APPENDIX A

TABLES AND FIGURES

APPENDIX A

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TABLE A-1
STEERING COMMITTEE MEMBERS

Name	Agency
Brian Williams	Washington Department of Fish and Wildlife
Bob Warinner	Washington Department of Fish and Wildlife
Bob Everitt	Washington Department of Fish and Wildlife
Belinda Schuster	Washington Department of Fish and Wildlife
Mike Davison	Washington Department of Fish and Wildlife
Bob Barnard	Washington Department of Fish and Wildlife
Ray Berg	Washington Department of Fish and Wildlife
Shirley Solomon	Skagit Watershed Council
Ed Connor	Seattle City Light
Tom Slocum	Skagit Conservation District
Mike Shelby	Western Washington Agriculture Association

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	-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).

MHHW = mean higher high water

MHW = mean high water

MLW = mean low water

MSL = mean sea level

MTL = mean tide level

TABLE A-3
FIR ISLAND FARM INTERIOR DRAINAGE AREAS

Name	Area (acres)	Area (square mile)	Length (feet)
Rawlins Road	426	0.7	N/A
Brown Slough	203	0.3	6,000
No Name Slough	961	1.5	9,060
Claude O Davis Slough	46	0.1	1,330
Dry Slough (West)	976	1.5	8,110
Dry Slough (East-US)	310	0.5	13,435
Dry Slough (East-DS)	77	0.1	4,300
MacDonald Slough	457	0.7	6,190
Total Drainage Area	**3,456**	**5.4**	

TABLE A-4
SUMMARY OF SNOW GOOSE FORAGE SUPPLEMENT PROGRAMS MANAGED BY THE WASHINGTON DEPARTMENT OF FISH AND WILDLIFE

Program	Acres	kcal Provided	Percentage provided	Snow Geese Supported
Fir Island Reserve	615	1,071,203,806	11.7	8,856
Stanwood Reserve	181	315,264,862	3.5	2,606
Snow Goose Quality Hunt	934	1,626,244,148	17.8	13,445
Total	**1,730**	**3,012,712,815**	**33.0**	**24,907**

TABLE A-5
FIR ISLAND FARM ALTERNATIVES COST SUMMARY

	Alternative 1	Alternative 2	Alternative 2A	Alternative 3	Alternative 4	Alternative 5	Alternative 6
Construction Costs	$ 12,654,000	$ 11,716,000	$ 10,831,000	$ 11,016,000	$ 2,688,000	$ 1,638,000	$ 1,385,000
Real Estate Acquisition and Easements	$ 1,729,000	$ 1,274,000	$ 1,053,000	$ 702,000	$ 142,000	$ 61,000	$ -
Engineering Design, Permitting and Construction Oversight	$ 2,404,000	$ 2,226,000	$ 2,058,000	$ 2,093,000	$ 516,000	$ 315,000	$ 266,000
Total Project Capital Costs	**$ 16,787,000**	**$ 15,216,000**	**$ 13,942,000**	**$ 13,811,000**	**$ 3,346,000**	**$ 2,014,000**	**$ 1,651,000**

TABLE A-6
ALTERNATIVES EVALUATION METRICS

	Restoration Alternatives	Alt 1	Alt 2	Alt 2A	Alt 3	Alt 4	Alt 5	Alt 6
1	Total Project Site Footprint (acres)	225.0	168.0	144.2	97.0	27.0	11.9	13.2
2	Total Converted Farmland (acres)	201.5	146.0	130.0	76.3	11.3	7.4	0.0
3	Total Converted WDFW Farmland (acres)	194.9	139.4	130.0	69.7	8.0	7.4	0.0
4	Total Converted Private Farmland (acres)	6.6	6.6	0.0	6.6	3.3	0.0	0.0
5	Market Value of Converted Farmland ($8200/acre)	$1,652,300	$1,197,200	$1,066,000	$625,660	$92,660	$60,680	$0
6	Annual Value of Lost Crop Production ($2593/acre)	$522,490	$378,578	$337,090	$197,846	$29,301	$19,188	$0
7	Tidegate Fish Initiative Credits	209.4	151.3	130.0	77.1	11.6	7.6	2.5
8	Total Length of New Flood Dike	8,600	7,360	5,629	8,200	7,625	4,725	-
9	Restored Tidal Marsh Habitat (acres)	202.5	145.0	126.6	72.3	8.8	7.0	0.0
10	Low Tidal Marsh Habitat Restored (acres)(snow geese forage)	172.0	159.0	108.5	98.0	45.0	0.0	0.0
11	Restoration Cost Per Acre Tidal Marsh Restored	$81,590	$103,690		$180,166	$367,386	$334,000	N/A
12	Net Restored Channel Area Combined (SF Regression) (acres)	29.1	21.6	17.4	7.2	2.9	0.7	1.8
13	Chinook Smolts Produced Annually Chinook Model	108,795	80,654	65,194	26,686	5,426	1,305	6,659
14	Chinook Smolts Produced Annually – Reference Site	535,058	396,659	320,625	132,625	26,964	6,484	33,092
15	Chinook Smolts Produced Annually Per Acre Converted Farmland	2,655	2,717	2,466	1,738	2,386	876	N/A
16	Restoration Cost Per Chinook Smolt Produced - Referece Site - 50 Years	$0.63	$0.77	$0.87	$2.08	$2.48	$6.21	$1.00
17	Annual Adult Chinook Produced – Chinook Model	566	419	339	139	28	7	35
18	Annual Adult Chinook Produced – Reference Site	2,782	2,063	1,667	690	140	34	172
19	Restoration Cost Per Chinook Adult Produced - Referece Site - 50 years	$120.67	$147.54	$167.25	$400.52	$477.27	$1,194.66	$191.89
20	Snow Geese –WDFW Total Winter Forage Area Lost (acres)	202.0	146.0	130.0	76.0	11.3	7.4	0.0
21	Snow Geese - Hayton Total Winter Forage Area Lost (acres)	376.0	272.0	242.0	141.0	21.0	14.0	0.0
22	Snow Geese –WDFW Total Winter Forage Caloric Lost (kcal)	351,842,553	254,302,043	226,437,120	132,376,406	19,682,281	12,889,282	0
23	Snow Geese – Hayton Total Winter Forage Caloric Lost (kcal)	654,427,148	473,001,800	421,521,408	246,220,115	36,609,044	23,974,063	0
24	Snow Geese – WDFW Total Number Snow Geese Supported	2,909	2,102	1,872	1,094	163	107	0
25	Snow Geese – Hayton Total Number Snow Geese Supported	5,410	3,911	3,485	2,036	302	198	0
26	Snow Geese – WDFW Annual Lost Lease Revenue WDFW Only	$41,286	$29,768	$25,706	$15,496	$2,319	$1,529	0
27	Snow Geese – WDFW Lost Lease Revenue WDFW + Hayton	$84,537	$61,101	$54,405	$31,806	$4,729	$3,097	0
28	Snow Geese – NAWCA Reimbursement Cost ($8200/acre)	$1,656,400	$1,197,200	$1,066,000	$623,200	$92,660	$60,680	0
29	Public Access Amenities	maintain	maintain	maintain	maintain	maintain	maintain	maintain
30	Capital Cost of New Drainage/Flood Infrastructure	$12,654,000	$11,716,000	$10,831,000	$11,016,000	$2,688,000	$1,638,000	$1,385,000
31	Real Estate Acquisition, Easements, NAWCA Costs	$1,729,000	$1,274,000	$1,053,000	$702,000	$142,000	$61,000	$0
32	Engineering, Permits, Administration, Construction Oversight	$2,404,000	$2,226,000	$2,058,000	$2,093,000	$516,000	$315,000	$266,000
33	Total Restoration Cost	$16,787,000	$15,216,000	$13,942,000	$13,811,000	$3,346,000	$2,014,000	$1,651,000

Note:

50 percent Self Regulating Tidegate fish access modifier applied.

TABLE A-7
ALTERNATIVES PRIORITIZATION AND RANKING

Criteria #1	Alt 1		Alt 2		Alt 2a		Alt 3		Alt 4		Alt5			
Restore Ecosystem Health	Data	Score	Data	Score	Data	Score	Data	Score	Data	Score	Data	Score	Maximum	Minimum
1. Maximize Tidal Marsh Restoration (acres)	202.5	50.0	145.0	35.8	126.6	31.3	72.3	17.8	8.8	2.2	7.0	1.7	202.5	7.0
2. Maximize Tidal Channel Restoration (acres)	29.1	50.0	21.6	37.1	17.4	30.0	7.2	12.4	2.9	5.0	0.7	1.2	29.1	0.7
Score Total		100.0		72.9		61.2		30.2		7.2		2.9		
Rank		**1**		**2**		**3**		**4**		**5**		**6**		
Criteria #2	Alt 1		Alt 2		Alt 2a		Alt 3		Alt 4		Alt5			
Balance Natural Resource Benefits	Data	Score	Data	Score	Data	Score	Data	Score	Data	Score	Data	Score	Maximum	Minimum
1. Maximize Chinook smolt production.	535,058	25.0	396,659	24.7	320,625	20.0	132,625	8.3	26,964	1.7	6,484	0.4	535,058	6,484
2. Maximizes Chinook Smolts Per Acre Converted Farmland	2,655	24.4	2,717	33.3	2,466	30.2	1,738	21.3	2,386	29.2	876	10.7	2,717	876
3. Minimize Loss Of WDFW Snow Geese Forage Area	201.5	0.9	146.0	1.7	135.0	1.8	76.3	3.2	11.3	21.8	7.4	33.3	201.5	7.4
4. Maximize Restored Snow Geese Forage Areas (Low Marsh) (acres)	172.0	25.0	159.0	23.1	108.5	15.8	98.0	14.2	45.0	6.5	0.0	0.0	172.0	0.0
Score Total		75.4		82.8		67.8		47.0		59.3		44.4		
Rank		**2**		**1**		**3**		**5**		**4**		**6**		
Criteria #3	Alt 1		Alt 2		Alt 2a		Alt 3		Alt 4		Alt5			
Respect Agriculture Community	Data	Score	Data	Score	Data	Score	Data	Score	Data	Score	Data	Score	Maximum	Minimum
1. Minimize private farmland conversion.	6.6	0.0	6.6	0.0	0.0	33.0	6.6	0.0	3.3	16.5	0.0	33.0	6.6	0.0
2. Minimize Risks To Existing Drainage Of CDD#22	6.9	2.9	6.3	3.1	3.4	5.8	4.8	4.1	2.8	7.1	0.6	33.0	6.9	0.6
3. Maximize Tidegate Fish Initiative Credits	209.4	33.0	151.3	23.8	130.0	20.5	77.1	12.2	11.6	1.8	7.6	1.2	209.4	7.6
Score Total		35.9		27.0		59.3		16.3		25.4		67.2		
Rank		**3**		**4**		**2**		**6**		**5**		**1**		
Criteria #4	Alt 1		Alt 2		Alt 2a		Alt 3		Alt 4		Alt5			
Maintain Public Access and Recreation Opportunities	Data	Score	Data	Score	Data	Score	Data	Score	Data	Score	Data	Score	Maximum	Minimum
1. Maintain Parking Area	maintain	40.0	maintain	50.0	maintain	50.0	maintain	50.0	maintain	50.0	maintain	50.0	50.0	0.0
2. Maintain Snow Geese/Wildlife Viewing Opportunities	maintain	30.0	maintain	50.0	maintain	50.0	maintain	50.0	maintain	50.0	maintain	50.0	50.0	0.0
Score Total		70.0		100.0		100.0		100.0		100.0		100.0		
Rank		**2**		**1**		**1**		**1**		**1**		**1**		
Total Score Criteria 1-4		**281**		**283**		**288**		**194**		**192**		**215**		
Rank on Total Score Criteria 1-4		**3**		**2**		**1**		**5**		**6**		**4**		
Average Rank Criteria 1-4		**2.0**		**2.0**		**2.3**		**4.0**		**3.8**		**3.5**		
Crieria #5	Alt 1		Alt 2		Alt 2a		Alt 3		Alt 4		Alt5			
Social-Political Factors	Rating	Score	Rating	Score	Rating	Score	Rating	Score	Rating	Score	Rating	Score		
WDFW Future Drainage/Flood Liabilities - (Reduces Risks +20)	high	0.0	high	0.0	low	20.0	high	0.0	med	10.0	low	20.0		
CD22 Dry Slough Drainage Impacts (Reduce Drainage Impacts +20)	high	0.0	high	0.0	low	20.0	high	0.0	med	10.0	low	20.0		
Snow Goose Reserve Functions (Reduces Reserve Function Inpacts +20)	high	0.0	med	10.0	med	10.0	med	10.0	low	20.0	low	20.0		
CDD22 Legal (Satisfies Consent Decree +20)	high	20.0	med	10.0	med	10.0	low	0.0	low	0.0	low	0.0		
Hayton Family Farm Impacts (Reduces Farm Impacts +20)	high	0.0	med	10.0	med	10.0	high	0.0	med	10.0	low	20.0		
Score Total		20.0		30.0		70.0		10.0		50.0		80.0		
Rank		**5**		**4**		**2**		**6**		**3**		**1**		
Total Score Criteria 1-5		**301**		**313**		**358**		**204**		**242**		**295**		
Rank on Total Score Criteria 1-5		**3**		**2**		**1**		**6**		**5**		**4**		
Average Rank Criteria 1-5		**2.6**		**2.4**		**2.2**		**4.4**		**3.6**		**3.0**		

Maximum Point Score Criteria 1-4: 400pts
Maximum Point Score Criteria 1-5: 500pts

TABLE A-8
COMPARISON OF MAXIMUM WATER SURFACE ELEVATIONS FOR VARIOUS ALTERNATIVES

Alternative Description	Maximum WSE at No Name Slough Sta. 4705.413 (Downstream of Fir Island Road)	Maximum WSE at Dry Slough West Sta. 1432.005 (Downstream of Fir Island Road)
Existing	4.4 ft	6.4 ft
Alternative 2A (50-foot-wide storage area)	6.1 ft	---
Alternative 2A (100-foot-wide storage area)	5.1 ft	---
Alternative 2A (200-foot-wide storage area)	4.4 ft	---
Alternative 4	---	6.5 ft
Alternative 2A + 4 (200-foot-wide storage area)	5.7 ft	6.7 ft

TABLE A-9
SUMMARY OF ANTICIPATED WETLAND EFFECTS

Wetland Effect	Acres
Permanent Wetland Gain	**96.1**
Estuarine wetland gain from the reintroducing tidal waters to create new estuarine marsh throughout uplands.	*93.2*
Palustrine wetland gain from the replacement of existing interior drainage with pond behind (north) of new setback levee.	*2.9*
Permanent Wetland Loss	**1.9**
New setback levee will be located in portions of existing palustrine and potential farm wetlands.	
Permanent Wetland Alteration	**34.9**
Wetlands altered from palustrine to estuarine due to the introduction of tidal waters.	
Temporary Estuarine Wetland Impacts	**9.1**
Temporary impacts to existing bayfront estuarine wetlands as the bayfront borrow ditch is backfilled with the existing levee.	

TABLE A-10
VEGETATIVE SPECIES RECOMMENDED FOR MANAGEMENT

Common Name	Scientific Name	Habitat of Concern	Skagit County/State Noxious Weed Designation
Narrow leaf cattail	*Typha angustifolia*	High marsh	Not Listed
Cordgrass species	*Spartina sp.*	High marsh	A/B[1]
Reed canarygrass	*Phalaris arundinacea*	Drainage pond perimeter	C
Purple loosestrife	*Lythrum salicaria*	Drainage pond perimeter	B
Giant hogweed	*Heracleum mantegazzianu*	New setback levee	A
Japanese knotweed	*Polygonum cuspidatum*	New setback levee	B
Himalayan blackberry	*Rubus armeniacus*	New setback levee	C
Tansy ragwort	*Senecio jacobaea*	New setback levee	B
Knapweed species	*Centaurea sp.*	New setback levee	A/B[1]
Scotch broom	*Cytisus scoparius*	New setback levee	B

Note:
[1] The actual designation depends upon the specific species.

TABLE A-11
PREFERRED ALTERNATIVE 2A
CONSTRUCTION COST ESTIMATE

Item	Description	Unit	No. Units	Cost per unit	Subtotal	Unit Price Source & Reference	Notes
1	Construction Bonding	LS	1	$ 100,237.50	$ 100,237.50	RS Means 013113.90	1.25% of Construction cost (average)
2	Contractor Permits, Submittals, Construction M	LS	1	$ 360,855.00	$ 360,855.00	RS Means 011131.20	4.5% of Construction Cost over 2 year construction project.
3	Mobilization/Demobilization	LS	2	$ 20,000.00	$ 40,000.00	RS Means 015436	Assume 15 pieces of major equipment moved twice.
4	Traffic Control	DAY	240	$ 769.40	$ 184,656.00	Fisher Slough Average Bids (2010)	(2) 4 month construction periods requiring traffic control.
5	Construction Survey & As-builts	LS	1	$ 150,000.00	$ 150,000.00	Fisher Slough Average Bids (2010)	Contractor to provide all construction surveys and as-builts.
6	Site Preparation, Temporary Facilities	LS	1	$ 125,000.00	$ 125,000.00	Fisher Slough Average Bids (2010)	Assume basic site preparations to allow for heavy construction equipment access/staging.
7	TESC/BMPs	LS	1	$ 150,000.00	$ 150,000.00	Fisher Slough Average Bids (2010)	
8	Dike Setback						
8.01	Stripping	CY	17,000	$ 2.35	$ 39,950.00	RS Means 311413.23-1420	1' depth stripping.
8.02	Geotextiles Foundation Preparation	SY	13,200	$ 1.52	$ 20,064.00	RS Means 313219.16-1550	Assumed geotextiles along 25% of alignment due to soft soil foundation.
8.03	Haul Route Road Prep (Rock, Grade & Cor	CY	8,670	$ 51.00	$ 442,170.00	Fisher Slough Average Bids (2010)	Assumed circular haul route around site for new setback and levee removal and second access to Fir Island Road.
8.04	Suitable Levee Fill Import (100%)	CY	75,600	$ 15.00	$ 1,134,000.00	Fisher Slough Successful Bid (April 2010)	Average end area calculation along levee alignment.
8.05	Settlement	CY	17,000	$ 15.00	$ 255,000.00	Fisher Slough Successful Bid (April 2010)	Preliminary geotech estimated 1ft settlement along entire length of levee.
8.07	Rock Protection (100% of Dike)	CY	38,350	$ 60.00	$ 2,301,000.00	Fisher Slough Average Bids (2010)	Assume 100% of dike coastal face needs rock protection
8.08	Topsoil	CY	7,300	$ 15.70	$ 114,610.00	Fisher Slough Average Bids (2010)	Asssume 0.5ft of topsoil on levee faces.
8.09	Seeding	AC	9.0	$ 10,000.00	$ 90,000.00	Fisher Slough Average Bids (2010)	Assume seeding of levee topsoil surfaces (both sides of levee).
8.10	Road Surfacing	CY	3,250	$ 50.00	$ 162,500.00	Fisher Slough Average Bids (2010)	
8.11	Gates, Fences, Security	EA	4	$ 4,600.00	$ 18,400.00	Fisher Slough Average Bids (2010)	Assume access gates, locks, fences down to water line at gate locations along dike.
9	Existing Dike Removal/Ditch Fill	CY	61,204	$ 6.87	$ 420,471.48	RS Means 312316.42-0300, RS Means 312323.20-4016, RS Means 312316.46-5220	Assume excavate and/or push dike into adjacent borrow ditches.
10	Interior Drainage						
10.01	No Name Slough Culverts						
	Length of Pipe	FT	100				
	Width of Trench	FT	25				
	Dewatering						
	Check Dams	LS	2	$ 2,500.00	$ 5,000.00		Assume construct in dry with sump pumps and by-pass system.
	Sump system	LS	1	$ 15,000.00	$ 15,000.00	Fisher Slough Average Bids (2010)	Assume 1 week installation, 2 week operation, 1 week decomission for 100ft long pipes.
	Earthwork						
	Geotextile	SY	278	$ 3.12	$ 866.67	Fisher Slough Average Bids (2010)	
	Bedding w/ Compaction	CY	93	$ 39.78	$ 3,683.33	Fisher Slough Average Bids (2010)	1ft thick bedding material
	Backfill w/ Compaction	CY	463	$ 9.92	$ 4,592.59	Fisher Slough Average Bids (2010)	Backfill is for materials underneath levee
	HDPE Pipes	LF	200	$ 80.50	$ 16,100.00	RS Means 334113.50-1380	Replace w/ 48" HDPE
	Flapgate	EA	2	$ 11,400.00	$ 22,800.00	RS Means 352016.66-0150	Replace w/ 48" Aluminum flapgate
	Trash Rack	EA	1	$ 20,000.00	$ 20,000.00		
10.02	Interior Drainage Storage Excavation	CY	68,940	$ 6.87	$ 473,617.80	RS Means 312316.42-0300, RS Means 312323.20-4016, RS Means 312316.46-5220	

TABLE A-11
PREFERRED ALTERNATIVE 2A
CONSTRUCTION COST ESTIMATE

Item	Description	Unit	No. Units	Cost per unit	Subtotal	Unit Price Source & Reference	Notes
11	Channel Dredging and Field Grading	CY	10,920	$ 6.87	$ 75,020.40	RS Means 312316.42-0300, RS Means 312323.20-4016, RS Means 312316.46-5220	
12	Marsh plantings and seeding	AC	126.6	$ 15,000.00	$ 1,899,000.00	Fisher Slough Average Bids (2010)	Assume native seeding of entire area with headgate irrigation operations in spring of Phase 2 prior to tidal inundation.
Construction Subtotal					**$ 8,644,594.77**		
Taxes (7.8%)					$ 674,278.39		
Estimating Contingency (25%)					$ 2,161,148.69		
Construction Change Order Contingency (15%)					$ 1,296,689.22		
Construction Subtotal					**$ 12,776,711.07**		
Real Estate Acquisition & Easements							
15.1	Real Estate Acquisition (Haytons)	AC	0.0	$ 8,200.00	$ -		
15.2	Construction Easements (Haytons & Skagit Cty	AC	10.0	$ 1,500.00	$ 15,000.00		
15.3	NAWCA Reimbursement Costs (?)	AC	126.6	$ 8,200.00	$ 1,038,120.00		Assume all snow goose reserve acreage is offset with other NAWCA reserve areas.
Subtotal					**$ 1,053,120.00**		
Engineering, Design, Permits, Admin, Construction Oversight							
16.1	Engineering (8% of construction)	LS	1.0	$ 1,022,136.89	$ 1,022,136.89		Assume 8% of construction budget. Includes all testing, design, contracting, bidding and oversight
16.2	Permits (2% of construction)	LS	1.0	$ 255,534.22	$ 255,534.22		Assume 2% of construction budget and will require full JARPA and Shoreline Permitting
16.3	Project Administration of Design, Engineering, Permits (10% of eng. & permits costs)	LS	1.0	$ 127,767.11	$ 127,767.11		Assume 12% of Engineering and Permits Budgets for administration.
17	Construction Oversight & Admin (8% of const	LS	1.0	$ 1,022,136.89	$ 1,022,136.89		Assume 8% of construction budget. Includes all testing, design, contracting, bidding and oversight
Subtotal					**$ 2,427,575.10**		
Total Project Capital Costs (Construction, Real Estate, Engineering & Permits)					**$ 16,257,406.18**		

Item	Description	Unit	No. Units	Cost per unit	Subtotal	Unit Price Source & Reference	Notes
Options and Contingencies							
C.1	Flood Return Gates						
	Length of Structure (along levee)	FT	100				
	Width of Structure	FT	75				
	Height of Structure	FT	10				
	Earthwork						
	Geotextile	SY	833	$ 3.12	$ 2,600.00	Fisher Slough Average Bids (2010)	
	Bedding w/ Compaction	CY	278	$ 25.00	$ 6,944.44	Fisher Slough Average Bids (2010)	1ft thick bedding material
	Sheet piling, 60' depth, steel	SF	6,000	$ 17.10	$ 102,600.00	RS Means 314116.10 1500	
	Reinforced Concrete	CY	459	$ 650.00	$ 298,325.93	Fisher Slough Average Bids (2010)	

TABLE A-11
PREFERRED ALTERNATIVE 2A
CONSTRUCTION COST ESTIMATE

Item	Description	Unit	No. Units	Cost per unit	Subtotal	Unit Price Source & Reference	Notes
	36" x 60" Stainless Steel Gates	EA	8	$ 16,800.00	$ 134,400.00	RS Means 352016.26-0180	
C.2	Sheet piling, 20' depth, vinyl	SF	116,920	$ 17.10	$ 1,999,332.00	RS Means 314116.10 1500	
C.3	Pump Station	LS	1	$ 300,000.00	$ 300,000.00	RS Means 314116.10 1500	
C.4	West Dike Brown Slough Rock Protection	CY	3,556	$ 60.00	$ 213,333.33	RS Means 312316.42-0300, RS Means 312323.20-4016	Assume no import of material
C.5	Brown Slough Log Boom	LS	1	$ 25,000.00	$ 25,000.00	RS Means 312316.42-0300, RS Means 312323.20-4016	Assume no import of material
C.6	Marsh Fill Grading (use excess channel excava	CY	35,724	$ 4.11	$ 146,825.64	RS Means 312316.42-0300, RS Means 312323.20-4016	Assume no import of material
	Levee toe large wood debris structures	LS	1	$ 200,000.00	$ 200,000.00	RS Means 312316.42-0300, RS Means 312323.20-4016	Assume no import of material
C.7	Disposal contaminated dredge materials	CY	10,000	$ 20.00	$ 200,000.00	RS Means 312316.42-0300, RS Means 312323.20-4016	Assume no import of material
C.8	Fir Island Road Improvements & Turnout	LS	1	$ 300,000.00	$ 300,000.00	RS Means 311216.13-2170	Assume minor roadway improvements to entrance and pullouts along road.
Subtotal					**$ 3,929,361.34**		

Note: Costs are from RS Means 2011 and Fisher Slough Bids in spring 2010.

