WDFW)	See Note 3						

Notes:
[1] Loggers originally installed at bottom of casing
[2] Logger installation elevation raised from bottom of casing
[3] Unit is installed above ground surface to log barometric pressure; not surveyed
[4] Survey datum is Washington State Plane North – 4601, NAD83, NAVD88
[5] Original SCD HOBO level temperature loggers replaced w/ HOBO level temperature loggers owned by (WDFW).
HOBO = Onset Computer Corporation: HOBO U20 Water Level Logger
Levelogger - LTC = Solinst: Levelogger Junior [Level, temperature, conductivity]
SCL = Seattle City Light
SCD = Skagit Conservation District
TOC = total organic carbon
WDFW = Washington Department of Fish and Wildlife

TABLE A-5
CULVERT INVENTORY DATA

Geoprobe ID	Description	Easting (ft)	Northing (ft)	Elevation (ft)
GP-01-10	Geoprobe and groundwater well	1,258,418.75	488,282.08	13.97
GP-02-10	Geoprobe and groundwater well	1,258,492.76	488,362.89	5.46
GP-03-10	Geoprobe and groundwater well	1,258,509.59	489,407.13	6.91
GP-04-10	Geoprobe	1,258,833.64	490,313.96	6.47
GP-05-10	Geoprobe	1,258,834.80	491,372.77	6.13
GP-06-10	Geoprobe	1,257,559.95	491,016.03	6.73
GP-07-10	Geoprobe	1,258,050.42	490,266.51	6.09
GP-08-10	Geoprobe	1,258,262.39	489,075.61	5.03
GP-09-10	Geoprobe	1,256,978.83	490,361.76	5.60
GP-10-10	Geoprobe	1,256,982.69	492,441.34	6.86
GP-11-10	Geoprobe	1,258,004.09	492,300.78	7.85
GP-12-10	Geoprobe	1,258,771.15	492,103.85	7.77

Note:
ft = feet

TABLE A-6
CULVERT INVENTORY DATA

Location	Description	Size (in)	Gate/ Open	Type of Gate	Material	Easting (ft)[1]	Northing (ft)[1]	Inlet I.E. (ft)[2]	Outlet I.E. (ft)[2]	Length (ft)	Slope (ft/ft)	Notes
Browns - Fir Island Road	East culvert	48	Tidegate	Flap-top	RCP	1,255,990.16	493,096.54	2.93	1.58	86	0.0157	Need to check RCP vs CMP.
Browns - Bay Dike	East culvert	48	Tidegate	Screwgate	CMP	1,255,963.88	491,077.43	4.74	1.93	56	0.0501	Estimated outlet elevation. Outlet crow survey data appeared incorrect.
Browns - Bay Dike	Middle culvert	48	Tidegate	Flap-top	CMP	1,255,949.28	491,085.49	5.77	2.93	56	0.0507	
Browns - Bay Dike	West culvert	48	Tidegate	Flap-top	CMP	1,255,942.29	491,091.00	5.77	2.68	56	0.0552	
No Name	East culvert	36	Open		RCP	1,256,441.94	493,149.30	3.06	1.82	55	0.0226	
No Name	West culvert	36	Open		RCP	1,256,435.14	493,148.58	3.06	1.86	34	0.0354	Assumed same inlet invert as east pipe.
Claude O' Davis	Mouth of Slough	15	Open		PEP	1,256,633.98	489,441.90	3.14	2.12	21	0.0484	
Claude O' Davis	South Drainage Channel	48	Open		CMP	1,256,696.03	489,342.61	1.66	1.30	21	0.0170	
Claude O' Davis	Bay Dike North	48	Tidegate	Flap-top	CMP	1,256,458.09	489,449.53	0.45	0.76	59	-0.0053	
Claude O' Davis	Bay Dike South	48	Tidegate	Flap-top	CMP	1,256,461.20	489,441.38	0.23	0.42	59	-0.0033	
Dry Slough	Fir Island Road - West Drainage, RCP West	36	Open		RCP	1,259,560.78	493,114.19	0.00	0.00	32	0.0000	Assume culvert inverts match XS inverts.
Dry Slough	Fir Island Road - West Drainage, Box East	48	Open		RCP - BOX	1,259,560.78	493,114.19	0.00	0.00	32	0.0000	Assume culvert inverts match XS inverts.
Dry Slough	Fir Island Road - Hayton Farm East	48	Open		CMP	1,261,694.77	493,041.82	-	0.46	62	0.0002	Damaged inlet filled w/ sediment. Assumed slope.
Dry Slough	Fir Island Road - Hayton Farm West	48	Open		CMP	1,261,687.39	493,041.14	-	0.36	62	0.0002	Damaged inlet filled w/ sediment. Assumed slope.
Dry Slough	McDonald Slough2	36	Tidegate	Flap-top	CMP	1,258,410.57	488,392.93	0.74	0.67	24	0.0002	Survey pts. provided by SCD survey data 12-08-06.
Dry Slough	Bay Dike (East)	48	Tidegate	Flap-top	PEP	1,258,173.78	488,303.42	0.26	0.12	99	0.0014	
Dry Slough	Bay Dike (West)	48	Tidegate	Flap-top	PEP	1,258,145.13	488,309.26	0.97	0.95	97	0.0002	

Notes:
[1] Culvert location (easting/northing) refers to outlet location.
[2] Invert elevations compiles from various sources including Summer 2010 Global Positioning System (GPS) and Skagit Conservation District (SCD) surveys. Recommend tying all invert elevations with total station or level loop surveys as part of future engineering work.
CMP = corrugated metal pipe; PEP = polyethylene plastic pipe; RCP = reinforced concrete pipe

TABLE A-7
FIR ISLAND FARM, SURVEY DATA CHECKS

Point	Easting (ft)	Northing (ft)	Elevation (NAVD88-ft)	Description
WDFW TBM 6	1,258,102.12	488,370.32	10.96	WDFW Survey Benchmark TBM6 near Dry Slough
SW GPS SURVEY PT 6	1,258,102.10	488,370.36	10.96	
Difference	**0.02**	**-0.05**	**0.00**	
TBM 7	1,256,443.51	491,734.89	8.40	WDFW Survey Benchmark TBM7 north of parking lot.
GPS SURVEY PT 7	1,256,443.25	491,734.79	8.446	
Difference	**0.26**	**0.10**	**-0.05**	
WDFW TBM 8	1,256,174.11	491,081.03	8.79	WDFW Survey Benchmark TBM8 at south end of parking lot.
GPS SURVEY PT 8	1,256,174.12	491,081.04	8.79	
Difference	**-0.01**	**-0.01**	**0.00**	
LIDAR NAVD88 Grid Point			12.84	Fir Island Road (EOP) at Dry Slough crossing near Haytons.
GPS Point 280	1,261,695.99	493,093.72	12.52	
Difference			**-0.33**	
LIDAR NAVD88 Grid Point			15.16	Top of levee near Claude O' Davis culverts.
GPS Point 992	1,256,528.18	489,328.43	14.27	
Difference			**-0.89**	
LIDAR NAVD88 Grid Point			6.63	Vegetated thalweg, partly dry cattails in Dry Slough near Fir Island Farm road and Hayton Driveway
GPS Point 266	1,261,576.61	493,186.57	3.86	
Difference			**-2.77**	
LIDAR NAVD88 Grid Point			4.78	Unvegetated thalweg No Name Slough XS-2
GPS Point 505	1,256,901.64	490,863.17	-0.76	
Difference			**-5.54**	

Notes:
ft = feet
GPS = Global Positioning System
WDFW = Washington Department of Fish and Wildlife

APPENDIX B

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION (NOAA) TIDAL DATUM AND EXTREME EVENT DATA SHEETS

Crescent Harbor, Whidbey Island, WA

Station ID: 9447952

Crescent Harbor, Whidbey Island, WA: Data Inventory

Page Help

Datums

Click HERE for printable version

Data Units:

Feet Meters Apply Change

Oct 27 2010 19:47 ELEVATIONS ON STATION DATUM
National Ocean Service (NOAA)

Station: 9447952 **T.M.: 120 W**
Name: CRESCENT HARBOR, WHIDBEY ISLAND, WA **Units: Feet**
Status: Accepted **Epoch: 1983-2001**

Datum	Value	Description
MHHW	13.68	Mean Higher-High Water
MHW	12.78	Mean High Water
DTL	7.85	Mean Diurnal Tide Level
MTL	8.80	Mean Tide Level
MSL	8.82	Mean Sea Level
MLW	4.82	Mean Low Water
MLLW	2.02	Mean Lower-Low Water
GT	11.66	Great Diurnal Range
MN	7.96	Mean Range of Tide
DHQ	0.90	Mean Diurnal High Water Inequality
DLQ	2.81	Mean Diurnal Low Water Inequality
HWI	0.47	Greenwich High Water Interval (in Hours)
LWI	6.58	Greenwich Low Water Interval (in Hours)
NAVD	4.23	North American Vertical Datum
Maximum		Highest Water Level on Station Datum
Max Date		Date Of Highest Water Level
Max Time		Time Of Highest Water Level
Minimum		Lowest Water Level on Station Datum
Min Date		Date Of Lowest Water Level
Min Time		Time Of Lowest Water Level

To refer Water Level Heights to a Tidal Datum, apply the desired Datum Value.

Click HERE for further station information including New Epoch products.

To refer Water Level Heights to either
NGVD (National Geodetic Vertical Datum of 1929) or
NAVD (North American Vertical Datum of 1988), apply the values located at:
National Geodetic Survey

La Conner, Swinomish Slough, WA

Station ID: 9448558

La Conner, Swinomish Slough, WA: Data Inventory

Page Help

Datums

Click HERE for printable version

Data Units:

Feet Meters Apply Change

Oct 27 2010 19:44 **ELEVATIONS ON STATION DATUM**
National Ocean Service (NOAA)

Station: 9448558 **T.M.:** 120 W
Name: LA CONNER, SWINOMISH SLOUGH, WA **Units:** Feet
Status: Accepted **Epoch:** 1983-2001

Datum	Value	Description
MHHW	14.85	Mean Higher-High Water
MHW	13.93	Mean High Water
DTL	9.68	Mean Diurnal Tide Level
MTL	10.56	Mean Tide Level
MSL	10.46	Mean Sea Level
MLW	7.20	Mean Low Water
MLLW	4.50	Mean Lower-Low Water
GT	10.35	Great Diurnal Range
MN	6.73	Mean Range of Tide
DHQ	0.92	Mean Diurnal High Water Inequality
DLQ	2.70	Mean Diurnal Low Water Inequality
HWI	0.75	Greenwich High Water Interval (in Hours)
LWI	7.29	Greenwich Low Water Interval (in Hours)
NAVD		North American Vertical Datum
Maximum		Highest Water Level on Station Datum
Max Date		Date Of Highest Water Level
Max Time		Time Of Highest Water Level
Minimum		Lowest Water Level on Station Datum
Min Date		Date Of Lowest Water Level
Min Time		Time Of Lowest Water Level

To refer Water Level Heights to a Tidal Datum, apply the desired Datum Value.

Click HERE for further station information including New Epoch products.

To refer Water Level Heights to either
NGVD (National Geodetic Vertical Datum of 1929) or
NAVD (North American Vertical Datum of 1988), apply the values located at:
National Geodetic Survey

La Conner, Swinomish Slough, WA

La Conner, Swinomish Slough, WA: Data Inventory

Station ID: 9448558

Page Help

Extremes

Monthly Extremes (W3)

```
Station        --   Unique seven character identifier for the station
Year           --   Year  of data
Mo             --   Month of data
Max            --   Monthly maximum value
Max Date Time  --   Date of maximum value
Min            --   Monthly minimum value
Min Date Time  --   Date of minimum value
Datum Offset   --   Station Datum
```

Station	Year	Mo		Max	Max Date	Time	Min	Min Date	Time
9448558	1972	12	LST	17.48	19721222	07:36	2.03	19721219	22:36
9448558	1973	1	LST	16.94	19730119	05:54	2.35	19730119	23:42

Monthly Extremes - Max/Min

Begin Date: Jan 1 1900

End Date: Oct 27 2010

Data Units: Feet Meters

Apply Change

Sneeoosh Point, WA

Station ID: 9448576

Sneeoosh Point, WA: Data Inventory
Page Help

Datums

Click HERE for printable version

Data Units:
Feet Meters
Apply Change

Oct 27 2010 19:43 **ELEVATIONS ON STATION DATUM**
National Ocean Service (NOAA)

Station: 9448576 **T.M.:** 0 W
Name: SNEEOOSH POINT, SKAGIT BAY, WA **Units:** Feet
Status: Accepted **Epoch:** 1983-2001

Datum	Value	Description
MHHW	14.57	Mean Higher-High Water
MHW	13.71	Mean High Water
DTL	9.04	Mean Diurnal Tide Level
MTL	9.90	Mean Tide Level
MSL	9.90	Mean Sea Level
MLW	6.08	Mean Low Water
MLLW	3.51	Mean Lower-Low Water
GT	11.05	Great Diurnal Range
MN	7.63	Mean Range of Tide
DHQ	0.86	Mean Diurnal High Water Inequality
DLQ	2.56	Mean Diurnal Low Water Inequality
HWI	0.93	Greenwich High Water Interval (in Hours)
LWI	7.29	Greenwich Low Water Interval (in Hours)
NAVD	5.53	North American Vertical Datum
Maximum	15.55	Highest Water Level on Station Datum
Max Date	20000609	Date Of Highest Water Level
Max Time	07:06	Time Of Highest Water Level
Minimum	0.04	Lowest Water Level on Station Datum
Min Date	20000702	Date Of Lowest Water Level
Min Time	19:30	Time Of Lowest Water Level

To refer Water Level Heights to a Tidal Datum, apply the desired Datum Value.

Click HERE for further station information including New Epoch products.

Sneeoosh Point, WA

Sneeoosh Point, WA: Data Inventory

Station ID: 9448576

Page Help

Extremes

Monthly Extremes (W3)

```
Station        --   Unique seven character identifier for the station
Year           --   Year  of data
Mo             --   Month of data
Max            --   Monthly maximum value
Max Date Time  --   Date of maximum value
Min            --   Monthly minimum value
Min Date Time  --   Date of minimum value
Datum Offset   --   Station Datum
```

Station	Year	Mo		Max	Max Date	Time	Min	Min Date	Time
9448576	2000	6	GMT	15.55	20000609	07:06	0.23	20000603	19:42
9448576	2000	7	GMT	15.52	20000706	04:48	0.04	20000702	19:30

maxmin

Begin Date: 0 1 1900

End Date: 9 27 2010

Data Units: Feet Meters

Apply Change

APPENDIX C

SURVEY FIGURES

APPENDIX C

SURVEY FIGURES

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C-1	WDFW Survey Control Points
C-2	GPS Survey Points, Aug-Sep, 2010
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C-6	Culverts
C-7	SCD, 2008 Dry Slough Survey Cross Section Locations (1/2)
C-8	SCD, 2008 Dry Slough Survey Cross Section Locations (2/2)
C-9	SCD, 2008 Dry Slough Survey Thalweg Profile
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STATE OF WASHINGTON
DEPARTMENT OF FISH & WILDLIFE

TOPOGRAPHIC SURVEY IN SECTION 22, TOWNSHIP 33 NORTH, RANGE 3 EAST, W.M.
SKAGIT COUNTY

FIR ISLAND FARMS

WASH. STATE DEPT OF FISH AND WILDLIFE — SWA GPS-3 — ELEV 7.12'

3
TBM SWA GPS-3
SET 3/4" REBAR WITH
2 1/2" ALUM. CAP MARKED AS
SHOWN ±37' SOUTHWEST OF
CORNER TO SECS. 22,23,26,27.
NOTE: TBM SWA GPS-3 IS A
HORIZONTAL AND VERTICAL
CONTROL STATION AND IS NOT
A WDFW PROPERTY CORNER.
NAVD 88 ELEV: 7.12'
GRID N: 493110.448
GRID E: 1259287.617
LATITUDE: 48°20'28.265"
LONGITUDE: −122°24'02.046"

WASH. STATE DEPT OF FISH AND WILDLIFE — SWA GPS-4 — ELEV 8.85'

4
TBM SWA GPS-4
SET 3/4" REBAR WITH
2 1/2" ALUM. CAP MARKED AS
SHOWN ±2' EAST OF GRAVEL
ENTRANCE ROAD AND ±30'
SOUTH OF C/L FIR ISLAND ROAD.
NOTE: TBM SWA GPS-4 IS A
HORIZONTAL AND VERTICAL
CONTROL STATION AND IS NOT A
WDFW PROPERTY CORNER.
NAVD 88 ELEV: 8.85'
GRID N: 493135.024
GRID E: 1256828.240
LATITUDE: 48°20'28.012"
LONGITUDE: −122°24'38.451"

WASH. STATE DEPT OF FISH AND WILDLIFE — 6 — ELEV 10.96'

6
TBM 6
SET 3/4" REBAR WITH
2 1/2" ALUM. CAP MARKED AS
SHOWN.
NOTE: TBM 6 IS A HORIZONTAL
AND VERTICAL CONTROL STATION
AND IS NOT A WDFW PROPERTY
CORNER.
NAVD 88 ELEV: 10.96'
GRID N: 488370.315
GRID E: 1258102.115
LATITUDE: 48°19'41.259"
LONGITUDE: −122°24'18.158"

WASH. STATE DEPT OF FISH AND WILDLIFE — 7 — ELEV 8.40'

7
TBM 7
SET 3/4" REBAR WITH
2 1/2" ALUM. CAP MARKED AS
SHOWN ±4' EAST OF METAL
SWING GATE POST.
NOTE: TBM 7 IS A HORIZONTAL
AND VERTICAL CONTROL STATION
AND IS NOT A WDFW PROPERTY
CORNER.
NAVD 88 ELEV: 8.40'
GRID N: 491734.887
GRID E: 1256443.512
LATITUDE: 48°20'14.120"
LONGITUDE: −122°24'43.719"

WASH. STATE DEPT OF FISH AND WILDLIFE — 8 — ELEV 8.79'

8
TBM 8
SET 3/4" REBAR WITH
2 1/2" ALUM. CAP MARKED AS
SHOWN ±3' NORTHEAST FROM
WOOD FENCE POST AT ANGLE
POINT IN FENCE IN SOUTH EDGE
OF GRAVEL.
NOTE: TBM 8 IS A HORIZONTAL
AND VERTICAL CONTROL STATION
AND IS NOT A WDFW PROPERTY
CORNER.
NAVD 88 ELEV: 8.79'
GRID N: 491081.035
GRID E: 1256174.112
LATITUDE: 48°20'07.614"
LONGITUDE: −122°24'47.507"

LEGEND

PROJECT TBM
SET 3/4" REBAR WITH 2 1/2"
ALUM. CAP STAMPED WITH
NAVD 88 ELEVATION AS SHOWN.

SET 48" METAL POST

0 500 1000
250
SCALE IN FEET

VERTICAL DATUM

NAVD 88 DERIVED FROM NGS BENCHMARK
DESIGNATION – T 331 RESET 1975
PID – TR0121
ELEVATION – 54.31 FEET

BASIS OF BEARINGS

NAD83 WA. STATE PLANE NORTH ZONE

NOTES

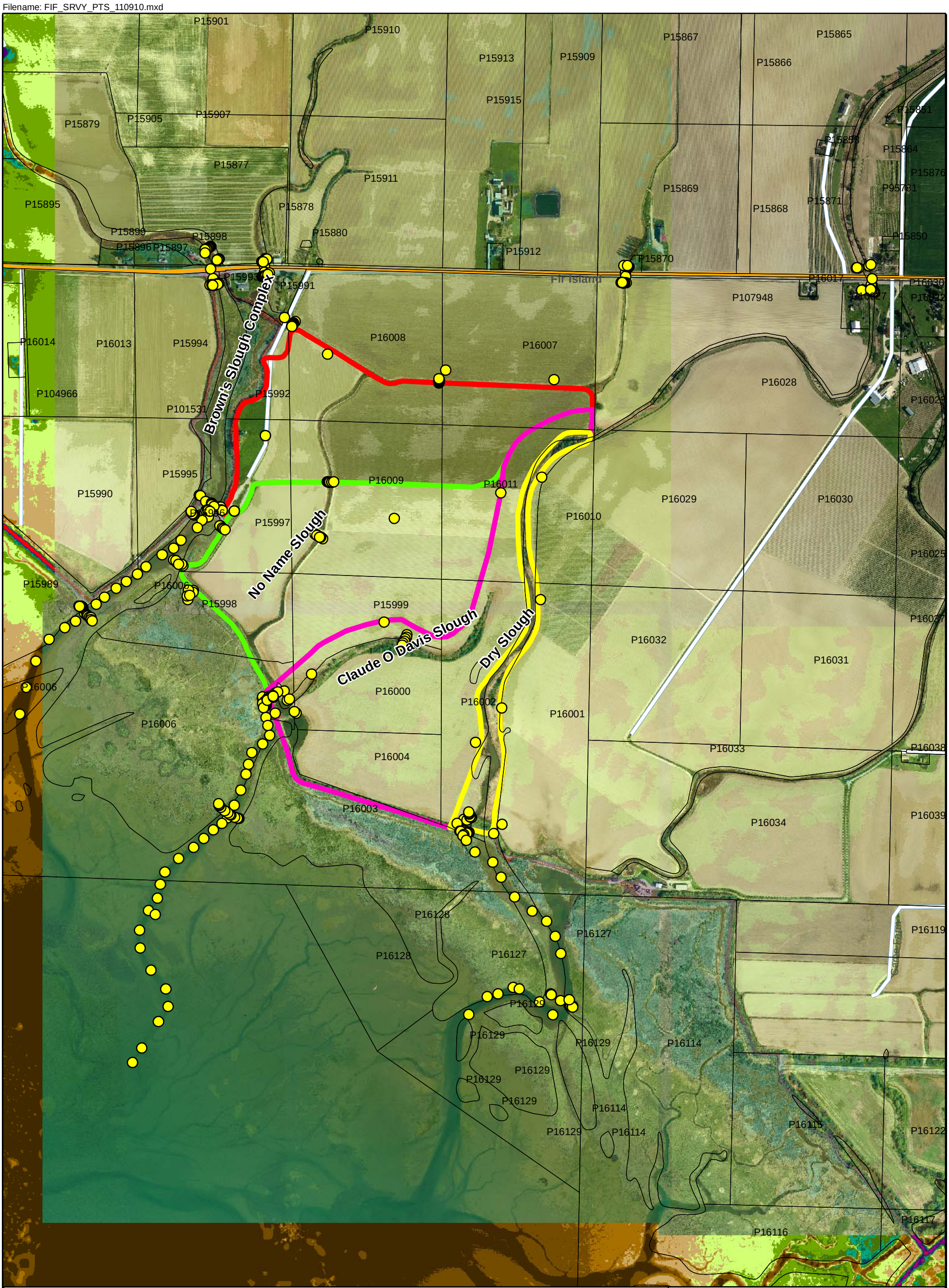
EQUIPMENT USED
TOPCON GTS-600 TOTAL STATION THEODOLITE
WILD NA 2002 DIGITAL LEVEL
TRIMBLE GPS RECEIVERS MODEL 4700

FIELD BOOK(S)
400.58

DISCLAIMER
THIS MAP IS INTENDED FOR USE
AS A TOPOGRAPHICAL MAP ONLY.