Cost Escalation 2011 to 2015	**2011 Costs**	**2015 Costs**
Construction	$12,776,711	$14,380,301
Real Estate (NAWCA)	$1,053,120	$1,185,296
Engineering Design	$1,022,137	$1,150,424
Permits	$255,534	$287,606
Admin	$127,767	$143,803
Construction Oversight	$1,022,137	$1,150,424
Project Total	**$16,257,406**	**$18,297,854**
Options and Contingencies	$3,929,361	$4,422,531

TABLE A-12
ALTERNATIVE 2A QUANTITY TAKEOFFS

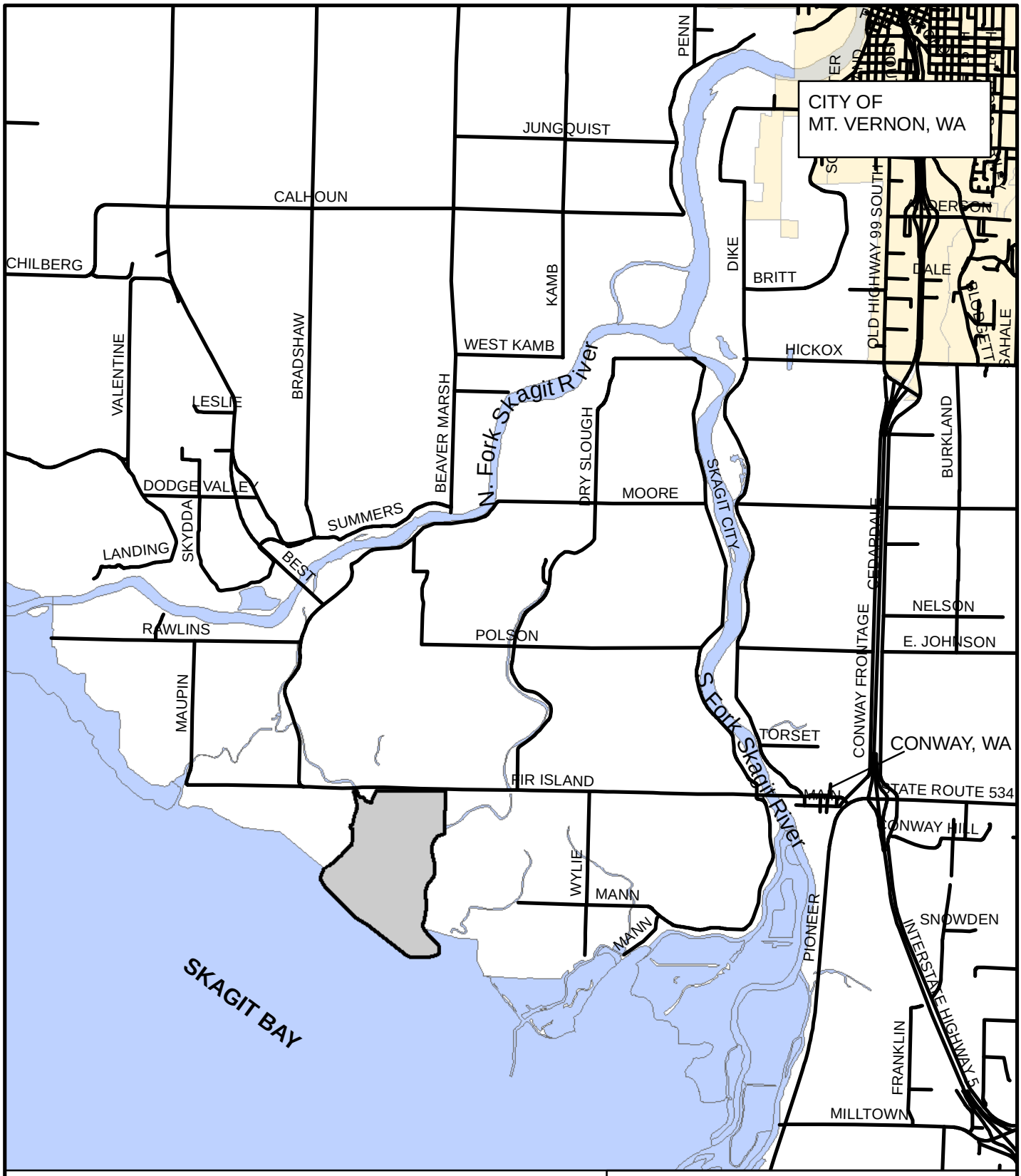
Item No.	Description	Dimension	Quantity	Units	Explanation
8.01	Stripping Volume (+)	Surface Area (2d)	**458,015**	ft^2	From AutoCAD 2d Surface Area - New Dike
	Surface Area check (2d)	Length	5,846	ft	
		Avg Width	81	ft	
		Area (check)	*473,526*	ft^2	(not used in calculations)
		Depth	**1.00**	ft	
		Volume	17,000	yd^3	Rounded up to nearest hundred
8.02	Geotextile Prep	Length	1,462	ft	Assume 25%
		Width	81	ft	Approximate
		Area	13,200	yd^2	Rounded up to nearest hundred
8.03	Haul Route Improvements	Length	**11,700**	ft	3900' along removal, 5900' along new dike, 1900' from Pioneer Hwy
		Depth	**1**	ft	
		Width	**20**	ft	
		Volume	8,670	yd^3	Rounded up to nearest ten
8.04	Dike Fill (Shell)	Unadjusted Volume	**107,462**	yd^3	AutoCAD Surface Comparison: EG vs. New Dike
	Volume check	Length	**5,846**	ft	Alignment Stationing
		Avg Height	**11**	ft	17' top elev - 6' avg bottom elev (Note this is used for slope length as well)
		Side Slope	**3**	H:1V	
		Top Width	**15**	ft	
		Volume (check)	*114,322*	yd^3	(not used in calculations)
		Stripping Volume (+)	*17,000*		
		Rock Protection Volume (-)	*-28,760*		
		Topsoil Volume (-)	*-7,300*		
		Road Surfacing Volume (-)	*-3,250*		
	Amount of Levee Fill to Import	Volume	85,200	yd^3	Rounded up to nearest hundred
8.05	Settlement	2d Surface Area	458,015	ft^2	
		Settlement Depth	**1.00**	ft	
		Settlement Volume	17,000	yd^3	Rounded up to nearest hundred

TABLE A-12
ALTERNATIVE 2A QUANTITY TAKEOFFS

Item No.	Description	Dimension	Quantity	Units	Explanation
8.07	Rock Protection	Length	**5,846**	ft	Assumed 25%
		Slope Length	44.3	ft	
		Thickness	**3.00**	ft	
		Volume	28,760	yd^3	Rounded up to nearest ten
8.08	Topsoil	Surface Area (3d)	**477,748**	ft^2	From AutoCAD 3d Surface Area - New Dike
		(-) Road Area	87,690	ft^2	
		Topsoil Area	390,058	ft^2	
		Depth	**0.50**	ft^2	
		Volume	7,300	yd^3	Rounded up to nearest ten
8.09	Seeding	Area	390,058	ft^2	
		Area	9.00	acres	Rounded up to nearest tenth of an acre
8.10	Road Surfacing	Length	5,846	ft	
		Width	15	ft	
		Depth	**1.00**	ft	
		Volume	3,250	yd^3	Rounded up to nearest ten
9	Dike Removal	Removal (cut) Volume	**61,204**	yd^3	AutoCAD Surface Comparison: EG vs. FG-Levee Removal
	Volume check	Length	**3,900**	ft	
		Avg Depth	**8**	ft	14' avg. top elev - 6' avg bottom elev
		Side Slope	**3**	H:1V	
		Top Width	**15**	ft	
		Volume (check)	*45,067*	yd^3	Note: CAD Surface comparison should be more accurate
	Fill Existing Ditches	Length	**3,900**		
		Avg Depth	**7**	ft	0' bottom elev, 7' avg top elev
		Side Slope	**2.00**	H:1V	
		Top Width	**50**	ft	
		Volume	36,400	yd^3	
		Excess Volume	24,804	yd^3	

TABLE A-12
ALTERNATIVE 2A QUANTITY TAKEOFFS

Item No.	Description	Dimension	Quantity	Units	Explanation
10.03	Storage Area	Length	1,650	ft	As shown on plans
		Bottom Width	**176**	ft	
		Side Slope	**2.00**	H:1V	
		Depth	**6**	ft	
		Top Width	200	ft	Top width ~200' in model
		Average Width	188	ft	
		Volume	68,940	yd^3	Rounded up to nearest ten
11	Pilot Channel Excavation	Cut Volume	**10,920**	yd^3	From AutoCAD Surface comparison
A.1	Sheet Piling	Length	5,846	ft	
		Depth	**20**	ft	
		Area	116,920	ft^2	
B.1	Marsh Fill Volume	Volume	35,724	yd^3	Excess pilot channel and dike removal material
		Surface Area	**20.5**	acres	As shown on plans
		Avg. Depth	0.93	ft	Estimated
C.2	Rock Protection (Extg Dike)	Length	**700**	ft	Assumed 25%
		Slope Length	25.3	ft	
		Thickness	**3.00**	ft	
		Volume	1,970	yd^3	Rounded up to nearest ten



ROADS

CITY_LIMITS

FIR_ISLAND_FARM_PROJECT

RIVER-SHORELINE

Fir Island Farm Restoration
Skagit Snow Goose Reserve
Skagit County, Washington

VICINITY MAP

December 2011 21-1-12318-003

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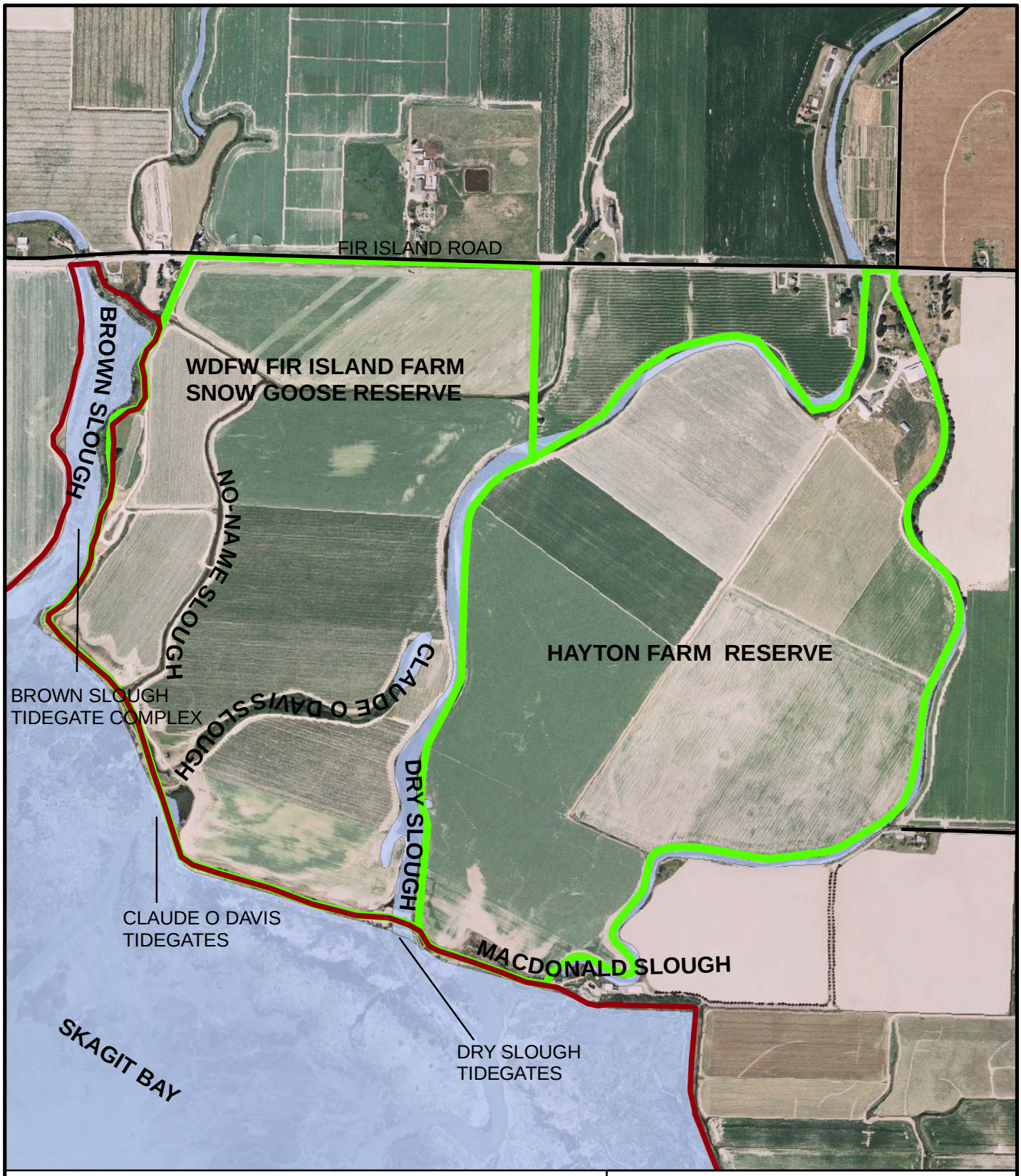
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

FIG. A-1

Filename: FIG_1_VICINITY_8.5X11P.MXD Date:11/29/11 drc



DIKES

ROADS

RESERVE

RIVER-SHORELINE

0 500 1,000 1,500 2,000 Feet

N

Fir Island Farm Restoration
Skagit Snow Goose Reserve
Skagit County, Washington

SITE MAP

December 2011 21-1-12318-003

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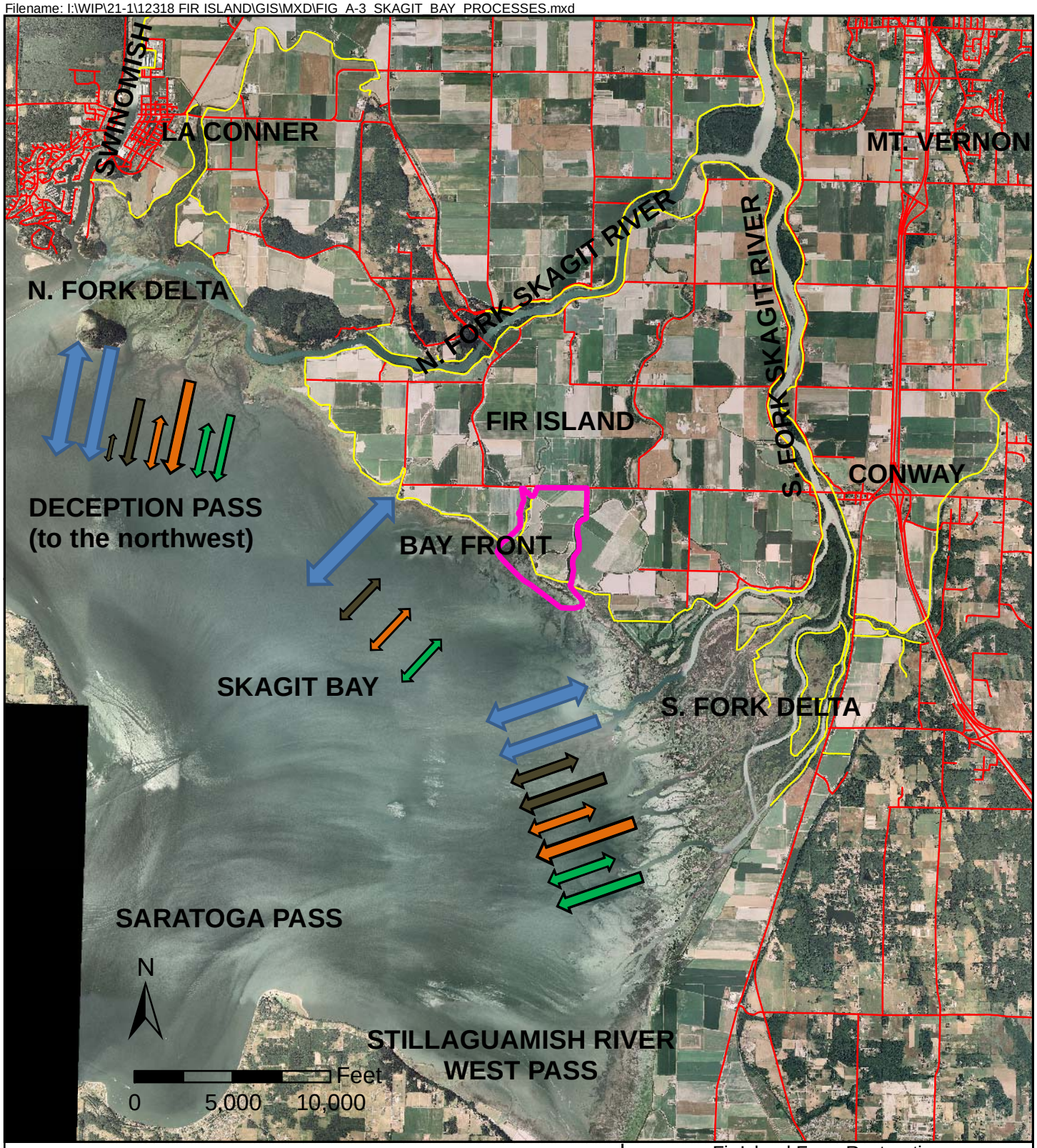
FIG. A-2

Filename: FIG_1_VICINITY_8.5X11P.MXD Date:11/29/11 drc

Filename: I:\WIP\21-1\12318 FIR ISLAND\GIS\MXD\FIG_A-3_SKAGIT_BAY_PROCESSES.mxd



PROJECT FOOTPRINT
LEVEE
ROADS
TIDAL FLOW
RIVER FLOW

COASTAL WOOD DEBRIS
RIVER WOOD DEBRIS
COASTAL SEDIMENT
RIVER SEDIMENT
COASTAL BIOLOGICAL
RIVER BIOLOGICAL

State Plane Washington
North 4601 NAD83/NAVD88

Fir Island Farm Restoration
Skagit Snow Goose Preserve
Skagit County, Washington

DRAFT

SKAGIT RIVER DELTA GEOMORPHOLOGIC PROCESSES

December 2011 | 21-1-12318-003

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FIG. A-3

Filename: I:\WIP\21-1\12318 FIR ISLAND\CAD\21-1-12318-001 Geologic Map.dwg Date: 11-30-2011 Login: cnt

Geologic Units

QUATERNARY SEDIMENTARY AND VOLCANIC DEPOSITS

Holocene Nonglacial Deposits

- af — Fill
- Qn — Nearshore deposits (Holocene)
- Qm — Marsh deposits (Holocene)
- Qas — Skagit River alluvium, undivided (Holocene)
- Qasl — Sand levees (Holocene) - Overbank sand deposits of the Skagit River

Pleistocene Glacial and Nonglacial Deposits

- Qgdme — Everson glaciomarine drift, undivided (Pleistocene)

TERTIARY SEDIMENTARY AND VOLCANIC ROCKS

- ΦEcbcg — Rocks of Bulson Creek, lower conglomeratic lithofacies (Oligocene to Eocene)
- Ecb — Chuckanut Formation, Bellingham Bay Member (Eocene)

Geologic Symbols

- Contact - Dashed were Inferred
- Fault - Dashed where Inferred; Dotted where Concealed
- Strike-slip fault - Arrows show relative horizontal movement; dotted where concealed
- Syncline - Showing direction of plunge; dotted where concealed
- Stike and dip of Quarternary bedding
- inclined; 'f' adjacent to symbol indicates foreset bedding

NOTE

Modified from Dragovich and others (2002).

0 1/2 1

Approximate Scale in Miles

Fir Island Farm Restoration
Skagit Wildlife Area
Skagit County, Washington

SURFICIAL GEOLOGIC MAP

December 2011 21-1-12318-003

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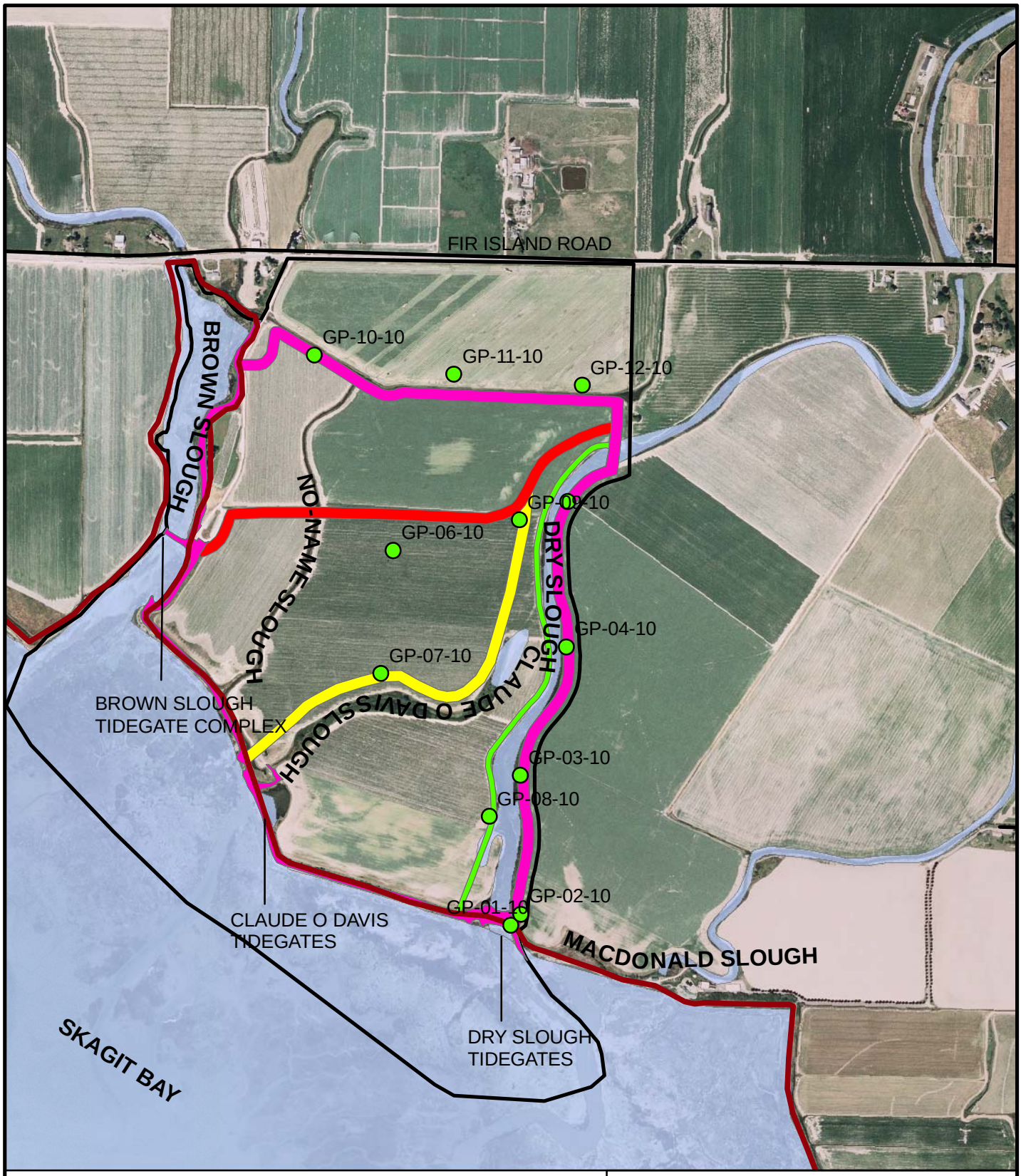
FIG. A-4

FIG. A-4



GEOPROBES
DIKES
ROADS
PROJECT_FOOTPRINT
Alt_1
Alt_2
Alt_3
Alt_4

0 500 1,000 1,500 2,000 Feet

N

Fir Island Farm Restoration
Skagit Snow Goose Reserve
Skagit County, Washington

GEOPROBE LOCATIONS

December 2011 21-1-12318-003

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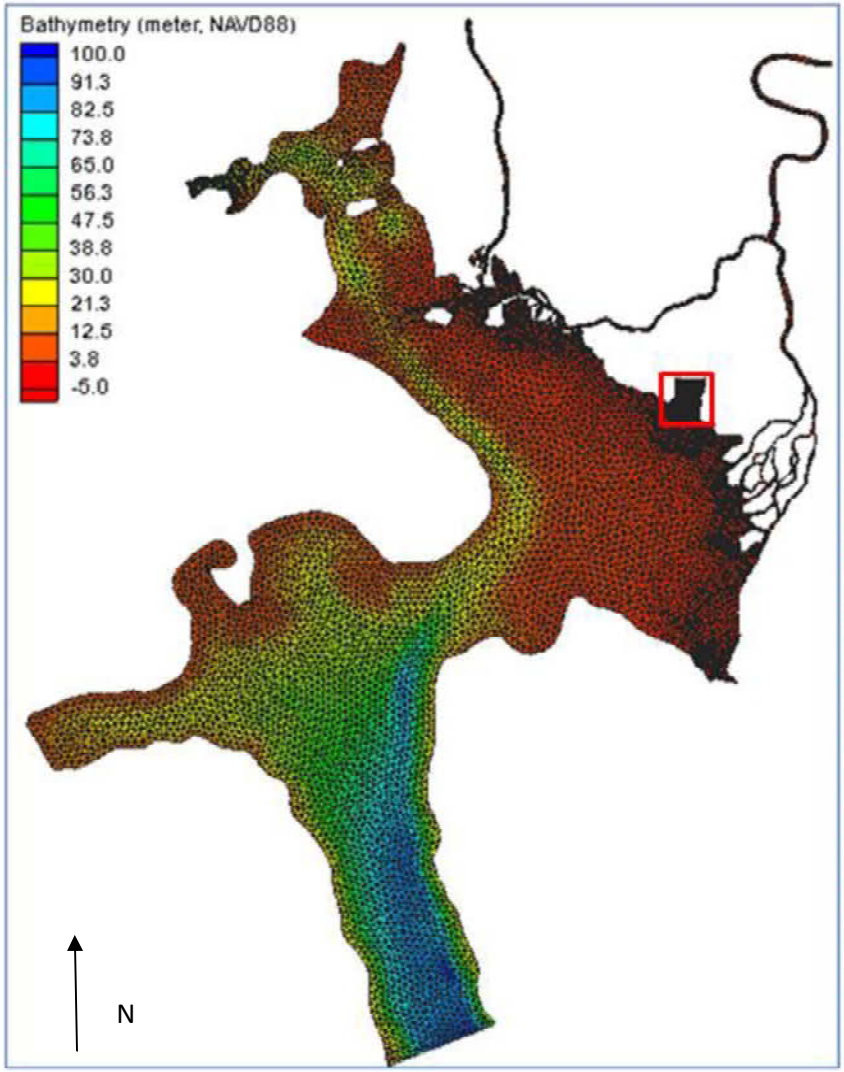
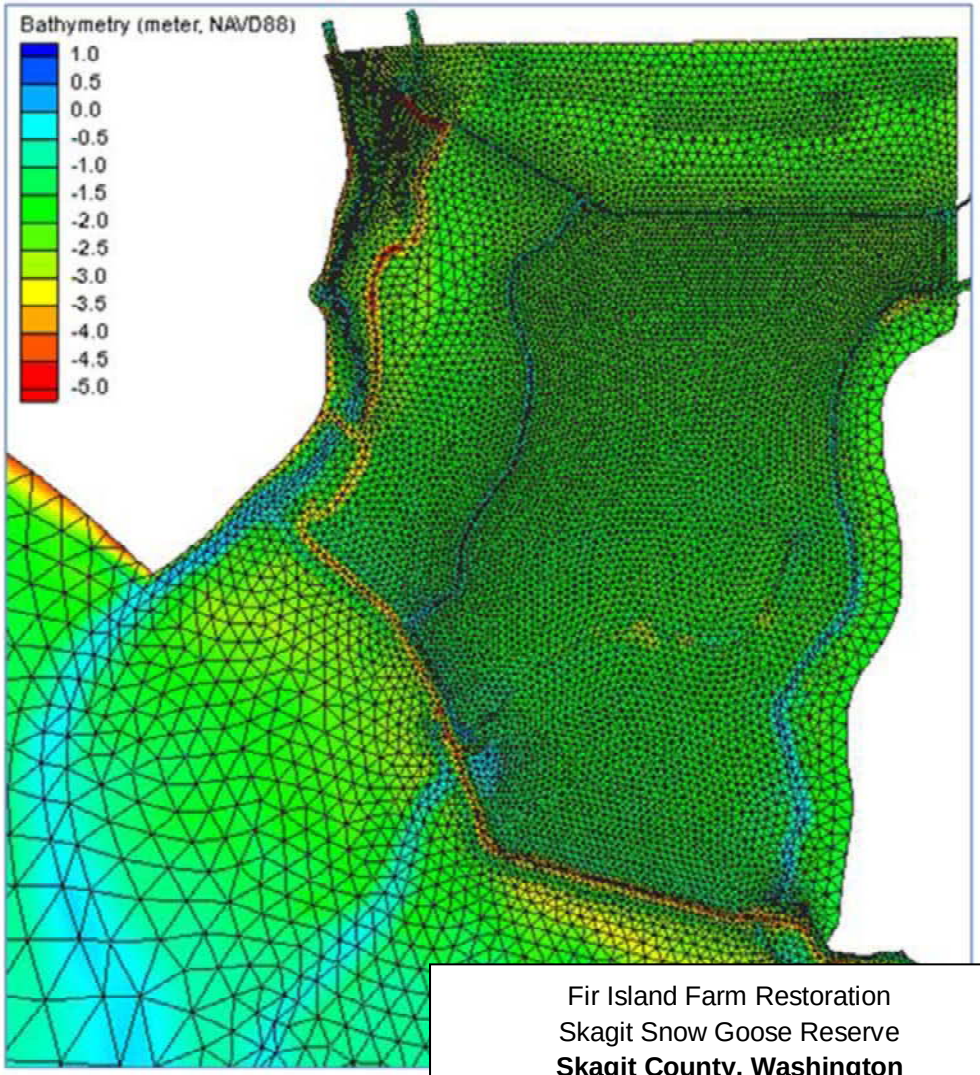
FIG. A-5

Filename: FIG_1_VICINITY_8.5X11P.MXD Date:11/29/11 drc





Fir Island Farm Restoration
Skagit Snow Goose Reserve
Skagit County, Washington

Battelle, PNNL
Puget Sound 3D Hydrodynamic Model Geometry
Source: PNNL Memo, April 18, 2011

December 2011 | 21-1-12318-003

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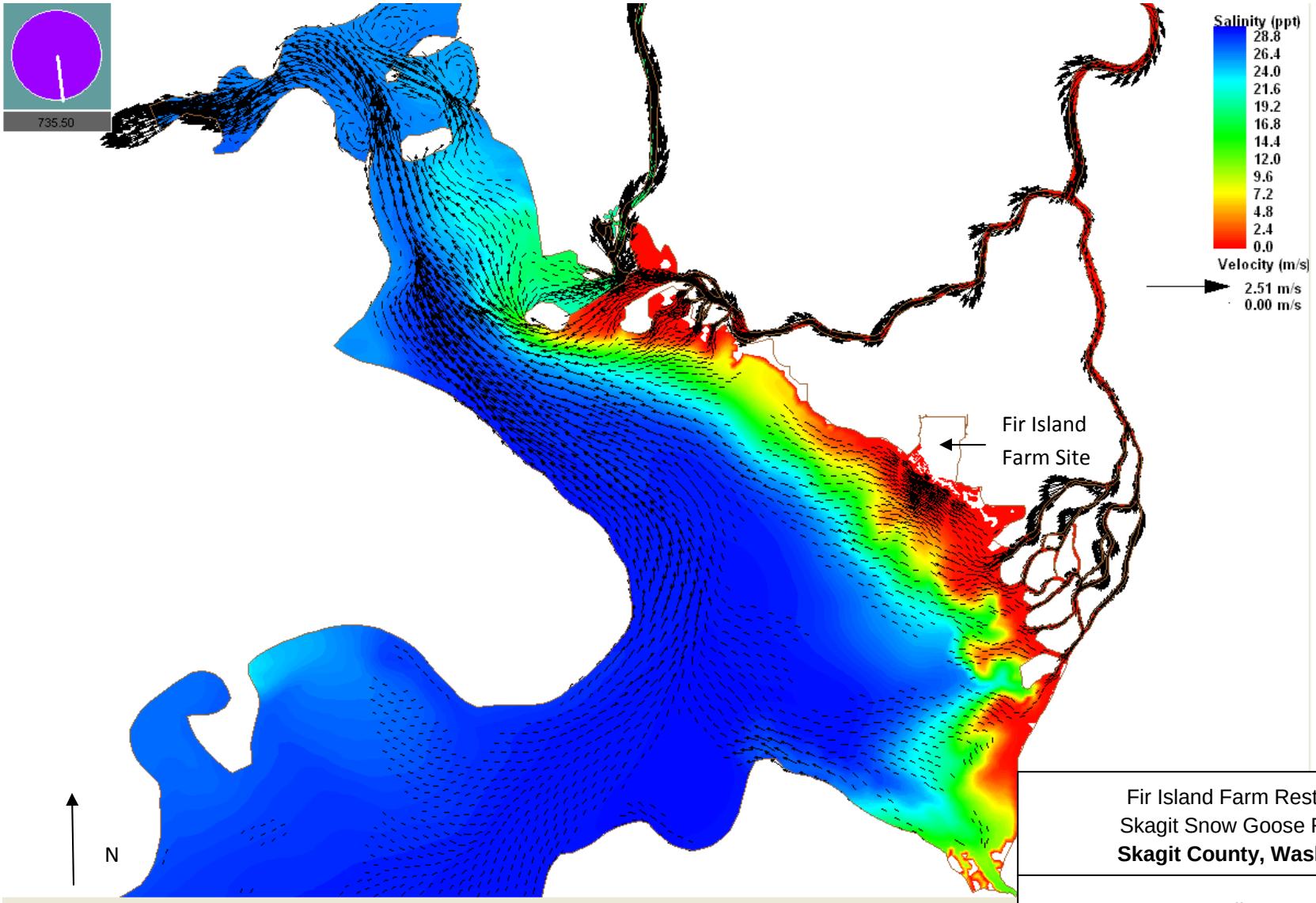
Fig. A-6



Fir Island Farm Restoration
Skagit Snow Goose Reserve
Skagit County, Washington

Battelle, PNNL
Puget Sound 3D Hydrodynamic Model
High Tide – Salinity, Velocity
Source: PNNL Memo, April 18, 2011

December 2011 | 21-1-12318-003

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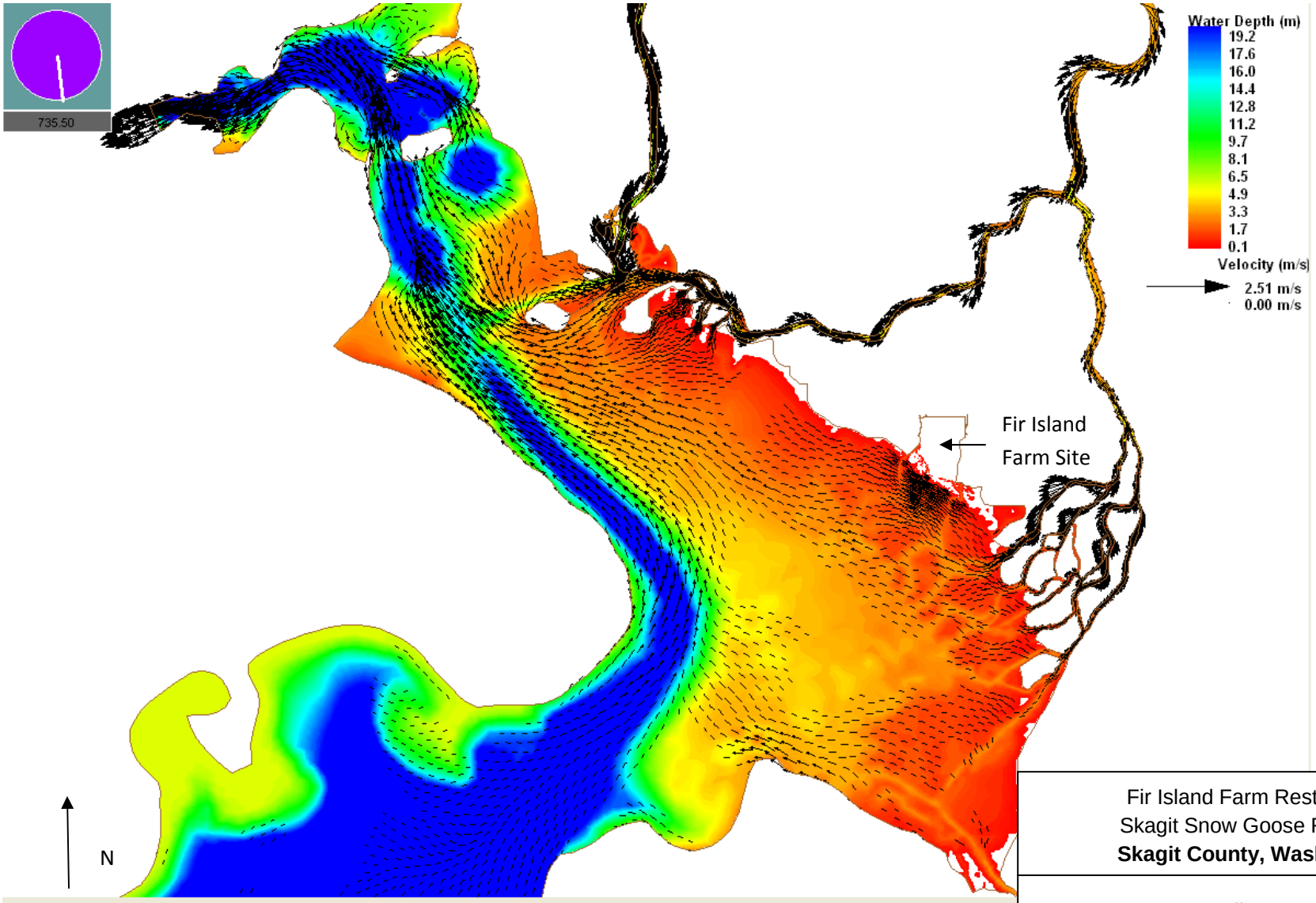
Fig. A-7



Fir Island Farm Restoration
Skagit Snow Goose Reserve
Skagit County, Washington

Battelle, PNNL
Puget Sound 3D Hydrodynamic Model
High Tide – Depth, Velocity
Source: PNNL Memo, April 18, 2011

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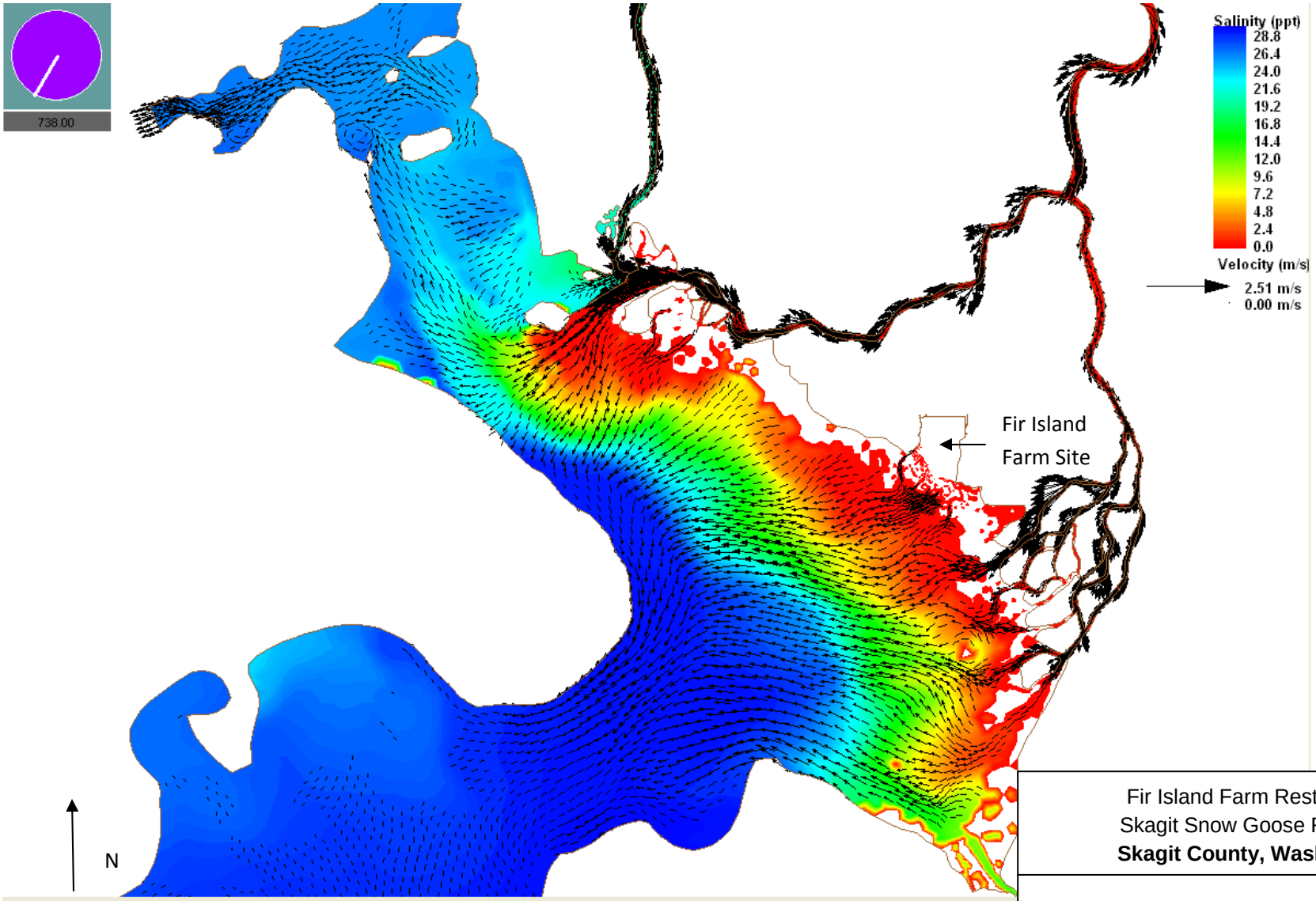
Fig. A-8



Fir Island Farm Restoration
Skagit Snow Goose Reserve
Skagit County, Washington

Battelle, PNNL
Puget Sound 3D Hydrodynamic Model
Ebb Tide – Salinity, Velocity
Source: PNNL Memo, April 18, 2011

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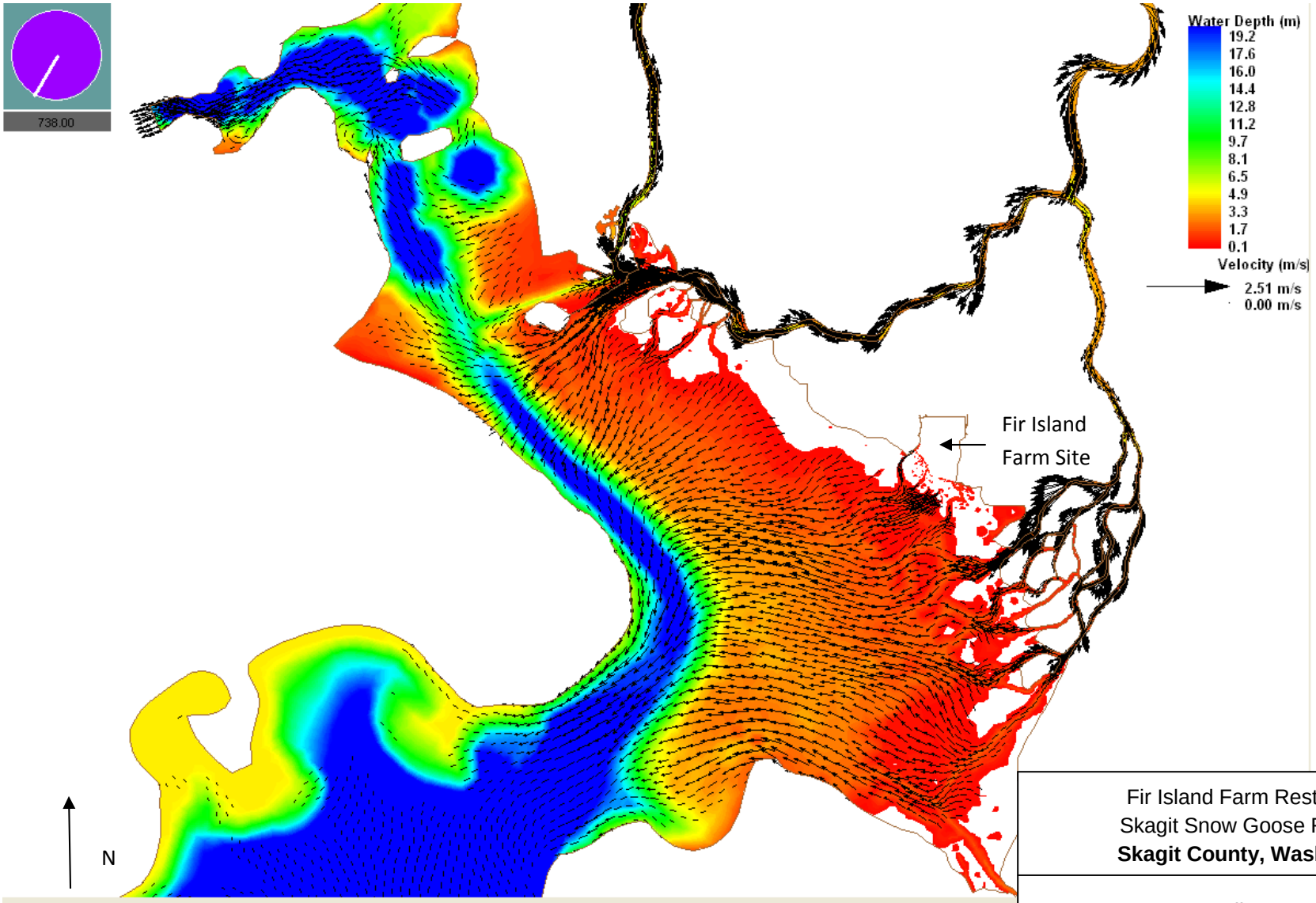
Fig. A-9



Fir Island Farm Restoration
Skagit Snow Goose Reserve
Skagit County, Washington

Battelle, PNNL
Puget Sound 3D Hydrodynamic Model
Ebb Tide – Depth, Velocity
Source: PNNL Memo, April 18, 2011

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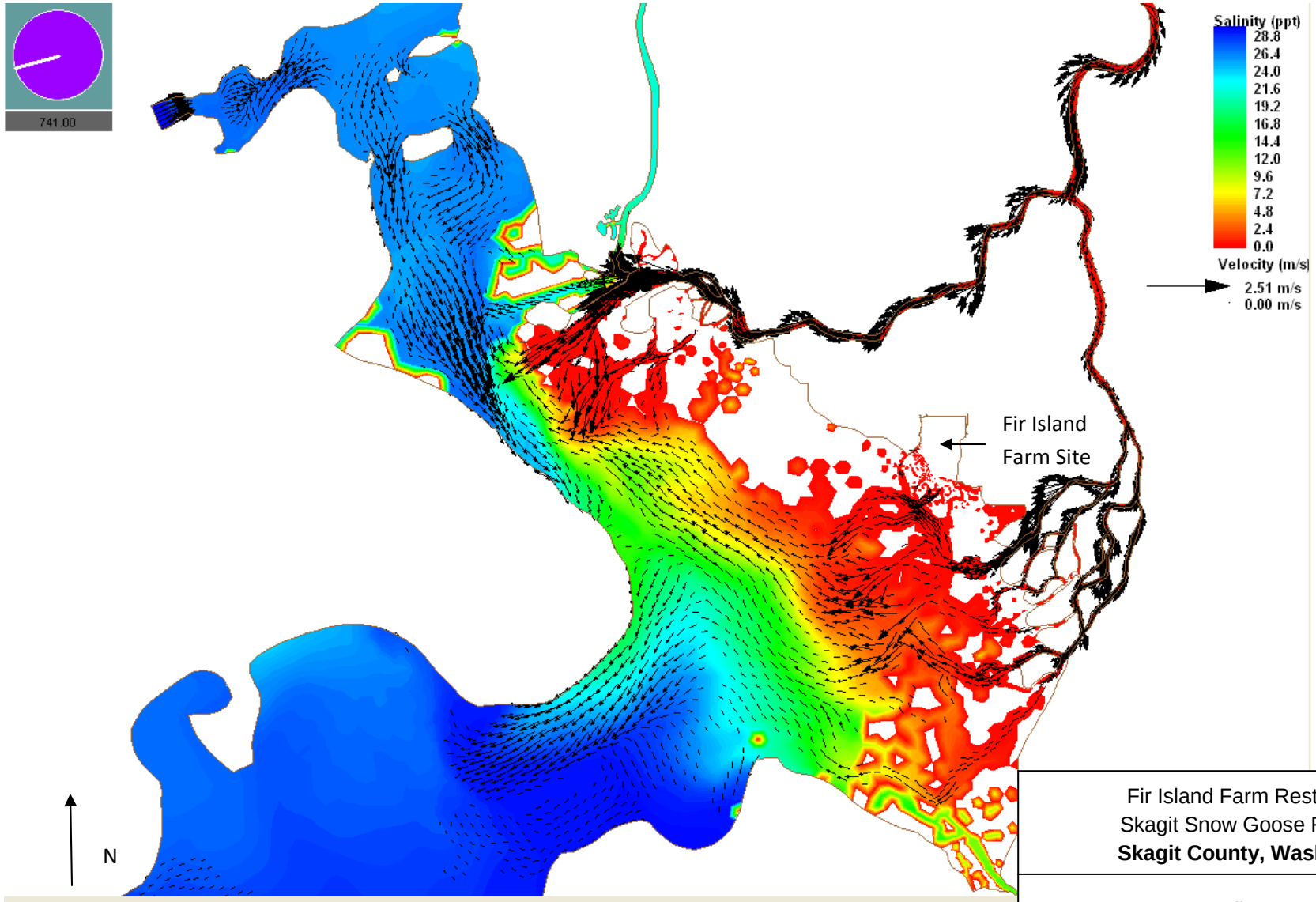
Fig. A-10



Fir Island Farm Restoration
Skagit Snow Goose Reserve
Skagit County, Washington

Battelle, PNNL
Puget Sound 3D Hydrodynamic Model
Low Tide – Salinity, Velocity
Source: PNNL Memo, April 18, 2011

December 2011 | 21-1-12318-003

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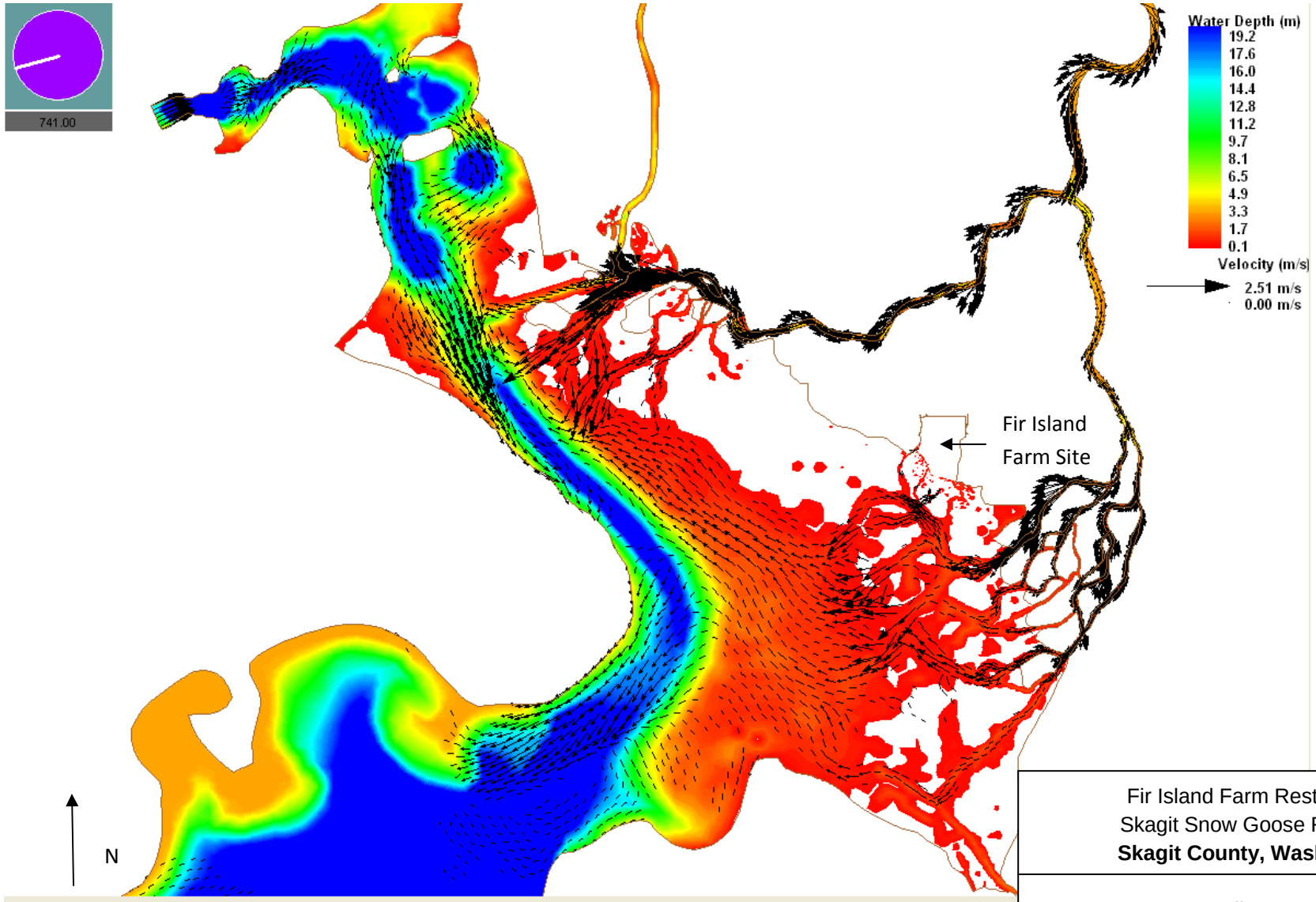
Fig. A-11