DRAWN BY:	A. HAMMOND	DATE:	JUNE 28, 2010
CHECKED BY:		DRAWING NO.:	051910 FIR ISLAND FARMS.dwg
JOB NO.:	84925	SHEET	1 OF 1

Filename: FIF_SRVY_PTS_110910.mxd



FIF_SRVY_PTS_110910
PNumbers
Parcels
Alt_4_110510
Alt_3_110510
Alt_2_110510
Alt_1_110510

DRAFT

NOTE

Washington State-Plane
North 4601
NAD83/NAVD88

N
W E
S

0 250 500 1,000
Feet

FIR ISLAND FARM RESTORATION
SKAGIT SNOW GOOSE PRESERVE
SKAGIT COUNTY, WA

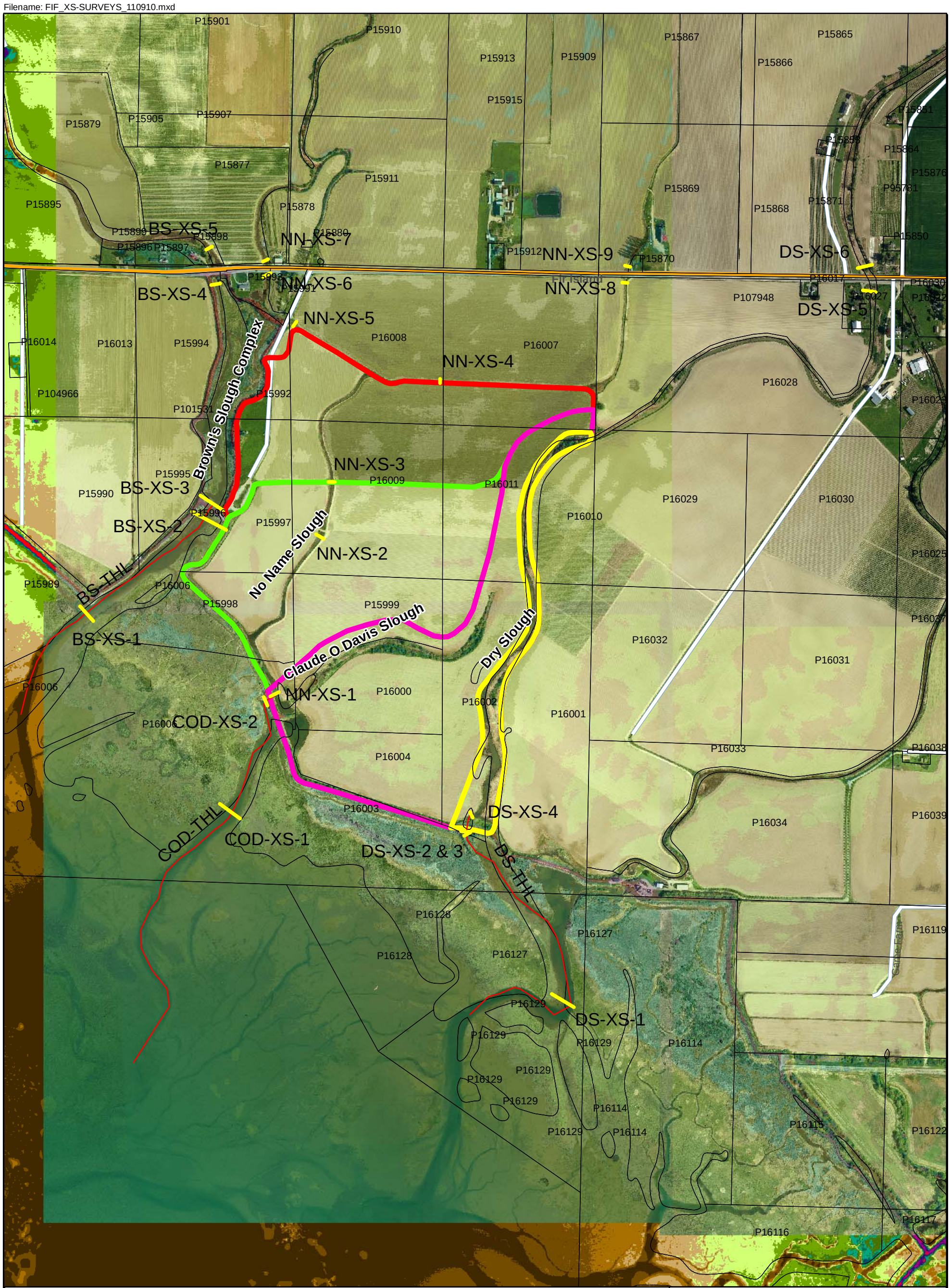
GPS SURVEY POINTS
AUG-SEP, 2010

November 2010 | 21-1-12318-001

SHANNON & WILSON, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

FIG. C-2

Filename: FIF_XS-SURVEYS_110910.mxd



XS_SURVEY_LINES
THL_LINES
PNumbers
Parcels
Alt_4_110510
Alt_3_110510
Alt_2_110510
Alt_1_110510

DRAFT

N
W E
S

NOTE

Washington State-Plane
North 4601
NAD83/NAVD88

0 250500 1,000
Feet

FIR ISLAND FARM RESTORATION
SKAGIT SNOW GOOSE PRESERVE
SKAGIT COUNTY, WA

CROSS SECTION &
THALWEG PROFILE SURVEYS

November 2010 | 21-1-12318-001

SHANNON & WILSON, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

FIG. C3

Filename: FIF_SW-GW_GAGES_111010.mxd

SW-GW_LOGGERS
TYPE
- GW-LT
- SW-LT
- SW-LTC
- Alt_4_110510
- Alt_3_110510
- Alt_2_110510
- Alt_1_110510
- Parcels

DRAFT

N W E S

NOTE

Washington State-Plane
North 4601
NAD83/NAVD88

0 250500 1,000
Feet

FIR ISLAND FARM RESTORATION
SKAGIT SNOW GOOSE PRESERVE
SKAGIT COUNTY, WA

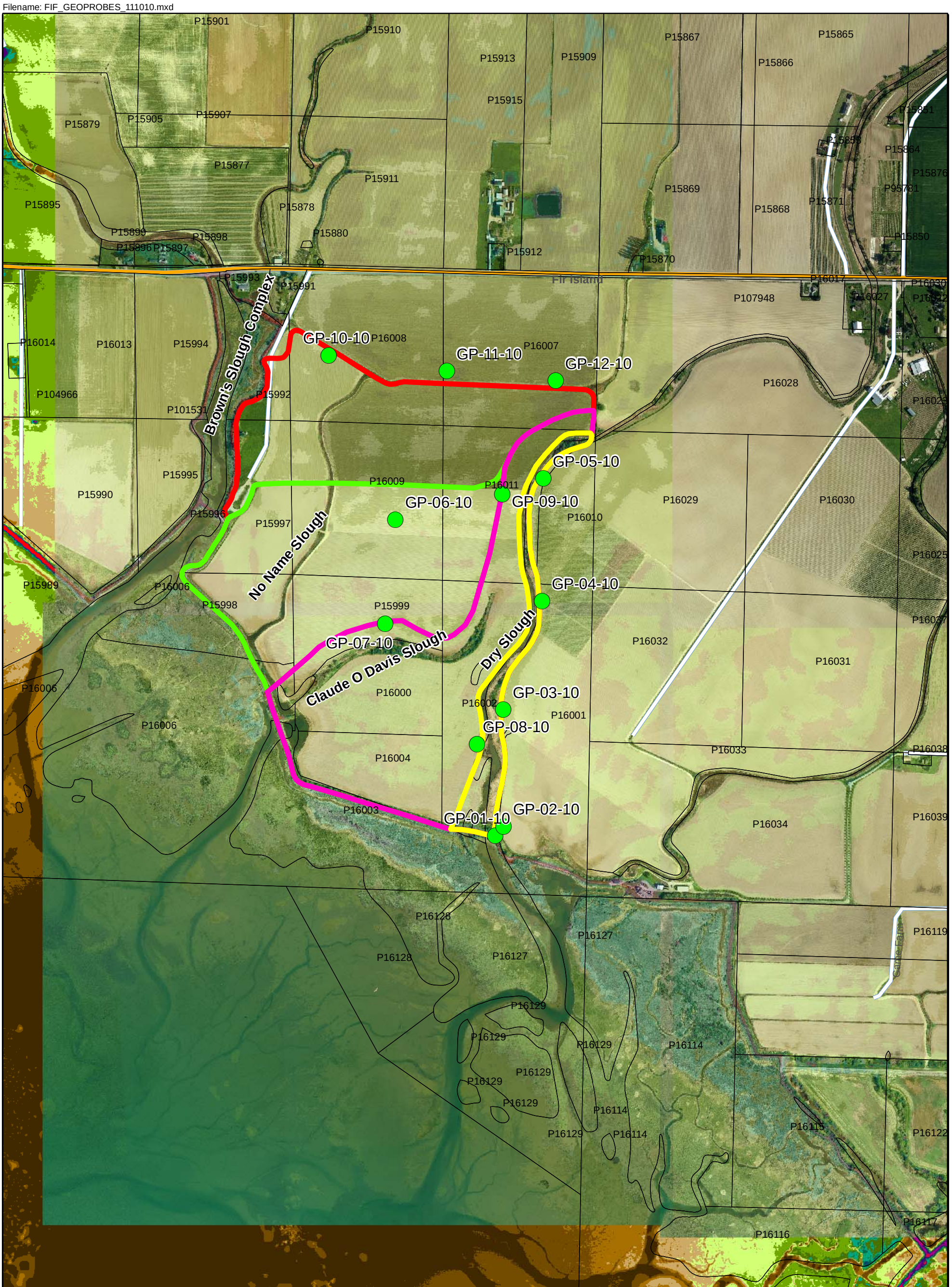
SURFACE WATER & GROUNDWATER MONITORING GAUGES

November 2010 | 21-1-12318-001

SHANNON & WILSON, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

FIG. C-4

Filename: FIF_GEOPROBES_111010.mxd



GEOPROBES
Alt_4_110510
Alt_3_110510
Alt_2_110510
Alt_1_110510
Parcels

DRAFT

N
W E
S

NOTE

Washington State-Plane
North 4601
NAD83/NAVD88

0 250500 1,000
Feet

FIR ISLAND FARM RESTORATION
SKAGIT SNOW GOOSE PRESERVE
SKAGIT COUNTY, WA

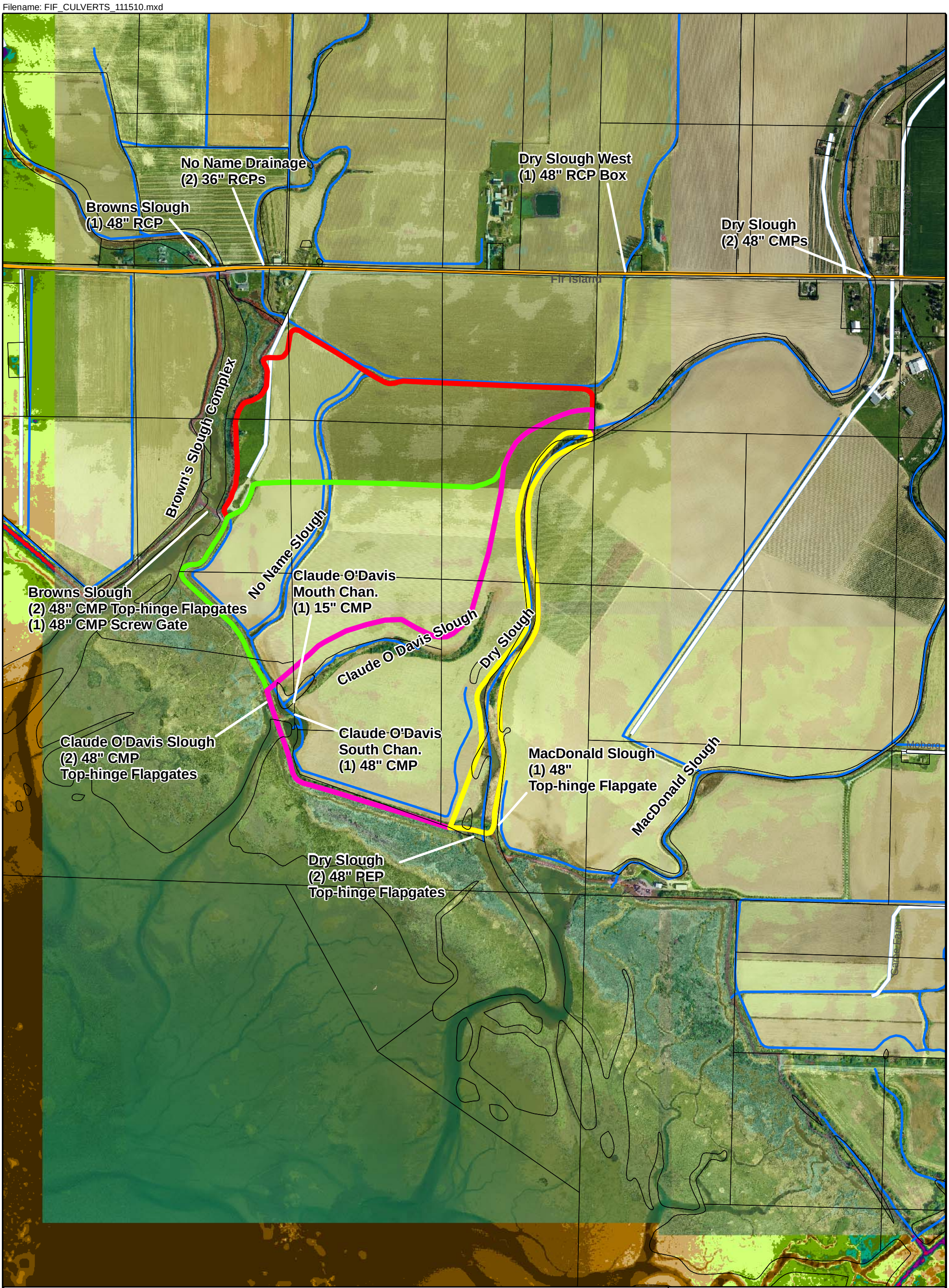
GEOPROBE EXPLORATION LOCATIONS

November 2010 | 21-1-12318-001

SHANNON & WILSON, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

FIG. C-5

Filename: FIF_CULVERTS_111510.mxd



Parcels
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Alt_3_110510
Alt_2_110510
Alt_1_110510
wc_arc

DRAFT

N
W E
S

NOTE

Washington State-Plane
North 4601
NAD83/NAVD88

0 250500 1,000
Feet

FIR ISLAND FARM RESTORATION
SKAGIT SNOW GOOSE PRESERVE
SKAGIT COUNTY, WA

CULVERTS

November 2010 21-1-12318-001

SHANNON & WILSON, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

FIG. C-6

APPENDIX D

SURVEY PROFILES AND CROSS SECTIONS
FIGURES AND TABLES

APPENDIX D

SURVEY PROFILES AND CROSS SECTIONS
FIGURES AND TABLES

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D-2 DS-XS-1
D-3 DS-XS-4
D-4 DS-XS-5
D-5 DS-XS-6
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D-7 COD-XS-2
D-8 NN-XS-1
D-9 NN-XS-2
D-10 NN-XS-3
D-11 NN-XS-4
D-12 NN-XS-5
D-13 NN-XS-6
D-14 NN-XS-7
D-15 NN-XS-8
D-16 NN-XS-9
D-17 BS-XS-1
D-18 BS-XS-2
D-19 BS-XS-3
D-20 BS-XS-4
D-21 BS-XS-5
D-22 DS-XS-U (Surveys by NSEA/SCD, Data Processing By M&N, Datum Name Changed from MLLW to NAVD88)
D-23 DS-XS-S (Surveys by NSEA/SCD, Data Processing By M&N, Datum Name Changed from MLLW to NAVD88)
D-24 DS-XS-F (Surveys by NSEA/SCD, Data Processing By M&N, Datum Name Changed from MLLW to NAVD88)
D-25 DS-XS-G (Surveys by NSEA/SCD, Data Processing By M&N, Datum Name Changed from MLLW to NAVD88)
D-26 DS-XS-H (Surveys by NSEA/SCD, Data Processing By M&N, Datum Name Changed from MLLW to NAVD88)
D-27 DS-XS-I (Surveys by NSEA/SCD, Data Processing By M&N, Datum Name Changed from MLLW to NAVD88)

TABLES (cont.)

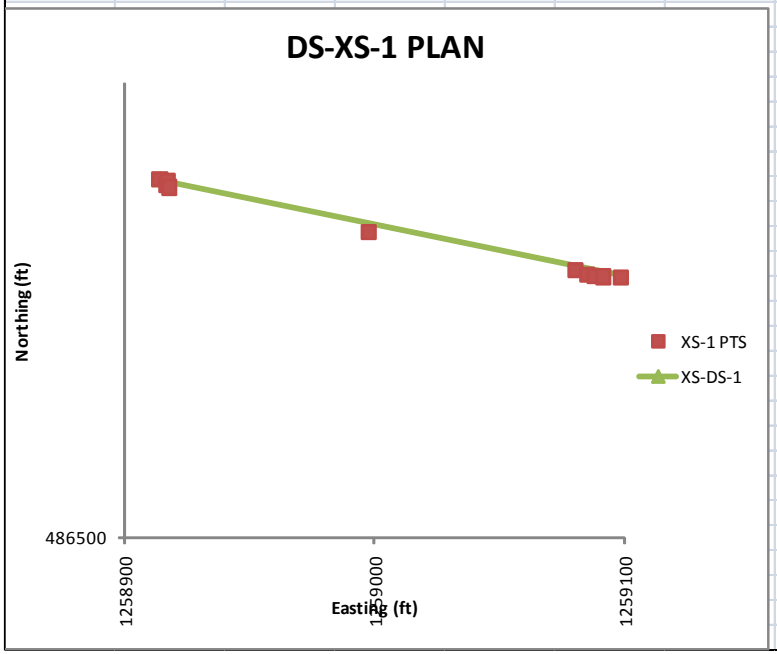
D-28 DS-XS-J (Surveys by NSEA/SCD, Data Processing By M&N, Datum Name Changed from MLLW to NAVD88)
D-29 DS-XS-K (Surveys by NSEA/SCD, Data Processing By M&N, Datum Name Changed from MLLW to NAVD88)
D-30 DS-XS-M (Surveys by NSEA/SCD, Data Processing By M&N, Datum Name Changed from MLLW to NAVD88)
D-31 DS-XS-N (Surveys by NSEA/SCD, Data Processing By M&N, Datum Name Changed from MLLW to NAVD88)
D-32 DS-XS-N (Surveys by NSEA/SCD, Data Processing By M&N, Datum Name Changed from MLLW to NAVD88)
D-33 DS-XS-P (Surveys by NSEA/SCD, Data Processing By M&N, Datum Name Changed from MLLW to NAVD88)
D-34 DS-XS-R (Surveys by NSEA/SCD, Data Processing By M&N, Datum Name Changed from MLLW to NAVD88)

FIGURES

D-1 Bay Front Channel Thalweg Alignments
D-2 Dry Slough Bay Front GPS Survey and Lidar Channel Profile
D-3 Claude O Davis Bay Front GPS Survey and Lidar Channel Profile
D-4 Browns Slough Bay Front GPS Survey and Lidar Channel Profile

Table D1. DS-XS-1

P	E	N	Z	D				UNIT VECTOR	STATION (FT)
713	1258914.2	486893.509	5.948	POFP				0.0000	0.0
714	1258916.9	486887.531	5.801	WSE				0.0248	5.4
712	1258917.4	486891.779	5.816	TOB				0.0171	3.7
715	1258918.0	486884.944	6.123	OHW				0.0351	7.6
716	1258997.7	486836.32	4.384	TOE				0.4664	100.9
705	1259080.7	486794.454	0.339	THL1				0.8952	193.7
706	1259085.2	486788.994	1.684	TOE				0.9260	200.4
708	1259088.0	486787.013	4.558	POB				0.9419	203.8
707	1259091.7	486786.75	5.976	WSE				0.9571	207.1
710	1259098.8	486785.553	6.827	OHW				0.9885	213.9
709	1259102.1	486786.332	7.274	TOB				1.0000	216.4



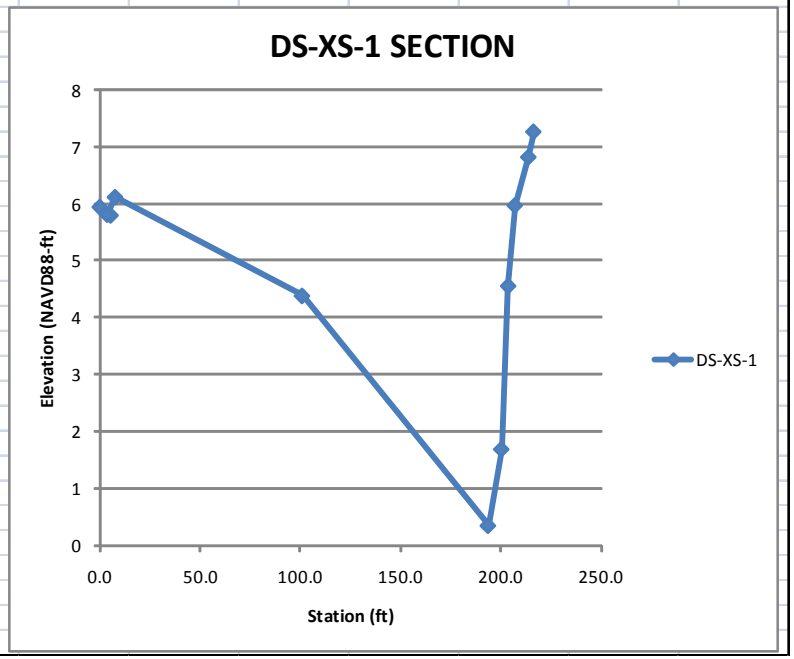
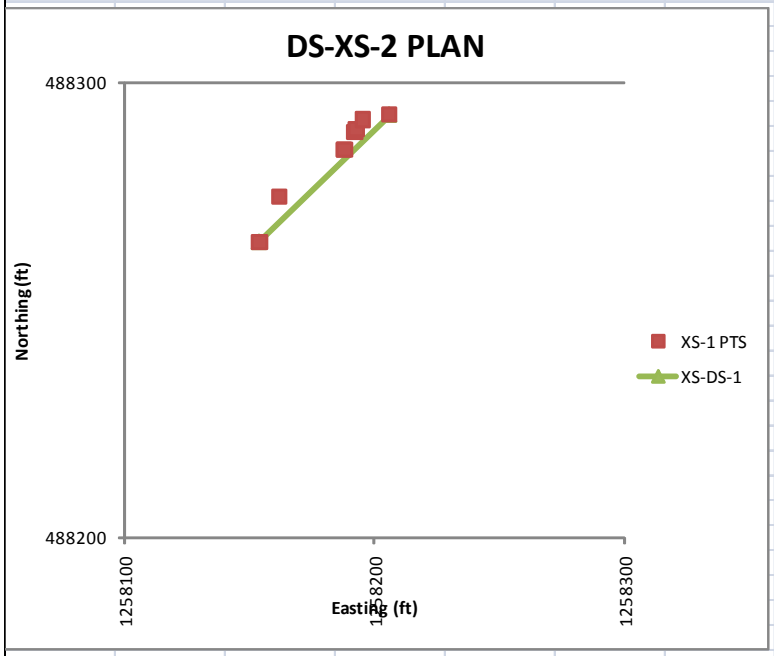


Table D2. DS-XS-1

FID	P	E	N	Z	D			UNIT VECTOR	STATION (FT)
374	423	1258154.13	488264.964	3.736	WSE			0.0000	0.0
373	422	1258162.2	488274.957	3.617	THL1			0.2007	11.8
369	418	1258187.93	488285.229	4.418	WSE			0.6672	39.4
368	417	1258188.1	488285.287	4.571	TOE			0.6702	39.5
367	416	1258192.29	488289.058	7.123	OHW			0.7630	45.0
366	415	1258192.84	488289.711	7.699	POB			0.7765	45.8
365	414	1258195.61	488291.888	9.19	TOB			0.8353	49.3
364	413	1258206.07	488292.966	12.391	POFP			1.0000	59.0



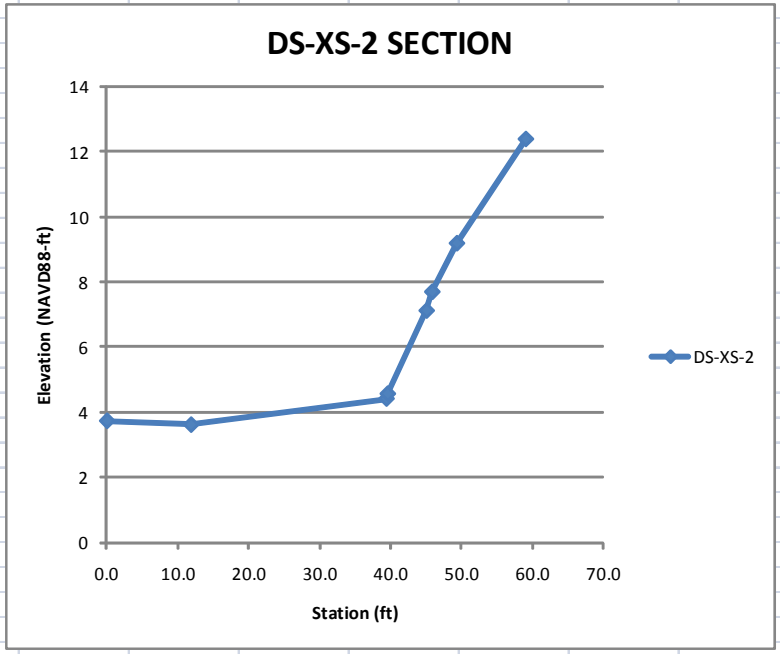
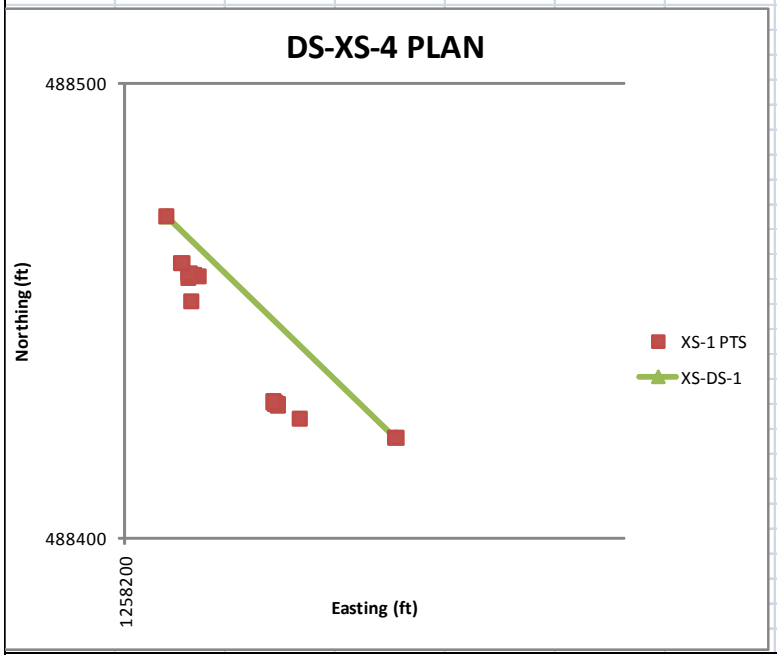