Fir Island Farm Restoration
Skagit Snow Goose Reserve
Skagit County, Washington

Battelle, PNNL
Puget Sound 3D Hydrodynamic Model
Low Tide – Depth, Velocity
Source: PNNL Memo, April 18, 2011

December 2011 | 21-1-12318-003

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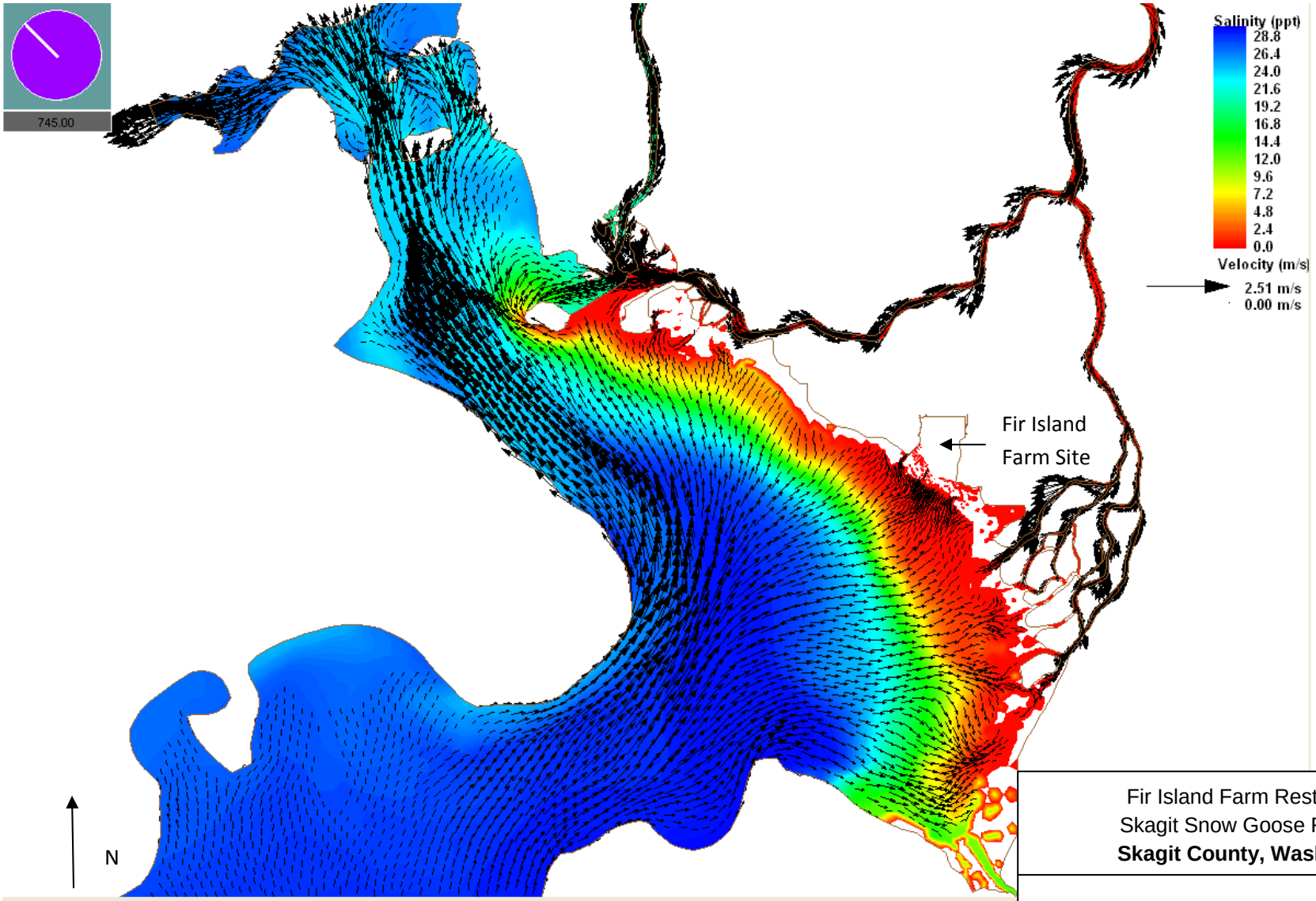
Fig. A-12



Fir Island Farm Restoration
Skagit Snow Goose Reserve
Skagit County, Washington

Battelle, PNNL
Puget Sound 3D Hydrodynamic Model
Flood Tide – Salinity, Velocity
Source: PNNL Memo, April 18, 2011

December 2011 | 21-1-12318-003

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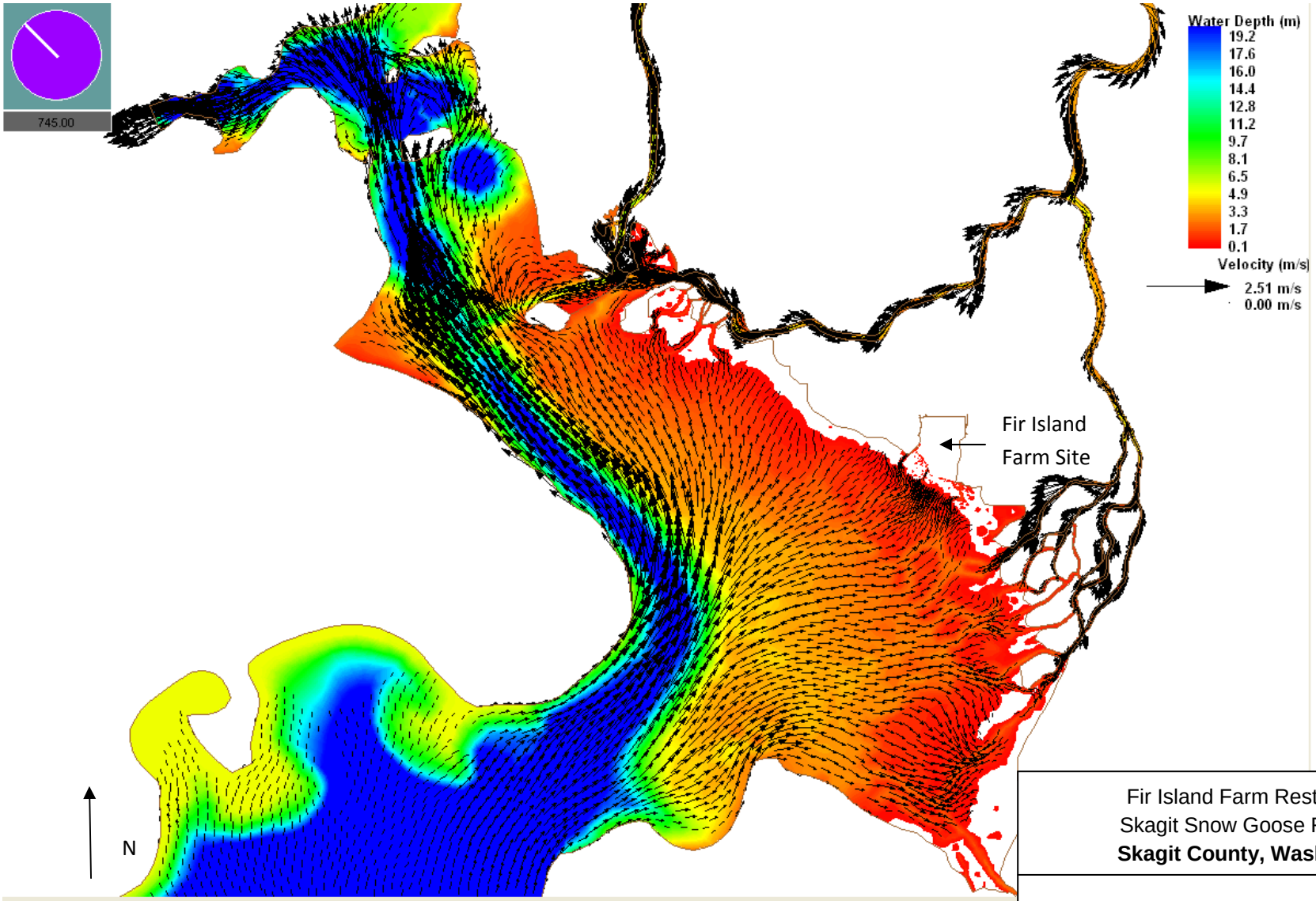
Fig. A-13



Fir Island Farm Restoration
Skagit Snow Goose Reserve
Skagit County, Washington

Battelle, PNNL
Puget Sound 3D Hydrodynamic Model
Flood Tide – Depth, Velocity
Source: PNNL Memo, April 18, 2011

December 2011 | 21-1-12318-003

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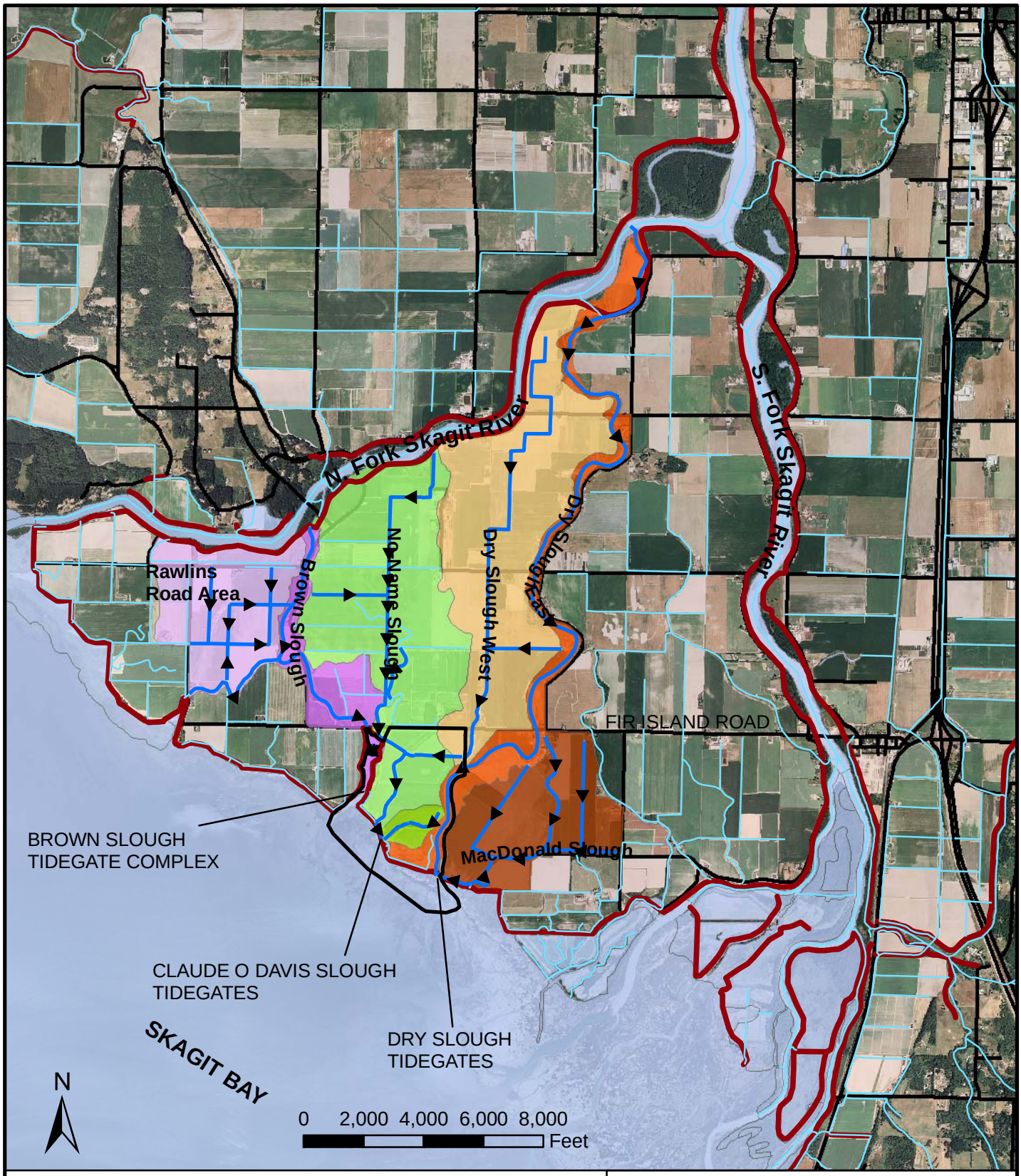
Fig. A-14



PROJECT_FOOTPRINT
FRESH
TIDAL
DIKES
MACDONALD SLOUGH
DRY SLOUGH (EAST)
DRY SLOUGH (WEST)
CLAUDE O' DAVIS SLOUGH
NO NAME SLOUGH
BROWN SLOUGH
RAWLINS ROAD
ROADS
SHORELINE

Fir Island Farm Restoration
Skagit Snow Goose Reserve
Skagit County, Washington

INTERIOR DRAINAGE AREAS

December 2011 21-1-12318-003

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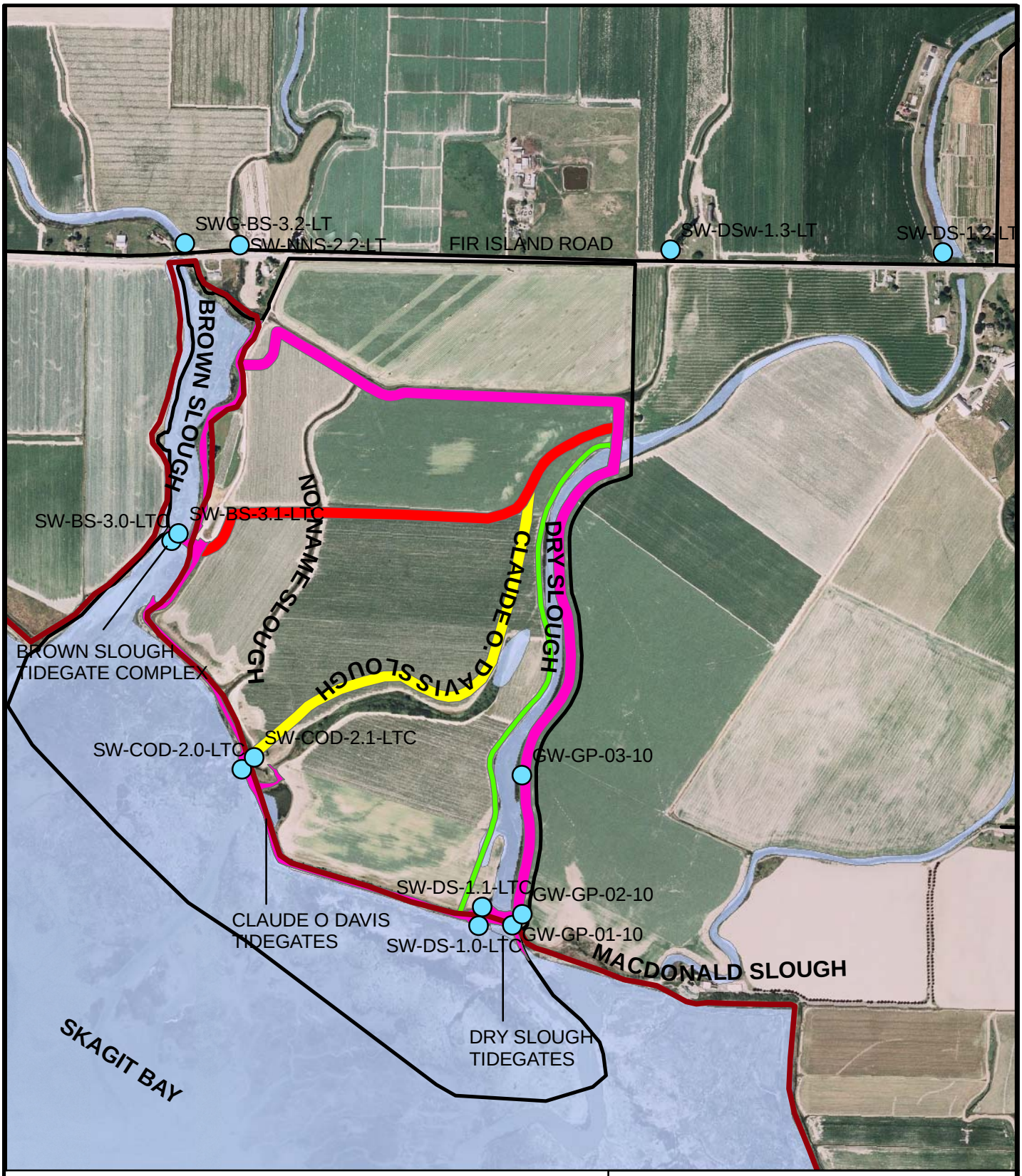
FIG. A-15

Filename: FIG_1_VICINITY_8.5X11P.MXD Date:11/29/11 drc



SW-GW_LOGGERS
DIKES
ROADS
PROJECT_FOOTPRINT
Alt_1
Alt_2
Alt_3
Alt_4

0 500 1,000 1,500 2,000 Feet

N

Fir Island Farm Restoration
Skagit Snow Goose Reserve
Skagit County, Washington

DATA LOGGER LOCATIONS

December 2011 21-1-12318-003

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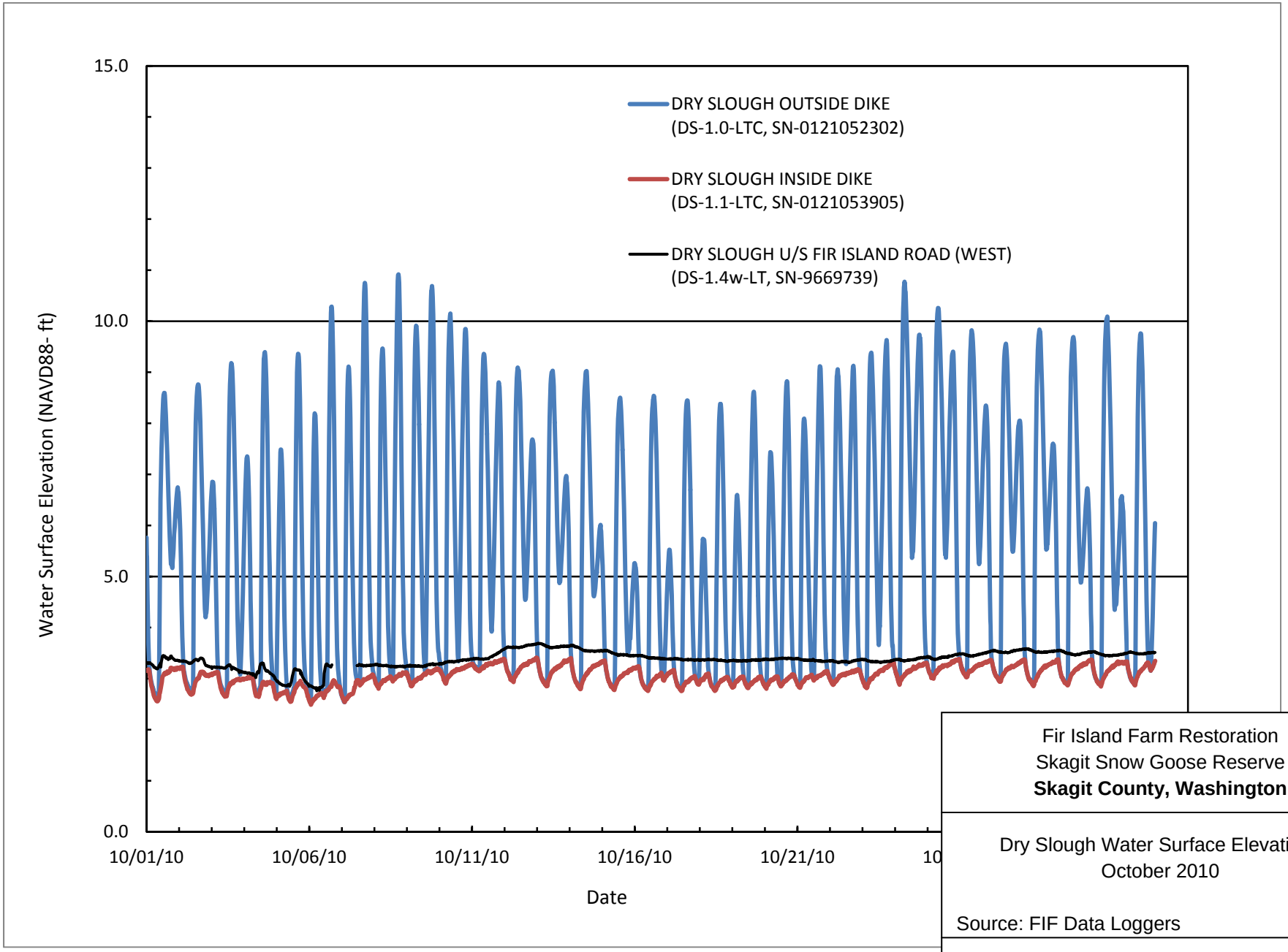
FIG. A-16

Filename: FIG_1_VICINITY_8.5X11P.MXD Date:11/29/11 drc



Fir Island Farm Restoration
Skagit Snow Goose Reserve
Skagit County, Washington

Dry Slough Water Surface Elevations
October 2010

Source: FIF Data Loggers

December 2011 | 21-1-12318-003

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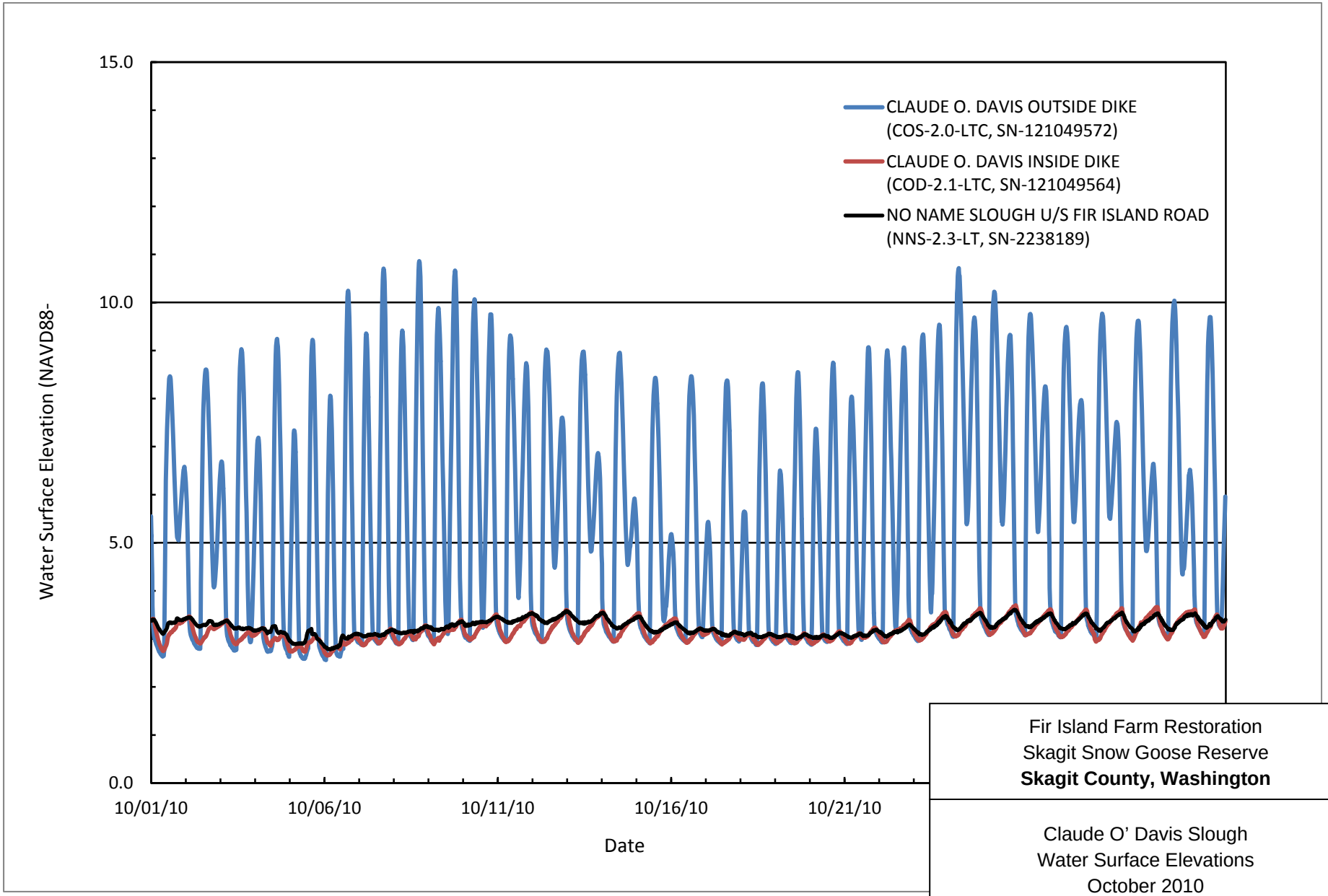
Geotechnical and Environmental Consultants