Table D3. DS-XS-4

FID	P	E	N	Z	D			UNIT VECTOR	STATION (FT)
351	400	1258227.17	488421.905	6.016	POFP			0.0000	0.0
352	401	1258217.6	488426.11	5.546	TOB			0.1459	7.9
353	402	1258215.37	488429.155	4.471	OHW			0.2144	11.6
354	403	1258215.4	488429.26	4.118	POB			0.2160	11.7
355	404	1258215.06	488429.607	3.634	TOE			0.2244	12.1
356	405	1258214.87	488429.859	3.582	WSE			0.2301	12.4
357	406	1258206.74	488451.935	3.556	THL1			0.6642	35.9
359	408	1258207.36	488457.414	2.996	TOE			0.7511	40.6
358	407	1258206.45	488457.225	3.545	WSE			0.7550	40.8
360	409	1258207.02	488457.731	3.905	OHW			0.7590	41.0
361	410	1258206.48	488458.231	4.568	POB			0.7718	41.7
362	411	1258205.74	488460.454	5.778	TOB			0.8148	44.0
363	412	1258204.2	488470.782	5.309	POFP			1.0000	54.0



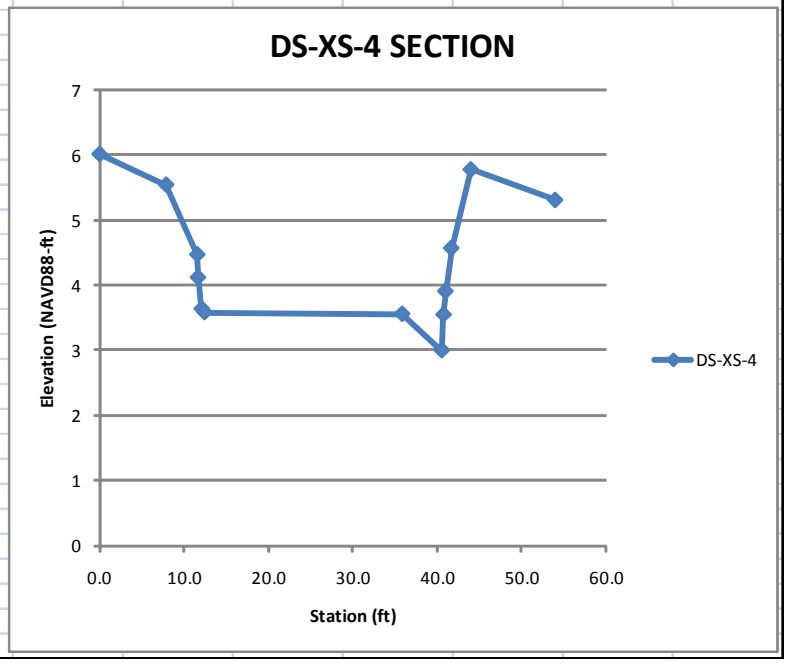
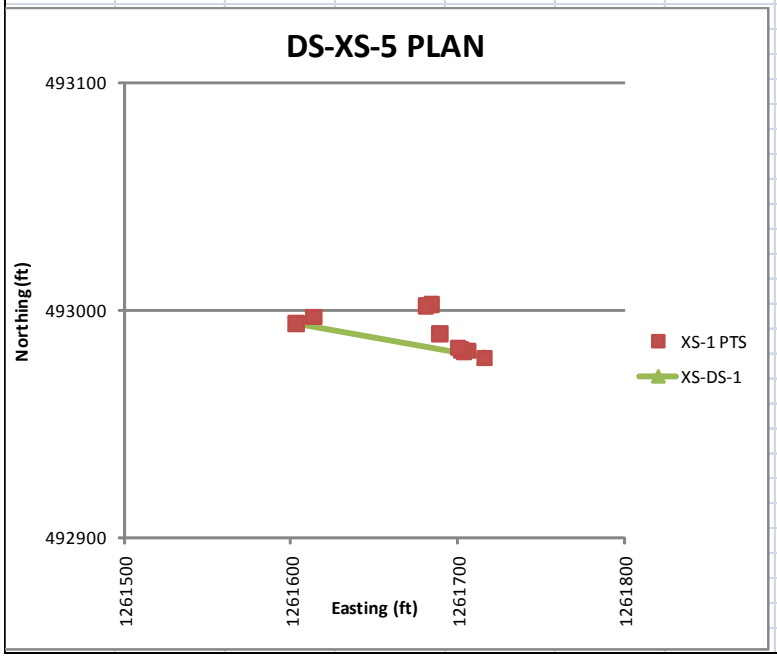


Table D4. DS-XS-5

FID	P	E	N	Z	D			UNIT VECTOR	STATION (FT)
249	269	1261716.46	492978.935	5.345	POFP			0.0000	0.0
250	270	1261706.36	492982.048	5.046	TOB			0.0912	10.4
251	271	1261703.65	492981.73	4.729	POB			0.1143	13.1
253	273	1261702.14	492982.465	4.488	OHW			0.1283	14.7
252	272	1261700.59	492983.223	4.053	TOE			0.1426	16.3
254	274	1261689.24	492989.546	3.991	THL1			0.2483	28.4
257	277	1261684.29	493002.322	4.521	TOE			0.3060	35.0
258	278	1261681.24	493001.683	5.007	POB			0.3317	37.9
255	275	1261613.81	492997.017	11.681	TOB			0.9110	104.1
256	276	1261603.15	492994.025	12.938	POFP			1.0000	114.3



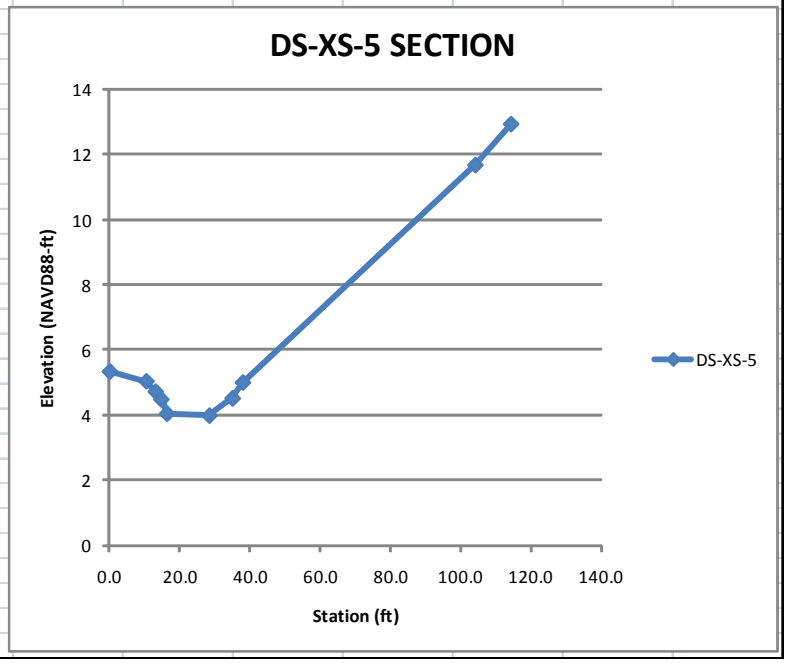
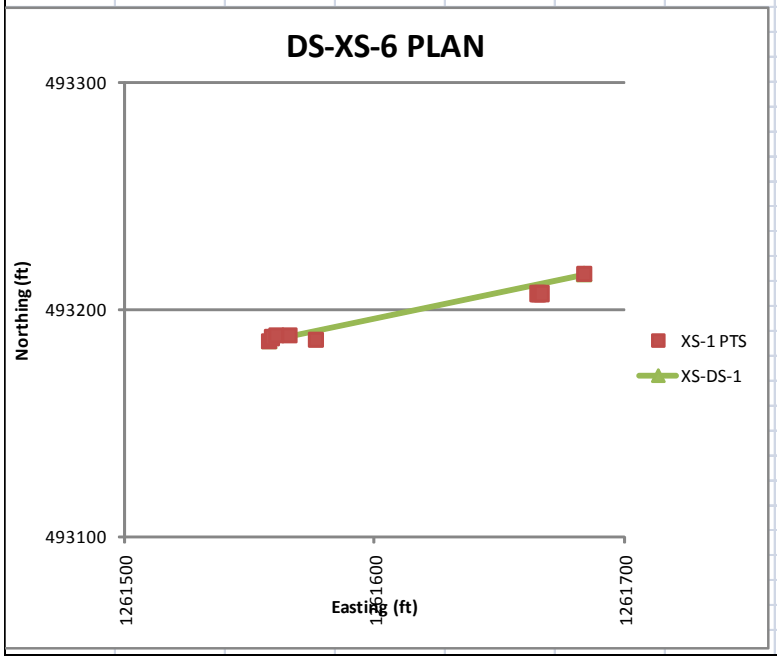


Table D5. DS-XS-6

FID	P	E	N	Z	D			UNIT VECTOR	STATION (FT)
238	258	1261558.02	493185.955	9.282	TOB			0.0000	0.0
239	259	1261559.27	493187.637	7.632	POB			0.0124	1.6
240	260	1261560.65	493188.678	6.489	OHW			0.0246	3.2
241	261	1261566.24	493188.609	4.703	TOE			0.0665	8.6
246	266	1261576.61	493186.567	3.864	THL1			0.1408	18.2
242	262	1261665.40	493206.896	5.427	TOE			0.8434	109.3
243	263	1261665.86	493206.952	5.579	OHW			0.8470	109.8
244	264	1261667.10	493206.865	6.161	POB			0.8562	111.0
245	265	1261684.21	493215.575	8.886	POFP			1.0000	129.6



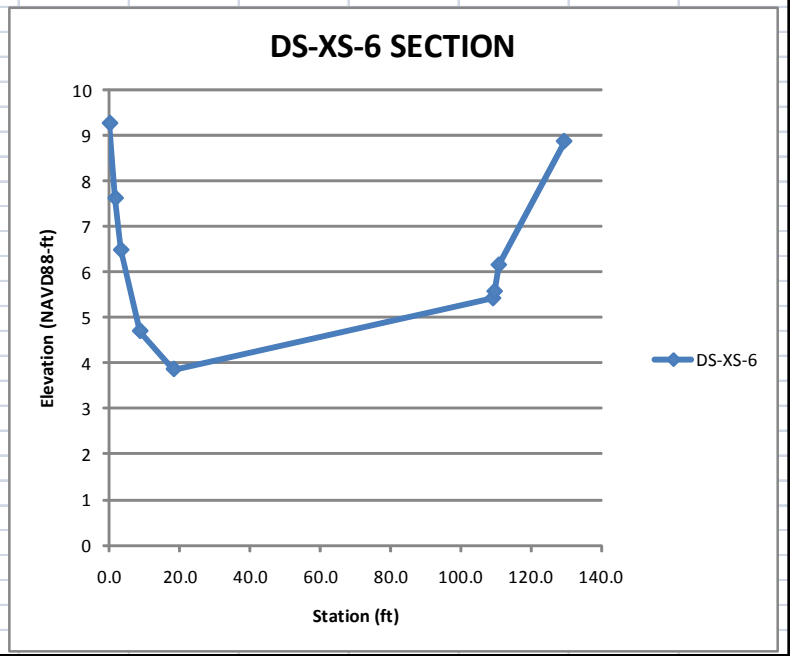
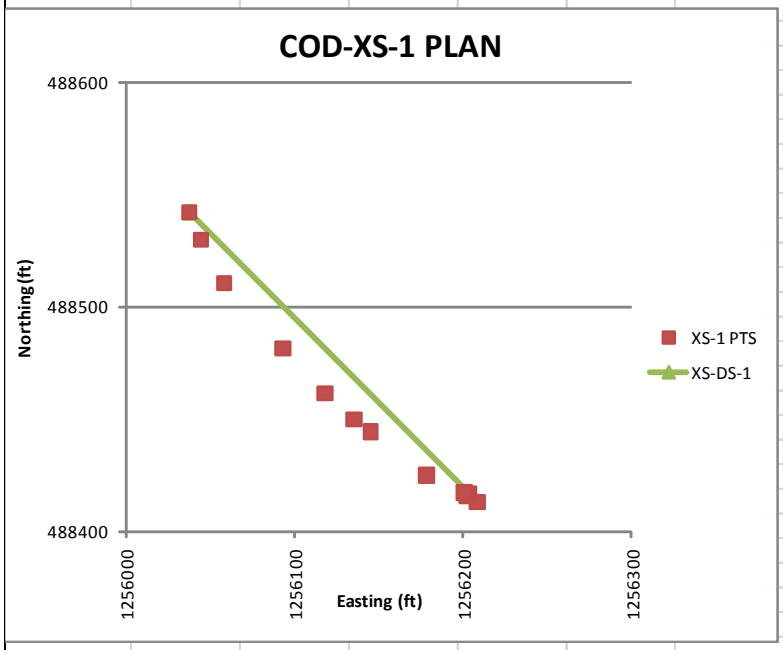


Table D6. COD-XS-1

FID	P	E	N	Z	D			UNIT VECTOR	STATION (FT)
321	359	1256208.55	488413.227	7.16	POB			0.0000	0.0
322	360	1256203.57	488417.044	7.006	TOB			0.0293	6.3
324	362	1256201.86	488415.699	6.195	OHW			0.0319	6.8
323	361	1256200.72	488417.27	5.332	TOE			0.0406	8.7
325	363	1256178.35	488425.045	4.041	POB			0.1459	31.2
326	364	1256145.39	488444.243	2.598	WSE			0.3230	69.1
327	365	1256135.38	488449.684	2.13	THL			0.3757	80.4
328	366	1256118.2	488461.545	2.748	WSE			0.4732	101.2
329	367	1256093.3	488481.223	3.273	POB			0.6215	133.0
330	368	1256058.2	488510.342	3.938	TOE			0.8344	178.5
332	370	1256044.47	488529.992	7.176	TOB			0.9410	201.3
333	371	1256037.76	488542.061	7.109	POFP			1.0000	213.9



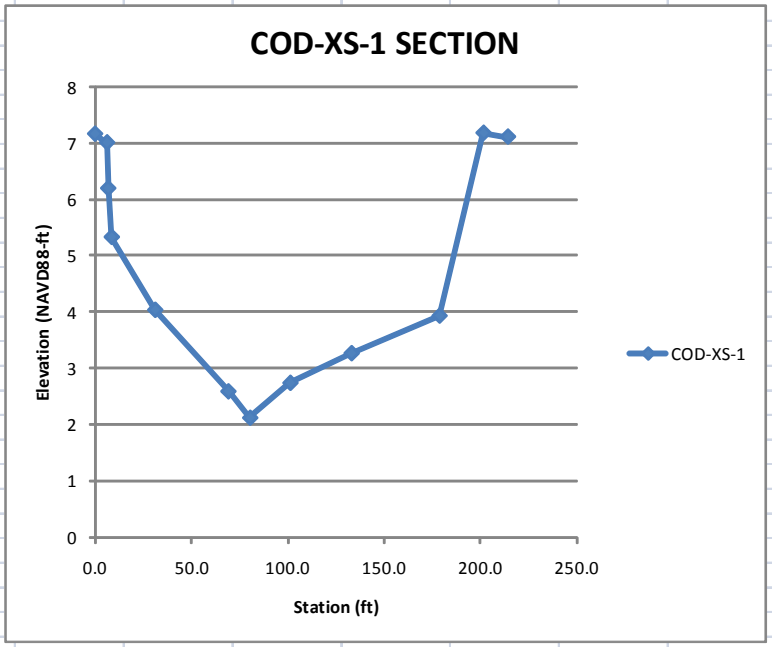
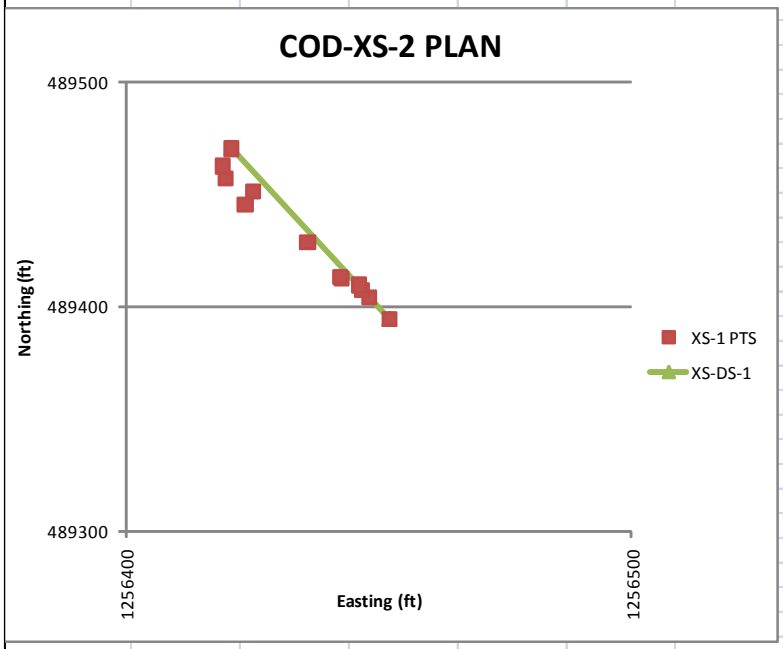


Table D7. COD-XS-2

FID	P	E	N	Z	D			UNIT VECTOR	STATION (FT)
278	316	1256452.11	489394.427	8.674	POFP			0.0000	0.0
279	317	1256448.18	489404.002	9.28	TOB			0.1264	10.4
280	318	1256446.71	489407.443	7.7	POB			0.1720	14.1
281	319	1256446.17	489409.447	6.333	OHW			0.1972	16.2
282	320	1256442.58	489412.414	3.074	TOE			0.2473	20.3
283	321	1256442.43	489413.128	2.887	WSE			0.2561	21.0
289	327	1256435.9	489428.35	2.667	THL2			0.4583	37.5
284	322	1256423.65	489445.437	3.018	TOE			0.7081	58.0
285	323	1256425.13	489450.996	4.843	OHW			0.7639	62.6
286	324	1256419.67	489456.855	8.684	POB			0.8554	70.1
287	325	1256419.2	489462.393	10.083	TOB			0.9201	75.4
288	326	1256420.9	489470.17	10.925	POFP			1.0000	81.9



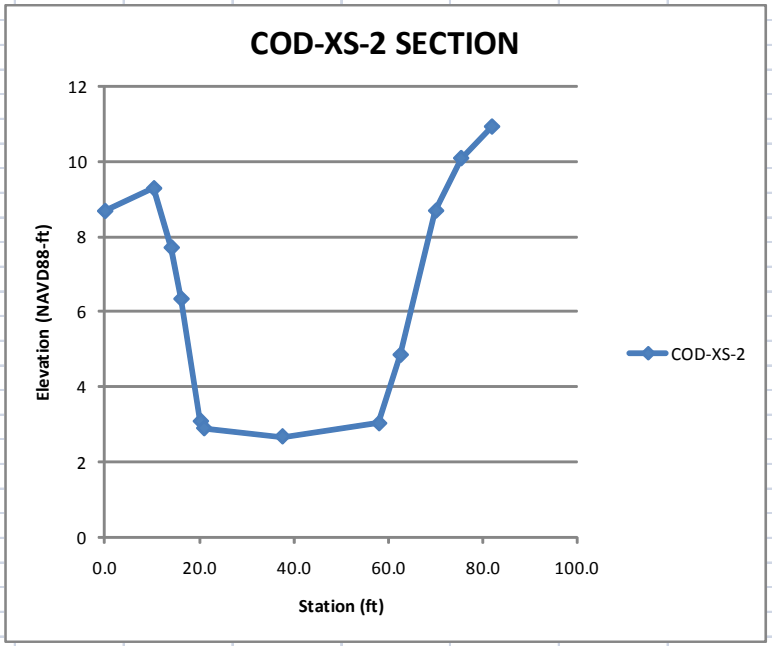
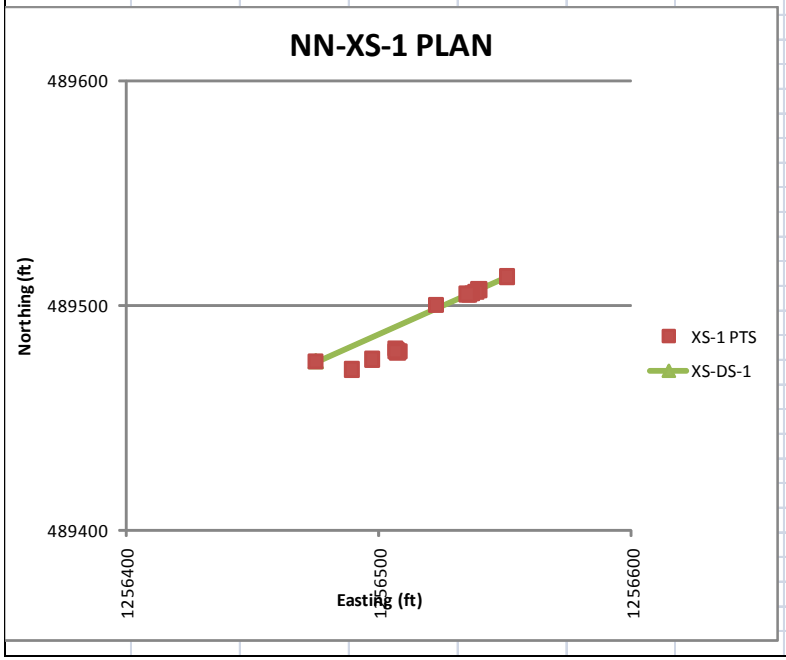


Table D8. NN-XS-1

FID	P	E	N	Z	D			UNIT VECTOR	STATION (FT)
340	378	1256550.87	489512.777	5.405	POFP			0.0000	0.0
338	376	1256539.55	489506.883	5.487	TOB			0.1504	12.8
337	375	1256538.36	489505.857	4.799	POB			0.1684	14.3
336	374	1256537.07	489505.435	3.928	OHW			0.1843	15.6
339	377	1256535.74	489504.71	3.357	TOE			0.2022	17.1
335	373	1256534.92	489504.975	2.516	WSE			0.2094	17.8
334	372	1256522.75	489499.985	2.773	THL2			0.3641	30.9
347	385	1256508.09	489479.429	2.812	TOE			0.6272	53.2
342	380	1256506.48	489480.601	3.525	TOB			0.6379	54.1
341	379	1256507.2	489479.754	2.904	WSE			0.6349	53.8
348	386	1256507.5	489479.223	3.055	WSE			0.6344	53.8
346	384	1256506.73	489479.29	3.644	OHW			0.6423	54.5
345	383	1256497.34	489475.957	9.638	POB			0.7589	64.3
344	382	1256489.17	489471.393	14.596	TOB			0.8692	73.7
343	381	1256475.03	489474.868	14.521	POFP			1.0000	84.8