Fig. A-17



Fir Island Farm Restoration
Skagit Snow Goose Reserve
Skagit County, Washington

Claude O' Davis Slough
Water Surface Elevations
October 2010
Source: FIF Data Loggers

December 2011 | 21-1-12318-003

SHANNON & WILSON, INC
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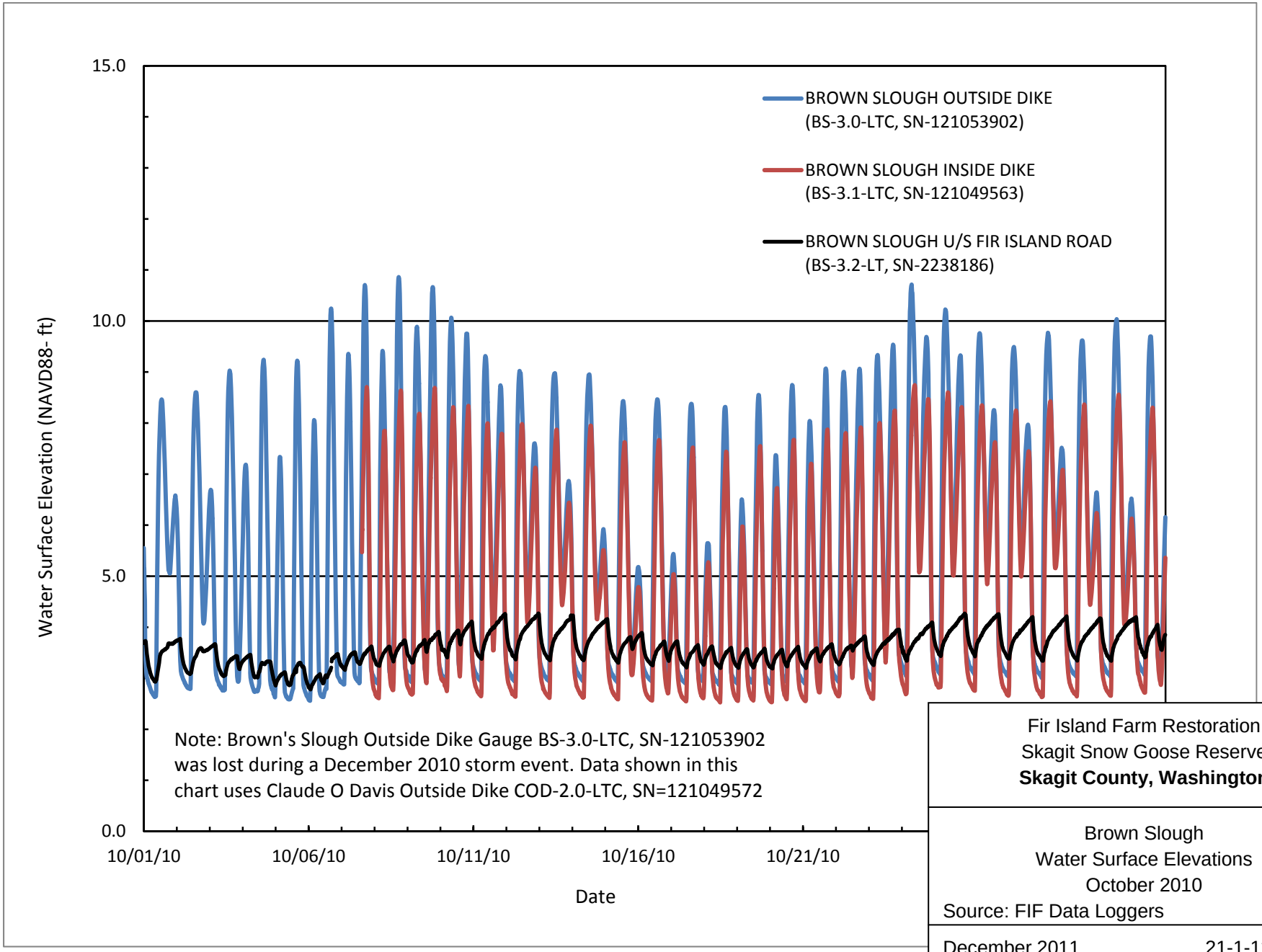
Fig. A-18



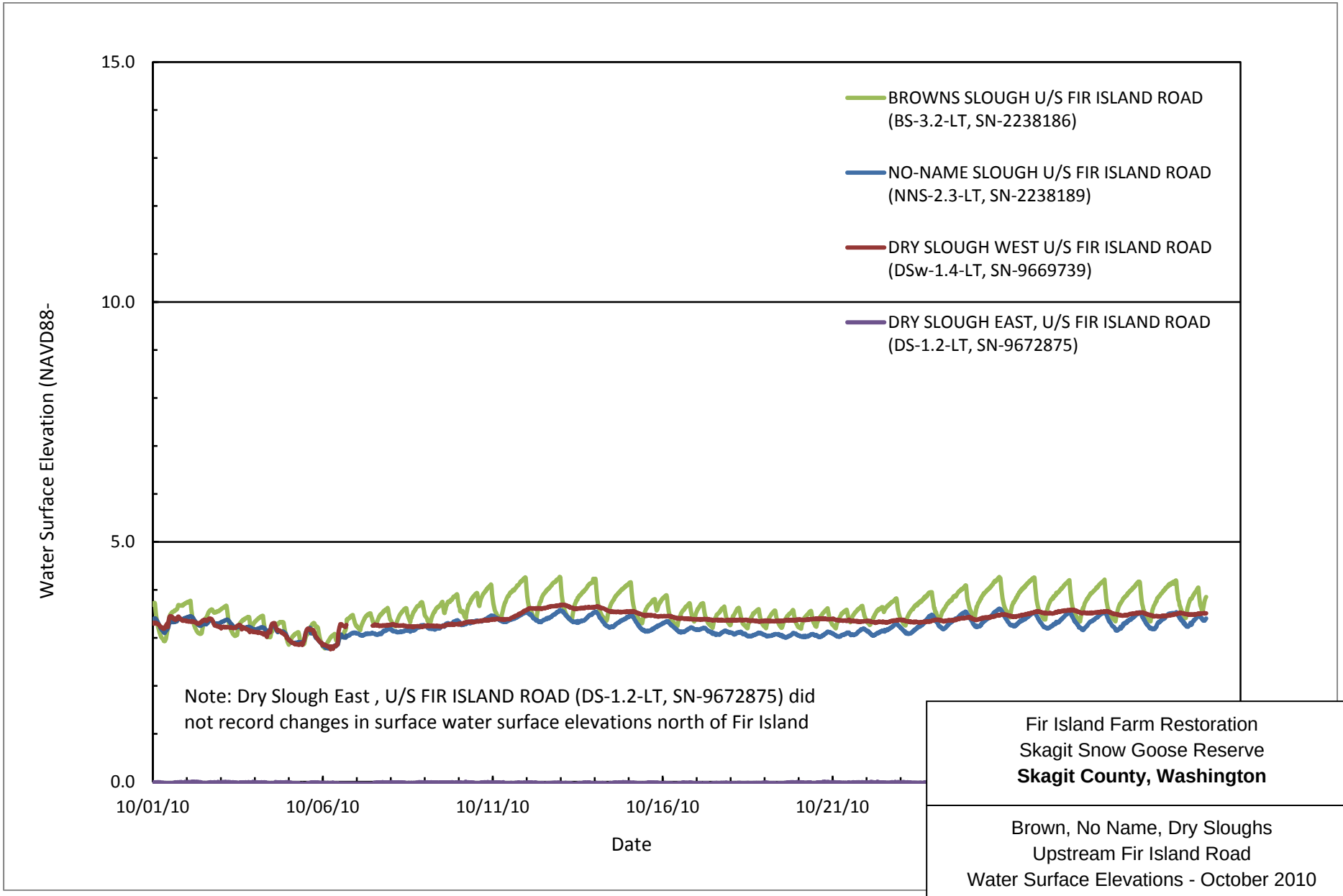
Fir Island Farm Restoration
Skagit Snow Goose Reserve
Skagit County, Washington

Brown Slough
Water Surface Elevations
October 2010
Source: FIF Data Loggers

December 2011 | 21-1-12318-003

SHANNON & WILSON, INC
Geotechnical and Environmental Consultants

Fig. A-19



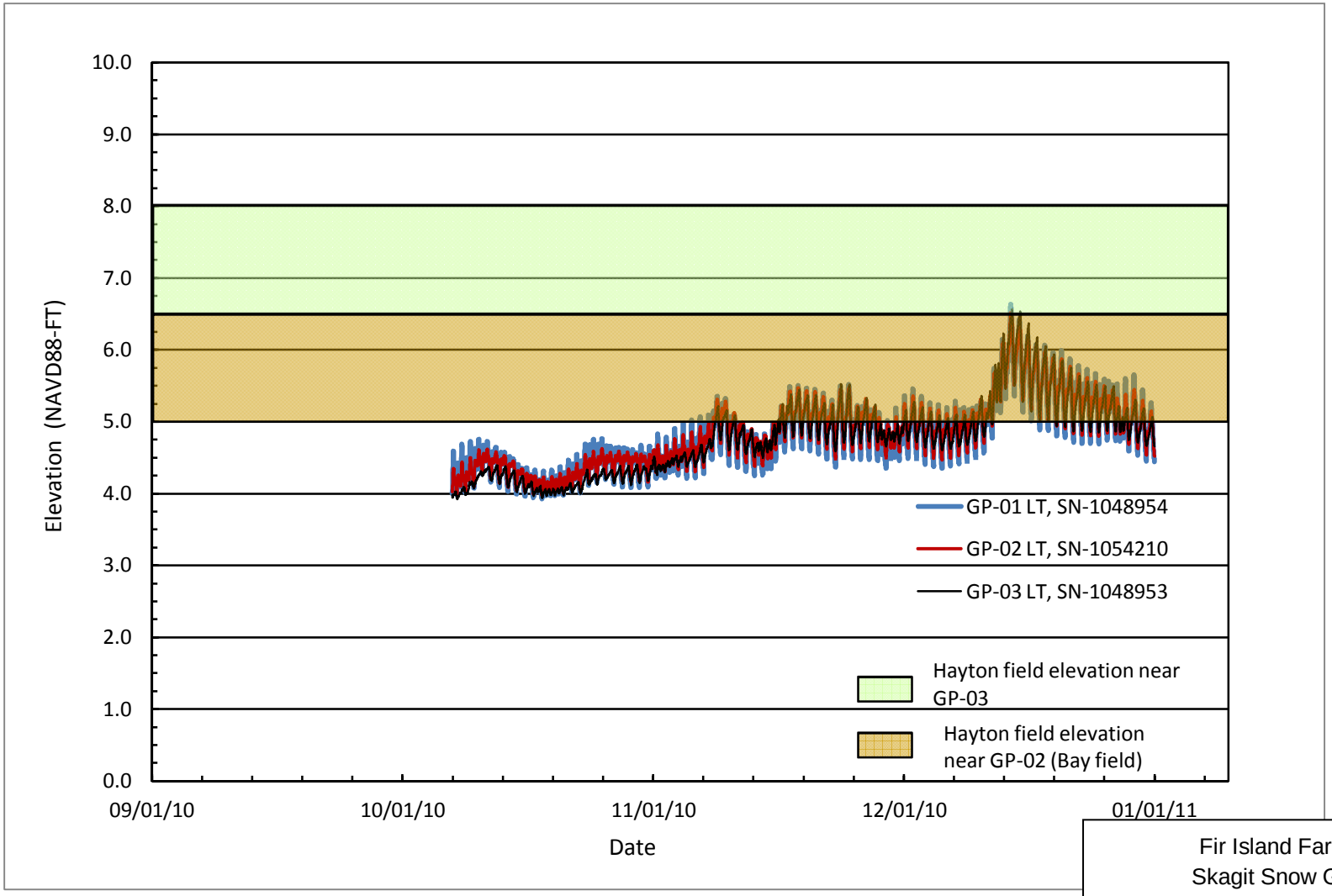
Fir Island Farm Restoration
Skagit Snow Goose Reserve
Skagit County, Washington

Brown, No Name, Dry Sloughs
Upstream Fir Island Road
Water Surface Elevations - October 2010
Source: FIF Data Loggers

December 2011 | 21-1-12318-003

SHANNON & WILSON, INC
Geotechnical and Environmental Consultants

Fig. A-20



Fir Island Farm Restoration
Skagit Snow Goose Reserve
Skagit County, Washington

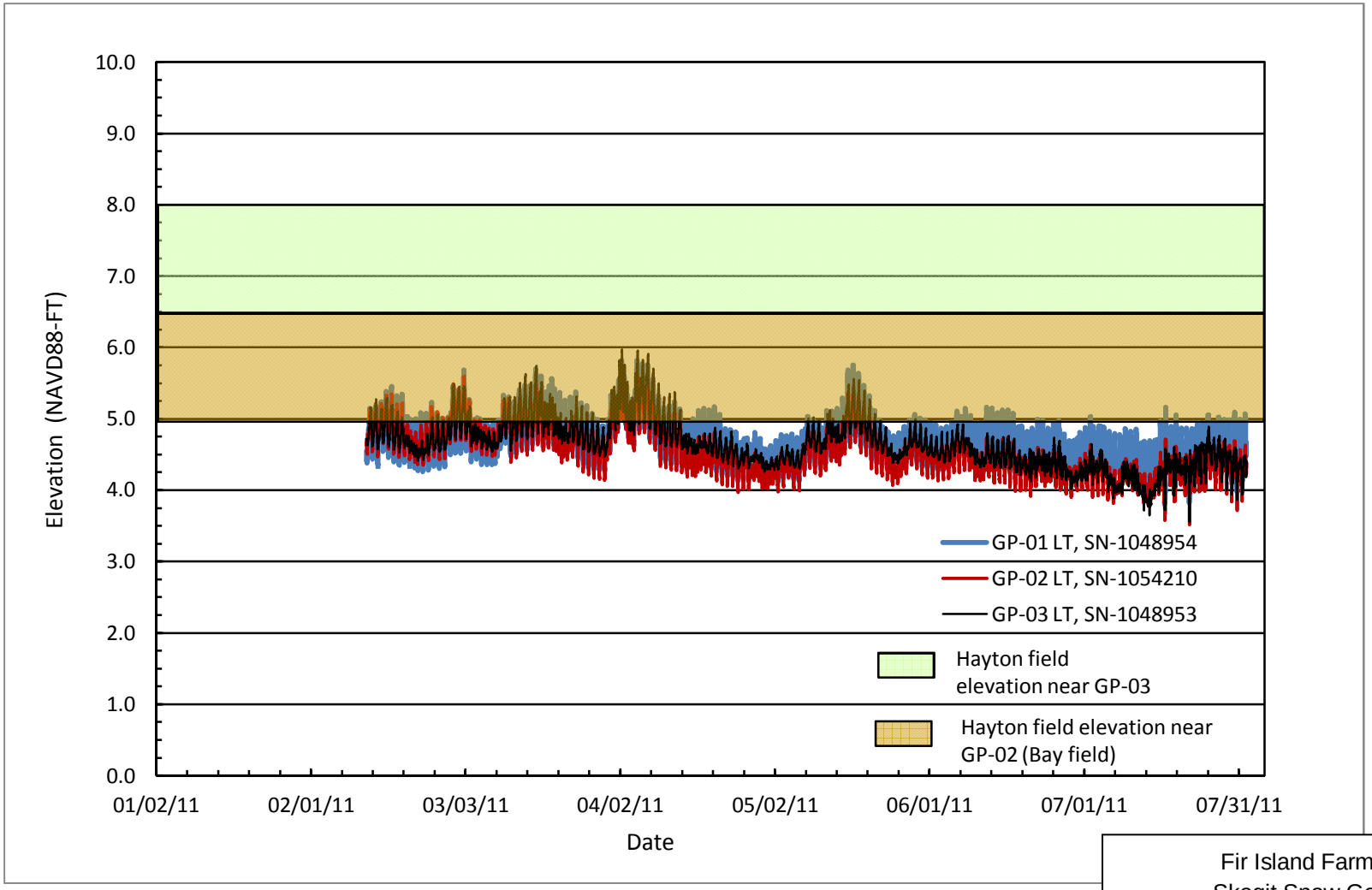
Groundwater Monitoring
Water Elevations – Oct. 2010 – Dec. 2010

Source: FIF Data Loggers

December 2011 | 21-1-12318-003

SHANNON & WILSON, INC
Geotechnical and Environmental Consultants

Fig. A-21



Fir Island Farm Restoration
Skagit Snow Goose Reserve
Skagit County, Washington

Groundwater Monitoring
Water Elevations – Feb. 2011 – July 2011

Source: FIF Data Loggers

December 2011 | 21-1-12318-003

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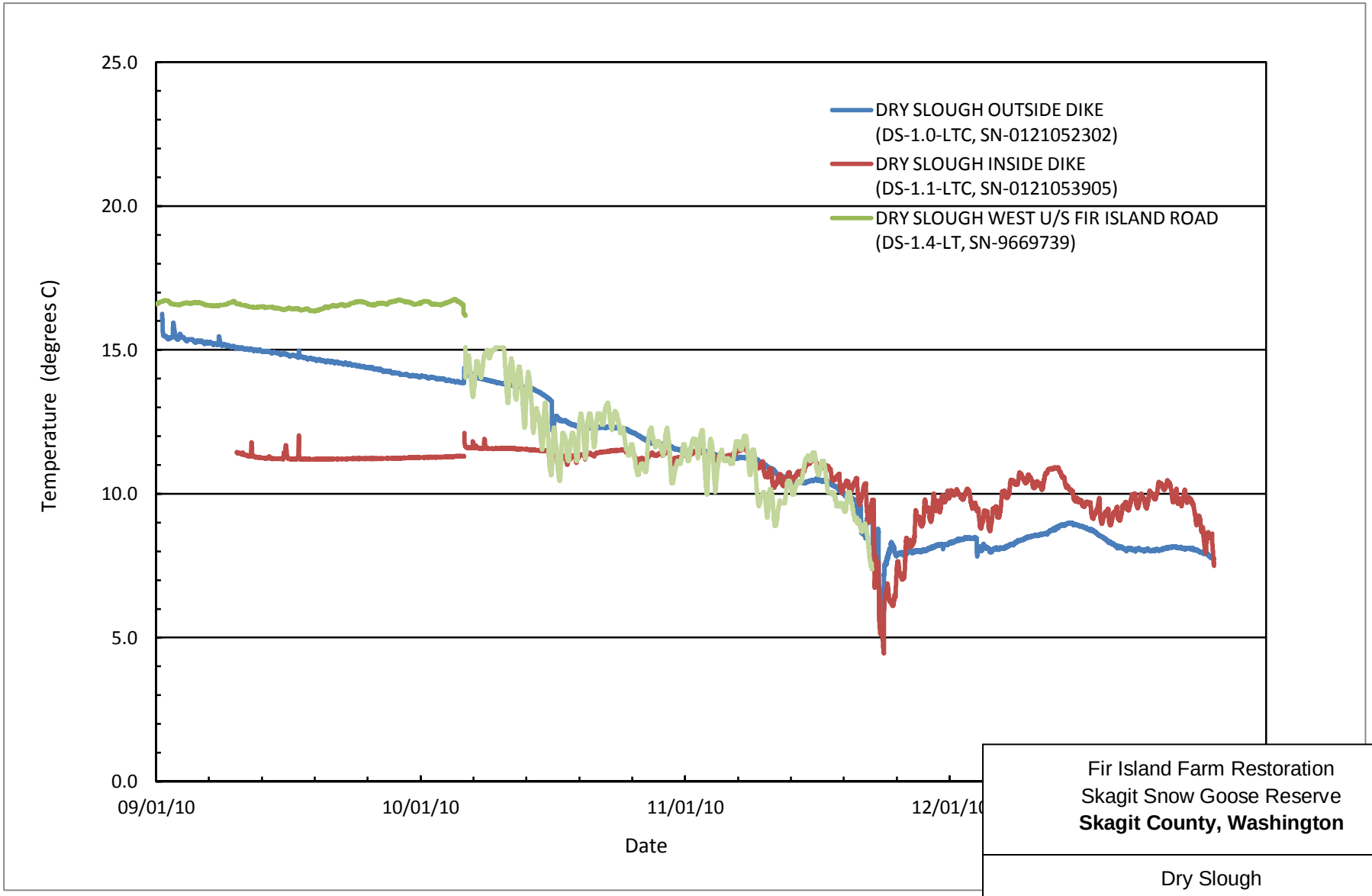
Geotechnical and Environmental Consultants

Fig. A-22



Fir Island Farm Restoration
Skagit Snow Goose Reserve
Skagit County, Washington

Dry Slough
Temperature – Sept. 2010 – Jan. 2011

Source: FIF Data Loggers

December 2011 | 21-1-12318-003

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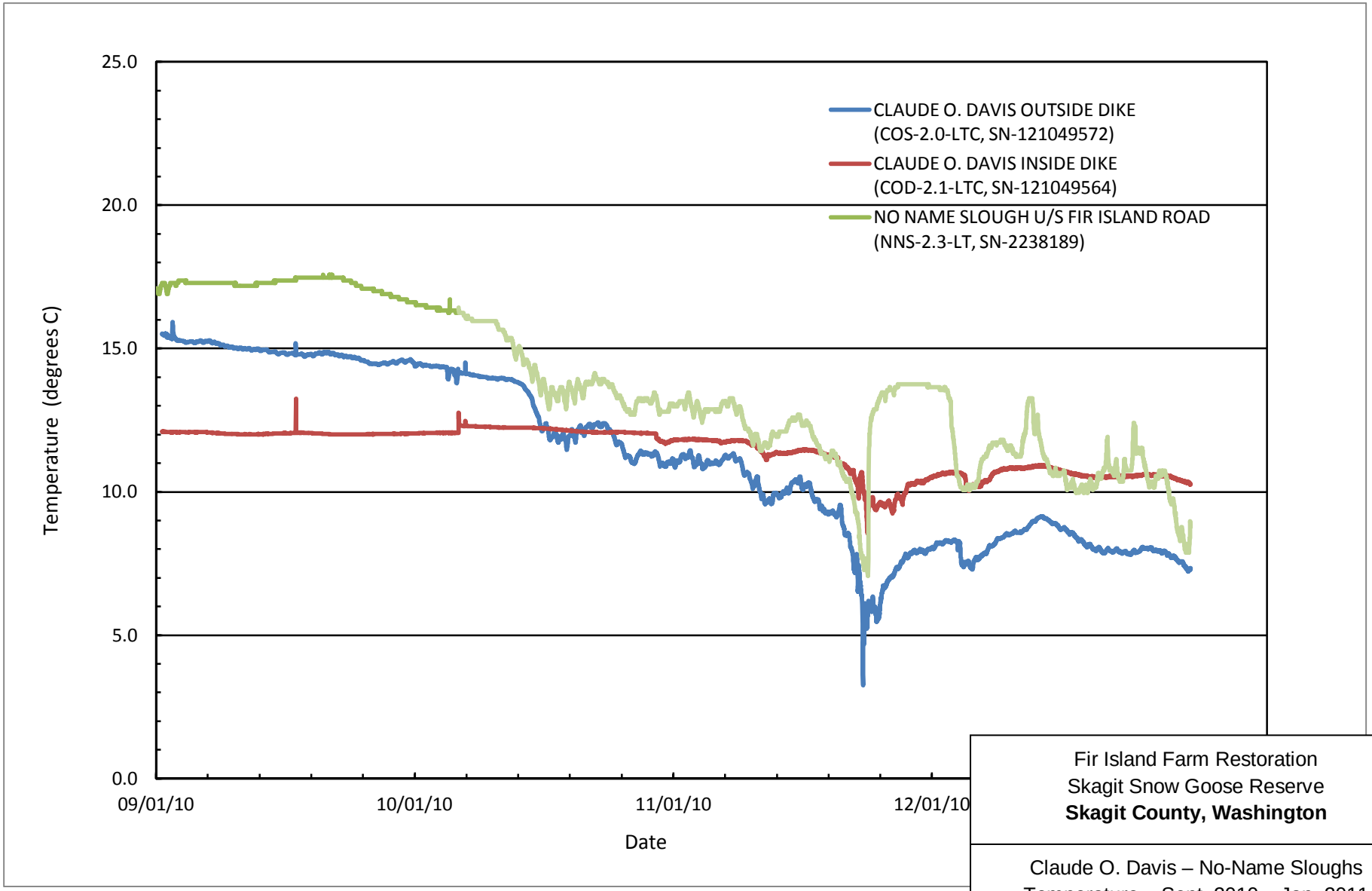
Geotechnical and Environmental Consultants