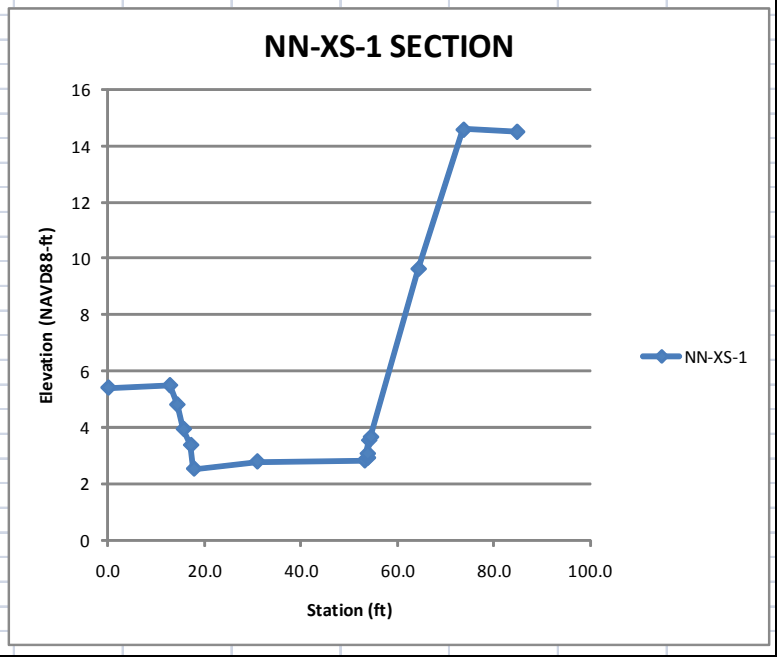
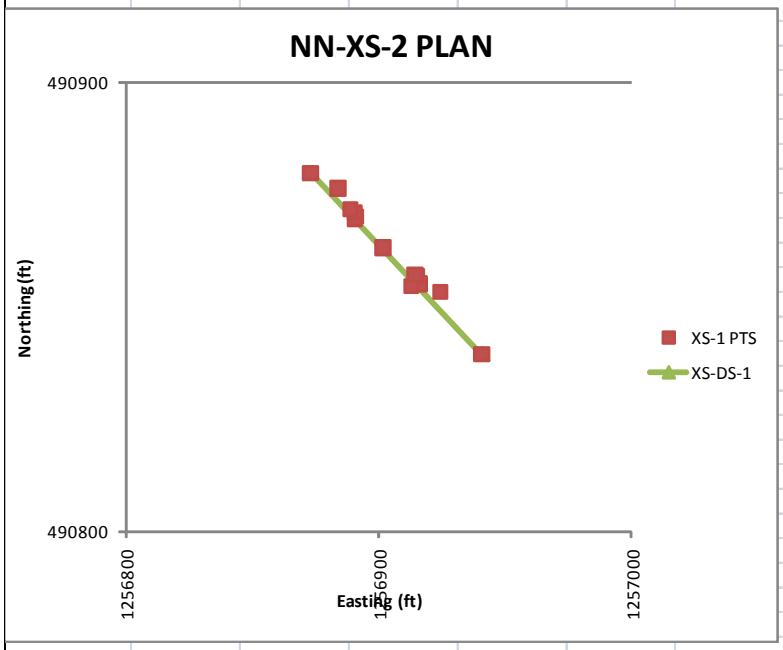


Table D9. NN-XS-2

FID	P	E	N	Z	D			UNIT VECTOR	STATION (FT)
23	500	1256940.74	490839.335	6.535	POFP			0.0000	0.0
24	501	1256924.38	490853.356	6.844	TOB			0.2689	21.2
26	503	1256916.49	490855.072	4.995	POB			0.3659	28.9
25	502	1256915.14	490856.819	3.868	OHW			0.3919	30.9
35	512	1256912.95	490854.601	2.965	WSE			0.4013	31.7
27	504	1256914.22	490857.133	2.797	TOE			0.4040	31.9
28	505	1256901.64	490863.167	-0.756	THL2			0.5799	45.8
29	506	1256890.89	490870.053	1.094	TOE			0.7416	58.6
34	511	1256890.31	490869.335	2.895	WSE			0.7432	58.7
31	508	1256890.35	490871.108	3.385	OHW			0.7543	59.6
30	507	1256888.92	490871.677	4.084	POB			0.7735	61.1
32	509	1256883.89	490876.323	6.27	TOB			0.8585	67.8
33	510	1256872.94	490879.777	5.656	POFP			1.0000	78.9



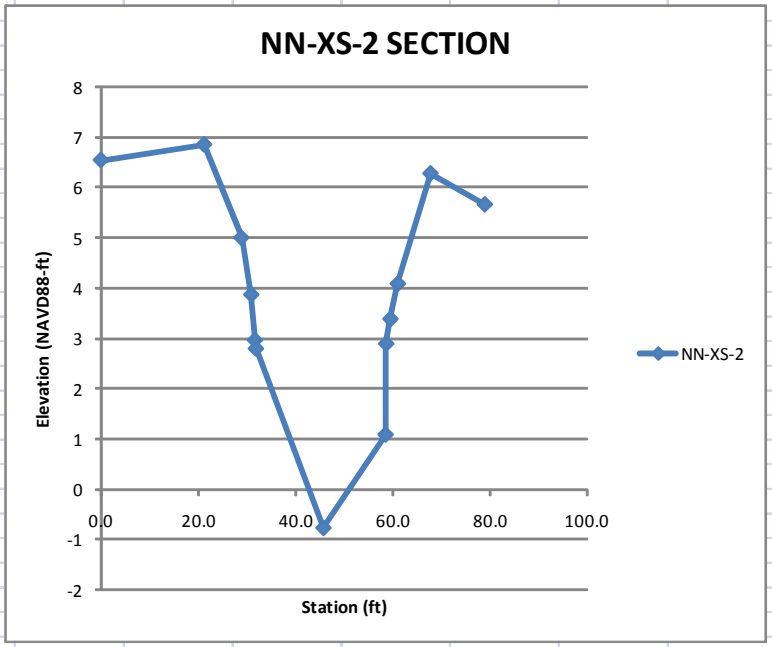
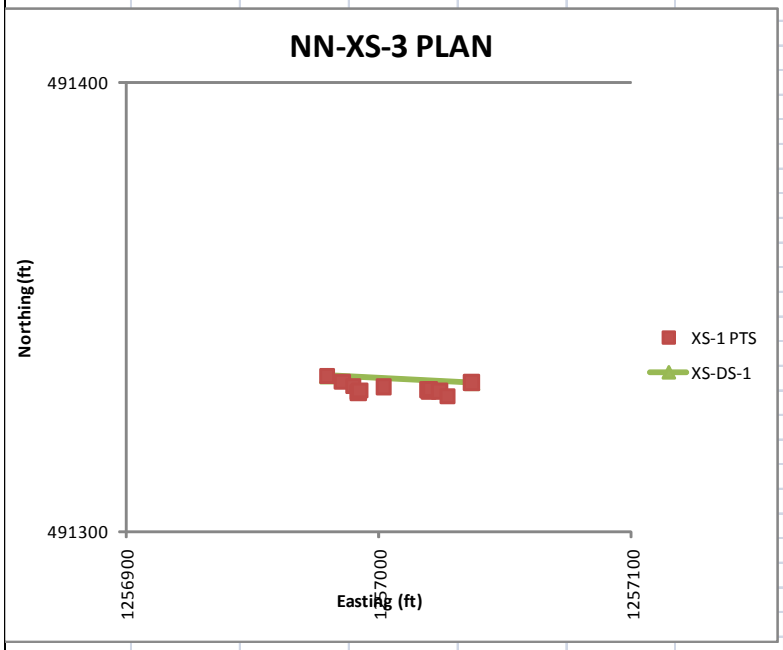


TABLE D10. NN-XS-3

FID	P	E	N	Z	D			UNIT VECTOR	STATION (FT)
115	592	1256979.74	491334.643	5.764	POFP			0.0000	0.0
116	593	1256985.67	491333.19	5.73	TOB			0.1047	6.0
117	594	1256990.03	491332.298	4.336	POB			0.1816	10.4
118	595	1256991.59	491331.062	3.537	OHW			0.2094	11.9
119	596	1256991.95	491330.817	3.174	WSE			0.2158	12.3
120	597	1256992.54	491331.451	1.898	TOE			0.2260	12.9
121	598	1257001.9	491332.193	-1.697	THL2			0.3897	22.2
126	603	1257019.33	491331.497	1.913	TOE			0.6956	39.7
125	602	1257019.69	491331.121	2.998	WSE			0.7021	40.0
124	601	1257020.18	491331.589	3.677	OHW			0.7106	40.5
123	600	1257023.99	491331.244	5.971	POB			0.7776	44.3
122	599	1257027.25	491330.054	7.386	TOB			0.8353	47.6
127	604	1257036.73	491333.1	7.146	POFP			1.0000	57.0



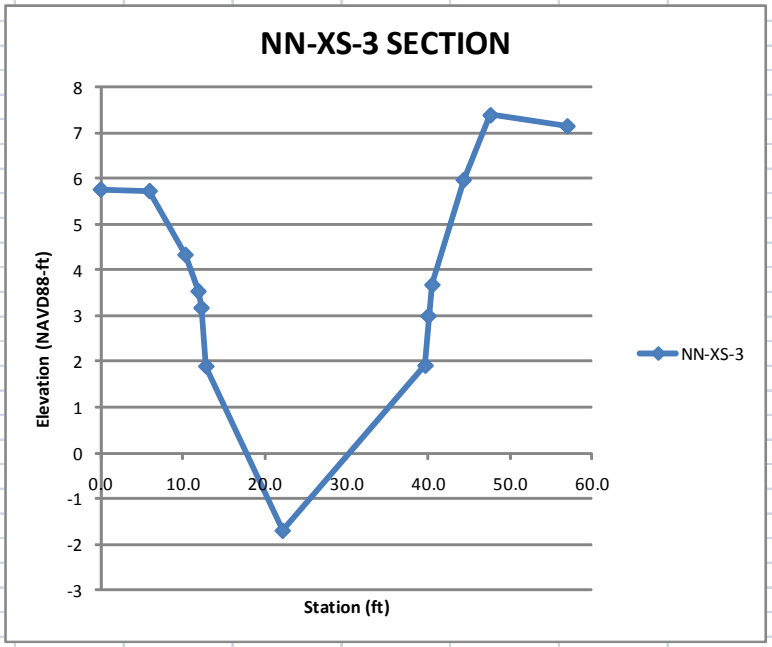
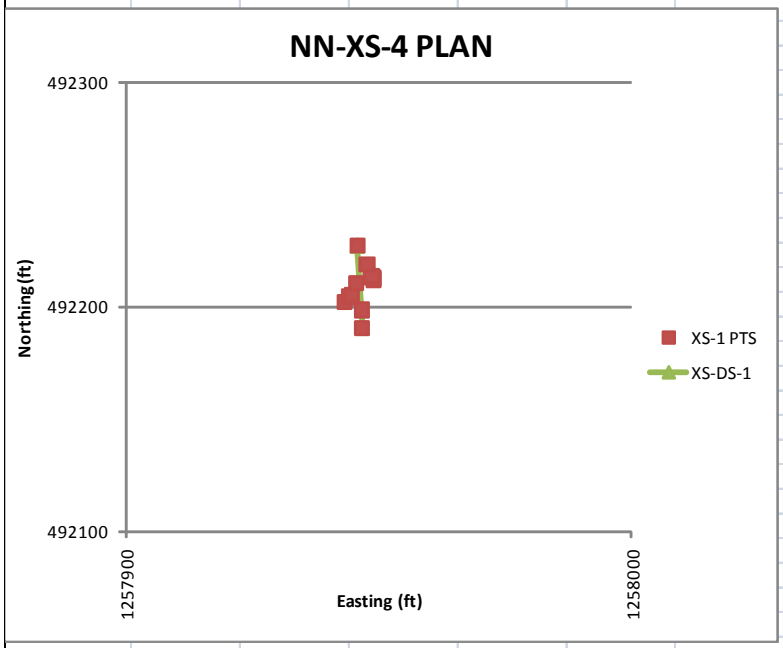


Table D11. NN-XS-4

FID	P	E	N	Z	D			UNIT VECTOR	STATION (FT)
36	513	1257946.72	492190.518	7.077	POFP			0.0000	0.0
37	514	1257946.76	492198.519	7.493	TOB			0.2181	8.0
38	515	1257943.21	492202.011	5.842	POB			0.3158	11.6
39	516	1257944.29	492204.024	3.576	OHW			0.3699	13.6
41	518	1257944.01	492204.643	2.926	WSE			0.3870	14.2
40	517	1257944.69	492205.388	2.535	TOE			0.4068	14.9
42	519	1257945.52	492210.644	2.1	THL			0.5494	20.2
44	521	1257948.91	492211.998	2.41	TOE			0.5839	21.4
43	520	1257948.92	492212.636	2.91	WSE			0.6013	22.1
46	523	1257948.33	492213.327	3.259	OHW			0.6205	22.8
45	522	1257948.53	492213.68	4.892	POB			0.6300	23.1
47	524	1257947.71	492218.834	7.164	TOB			0.7711	28.3
48	525	1257945.74	492227.179	6.701	POFP			1.0000	36.7



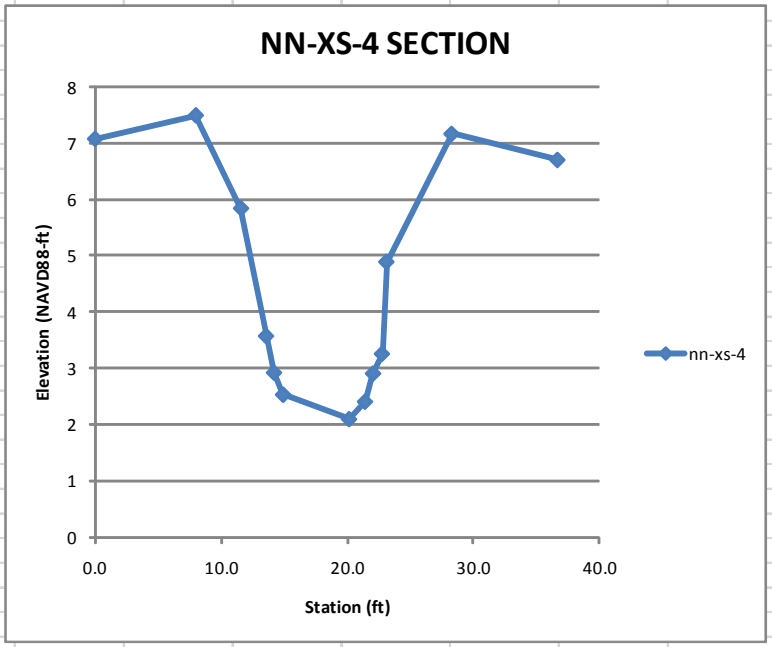
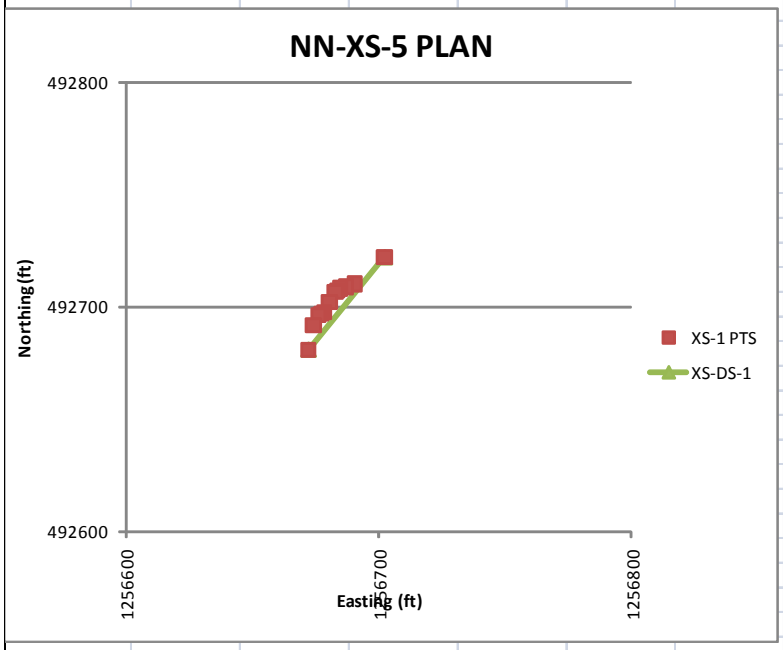


Table D12. NN-XS-5

FID	P	E	N	Z	D			UNIT VECTOR	STATION (FT)
49	526	1256702.32	492722.165	7.016	POFP			0.0000	0.0
50	527	1256690.32	492710.159	7.573	TOB			0.3286	16.8
51	528	1256686.89	492708.963	6.972	POB			0.3870	19.7
52	529	1256684.67	492708.283	4.461	OHW			0.4235	21.6
53	530	1256683.45	492707.351	2.821	WSE			0.4522	23.1
54	531	1256682.8	492706.507	2.319	TOE			0.4731	24.1
55	532	1256680.4	492701.945	0.083	THL			0.5731	29.2
56	533	1256678.44	492697.661	1.94	TOE			0.6636	33.9
57	534	1256677.45	492697.09	2.887	OHW			0.6840	34.9
59	536	1256677.43	492697.105	3.006	WSE			0.6841	34.9
58	535	1256676.15	492696.292	3.46	POB			0.7117	36.3
60	537	1256674.14	492691.856	6.102	TOB			0.8052	41.1
61	538	1256672.33	492680.885	6.248	POFP			1.0000	51.0



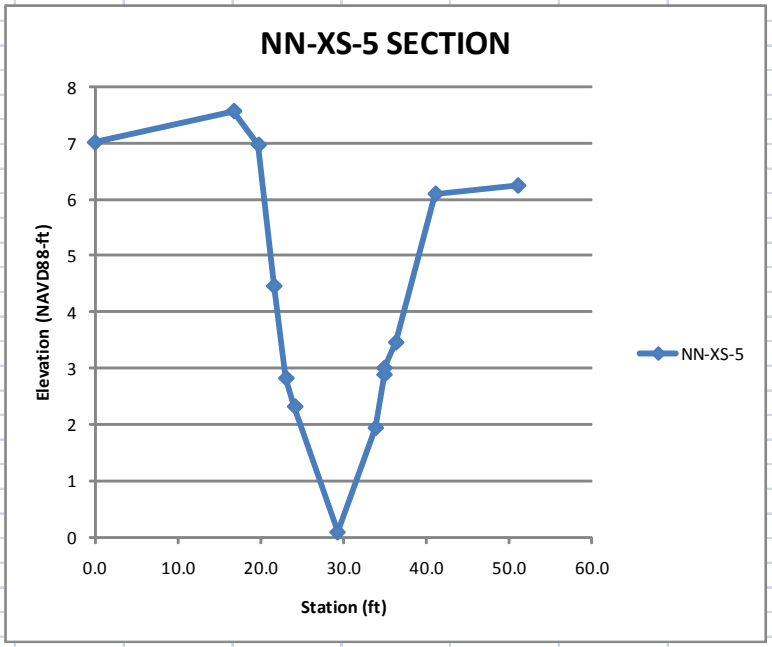
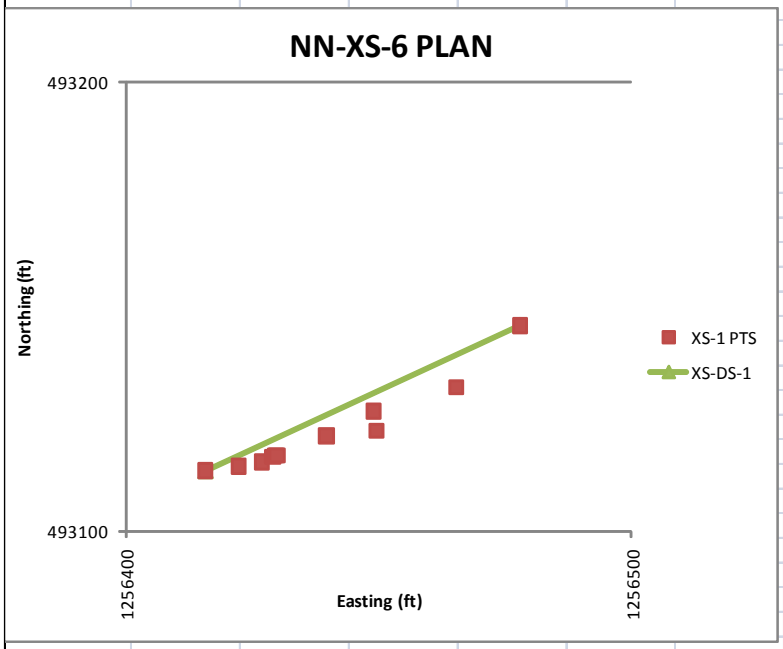


Table D13. NN-XS-6

FID	P	E	N	Z	D			UNIT VECTOR	STATION (FT)
62	539	1256415.74	493113.44	6.02	POFP			0.0000	0.0
63	540	1256422.23	493114.40	5.71	TOB			0.0885	6.2
64	541	1256426.87	493115.35	4.66	POB			0.1536	10.8
65	542	1256429.06	493116.42	3.18	OHW			0.1883	13.2
66	543	1256429.62	493116.81	2.70	WSE			0.1980	13.9
67	544	1256429.89	493116.80	2.15	TOE			0.2014	14.1
68	545	1256439.64	493121.16	-1.32	THL2			0.3535	24.8
69	546	1256449.51	493122.40	2.55	WSE			0.4867	34.1
70	547	1256449.07	493126.65	2.55	OHW			0.5090	35.7
74	551	1256465.37	493131.90	7.25	TOB			0.7501	52.6
73	550	1256477.92	493145.74	8.28	POFP			1.0000	70.1



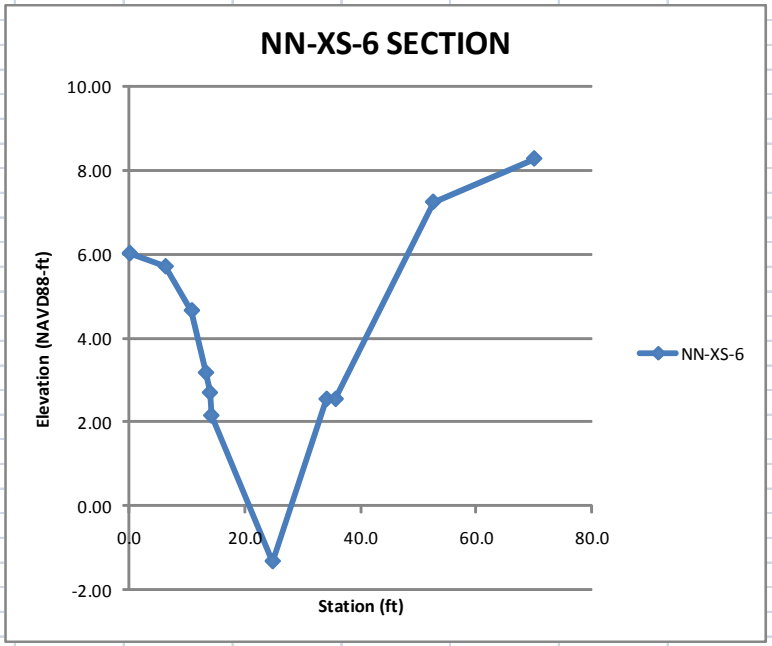
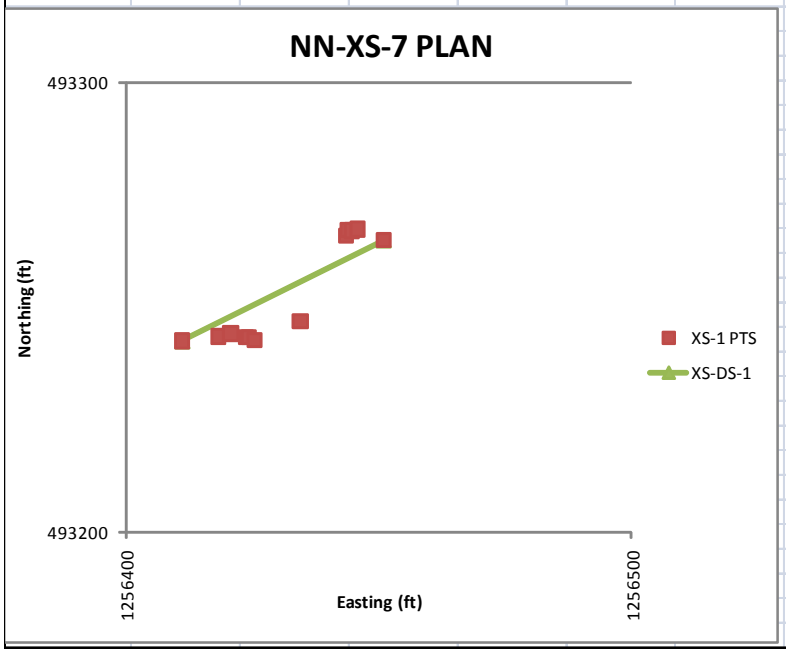


Table D14. NN-XS-7

FID	P	E	N	Z	D			UNIT VECTOR	STATION (FT)
75	552	1256411.06	493242.533	6.289	POFP			0.0000	0.0
76	553	1256418.26	493243.509	6.17	TOB			0.5105	7.1
77	554	1256420.75	493244.129	4.55	POB			0.6858	9.5
78	555	1256423.8	493243.344	3.252	OHW			0.9092	12.6
79	556	1256424.27	493243.368	2.9	WSE			0.9423	13.1
80	557	1256425.49	493242.58	1.512	TOE			1.0348	14.4
81	558	1256434.48	493246.898	-0.726	THL2			1.6544	23.0
82	559	1256443.48	493265.877	1.516	TOE			2.1875	30.4
83	560	1256443.95	493267.206	3.43	WSE			2.2130	30.7
84	561	1256444.62	493266.991	3.883	OHW			2.2628	31.4
85	562	1256445.8	493267.358	4.742	POB			2.3450	32.6
86	563	1256450.98	493264.851	7.856	TOB			2.7314	37.9
87	564	1256458.69	493265.032	8.018	POFP			3.2839	45.6
267	306	1256424.91	493241.388	8.302	SWG-2.3-LT			1.0000	13.9