Fig. A-23



Fir Island Farm Restoration
Skagit Snow Goose Reserve
Skagit County, Washington

Claude O. Davis – No-Name Sloughs
Temperature – Sept. 2010 – Jan. 2011

Source: FIF Data Loggers

December 2011 | 21-1-12318-003

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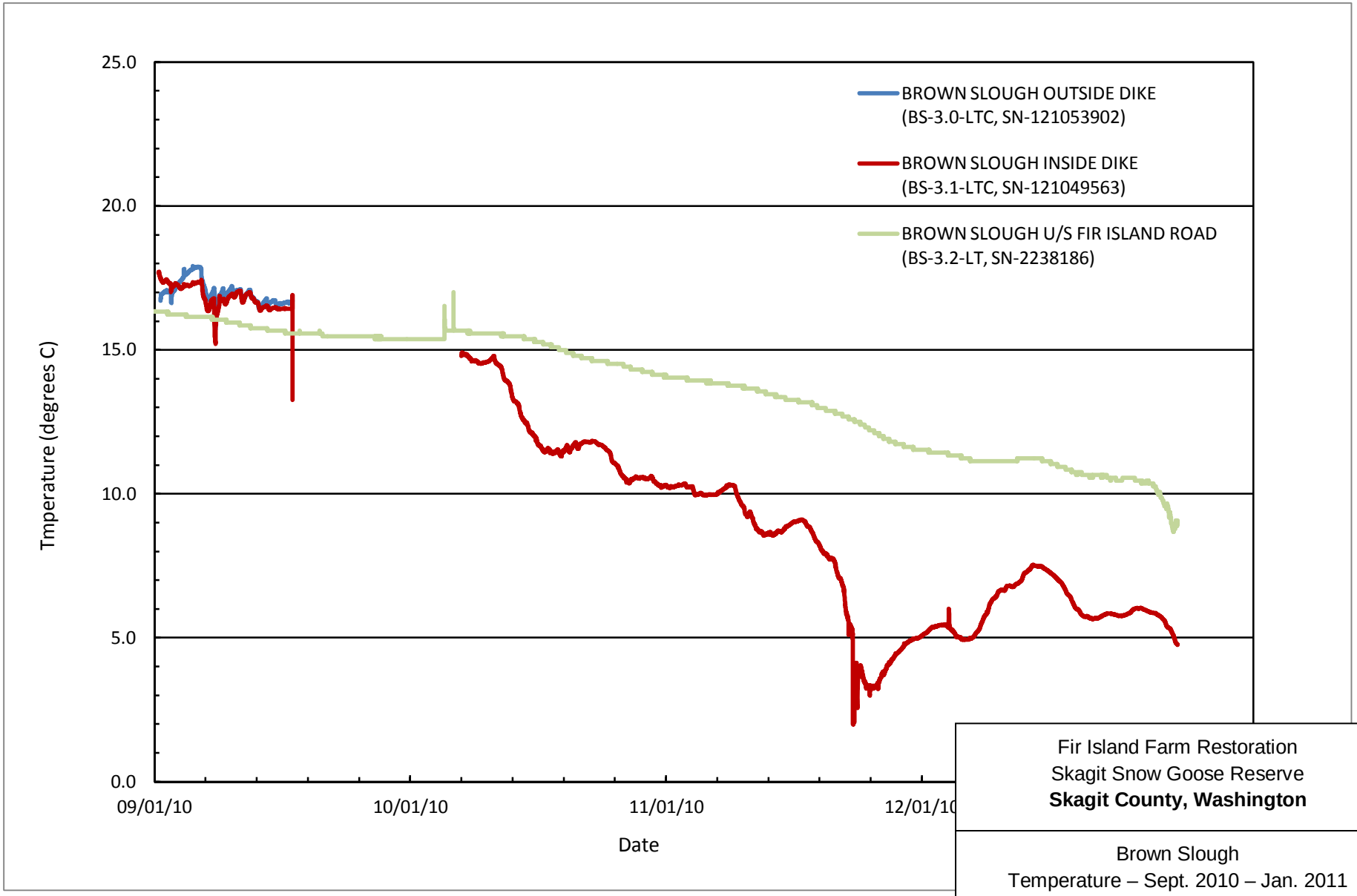
Geotechnical and Environmental Consultants

Fig. A-24



Fir Island Farm Restoration
Skagit Snow Goose Reserve
Skagit County, Washington

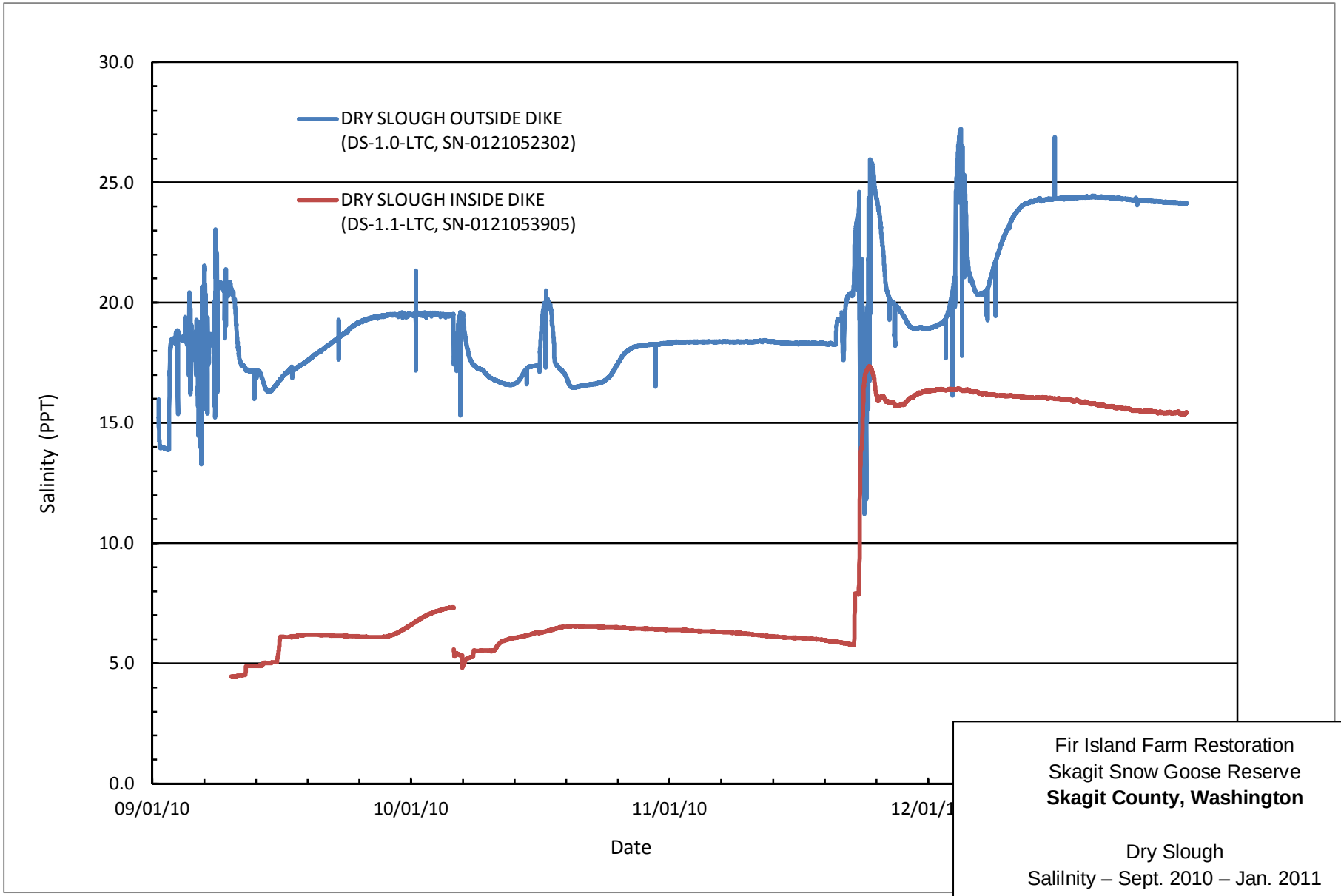
Brown Slough
Temperature – Sept. 2010 – Jan. 2011

Source: FIF Data Loggers

December 2011 | 21-1-12318-003

SHANNON & WILSON, INC
Geotechnical and Environmental Consultants

Fig. A-25

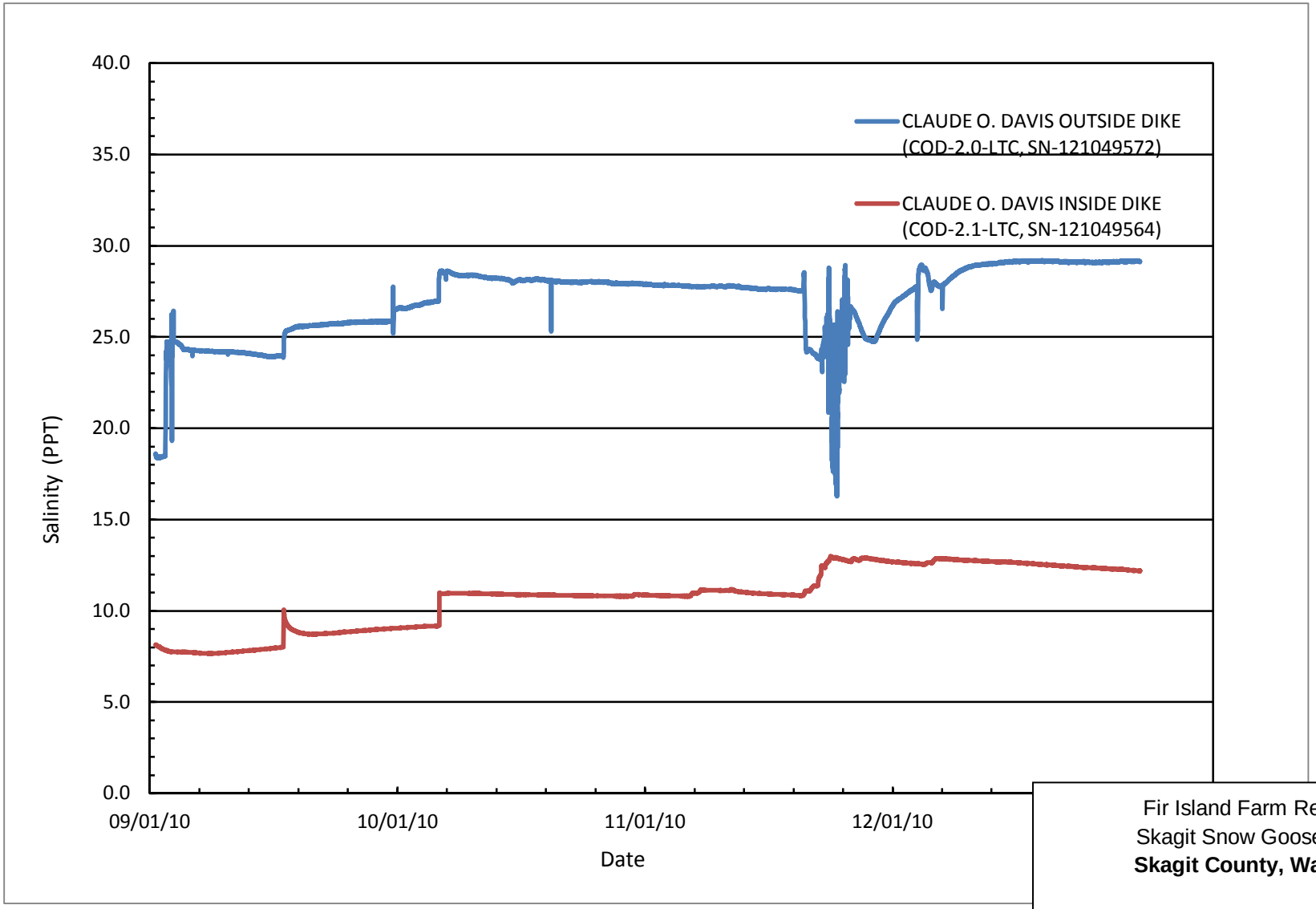


Fir Island Farm Restoration
Skagit Snow Goose Reserve
Skagit County, Washington

Dry Slough
Salilnity – Sept. 2010 – Jan. 2011

Source: FIF Data Loggers

December 2011	21-1-12318-003
SHANNON & WILSON, INC Geotechnical and Environmental Consultants	Fig. A-26

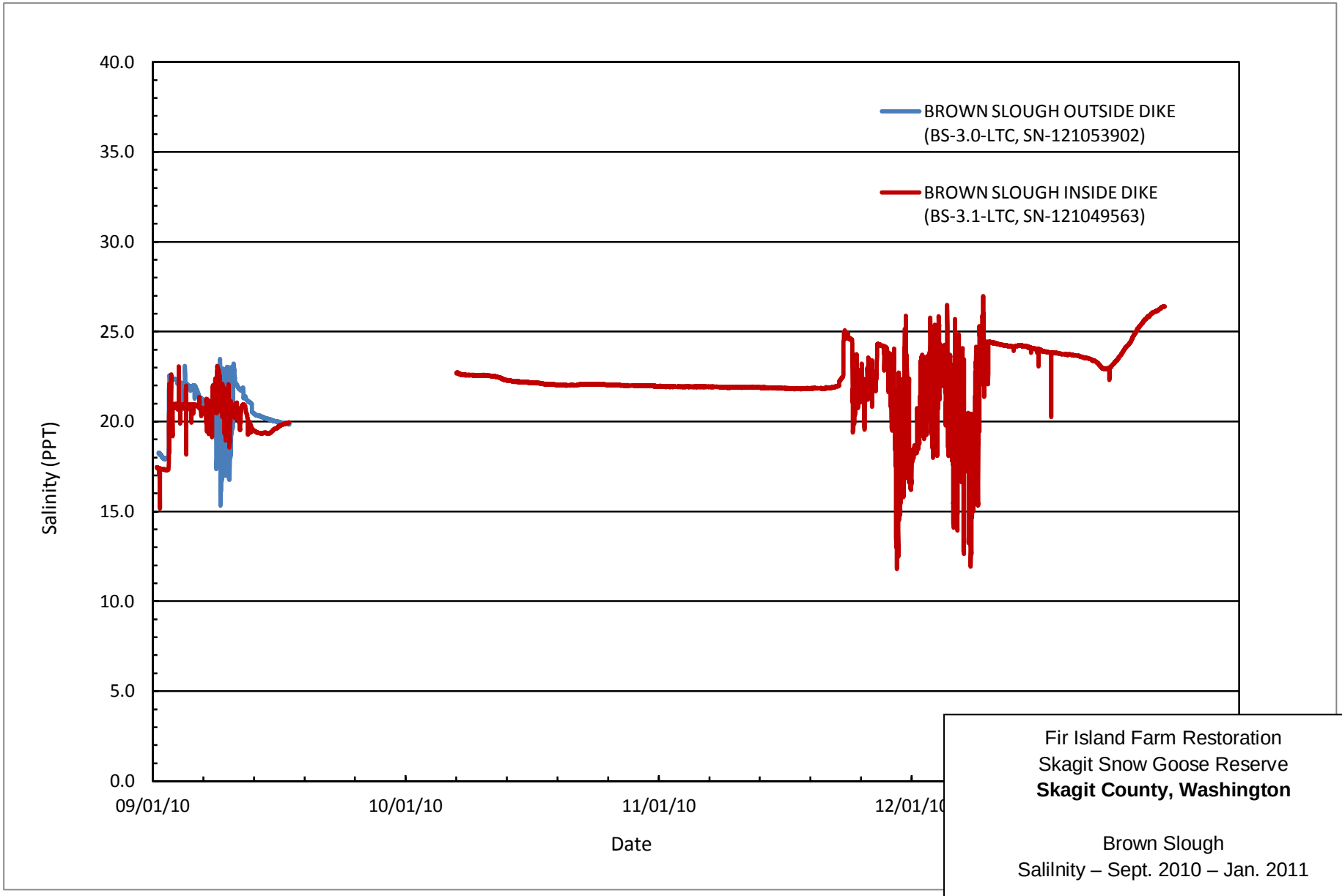


Fir Island Farm Restoration
Skagit Snow Goose Reserve
Skagit County, Washington

Claude O. Davis – No-Name Sloughs
Salilnity – Sept. 2010 – Jan. 2011

Source: FIF Data Loggers

December 2011	21-1-12318-003
SHANNON & WILSON, INC Geotechnical and Environmental Consultants	Fig. A-27

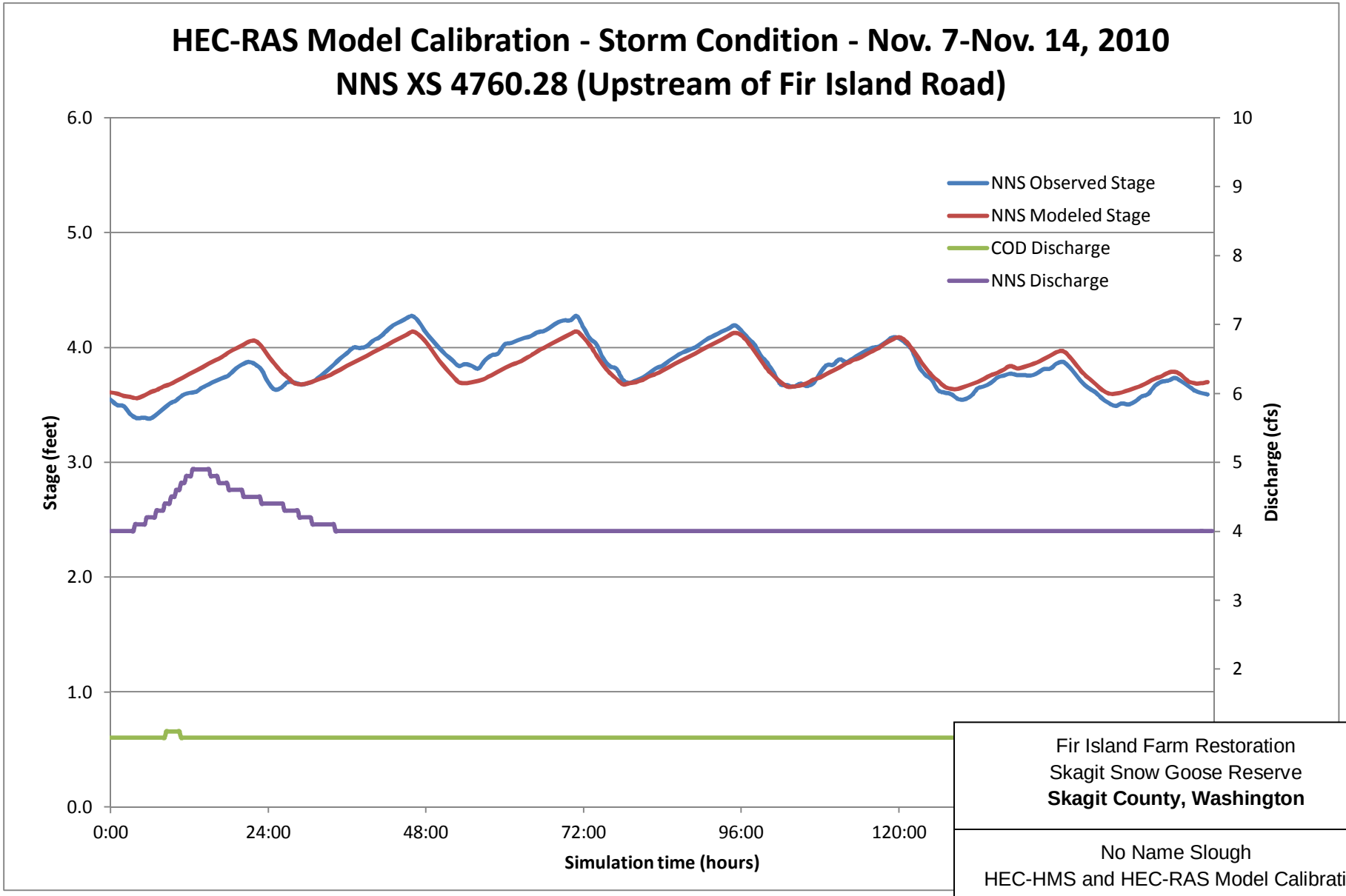


Fir Island Farm Restoration
Skagit Snow Goose Reserve
Skagit County, Washington

Brown Slough
Salilnity – Sept. 2010 – Jan. 2011

Source: FIF Data Loggers

December 2011	21-1-12318-003
SHANNON & WILSON, INC Geotechnical and Environmental Consultants	Fig. A-28



Fir Island Farm Restoration
Skagit Snow Goose Reserve
Skagit County, Washington

No Name Slough
HEC-HMS and HEC-RAS Model Calibration

Source: FIF Data Loggers/HEC-RAS Model

December 2011 | 21-1-12318-003

SHANNON & WILSON, INC
Geotechnical and Environmental Consultants

Fig. A-29

Legend

- Data Plot
- Farmed Potential Wetland

Cowardin Classifications

- Palustrine Unconsolidated Bottom (PUB)
- Palustrine Emergent (PEM)
- Palustrine Scrub-Shrub (PSS)
- Estuarine Subtidal Unconsolidated Shore (E1US)
- Estuarine Intertidal Unconsolidated Shore (E2US)
- Estuarine Intertidal Emergent (E2EM)

NOTE

Wetland boundaries are approximated through information gathered from an on-site field reconnaissance, aerial photograph interpolation, and light detection and ranging (LiDAR) elevation data. A formal wetland delineation is recommended to support permit documents.

N W E S

0 250 500 1,000 Feet

Fir Island Farm Restoration
Skagit County, Washington

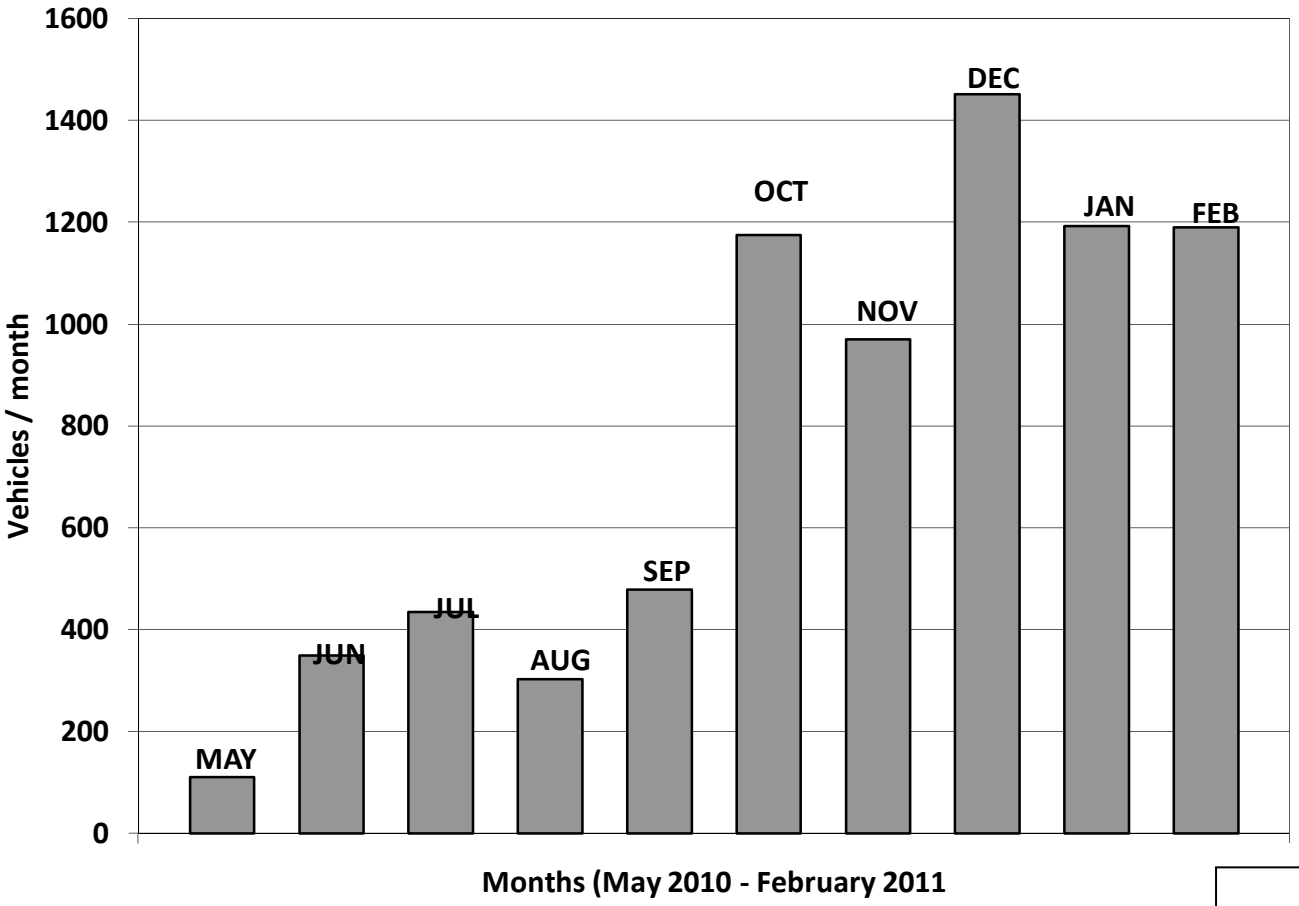
FIR ISLAND FARM BASELINE WETLAND RECONNAISSANCE

December 2011 21-1-12318-001

SHANNON & WILSON, INC. GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

FIG. A-30

Filename: T:\Project\21-2\16470_Fir_Island\AV_mxd\Wetland_Delineation.mxd Date: 12/29/11 ADH