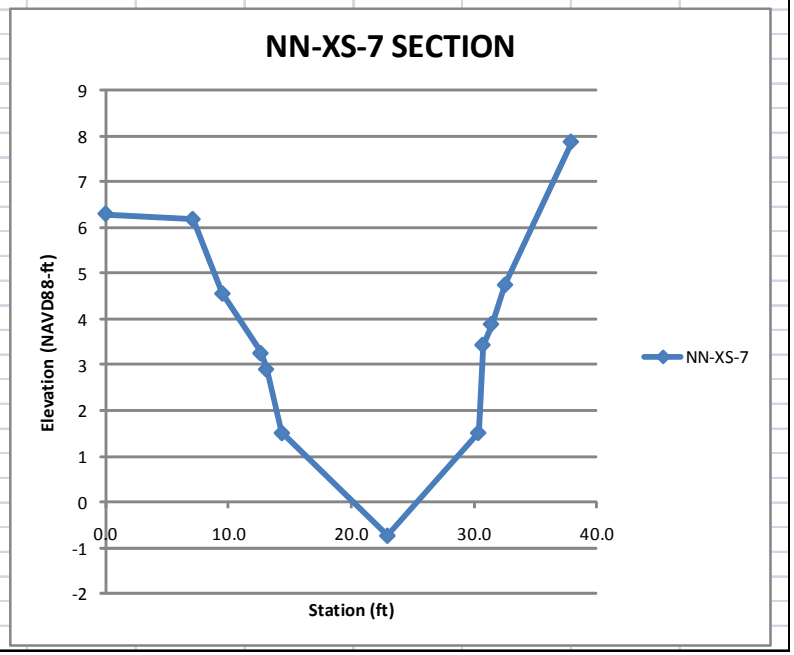
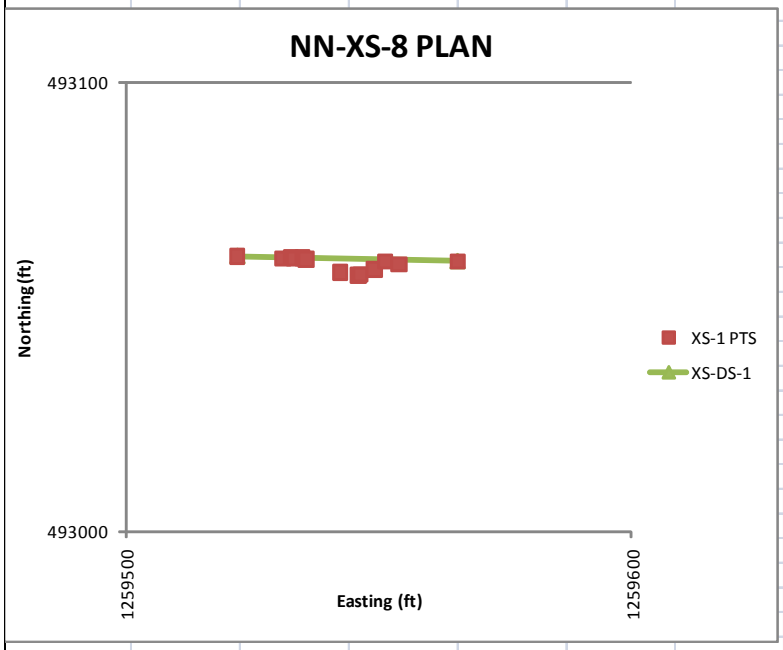


Table D15. NN-XS-8

FID	P	E	N	Z	D			UNIT VECTOR	STATION (FT)
225	245	1259521.99	493061.226	6.941	POFP			0.0000	0.0
226	246	1259531.03	493060.757	6.871	TOB			0.2075	9.0
237	257	1259532.62	493060.951	5.165	OHW			0.2437	10.6
234	254	1259533.3	493060.748	4.603	POB			0.2594	11.3
235	255	1259534.9	493060.843	2.243	TOE			0.2962	12.9
236	256	1259535.63	493060.522	2.167	WSE			0.3129	13.6
233	253	1259542.36	493057.648	-0.268	THL			0.4689	20.4
232	252	1259545.99	493057.049	3.219	WSE			0.5526	24.1
231	251	1259546.48	493057.243	3.265	TOE			0.5638	24.6
230	250	1259549.08	493058.31	4.991	OHW			0.6227	27.2
229	249	1259551.24	493060.102	6.17	POB			0.6710	29.3
228	248	1259554.02	493059.425	7.399	TOB			0.7352	32.1
227	247	1259565.59	493060.083	7.071	POFP			1.0000	43.6



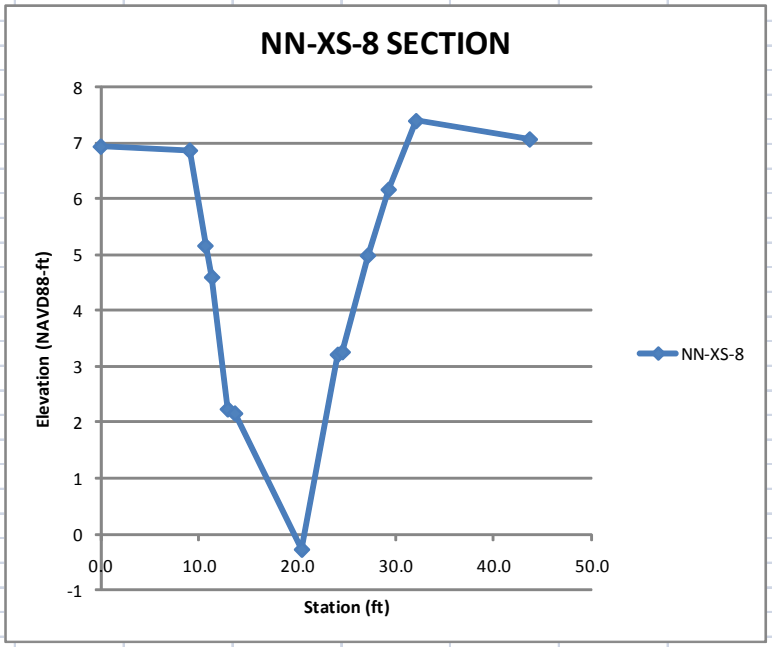
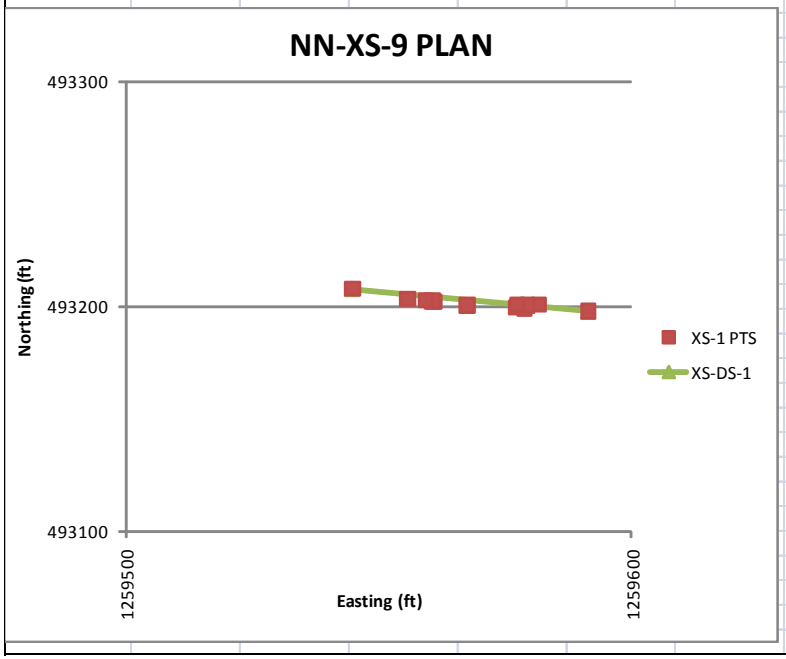


TABLE D16. NN-XS-9

FID	P	E	N	Z	D			UNIT VECTOR	STATION (FT)
212	232	1259591.47	493197.801	7.189	POFP			0.0000	0.0
213	233	1259581.61	493200.716	5.861	TOB			0.2149	10.3
216	236	1259578.71	493199.232	4.715	OHW			0.2678	12.8
214	234	1259579.37	493200.499	4.953	POB			0.2599	12.4
217	237	1259577.21	493199.656	3.809	WSE			0.3003	14.3
215	235	1259577.31	493200.895	3.659	TOE			0.3038	14.5
218	238	1259567.5	493200.456	-0.307	THL			0.5028	24.0
219	239	1259561.06	493201.952	4.125	WSE			0.6413	30.6
220	240	1259560.88	493201.941	4.321	TOB			0.6447	30.8
222	242	1259560.63	493202.402	4.807	OHW			0.6521	31.1
221	241	1259559.36	493202.537	5.737	POB			0.6785	32.4
223	243	1259555.74	493203.589	7.758	TOB			0.7574	36.2
224	244	1259544.8	493207.829	7.709	POFP			1.0000	47.7



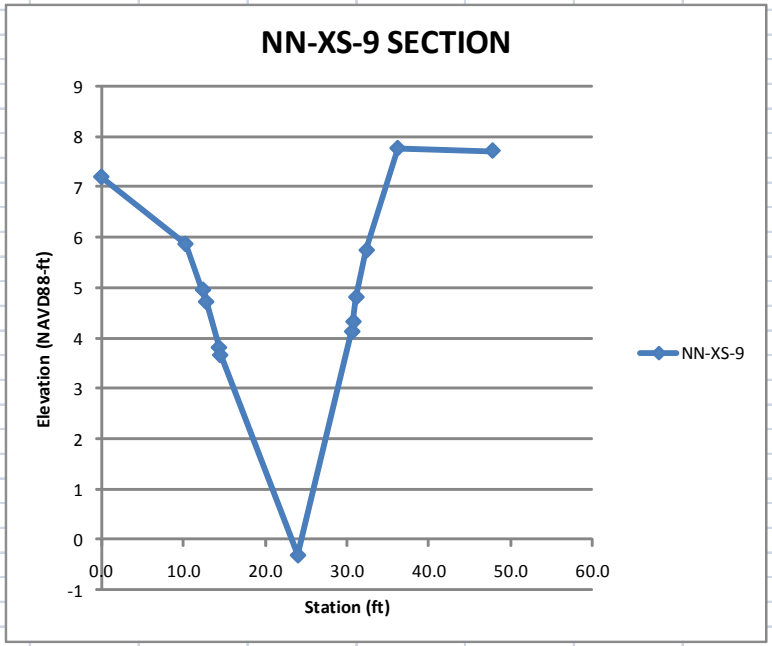
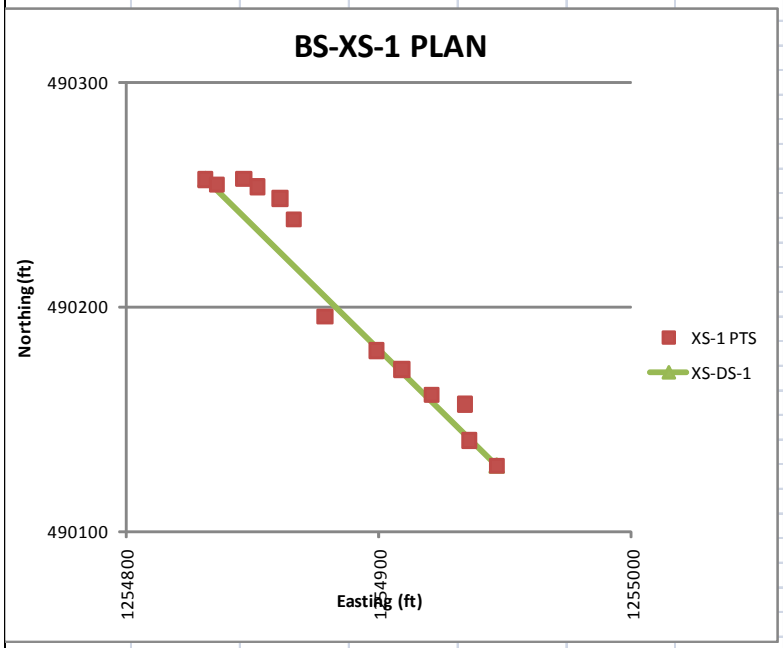


Table D17. BS-XS-1

FID	P	E	N	Z	D			UNIT VECTOR	STATION (FT)
152	740	1254831.55	490256.664	7.043	TOB			0.0000	0.0
153	741	1254836.01	490254.554	6.972	TOB			0.0265	4.6
151	739	1254846.64	490256.776	5.956	OHW			0.0585	10.0
150	738	1254852.24	490253.432	5.53	POB			0.0948	16.3
149	737	1254860.94	490248.235	4.789	WSE			0.1513	26.0
148	736	1254866.56	490238.914	2.709	TOE			0.2136	36.6
147	735	1254878.83	490195.522	2.088	THL3			0.4492	77.1
154	742	1254898.95	490180.475	4.423	TOE			0.5930	101.7
155	743	1254909.12	490172.089	4.87	WSE			0.6690	114.8
156	744	1254921.03	490160.719	5.102	POB			0.7647	131.2
157	745	1254933.93	490156.582	5.345	OHW			0.8330	142.9
158	746	1254935.86	490140.425	5.436	TOB			0.9104	156.2
159	747	1254946.56	490129.383	5.742	POFP			1.0000	171.5



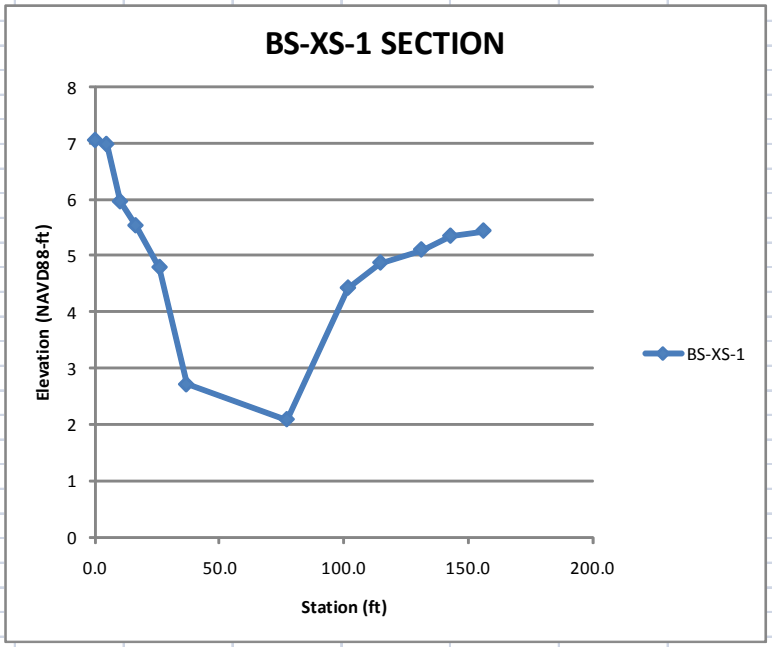
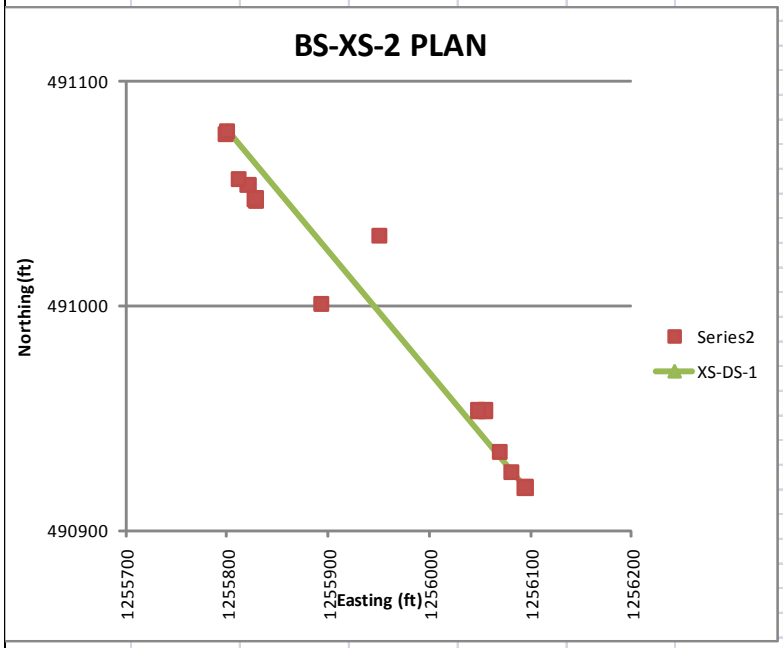


Table D18. BS-XS-2

FID	P	E	N	Z	D			UNIT VECTOR	STATION (FT)
173	761	1256094.8	490919.111	13.337	POFP			0.0000	0.0
172	760	1256081.34	490926.028	13.356	TOB			0.0453	15.1
171	759	1256069.65	490934.938	10.265	POB			0.0887	29.6
169	757	1256055.34	490953.377	7.164	OHW			0.1525	51.0
170	758	1256048.33	490953.386	6.04	TOE			0.1710	57.2
168	756	1255950.52	491030.924	4.591	WSE			0.5386	180.1
189	717	1255893.46	491000.914	1.028	THL3			0.6462	216.0
191	719	1255829.15	491046.546	5.239	WSE			0.8803	294.3
190	718	1255827.81	491047.632	5.216	TOE			0.8854	296.0
192	720	1255820.98	491053.673	6.794	OHW			0.9120	304.9
193	721	1255811.52	491056.348	7.915	POB			0.9407	314.5
194	722	1255798.79	491076.098	13.093	TOB			1.0022	335.1
195	723	1255800.5	491077.705	13.044	POFP			1.0000	334.3



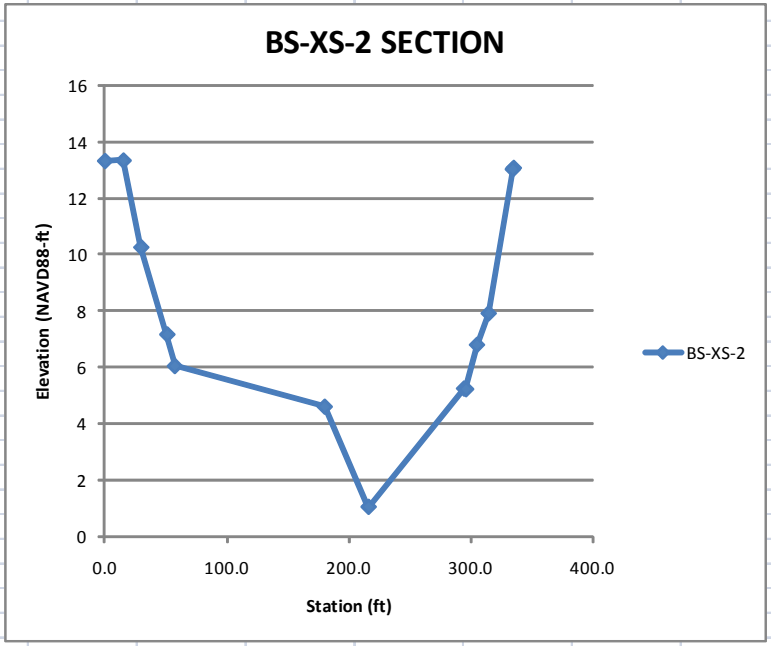
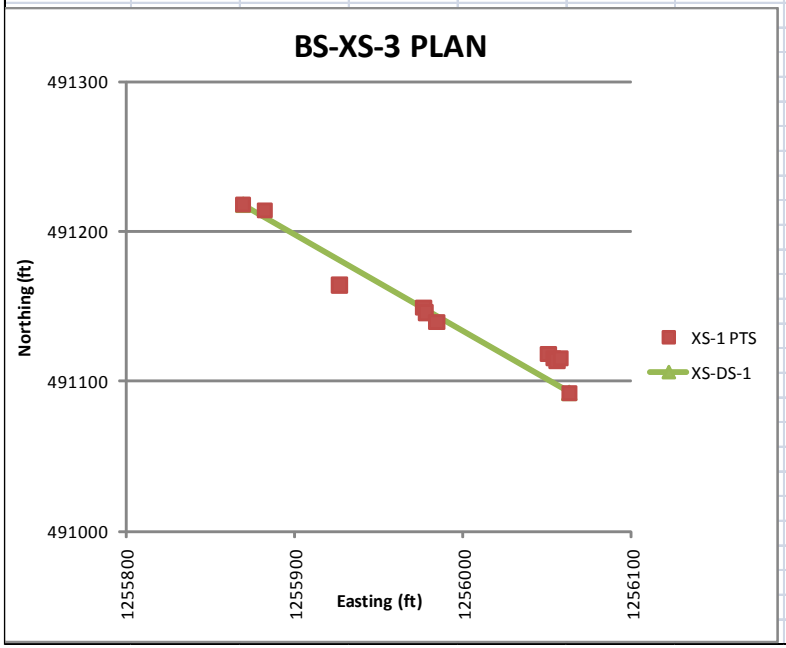


Table D19. BS-XS-3

FID	P	E	N	Z	D			UNIT VECTOR	STATION (FT)
101	578	1255869.74	491217.825	13.235	POFP			0.0000	0.0
102	579	1255882.25	491214.375	12.816	TOB			0.0536	12.4
103	580	1255926.67	491164.241	6.794	OHW			0.3335	76.9
104	581	1255976.59	491149.098	6.047	WSE			0.5509	127.0
105	582	1255978.13	491145.848	3.888	TOE			0.5642	130.1
167	755	1255984.35	491139.495	-0.713	THL3			0.6018	138.8
106	583	1256050.68	491118.51	2.501	TOE			0.8926	205.8
107	584	1256053.82	491115.125	5.95	WSE			0.9121	210.3
108	585	1256055.67	491113.93	7.197	OHW			0.9216	212.5
109	586	1256058.01	491115.699	7.744	POB			0.9260	213.5
110	587	1256063.25	491092.393	11.277	TOB			1.0000	230.6



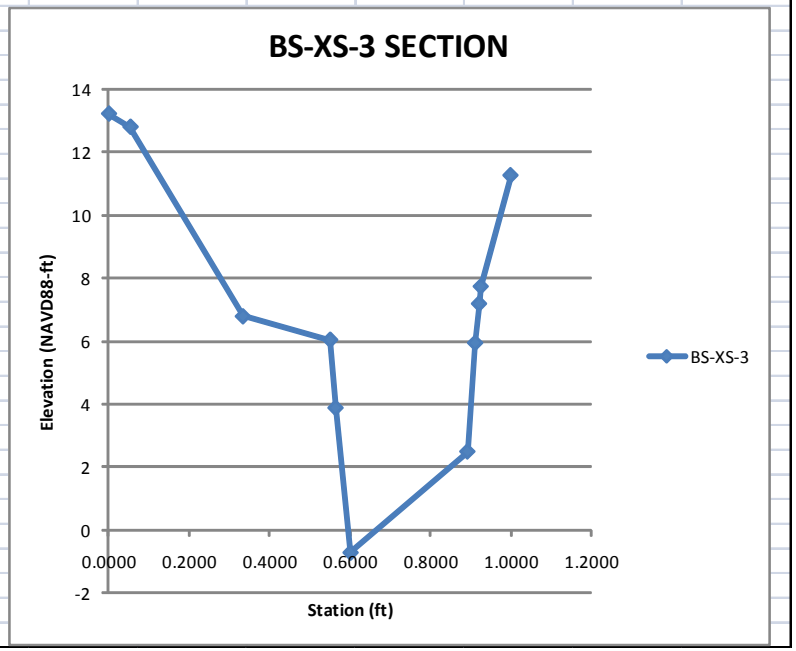
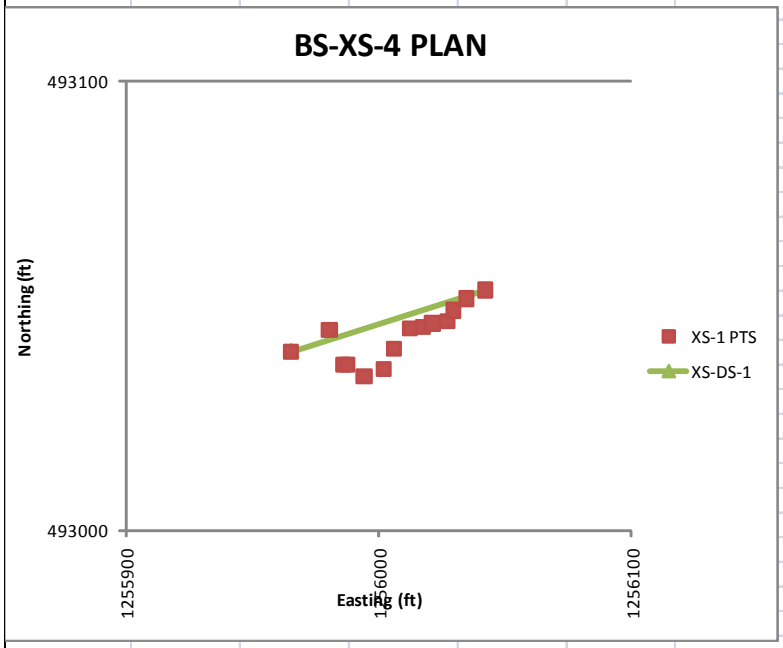


Table D20. BS-XS-4

FID	P	E	N	Z	D			UNIT VECTOR	STATION (FT)
16	217	1255965.2	493039.68	13.876	POFP			0.0000	0.0
17	218	1255980.43	493044.515	12.686	TOB			0.2024	15.8
210	230	1255985.79	493036.892	11.682	TOB			0.2528	19.8
211	231	1255987.52	493036.842	8.852	OHW			0.2744	21.5
207	227	1255994.2	493034.286	5.482	TOE			0.3528	27.6
206	226	1256001.8	493035.83	4.417	POB			0.4518	35.4
205	225	1256006.06	493040.446	2.216	WSE			0.5156	40.4
204	224	1256012.23	493044.997	1.252	THL3			0.6035	47.2
208	228	1256017.29	493045.152	2.339	WSE			0.6675	52.2
203	223	1256021.13	493045.992	3.299	TOB			0.7177	56.2
21	222	1256027.2	493046.499	6.389	POB			0.7951	62.2
20	221	1256029.46	493048.988	7.995	POB			0.8292	64.9
18	219	1256034.65	493051.556	9.508	TOB			0.9002	70.5
19	220	1256042.25	493053.418	8.14	POFP			1.0000	78.3



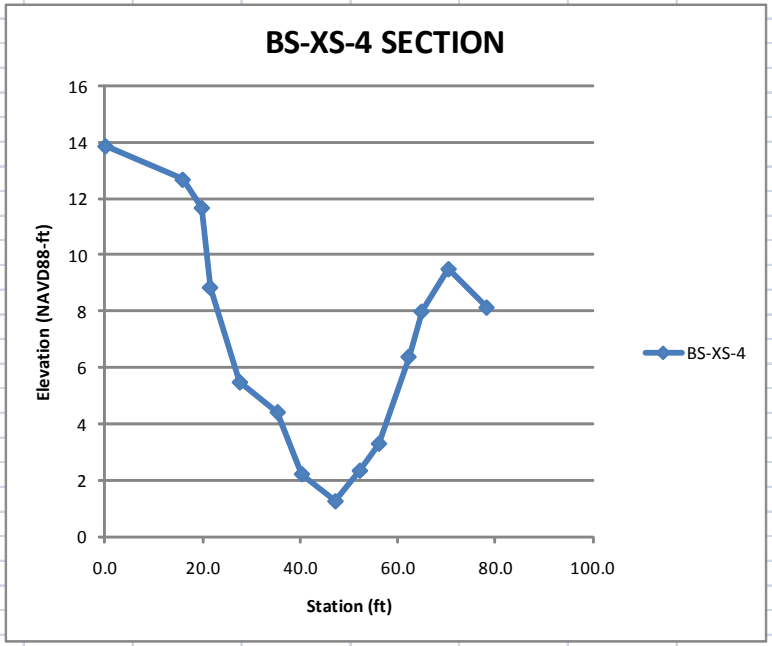
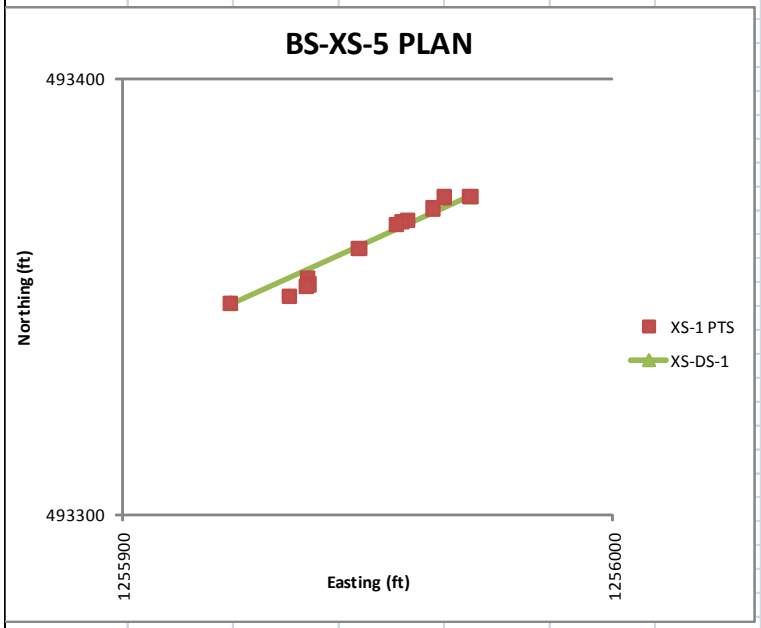


Table D21. BS-XS-5

FID	P	E	N	Z	D			UNIT VECTOR	STATION (FT)
88	565	1255970.93	493373.089	6.283	POFP			0.0000	0.0
89	566	1255965.67	493372.814	6.112	TOB			0.0880	4.8
90	567	1255963.33	493370.195	4.037	POB			0.1477	8.1
91	568	1255958.07	493367.424	3.024	OHW			0.2563	14.0
92	569	1255956.94	493367.196	2.819	WSE			0.2765	15.1
93	570	1255955.88	493366.623	0.663	TOE			0.2984	16.3
94	571	1255948.28	493361.006	-1.649	THL3			0.4686	25.7
95	572	1255937.8	493354.311	1.96	TOE			0.6945	38.0
97	574	1255938.16	493352.829	2.62	WSE			0.7008	38.4
96	573	1255937.57	493352.411	3.018	OHW			0.7139	39.1
98	575	1255933.99	493350.014	3.335	POB			0.7919	43.4
99	576	1255922.04	493348.403	3.924	TOB			1.0000	54.8



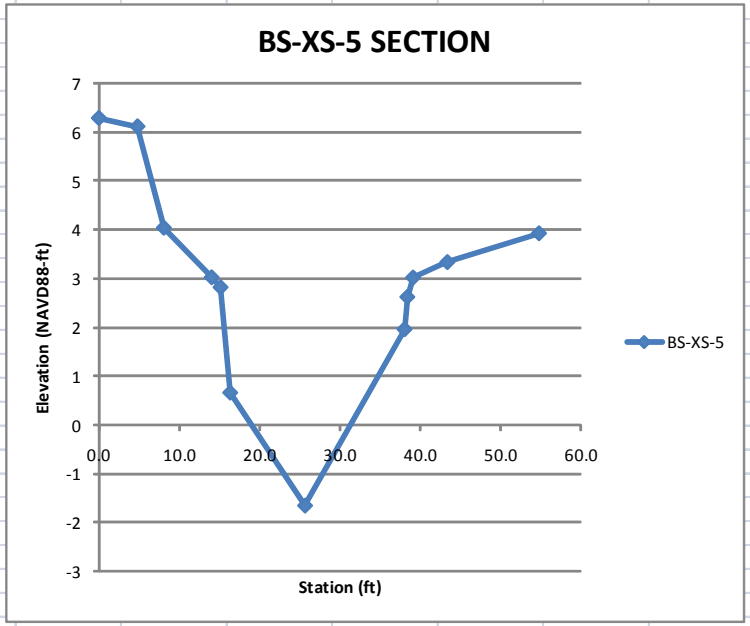
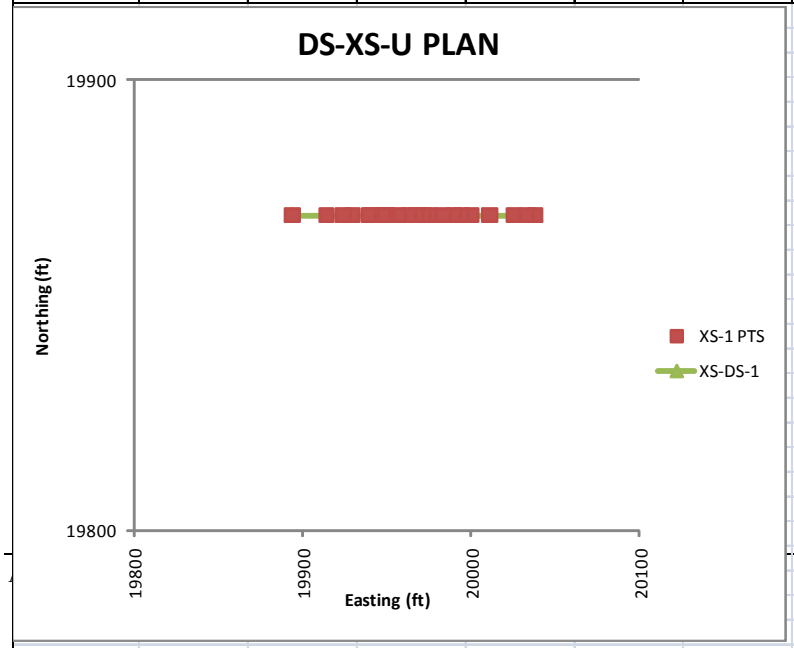


Table D22. DS-XS-U (SURVEYS BY NSEA/SCD, DATA PROCESSING BY M&N, DATUM CONVERTED MLLW TO NAVD88)

FID	P	E	N	Z	D			UNIT VECTOR	STATION (FT)	Skagit Conservation District, 2008. A Survey of Channel Profile and Cross Sections of Dry Slough, Fir Island, Skagit County,				
	601	20,038	19,870	5.97	UMF			0.000	0.0					
	602	20,033	19,870	6.97	UBSM			0.035	5.0					
	603	20,025	19,870	8.27	USSM			0.090	13.0					
	604	20,011	19,870	8.77	UTSM			0.188	27.0					
	605	20,000	19,870	8.37	USSM			0.264	38.0					
	606	19,994	19,870	7.87	UCTL			0.306	44.0					
	607	19,990	19,870	6.67	UTBL			0.333	48.0					
	608	19,984	19,870	3.12	UBBL			0.378	54.5					
	609	19,976	19,870	2.87	UWEL			0.434	62.5					
	610	19,972	19,870	1.87	UCH			0.458	66.0					
	611	19,967	19,870	1.27	UCH			0.493	71.0					
	612	19,963	19,870	1.27	UCH			0.521	75.0					
	613	19,957	19,870	1.87	UCH			0.563	81.0					
	614	19,951	19,870	2.87	UWER			0.608	87.5					
	615	19,949	19,870	3.97	UBRB			0.618	89.0					
	616	19,948	19,870	7.27	UTRB			0.625	90.0					
	617	19,941	19,870	9.27	USSM			0.674	97.0					
	618	19,939	19,870	9.87	USSM			0.688	99.0					
	619	19,930	19,870	10.87	UTSM			0.750	108.0					
	620	19,924	19,870	9.77	USSM			0.792	114.0					
	621	19,914	19,870	8.07	UBSM			0.861	124.0					
	622	19,894	19,870	7.07	USM			1.000	144.0					



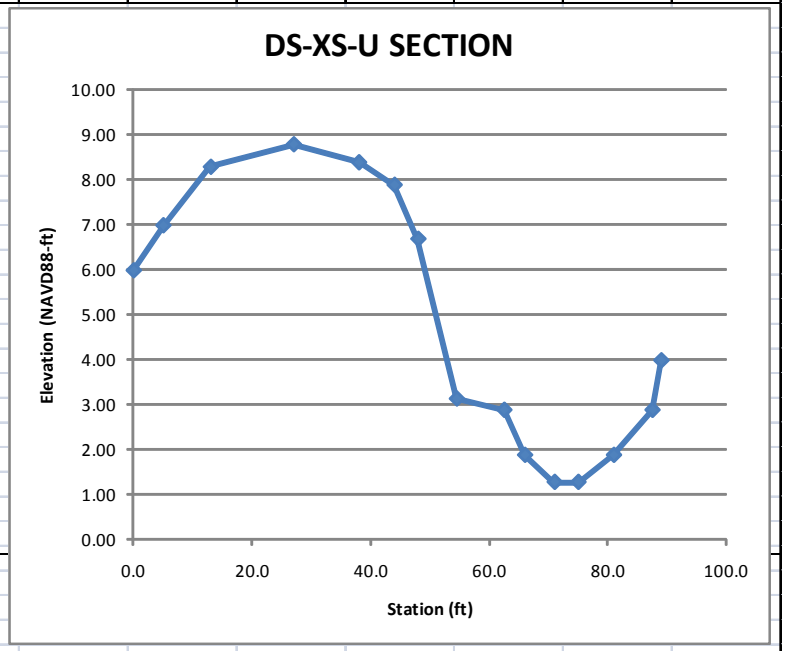
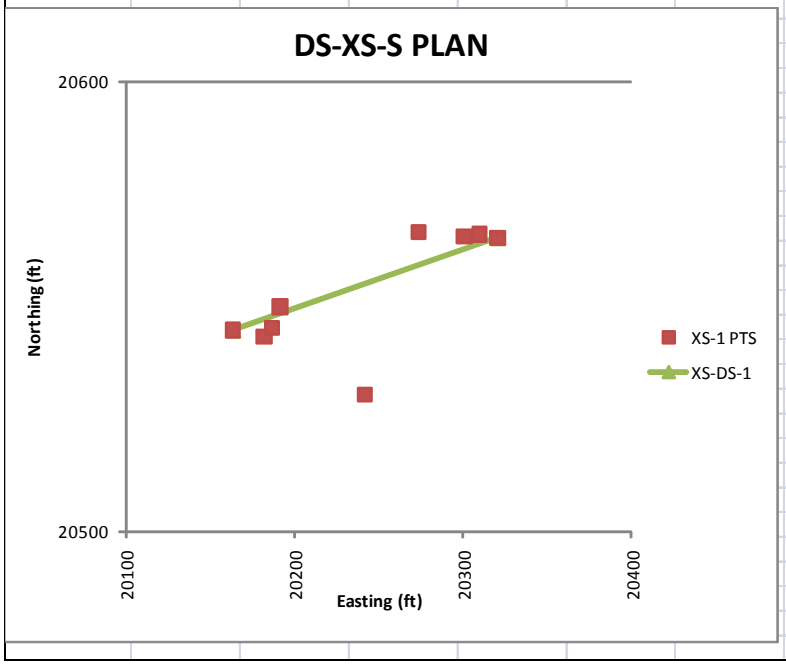


Table D23. DS-XS-S (SURVEYS BY NSEA/SCD, DATA PROCESSING BY M&N, DATUM NAME CHANGED FROM MLLW TO NAVD88)

FID	P	E	N	Z	D			UNIT VECTOR	STATION (FT)	Skagit Conservation District, 2008. A Survey of Channel Profile and Cross Sections of Dry Slough, Fir Island, Skagit County,				
	503	20,163	20,545	6.93	STBR			0.000	0.0					
	504	20,182	20,543	6.33	SFLR			0.115	18.2					
	505	20,187	20,545	3.75	SWER			0.147	23.4					
	506	20,191	20,550	-3.99	SCH			0.180	28.5					
	509	20,242	20,530	0.19	SCTL			0.478	75.8					
	510	20,274	20,567	1.24	SCTL			0.707	112.0					
	511	20,301	20,566	3.47	SBBL			0.876	138.8					
	512	20,310	20,566	7.25	STBL			0.933	147.8					
	513	20,320	20,565	6.13	SFLL			1.000	158.4					



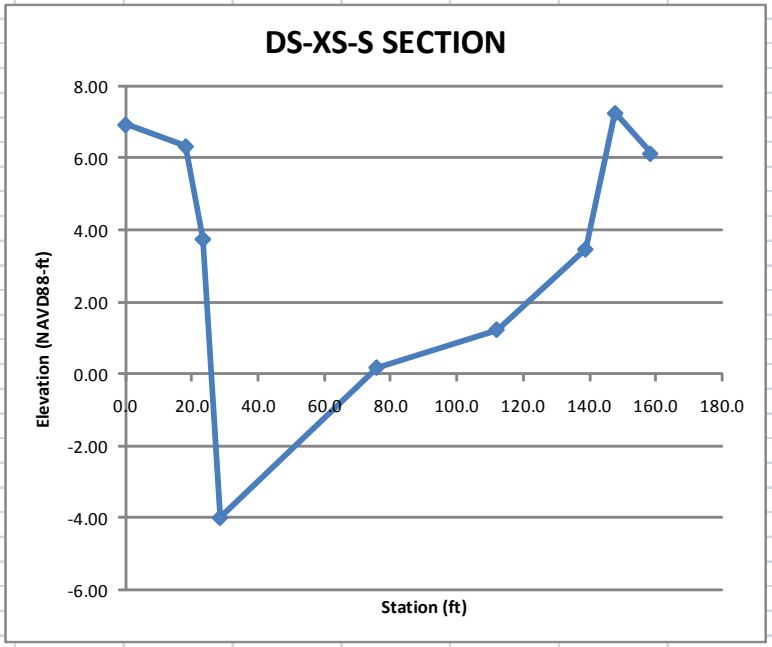
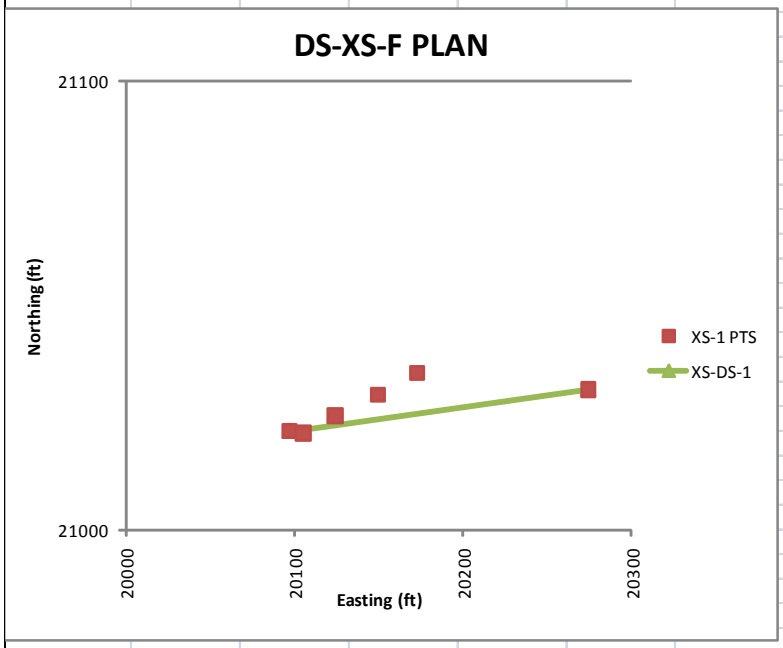


Table D24. DS-XS-F (SURVEYS BY NSEA/SCD, DATA PROCESSING BY M&N, DATUM CONVERTED MLLW TO NAVD88)

FID	P	E	N	Z	D			UNIT VECTOR	STATION (FT)	Skagit Conservation District, 2008. A Survey of Channel Profile and Cross Sections of Dry Slough, Fir Island, Skagit County,				
	45	20,097	21,022	7.93	FTBR			0.000	0.0					
	46	20,105	21,022	3.48	FWSR			0.045	7.9					
	47	20,124	21,025	0.30	FCH			0.153	27.1					
	48	20,149	21,030	-0.20	FCTL			0.297	52.5					
	49	20,172	21,035	3.29	FCTL			0.428	75.8					
	50	20,274	21,031	6.30	FTBL			1.000	177.0					



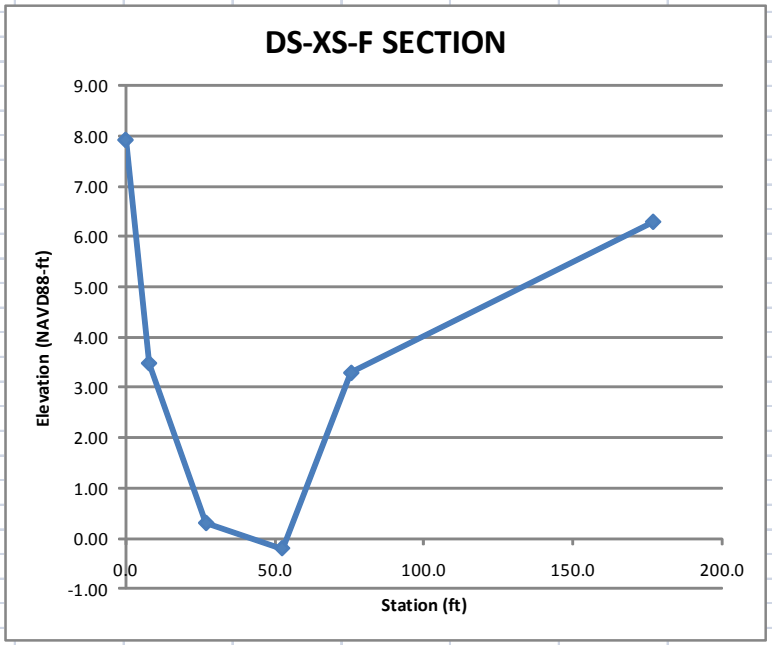
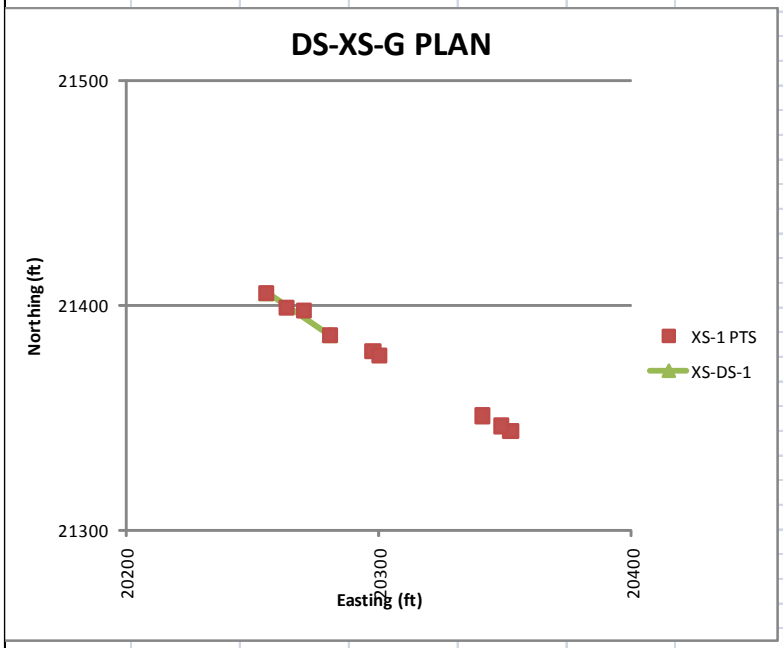


Table D25. DS-XS-G (SURVEYS BY NSEA/SCD, DATA PROCESSING BY M&N, DATUM CONVERTED MLLW TO NAVD88)

FID	P	E	N	Z	D			UNIT VECTOR	STATION (FT)	Skagit Conservation District, 2008. A Survey of Channel Profile and Cross Sections of Dry Slough, Fir Island, Skagit County,				
	51	20,256	21,406	6.8	GFLR			0.000	7.5					
	52	20,264	21,399	7.2	GTBR			0.328	11.9	Note: Unit vector data transformations not used for this section.				
	53	20,270	21,398	5.1	GWSR			0.525	20.6					
	54	20,352	21,344	2.6	GFLL			3.608	69.1					
	55	20,348	21,346	1.4	GTBL			3.469	72.4					
	56	20,341	21,351	-0.6	GBBL			3.197	90.4					
	57	20,298	21,380	3.3	GECL			1.557	105.1					
	58	20,300	21,377	7.1	GCTL			1.665	111.6					
	59	20,281	21,387	7.0	GCH			1.000	121.9					