Fir Island Farm Restoration
Skagit Snow Goose Reserve
Skagit County, Washington

Fir Island Farm Vehicle Count

Source: WDFW Traffic Counter 2010 - 2011

December 2011 | 21-1-12318-003

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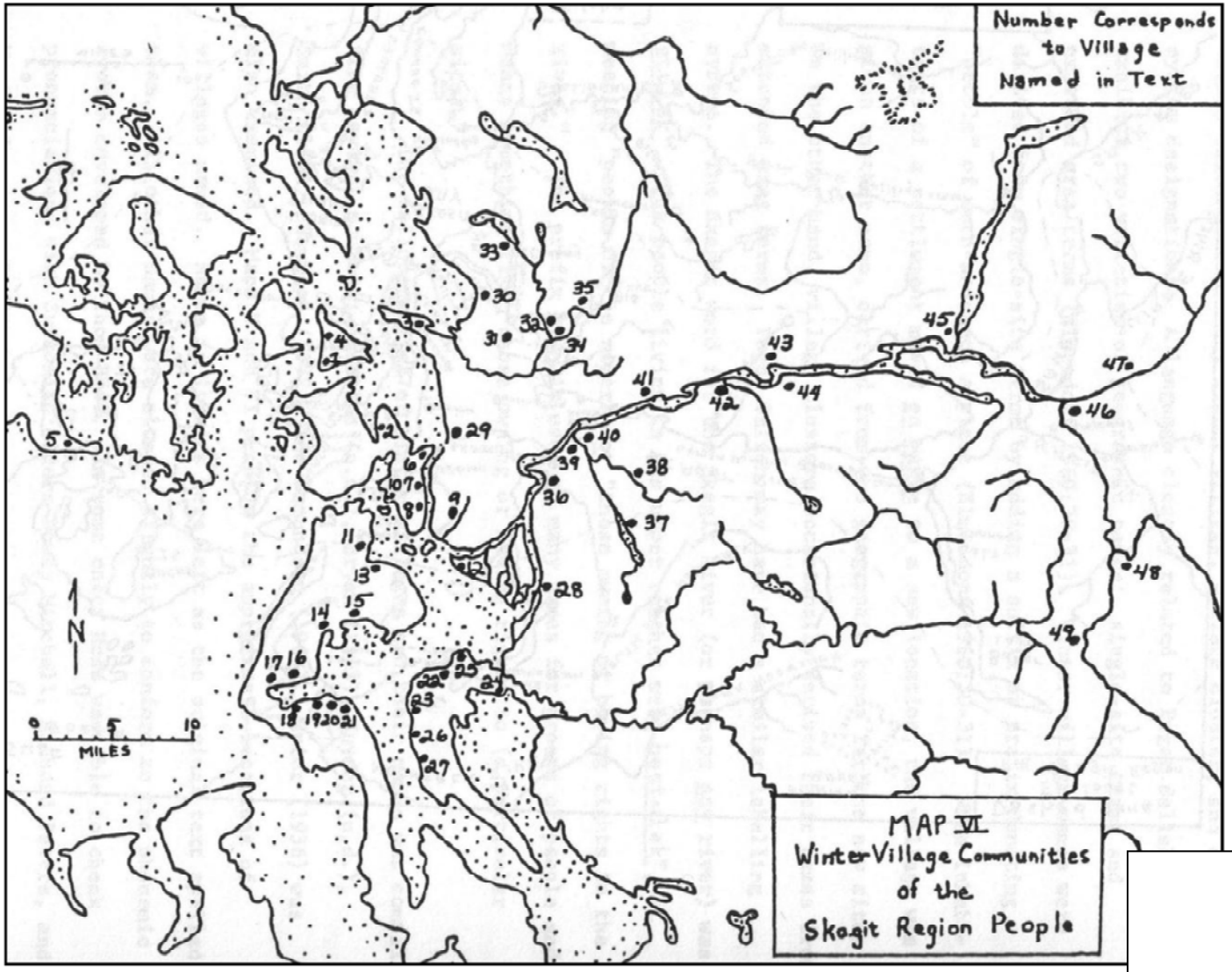
Fig. A-31



Fir Island Farm Restoration
Skagit Snow Goose Reserve
Skagit County, Washington

Skagit Native Village Map

Source: Roberts, 1975:48

December 2011 | 21-1-12318-003

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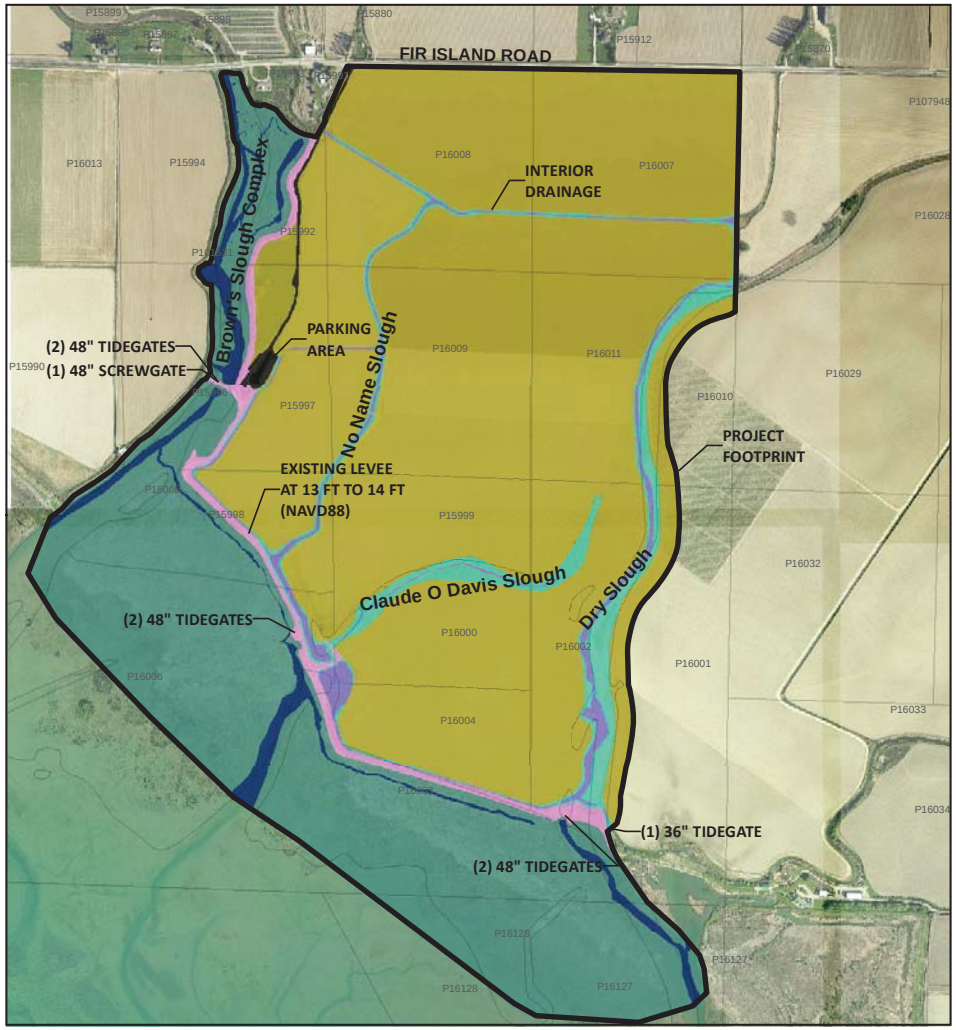
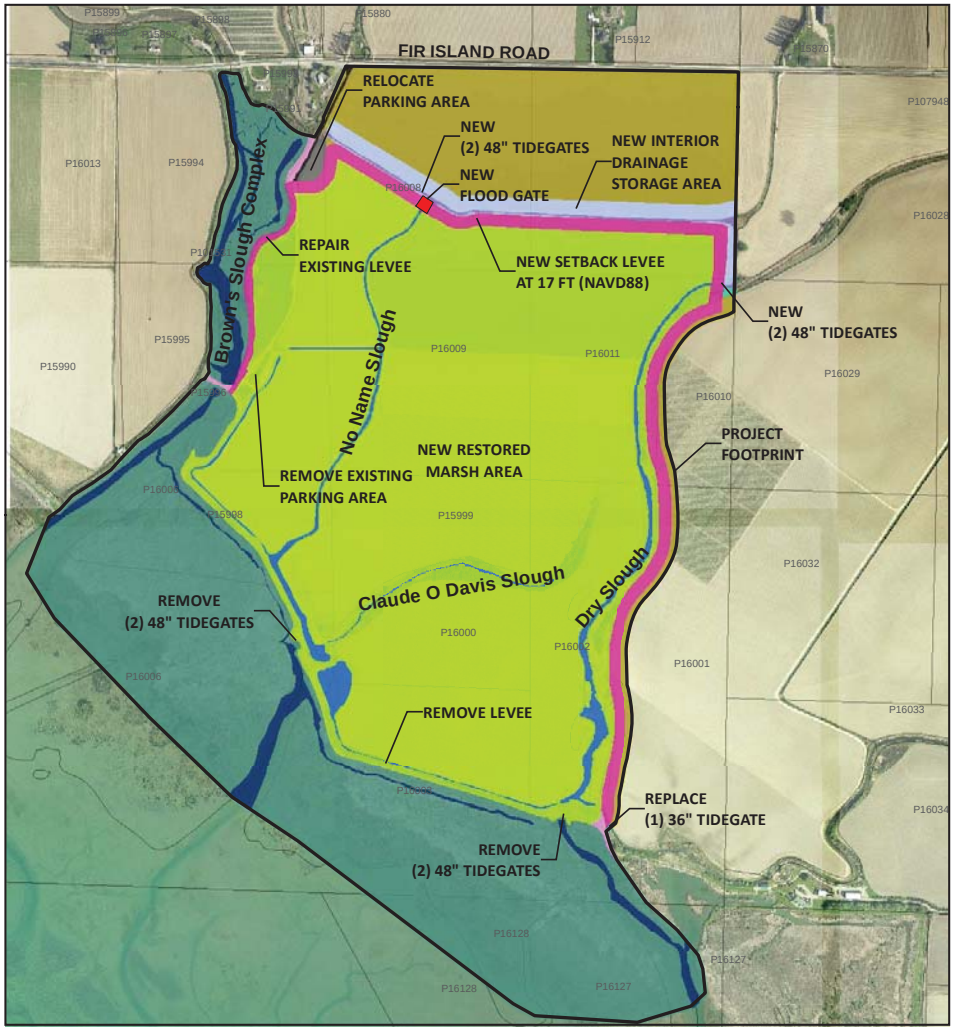
Fig. A-32





Alternative 0	Project Element	Map Symbol	Existing Area (ac)
	Levee		7.7
	Habitat Channels		10.3
	Drainage		8.0
	Tidal Marsh		122.1
	Freshwater Wetland		15.1
	Farm		250.1
	Roads		1.6

Note: Net change in drainage channel is always zero. New drainage will also function as freshwater wetland. This includes losses of drainage channels to habitat channel, for which new interior drainage channels are built in kind to offset the loss.

0 400 800
Scale in Feet

N W E S

State Plane Washington
North 4601 NAD83/NAVD88

Alternative 1	Project Element	Map Symbol Existing	Map Symbol New	Area (ac) Existing	Area (ac) Net Change	Area (ac) Total
	Levee			7.7	7.7	15.4
	Habitat Channels			10.3	6.9	17.2
	Drainage			8.0	-	8.0
	Tidal Marsh			122.1	202.5	324.7
	Freshwater Wetland		NONE	15.1	(14.9)	0.1
	Farm		NONE	250.1	(201.5)	48.6
	Roads			1.6	(0.6)	1.0

Fir Island Farm Restoration
Skagit Snow Goose Preserve
Skagit County, Washington

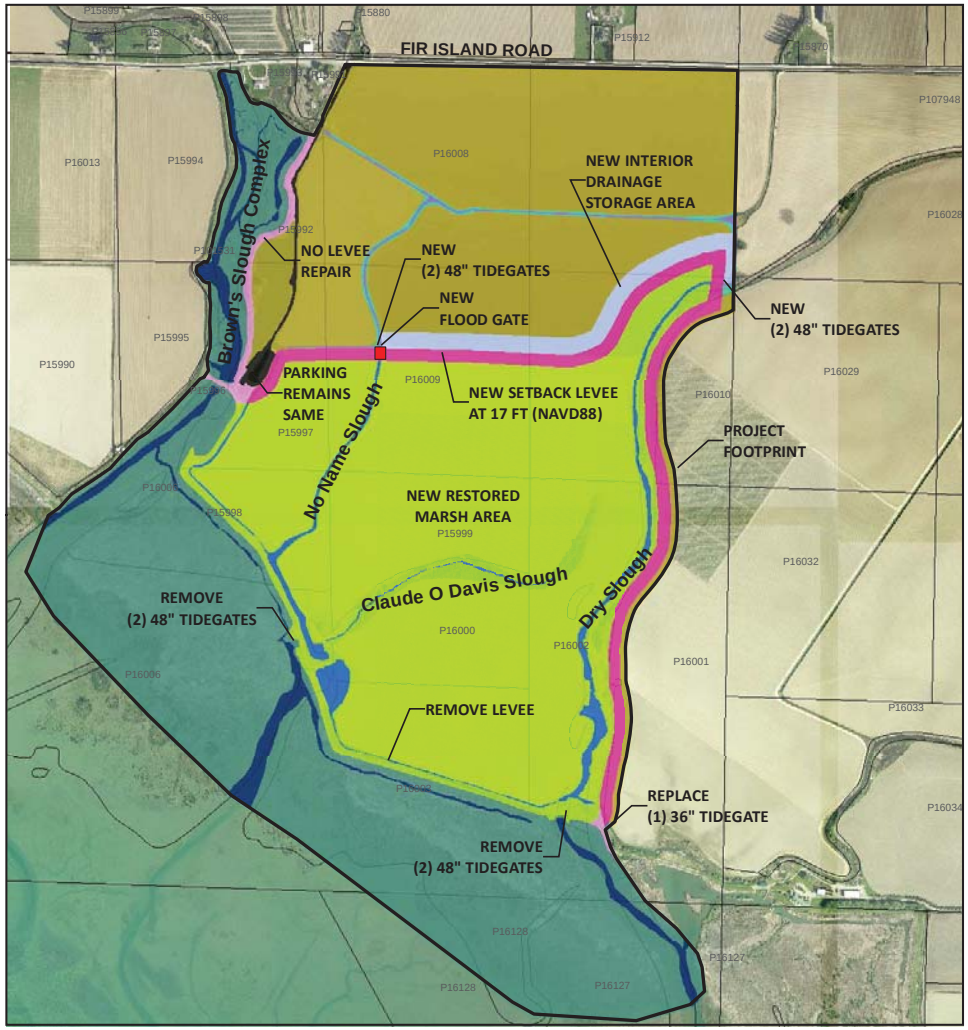
EXISTING CONDITIONS (ALT 0) & ALTERNATIVE 1

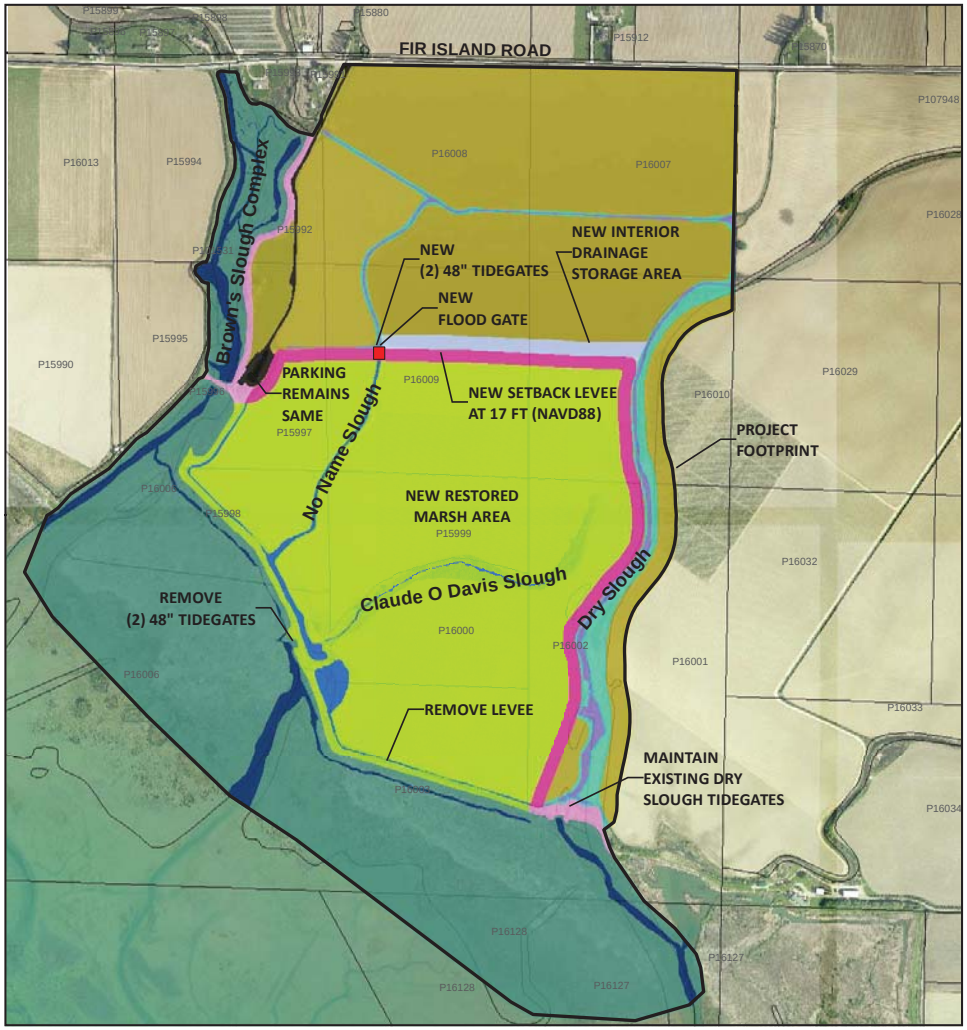
December 2011 21-1-12318-002

SHANNON & WILSON, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

FIG. A-33

Filename: I:\WIP\21-1\12318 FIR ISLAND\GIS\MXD\FIF_ALTS_0-1_050411.mxd Date: 12/29/2011 adh





Alternative 2

Project Element	Map Symbol Existing	Map Symbol New	Area (ac) Existing	Area (ac) Net Change	Area (ac) Total
Levee			7.7	8.4	16.1
Habitat Channels			10.3	6.3	16.6
Drainage			8.0	-	8.0
Tidal Marsh			122.1	145.0	267.1
Freshwater Wetland		NONE	15.1	(13.6)	1.5
Farm		NONE	250.1	(146.0)	104.1
Roads		NONE	1.6	-	1.6

State Plane Washington
North 4601 NAD83/NAVD88

0 400 800
Scale in Feet

N W E S

Note: Net change in drainage channel is always zero. New drainage will also function as freshwater wetland. This includes losses of drainage channels to habitat channel, for which new interior drainage channels are built in kind to offset the loss.

Alternative 2A

Project Element	Map Symbol Existing	Map Symbol New	Area (ac) Existing	Area (ac) Net Change	Area (ac) Total
Levee			7.7	6.2	13.9
Habitat Channels			10.3	3.4	13.7
Drainage			8.0	-	8.0
Tidal Marsh			122.1	126.6	248.7
Freshwater Wetland		NONE	15.1	(6.2)	8.9
Farm		NONE	250.1	(130.0)	120.1
Roads		NONE	1.6	-	1.6

Fir Island Farm Restoration
Skagit Snow Goose Preserve
Skagit County, Washington

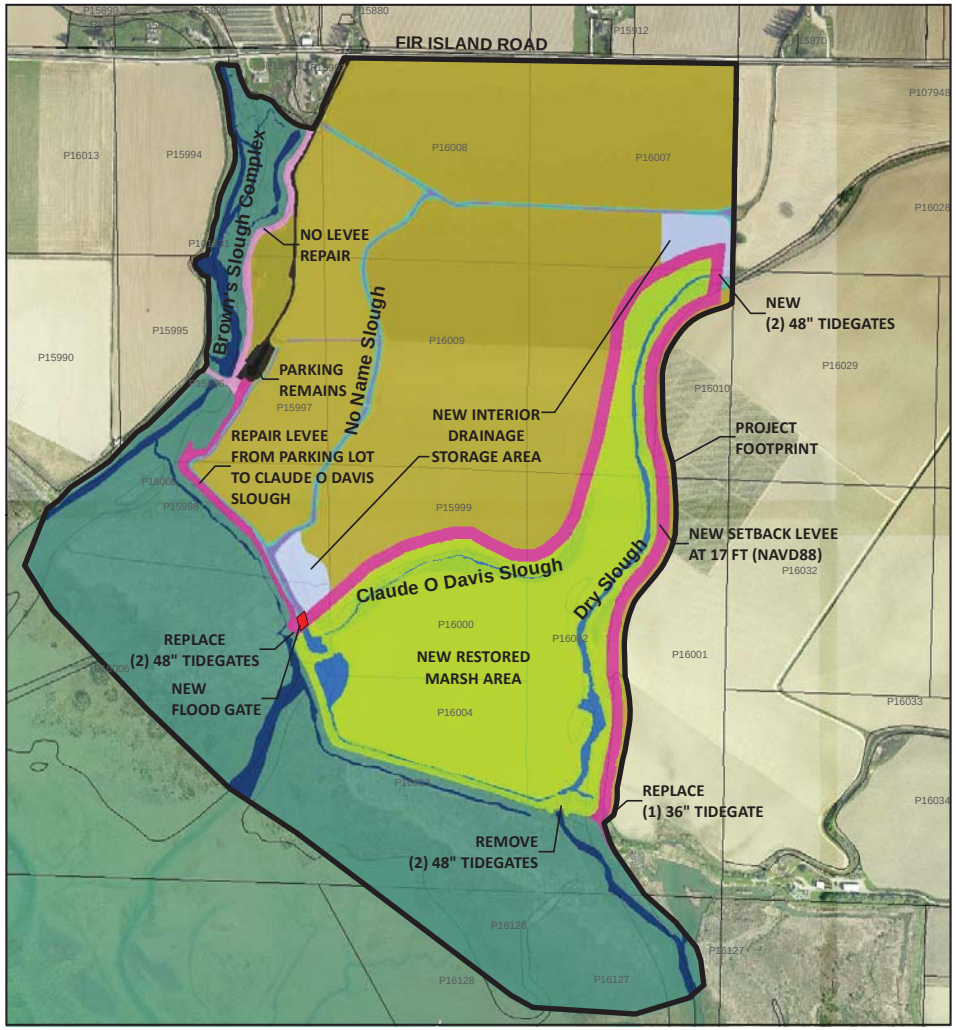
ALTERNATIVES 2 & 2A

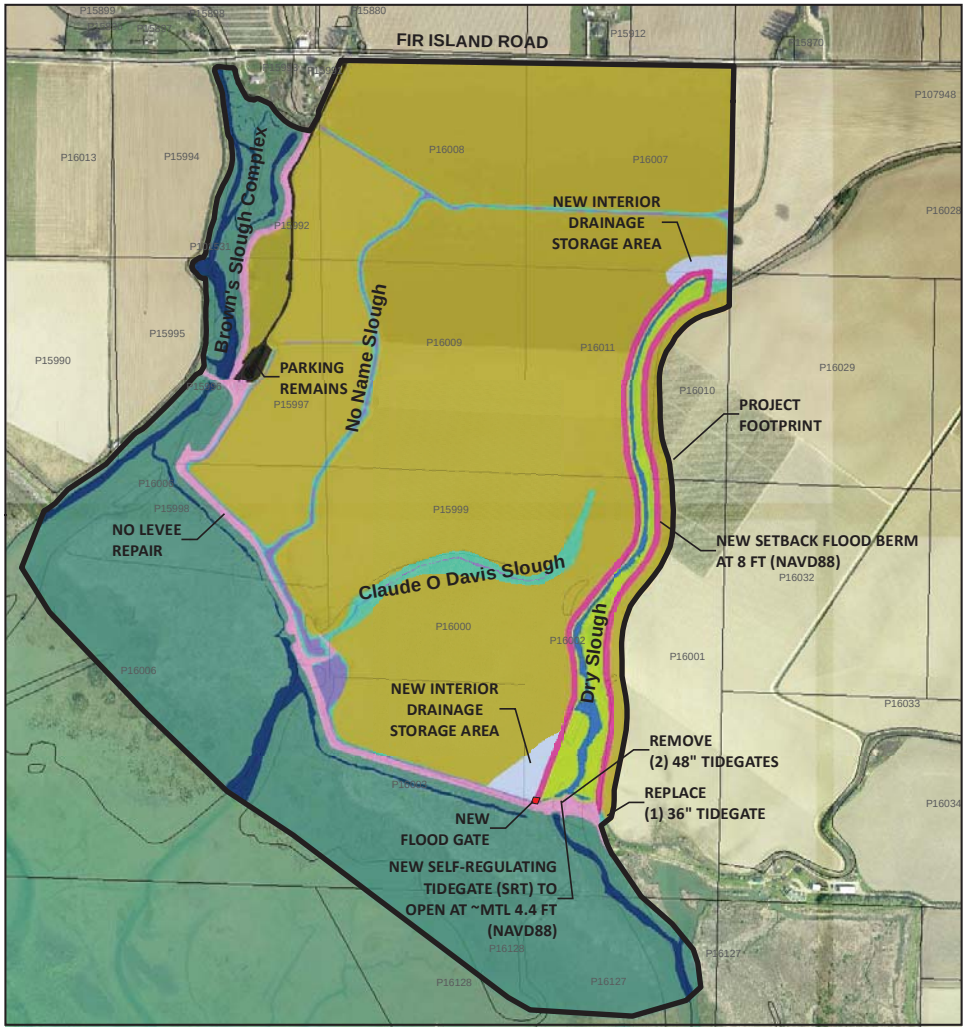
December 2011 21-1-12318-002

SHANNON & WILSON, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

FIG. A-34

Filename: I:\WIP\21-1\12318 FIR ISLAND\GIS\MXD\FIF_ALTS_2-2A_050411.mxd Date: 12/29/2011 adh





Alternative 3

Project Element	Map Symbol Existing	Map Symbol New	Area (ac) Existing	Area (ac) Net Change	Area (ac) Total
Levee			7.7	11.7	19.4
Habitat Channels			10.3	4.8	15.1
Drainage			8.0	-	8.0
Tidal Marsh			122.1	72.3	194.4
Freshwater Wetland		NONE	15.1	(12.4)	2.7
Farm		NONE	250.1	(76.3)	173.8
Roads		NONE	1.6	-	1.6

State Plane Washington
North 4601 NAD83/NAVD88

0 400 800
Scale in Feet

N W E S

Note: Net change in drainage channel is always zero. New drainage will also function as freshwater wetland. This includes losses of drainage channels to habitat channel, for which new interior drainage channels are built in kind to offset the loss.