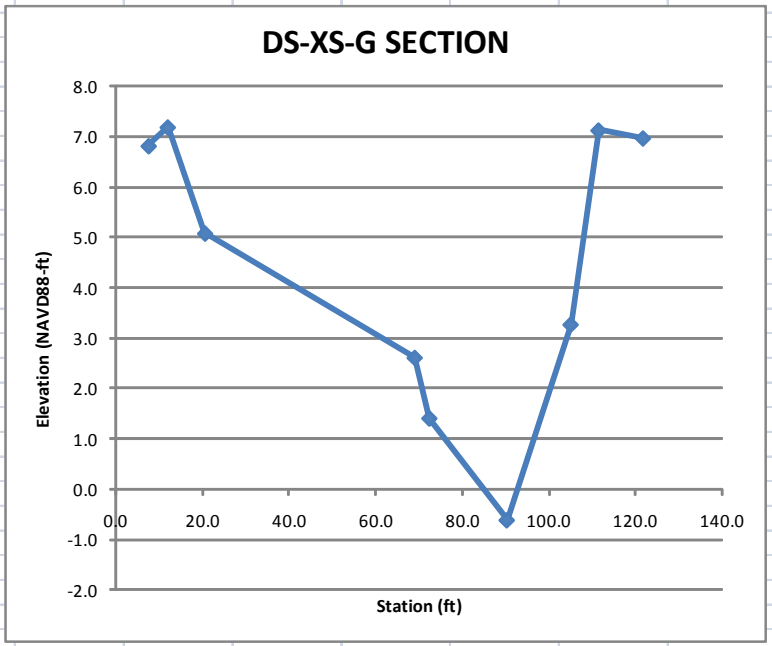
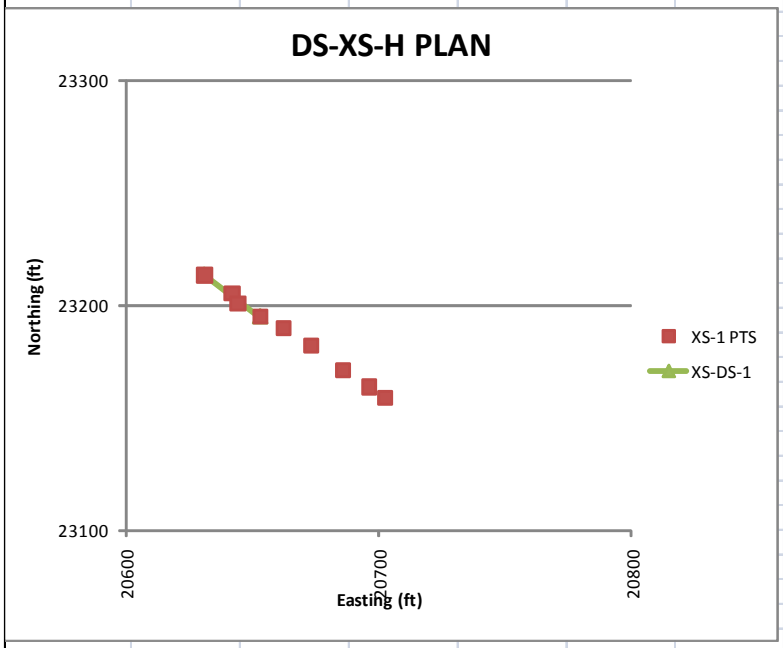


Table D26. DS-XS-H (SURVEYS BY NSEA/SCD, DATA PROCESSING BY M&N, DATUM CONVERTED MLLW TO NAVD88)

FID	P	E	N	Z	D			UNIT VECTOR	STATION (FT)	Skagit Conservation District, 2008. A Survey of Channel Profile and Cross Sections of Dry Slough, Fir Island, Skagit County,				
	66	20,631	23,213	6.1	HFLR			0.000	6.5					
	67	20,642	23,205	5.0	HTBR			0.468	14.4	Note: Unit vector data transformations not used for this section.				
	68	20,644	23,201	7.3	HWSR			0.636	27.2					
	69	20,703	23,159	4.0	HCH			3.131	43.8					
	70	20,696	23,164	0.6	HBBL			2.853	57.4					
	71	20,686	23,171	-0.5	HCTL			2.409	67.7					
	72	20,673	23,182	3.1	HTBL			1.830	78.2					
	73	20,662	23,190	6.8	HFLL			1.356	82.9					
	74	20,653	23,195	7.1	HFLL			1.000	96.3					



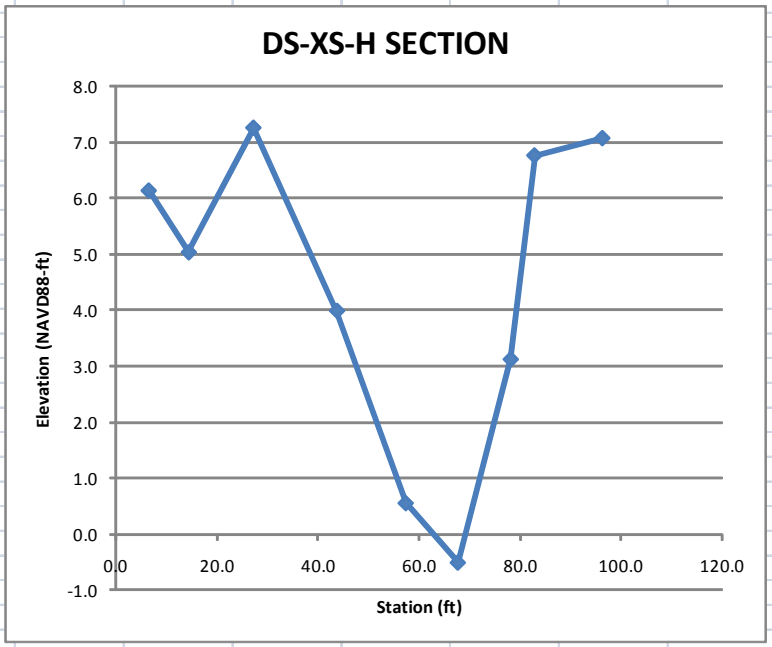
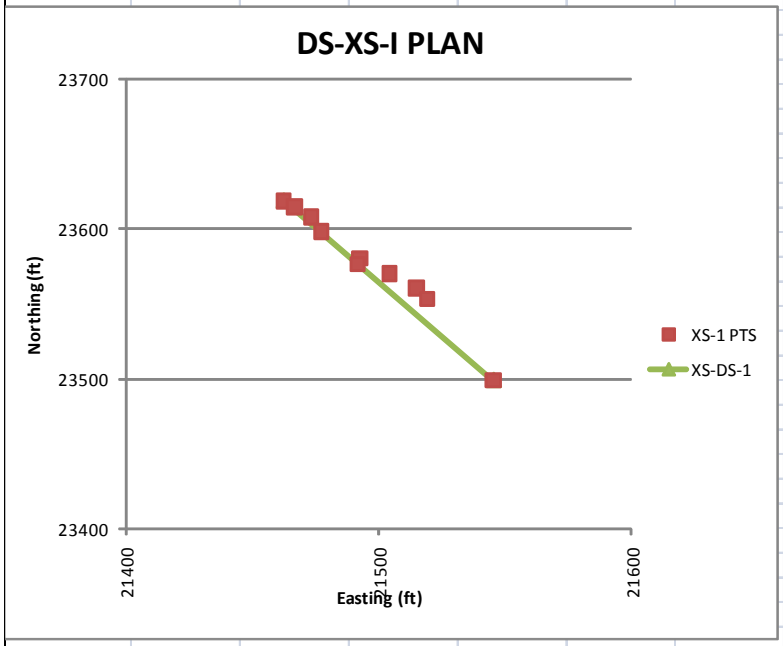


Table D27. DS-XS-I (SURVEYS BY NSEA/SCD, DATA PROCESSING BY M&N, DATUM CONVERTED MLLW TO NAVD88)

FID	P	E	N	Z	D			UNIT VECTOR	STATION (FT)	Skagit Conservation District, 2008. A Survey of Channel Profile and Cross Sections of Dry Slough, Fir Island, Skagit County,				
	83	21,463	23,619	6.86	IFLR			0.000	0.0					
	84	21,467	23,615	8.63	ITBR			0.040	5.8					
	85	21,473	23,608	3.50	IBBR			0.101	14.8					
	86	21,477	23,598	0.42	ICTR			0.172	25.1					
	87	21,493	23,580	1.96	ICTR			0.334	48.7					
	88	21,492	23,577	2.58	ICHR			0.352	51.3					
	89	21,504	23,570	2.17	ICH			0.436	63.6					
	90	21,515	23,561	3.66	IWSL			0.533	77.6					
	91	21,519	23,553	6.94	ITBL			0.590	86.0					
	92	21,545	23,499	6.75	IFLL			1.000	145.7					



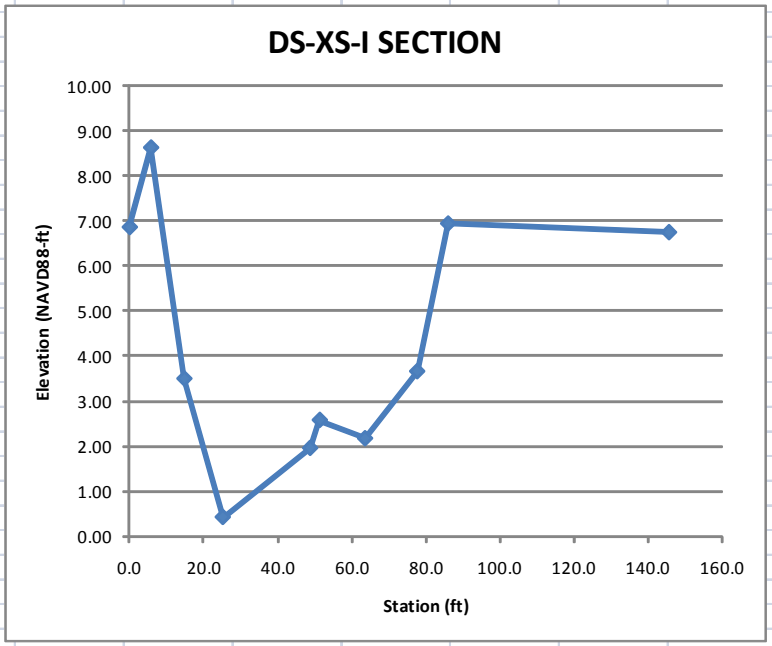
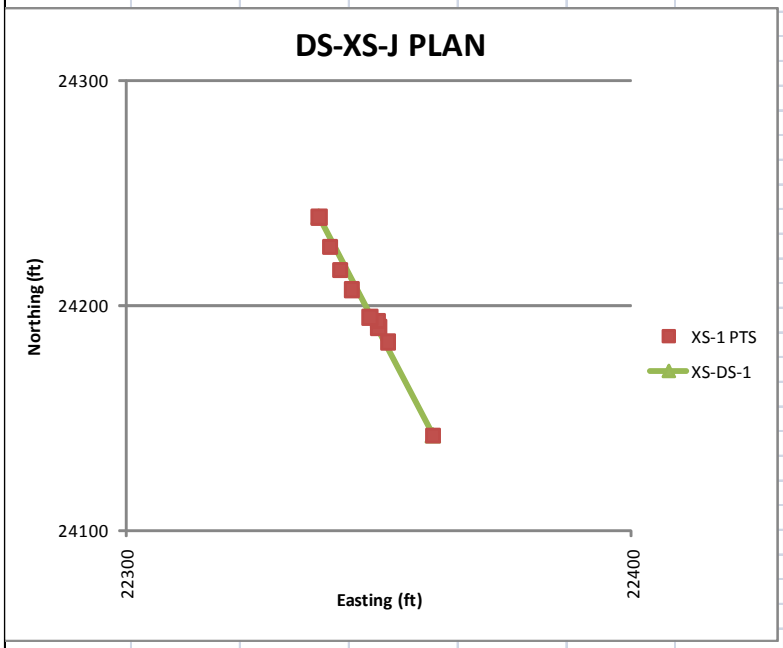


Table D28. DS-XS-J (SURVEYS BY NSEA/SCD, DATA PROCESSING BY M&N, DATUM CONVERTED MLLW TO NAVD88)

FID	P	E	N	Z	D			UNIT VECTOR	STATION (FT)	Skagit Conservation District, 2008. A Survey of Channel Profile and Cross Sections of Dry Slough, Fir Island, Skagit County,				
	98	22,361	24,142	6.98	JFLE			0.000	0.0					
	99	22,352	24,184	7.73	JTBL			0.428	42.7					
	100	22,350	24,190	5.80	JTBL			0.494	49.3					
	101	22,350	24,193	3.33	JWSL			0.522	52.1					
	102	22,348	24,195	1.52	JCHL			0.543	54.2					
	103	22,345	24,207	-0.17	JCH			0.670	66.9					
	104	22,342	24,216	2.03	JCHR			0.761	76.0					
	105	22,340	24,226	5.73	JTBR			0.865	86.4					
	106	22,338	24,239	6.80	JFLR			1.000	99.8					



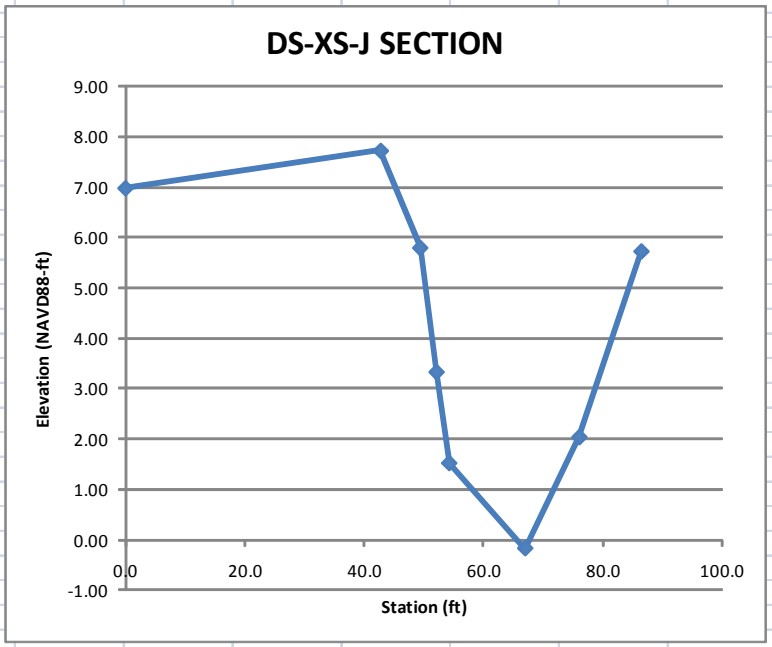
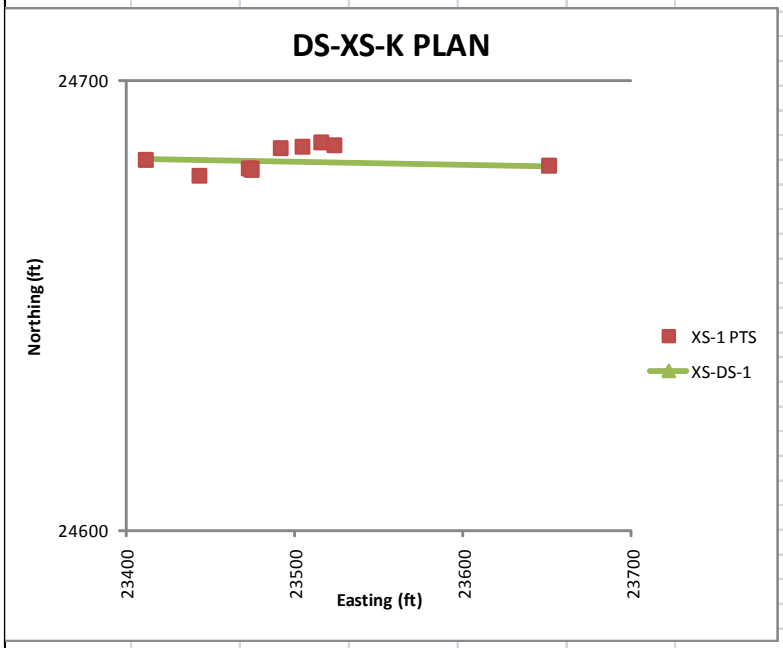


Table D29. DS-XS-K (SURVEYS BY NSEA/SCD, DATA PROCESSING BY M&N, DATUM CONVERTED MLLW TO NAVD88)

FID	P	E	N	Z	D			UNIT VECTOR	STATION (FT)	Skagit Conservation District, 2008. A Survey of Channel Profile and Cross Sections of Dry Slough, Fir Island, Skagit County,				
	114	23,412	24,682	11.2	KTBR			0.000	0.0					
	115	23,444	24,679	4.9	KCTR			0.132	31.6					
	116	23,473	24,680	4.6	KCTR			0.256	61.0					
	117	23,475	24,680	2.8	KBBR			0.263	62.8					
	121	23,492	24,685	2.0	KCH			0.335	79.9					
	123	23,505	24,685	3.2	KBBL			0.388	92.6					
	124	23,516	24,686	4.4	KCTL			0.435	103.9					
	125	23,524	24,686	5.3	KCTL			0.468	111.8					
	126	23,651	24,681	12.1	KTBL			1.000	238.7					



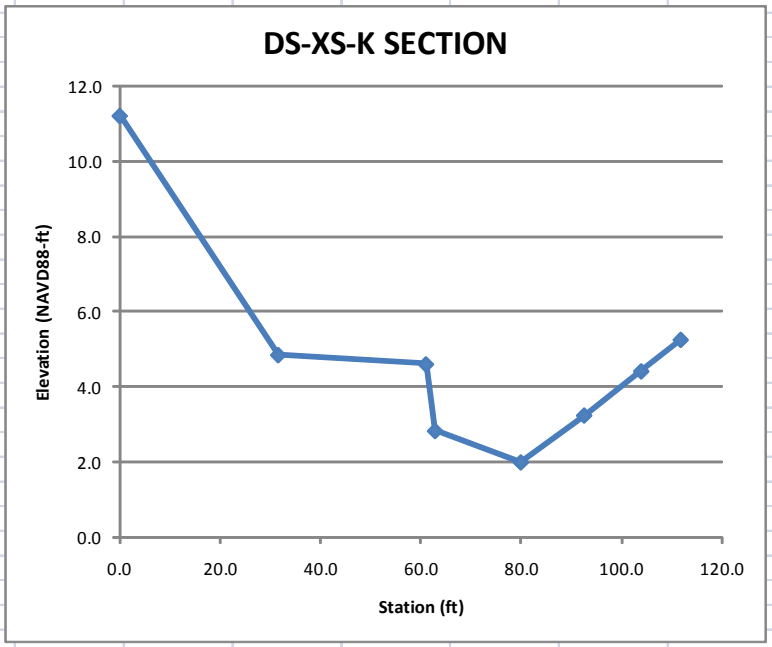
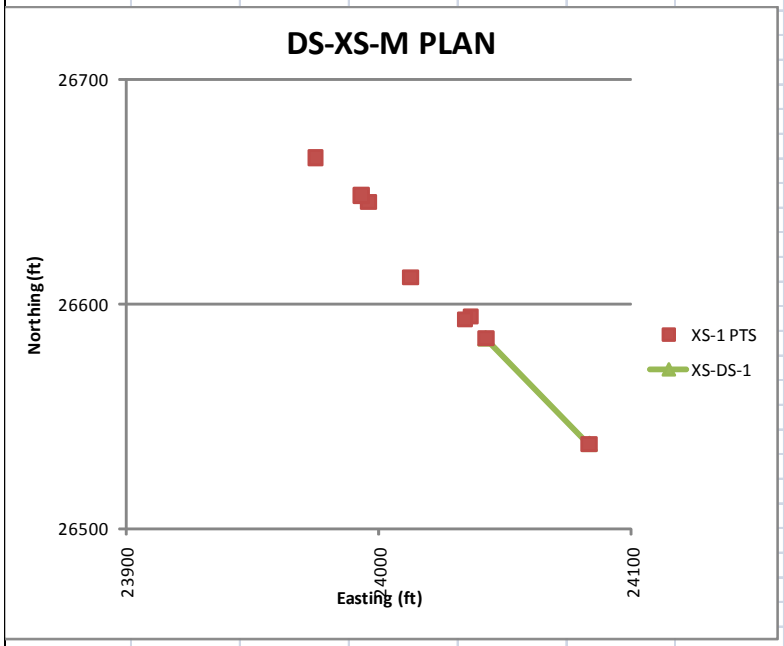


Table D30. DS-XS-M (SURVEYS BY NSEA/SCD, DATA PROCESSING BY M&N, DATUM CONVERTED MLLW TO NAVD88)

FID	P	E	N	Z	D			UNIT VECTOR	STATION (FT)	Skagit Conservation District, 2008. A Survey of Channel Profile and Cross Sections of Dry Slough, Fir Island, Skagit County,				
	142	24,042	26,585	13.8	MTBR			0.000	2.1					
	141	24,036	26,594	11.0	MBBR			-0.178	64.3					
	140	24,034	26,593	7.0	MCHR			-0.191	76.2					
	139	24,013	26,612	6.9	MCH			-0.644	76.3					
	138	23,996	26,645	6.3	MBBL			-1.226	104.3					
	137	23,993	26,648	6.7	MWSL			-1.290	140.8					
	136	23,975	26,665	7.4	MTBL			-1.685	144.7					
	143	24,083	26,538	12.0	MFLL			1.000	169.2					



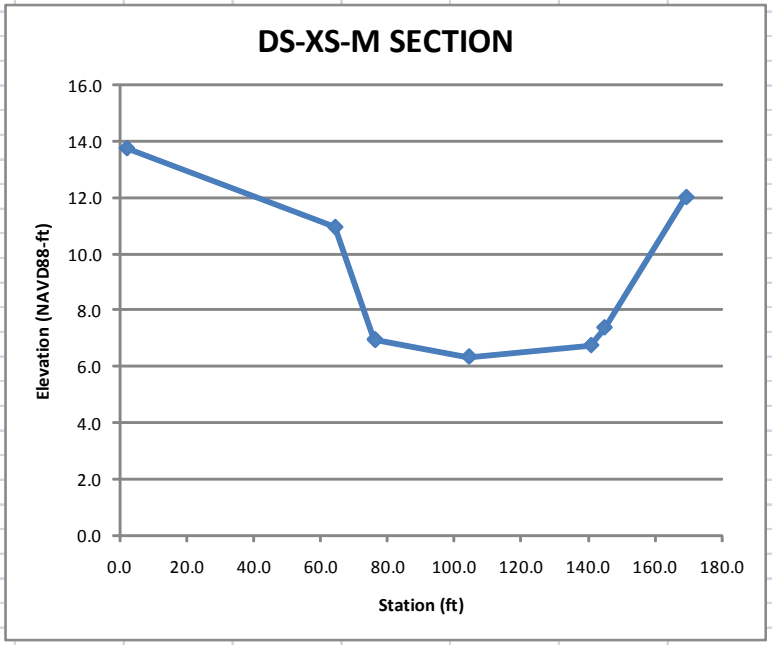
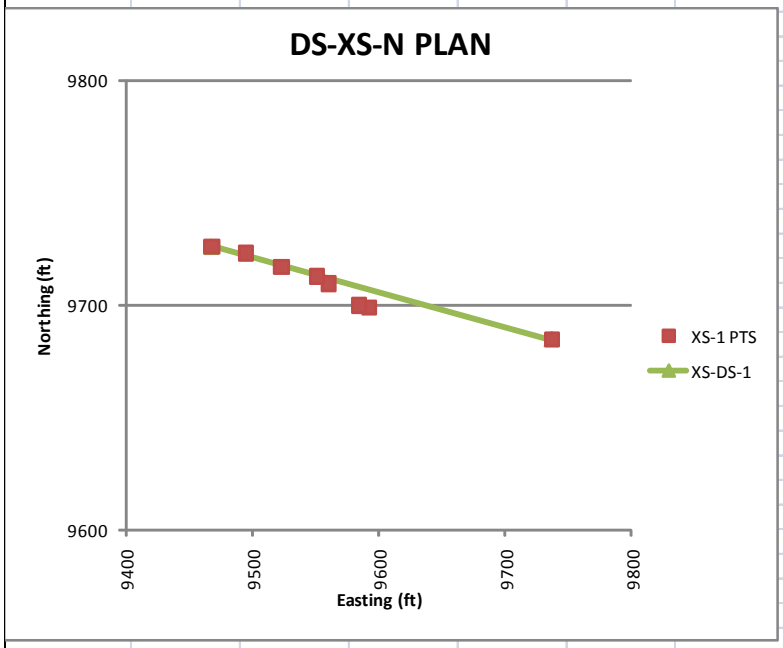


Table D31. DS-XS-N (SURVEYS BY NSEA/SCD, DATA PROCESSING BY M&N, DATUM NAME CHANGED FROM MLLW TO NAVD88)

FID	P	E	N	Z	D			UNIT VECTOR	STATION (FT)	Skagit Conservation District, 2008. A Survey of Channel Profile and Cross Sections of Dry Slough, Fir Island, Skagit County,				
89	566	9,737	9,685	15.56	TOB			0.000	0.0					
88	565	9,593	9,699	11.55	POFP			0.531	144.5					
90	567	9,584	9,700	8.87	POB			0.563	153.3					
92	569	9,560	9,710	7.75	WSE			0.655	178.3					
91	568	9,551	9,713	8.30	OHW			0.690	187.8					
93	570	9,523	9,717	8.74	TOE			0.794	216.0					
94	571	9,495	9,723	12.61	THL3			0.901	245.1					
95	572	9,468	9,726	13.16	TOE			1.000	272.1					



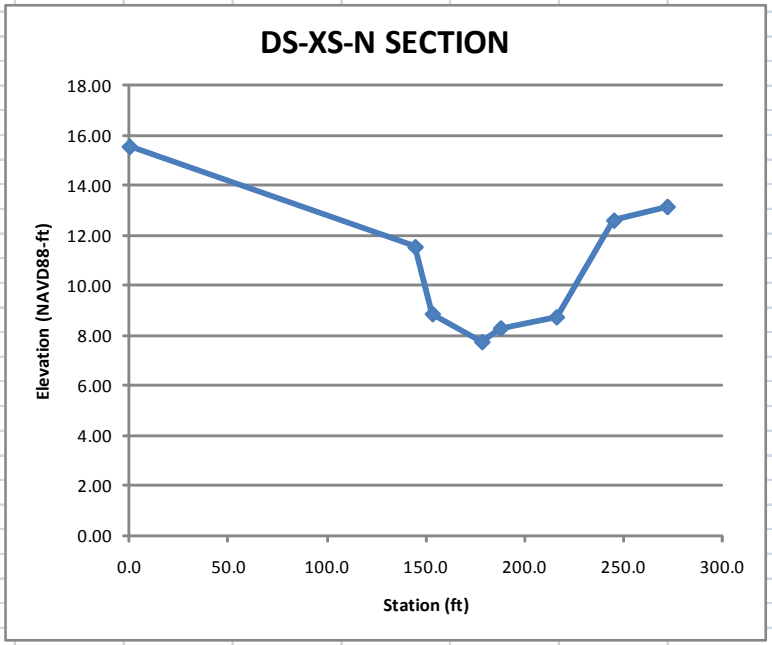
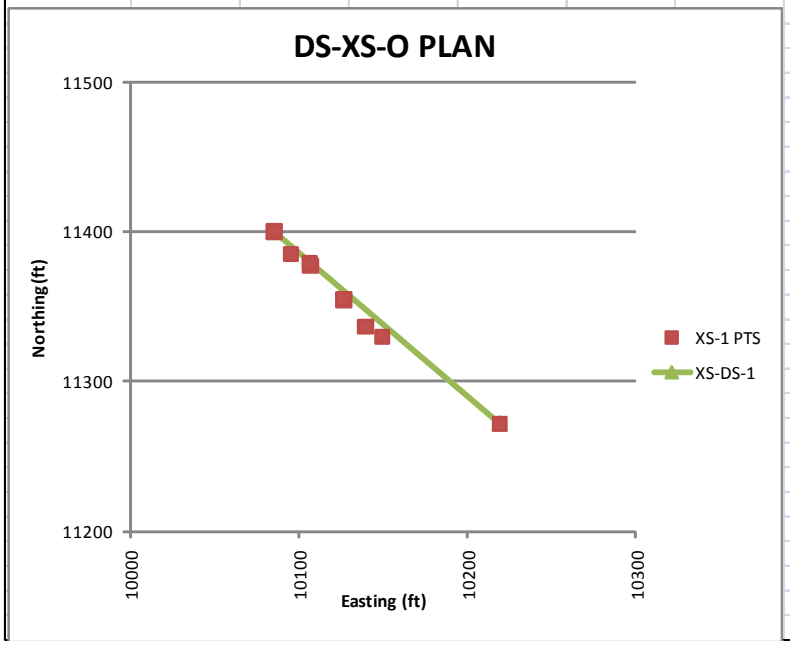


Table D32. DS-XS-N (SURVEYS BY NSEA/SCD, DATA PROCESSING BY M&N, DATUM CONVERTED MLLW TO NAVD88)

FID	P	E	N	Z	D			UNIT VECTOR	STATION (FT)	Skagit Conservation District, 2008. A Survey of Channel Profile and Cross Sections of Dry Slough, Fir Island, Skagit County,				
	215	10,219	11,272	14.7	OFLL			0.000	0.9					
	216	10,150	11,330	9.6	OTBL			0.488	90.5					
	217	10,140	11,337	6.0	OBBL			0.552	102.2					
	218	10,127	11,355	6.2	OCH			0.670	103.8					
	219	10,107	11,378	4.5	OCHR			0.833	124.2					
	220	10,106	11,379	4.9	OBBR			0.841	154.4					
	221	10,095	11,385	6.0	OTBR			0.907	156.0					
	222	10,086	11,400	11.8	OFLR			1.000	167.8					
	223	10,114	11,316	11.468					185.3					



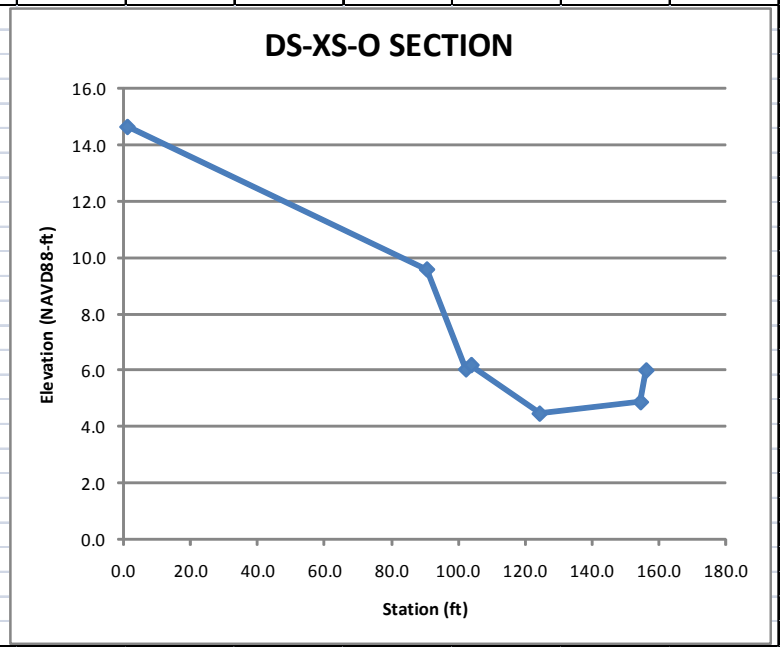
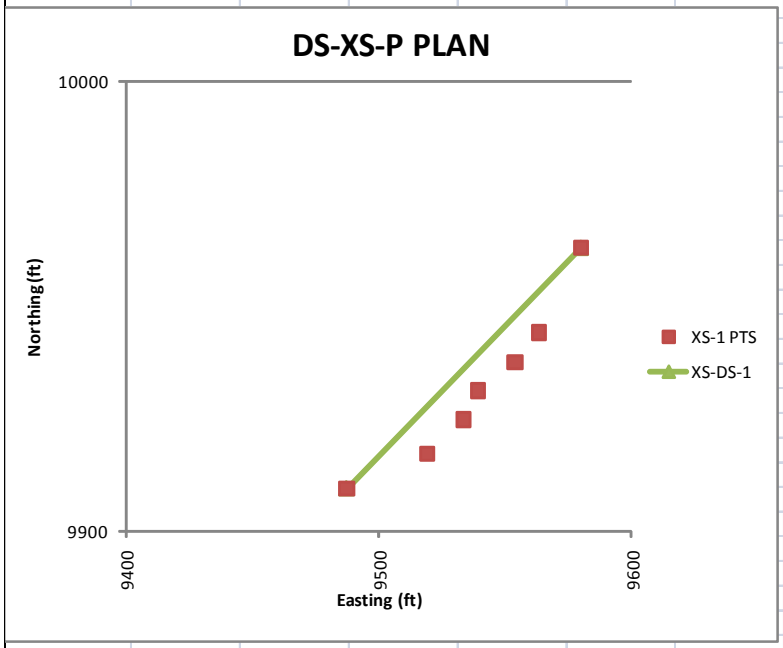


Table D33. DS-XS-P (SURVEYS BY NSEA/SCD, DATA PROCESSING BY M&N, DATUM CONVERTED MLLW TO NAVD88)

FID	P	E	N	Z	D			UNIT VECTOR	STATION (FT)	Skagit Conservation District, 2008. A Survey of Channel Profile and Cross Sections of Dry Slough, Fir Island, Skagit County,				
	215	9,580	9,963	13.96	OFLL			0.000	0.0					
	216	9,563	9,944	13.42	OTBL			0.225	24.1					
	217	9,554	9,938	7.14	OBBL			0.331	35.4					
	218	9,539	9,931	5.63	OCH			0.478	51.1					
	219	9,533	9,925	7.06	OCHR			0.557	59.6					
	220	9,519	9,917	12.83	OBBR			0.707	75.7					
	221	9,487	9,909	13.11	OTBR			1.000	107.1					



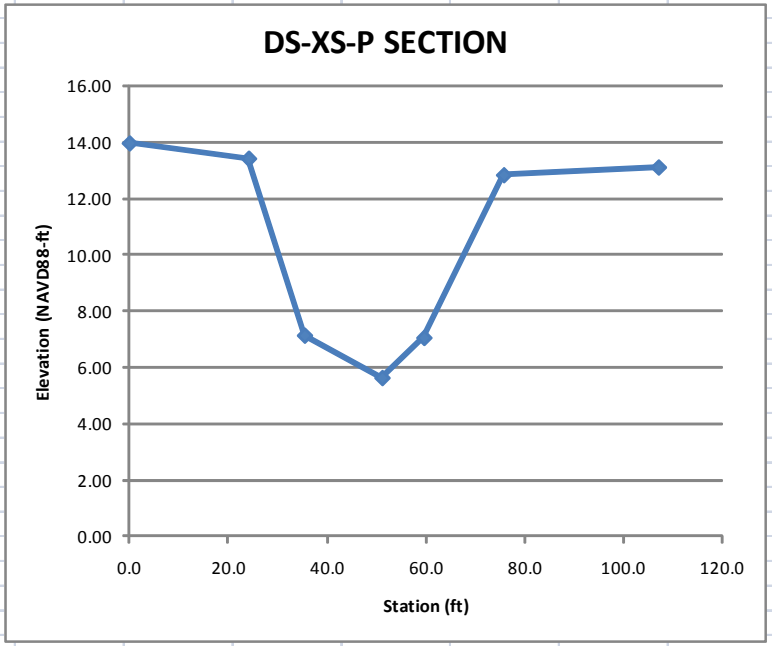
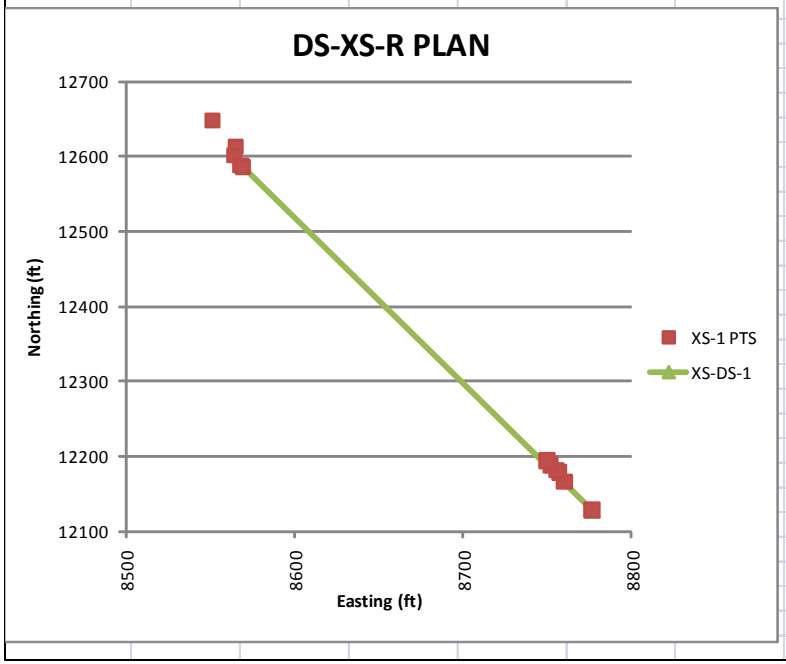
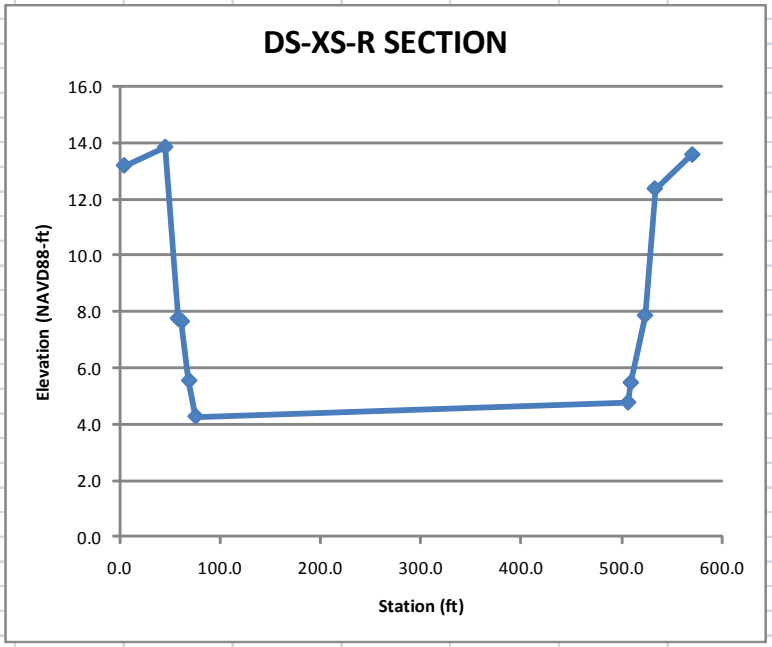
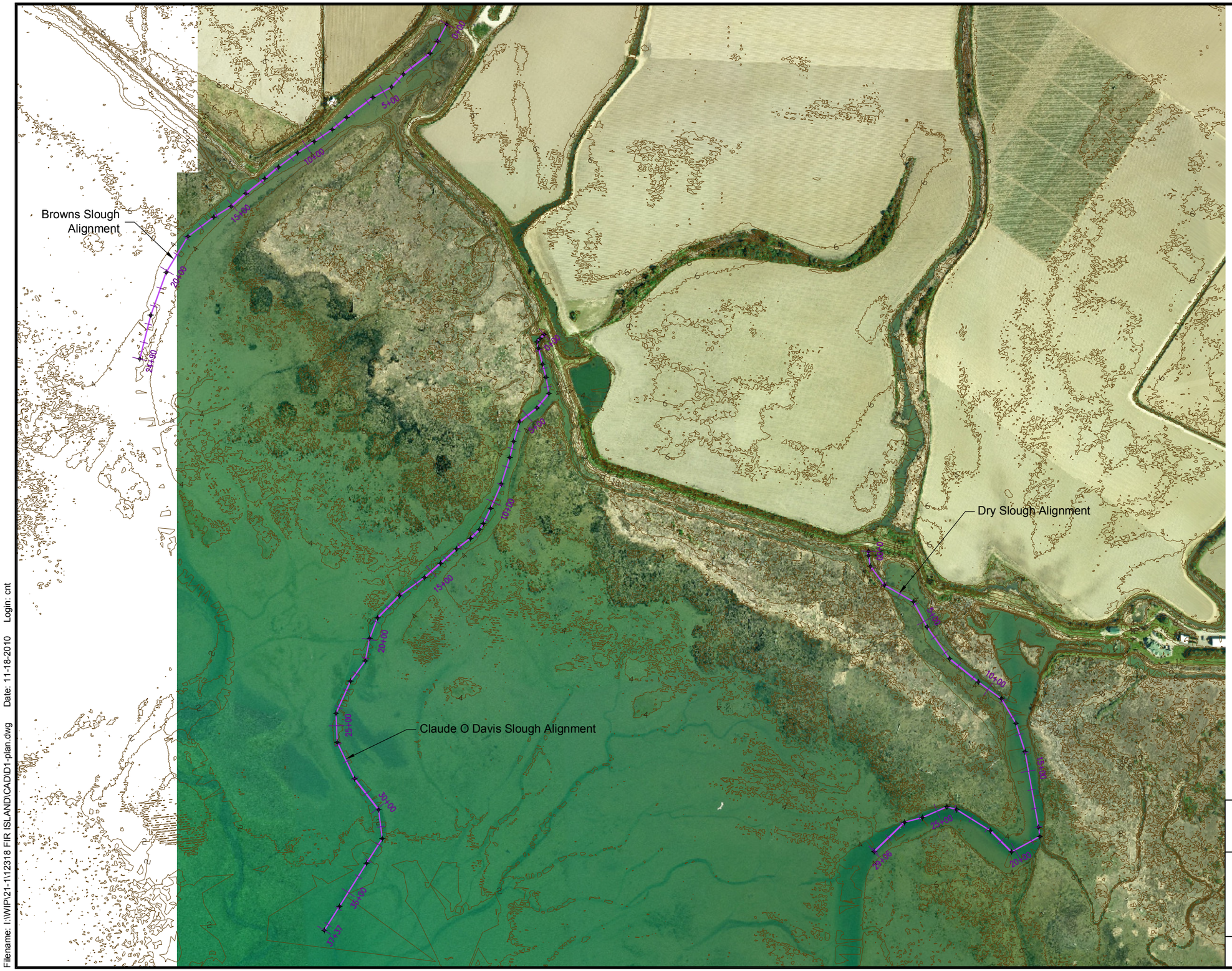


Table D34. DS-XS-R (SURVEYS BY NSEA/SCD, DATA PROCESSING BY M&N, DATUM CONVERTED MLLW TO NAVD88)

FID	P	E	N	Z	D			UNIT VECTOR	STATION (FT)	Skagit Conservation District, 2008. A Survey of Channel Profile and Cross Sections of Dry Slough, Fir Island, Skagit County,				
	316	8,776	12,128	13.2	RFLL			0.000	4.2			Note: Unit vector data transformations not used for this section.		
	317	8,760	12,166	13.8	RTBL			0.082	45.3					
	318	8,757	12,178	7.7	RBBL			0.107	57.9					
	319	8,755	12,182	7.6	REWL			0.115	61.7					
	320	8,752	12,188	5.5	RCTL			0.129	69.1					
	321	8,750	12,194	4.3	RCHL			0.142	75.5					
	322	8,552	12,648	4.8	RCHR			1.127	506.5					
	323	8,565	12,613	5.5	RCTR			1.053	509.2					
	324	8,565	12,602	7.8	RBBR			1.033	523.3					
	325	8,568	12,588	12.3	RTBR			1.005	533.1					
	326	8,570	12,586	13.6	RFLR			1.000	570.4					







LEGEND

✦ Thalweg Survey Points

NOTE

Figure adapted from aerial photograph provided by Skagit County dated 2009, topography produced by SRSC dated 2002, and GPS survey points by Shannon & Wilson dated 2010.

0 500 1,000

Scale in Feet

Fir Island Farms Restoration Feasibility
Skagit County, Washington

BAY FRONT CHANNEL THALWEG ALIGNMENTS

November 2010 21-1-12318-001

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FIG. D1

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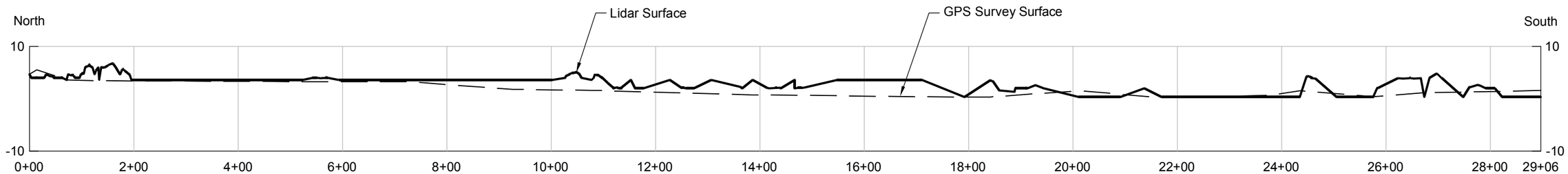

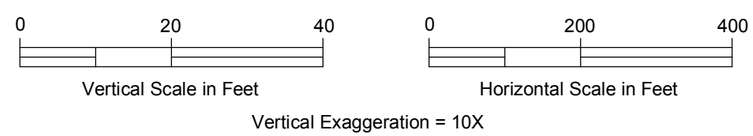

Fir Island Farms Restoration Feasibility
Skagit County, Washington

DRY SLOUGH BAY FRONT GPS SURVEY AND LIDAR CHANNEL PROFILE

November 2010 21-1-12318-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. D2

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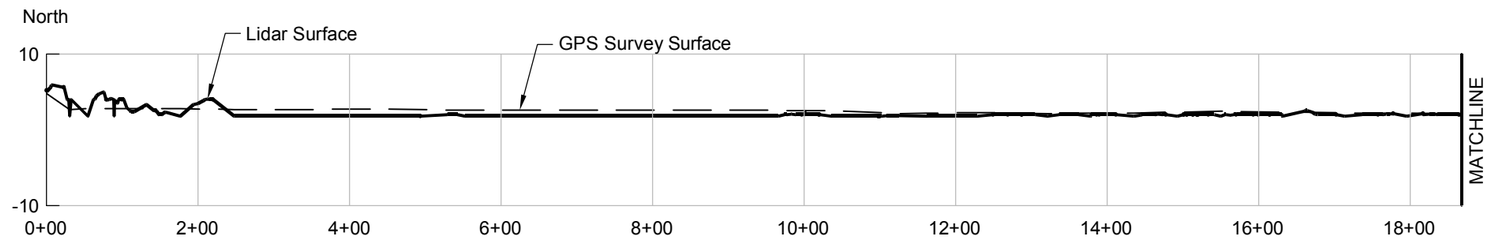

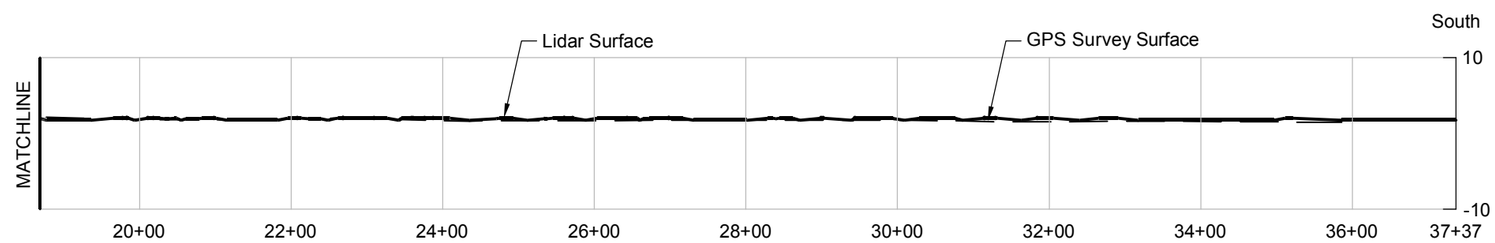

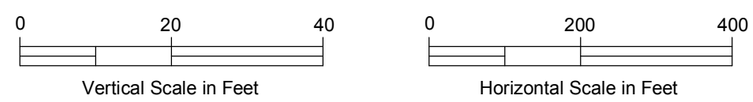

Vertical Exaggeration = 10X

Fir Island Farms Restoration Feasibility
Skagit County, Washington

CLAUDE O DAVIS BAY FRONT GPS SURVEY AND LIDAR CHANNEL PROFILE

November 2010 21-1-12318-001

SHANNON & WILSON, INC.
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FIG. D3

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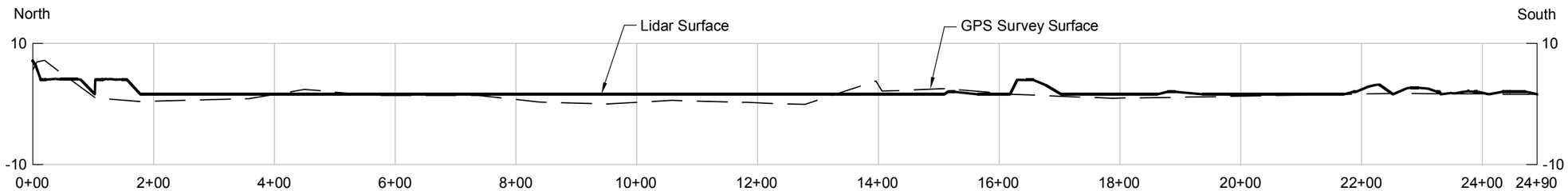

Vertical Scale in Feet

Horizontal Scale in Feet

Vertical Exaggeration = 10X

Fir Island Farms Restoration Feasibility
Skagit County, Washington

BROWNS SLOUGH BAY FRONT GPS SURVEY AND LIDAR CHANNEL PROFILE

November 2010 21-1-12318-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. D4

Filename: I:\WIP\21-1\12318 FIR ISLAND\CAD\D2thru4-profiles.dwg Date: 11-18-2010 Login: cnt