Alternative 4

Project Element	Map Symbol Existing	Map Symbol New	Area (ac) Existing	Area (ac) Net Change	Area (ac) Total
Levee			7.7	7.0	14.7
Habitat Channels			10.3	2.8	13.1
Drainage			8.0	-	8.0
Tidal Marsh			122.1	8.8	130.9
Freshwater Wetland		NONE	15.1	(7.3)	7.7
Farm		NONE	250.1	(11.3)	238.8
Roads		NONE	1.6	-	1.6

Fir Island Farm Restoration
Skagit Snow Goose Preserve
Skagit County, Washington

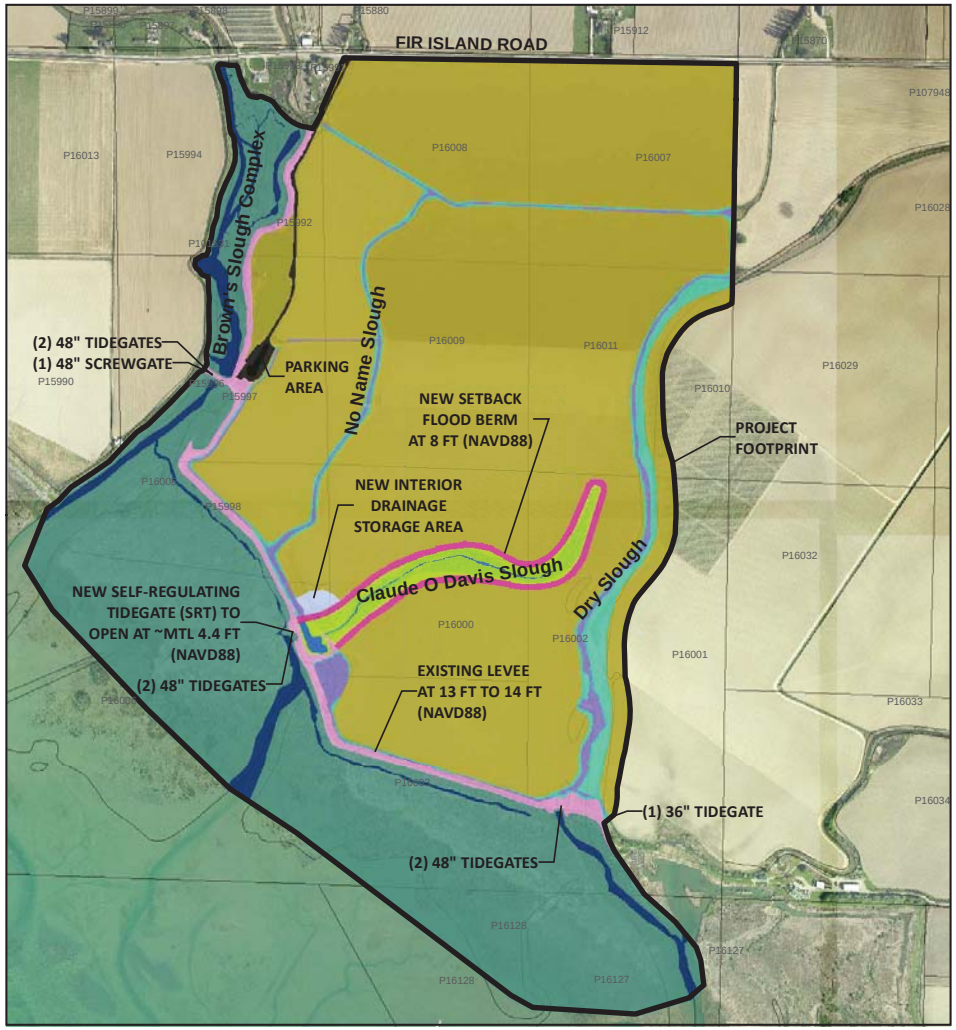
ALTERNATIVES 3 & 4

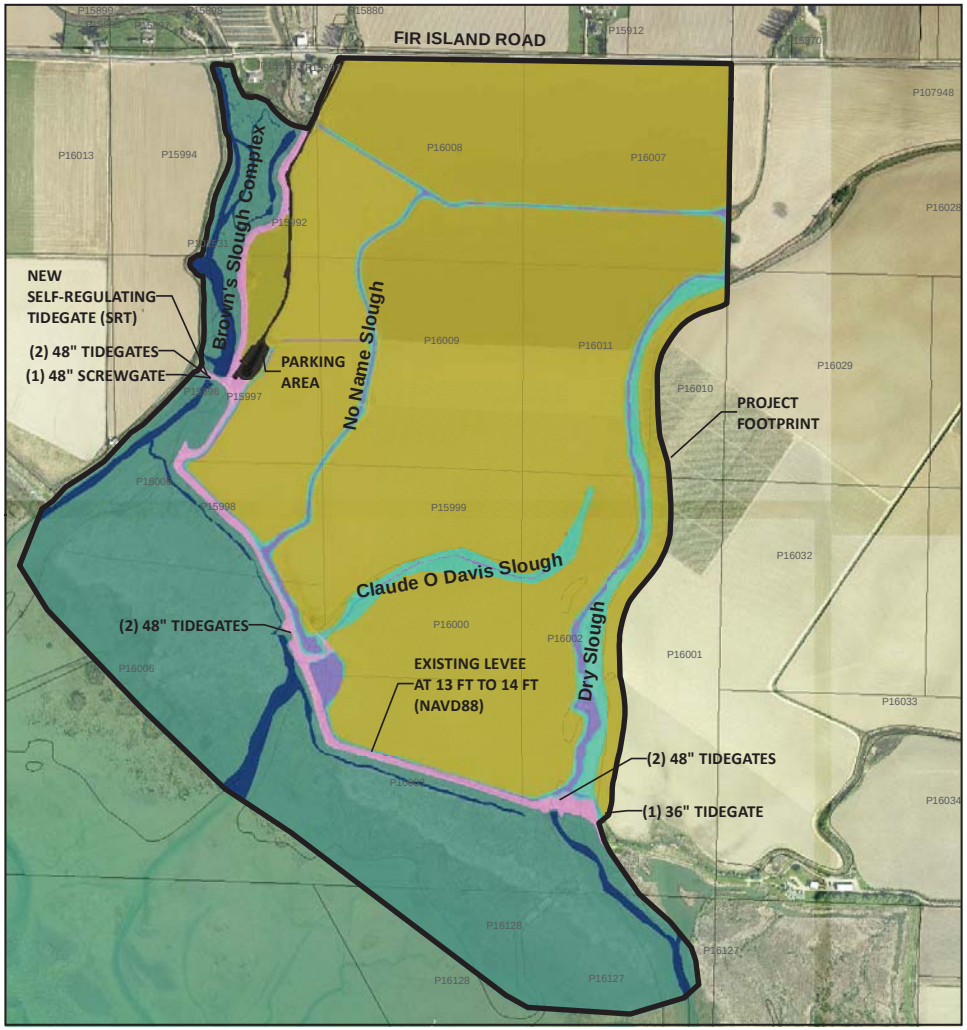
December 2011 21-1-12318-002

SHANNON & WILSON, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

FIG. A-35

Filename: I:\WIP\21-1\12318 FIR ISLAND\GIS\MXD\FIF_ALTS_3-4_050411.mxd Date: 12/29/2011 adh





Alternative 5	Project Element	Map Symbol Existing	Map Symbol New	Area (ac) Existing	Area (ac) Net Change	Area (ac) Total
	Levee			7.7	4.3	12.1
	Habitat Channels			10.3	0.6	10.9
	Drainage			8.0	-	8.0
	Tidal Marsh			122.1	7.0	129.1
	Freshwater Wetland		NONE	15.1	(4.6)	10.5
	Farm		NONE	250.1	(7.4)	242.7
	Roads		NONE	1.6	-	1.6

State Plane Washington
North 4601 NAD83/NAVD88

0 400 800
Scale in Feet

N W E S

Note: Net change in drainage channel is always zero. New drainage will also function as freshwater wetland. This includes losses of drainage channels to habitat channel, for which new interior drainage channels are built in kind to offset the loss.

Alternative 6	Project Element	Map Symbol Existing	Map Symbol New	Area (ac) Existing	Area (ac) Net Change	Area (ac) Total
	Levee		NONE	7.7	-	7.7
	Habitat Channels		NONE	10.3	-	10.3
	Drainage		NONE	8.0	-	8.0
	Tidal Marsh		NONE	122.1	-	122.1
	Freshwater Wetland		NONE	15.1	-	15.1
	Farm		NONE	250.1	-	250.1
	Roads		NONE	1.6	-	1.6

Fir Island Farm Restoration
Skagit Snow Goose Preserve
Skagit County, Washington

ALTERNATIVES 5 & 6

December 2011 21-1-12318-002

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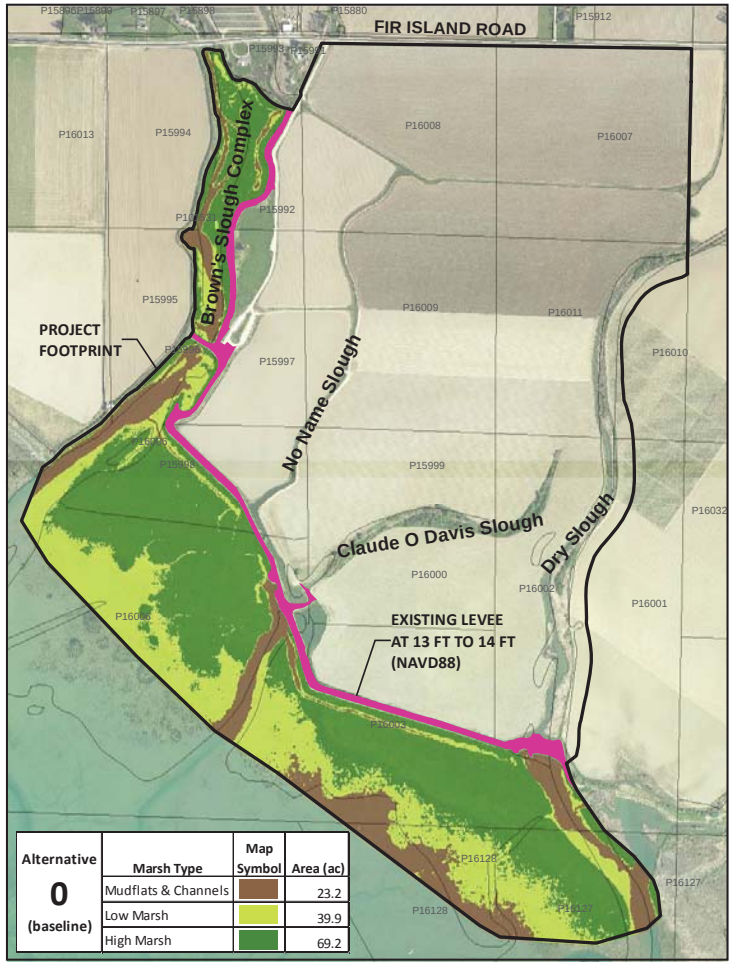
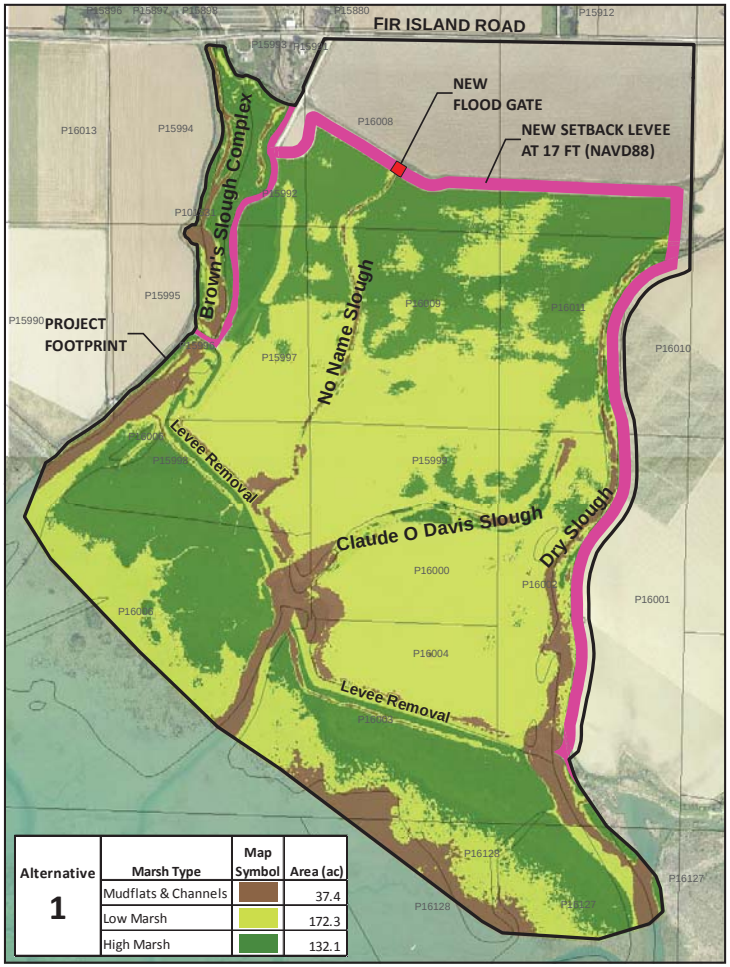
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

FIG. A-36

Filename: I:\WIP\21-1\12318 FIR ISLAND\GIS\MXD\FIF_ALTS_5-6_050411.mxd Date: 12/29/2011 adh



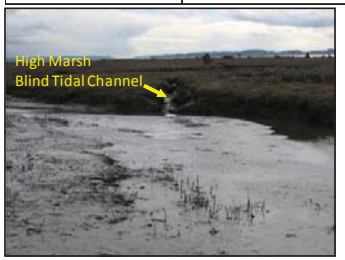
Alternative	Marsh Type	Map Symbol	Area (ac)
0 (baseline)	Mudflats & Channels		23.2
	Low Marsh		39.9
	High Marsh		69.2



Alternative	Marsh Type	Map Symbol	Area (ac)
1	Mudflats & Channels		37.4
	Low Marsh		172.3
	High Marsh		132.1

HIGH MARSH

Scientific Name	Common Name	Percent Cover
Agrostis stolonifera	Creeping bentgrass	65%
Argentina egedii	Pacific silverweed	20%
Carex lyngbyei	Lyngbye's sedge	15%



LOW MARSH

Scientific Name	Common Name	Percent Cover
Agrostis stolonifera	Creeping bentgrass	45%
Schoenoplectus maritimus	Saltmarsh bulrush	35%
Carex lyngbyei	Lyngbye's sedge	20%

0 400 800
Scale in Feet

Coordinate System:
State Plane Washington
North 4601 (feet)
NAD83/NAVD88

N W E S

Fir Island Farm Restoration
Skagit Snow Goose Preserve
Skagit County, Washington

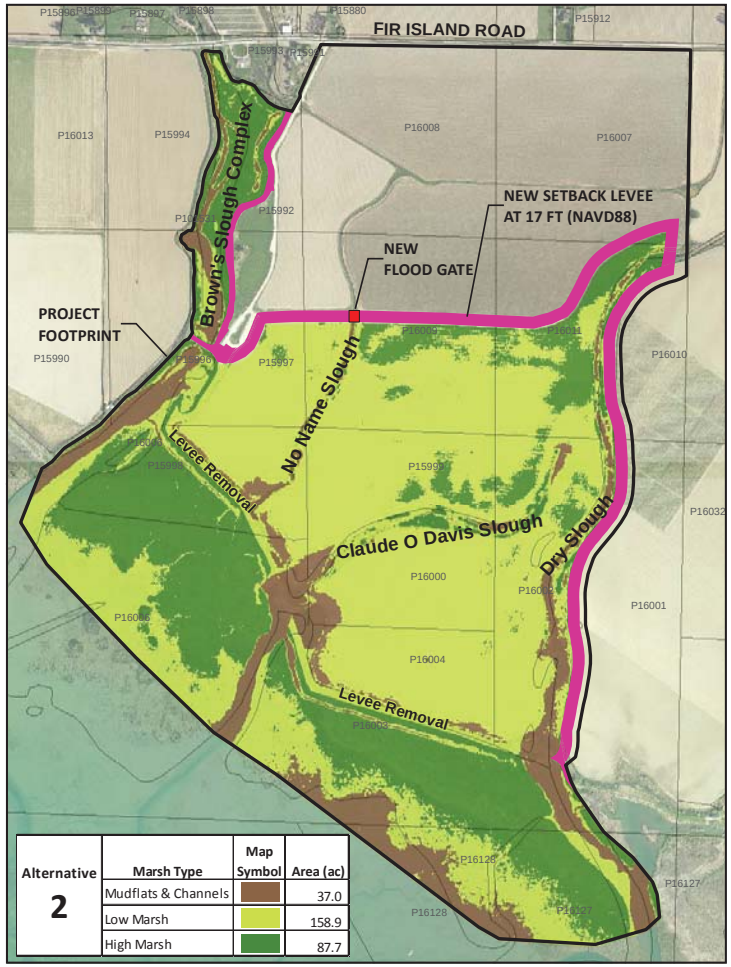
MUDFLATS, CHANNELS & MARSH AREAS ALTERNATIVES 0 & 1

December 2011 21-1-12318-002

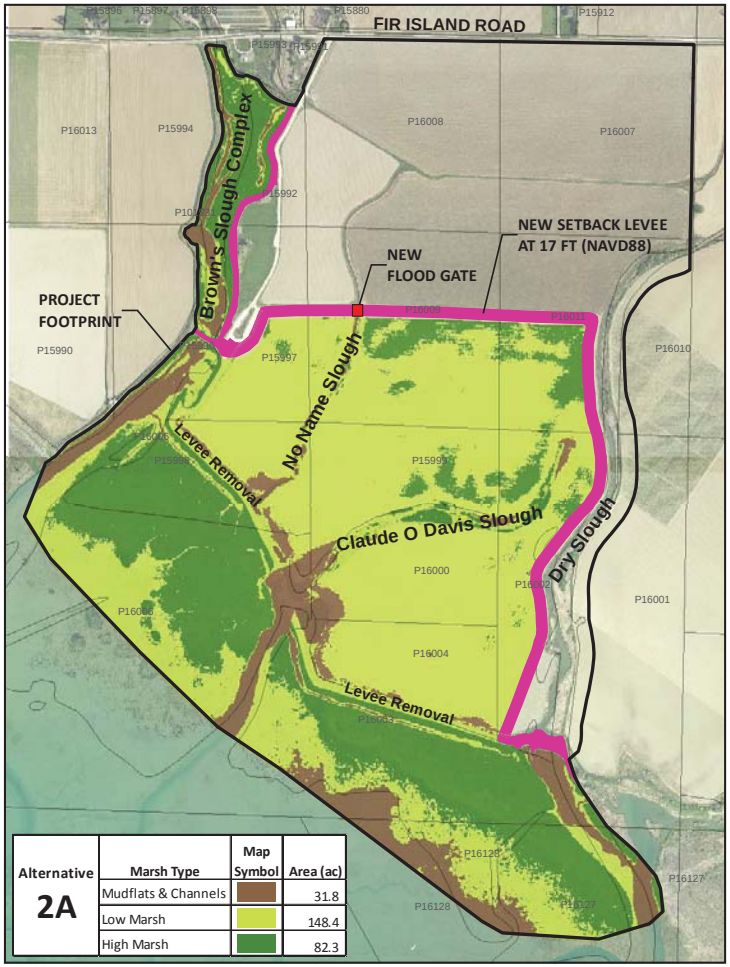
SHANNON & WILSON, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

FIG. A-37

Filename: I:\WIP\21-1\12318 FIR ISLAND\GIS\MXD\FIF_ALTS_0-1_MARSHTYPES.mxd Date: 12/29/2011 adh



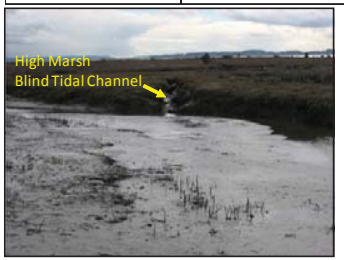
Alternative	Marsh Type	Map Symbol	Area (ac)
2	Mudflats & Channels		37.0
	Low Marsh		158.9
	High Marsh		87.7



Alternative	Marsh Type	Map Symbol	Area (ac)
2A	Mudflats & Channels		31.8
	Low Marsh		148.4
	High Marsh		82.3

HIGH MARSH

Scientific Name	Common Name	Percent Cover
Agrostis stolonifera	Creeping bentgrass	65%
Argentina egedii	Pacific silverweed	20%
Carex lyngbyei	Lyngbye's sedge	15%



LOW MARSH

Scientific Name	Common Name	Percent Cover
Agrostis stolonifera	Creeping bentgrass	45%
Schoenoplectus maritimus	Saltmarsh bulrush	35%
Carex lyngbyei	Lyngbye's sedge	20%

0 400 800
Scale in Feet

Coordinate System:
State Plane Washington
North 4601 (feet)
NAD83/NAVD88

N W E S

Fir Island Farm Restoration
Skagit Snow Goose Preserve
Skagit County, Washington

MUDFLATS, CHANNELS & MARSH AREAS ALTERNATIVES 2 & 2A

December 2011 21-1-12318-002

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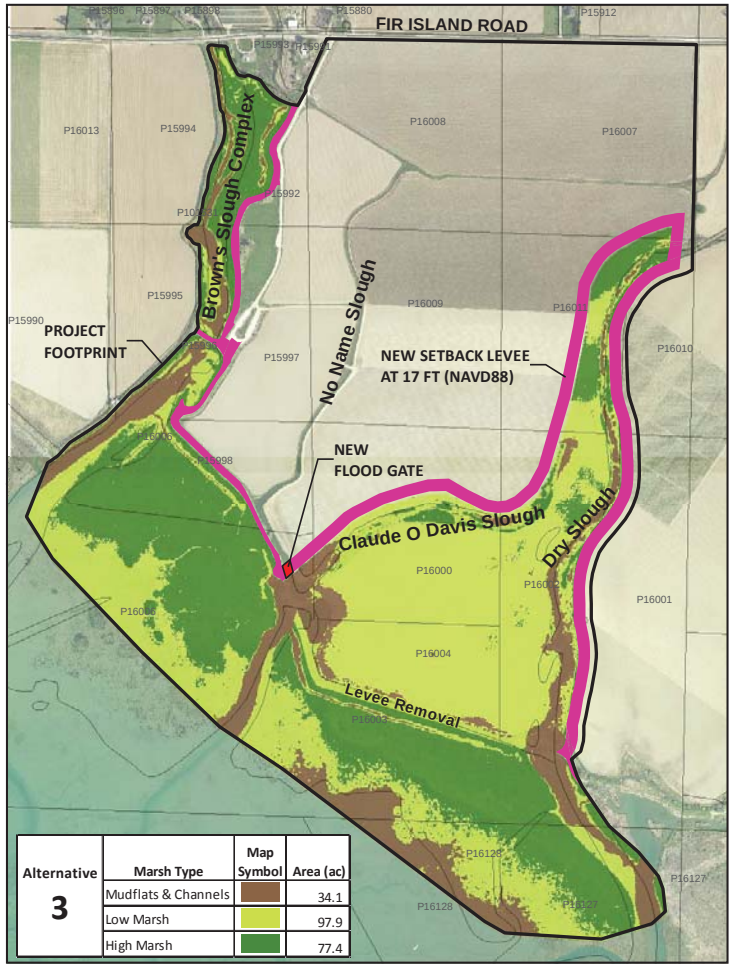
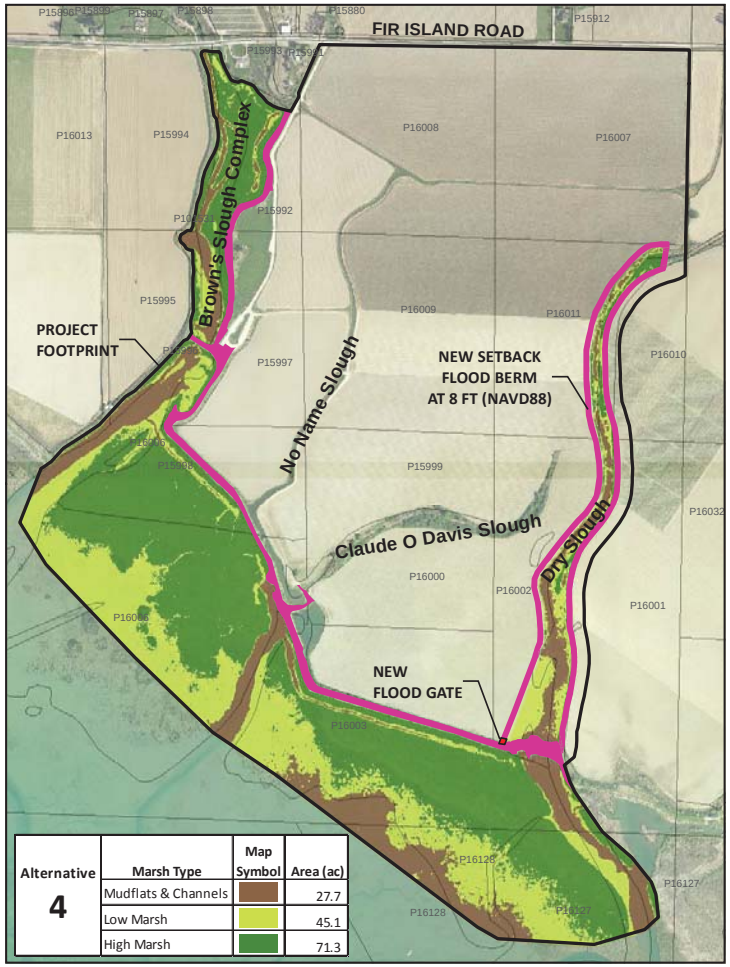
FIG. A-38

Filename: I:\WIP\21-1\12318 FIR ISLAND\GIS\MXD\FIF_ALTS_2-2A_MARSHTYPES.mxd Date: 12/29/2011 adh



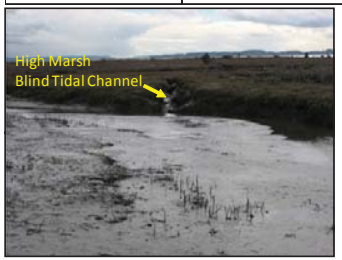
Alternative	Marsh Type	Map Symbol	Area (ac)
3	Mudflats & Channels		34.1
	Low Marsh		97.9
	High Marsh		77.4



Alternative	Marsh Type	Map Symbol	Area (ac)
4	Mudflats & Channels		27.7
	Low Marsh		45.1
	High Marsh		71.3

HIGH MARSH

Scientific Name	Common Name	Percent Cover
Agrostis stolonifera	Creeping bentgrass	65%
Argentina egedii	Pacific silverweed	20%
Carex lyngbyei	Lyngbye's sedge	15%



LOW MARSH

Scientific Name	Common Name	Percent Cover
Agrostis stolonifera	Creeping bentgrass	45%
Schoenoplectus maritimus	Saltmarsh bulrush	35%
Carex lyngbyei	Lyngbye's sedge	20%

0 400 800
Scale in Feet

Coordinate System:
State Plane Washington
North 4601 (feet)
NAD83/NAVD88

N W E S

Fir Island Farm Restoration
Skagit Snow Goose Preserve
Skagit County, Washington

MUDFLATS, CHANNELS & MARSH AREAS ALTERNATIVES 3 & 4

December 2011 21-1-12318-002

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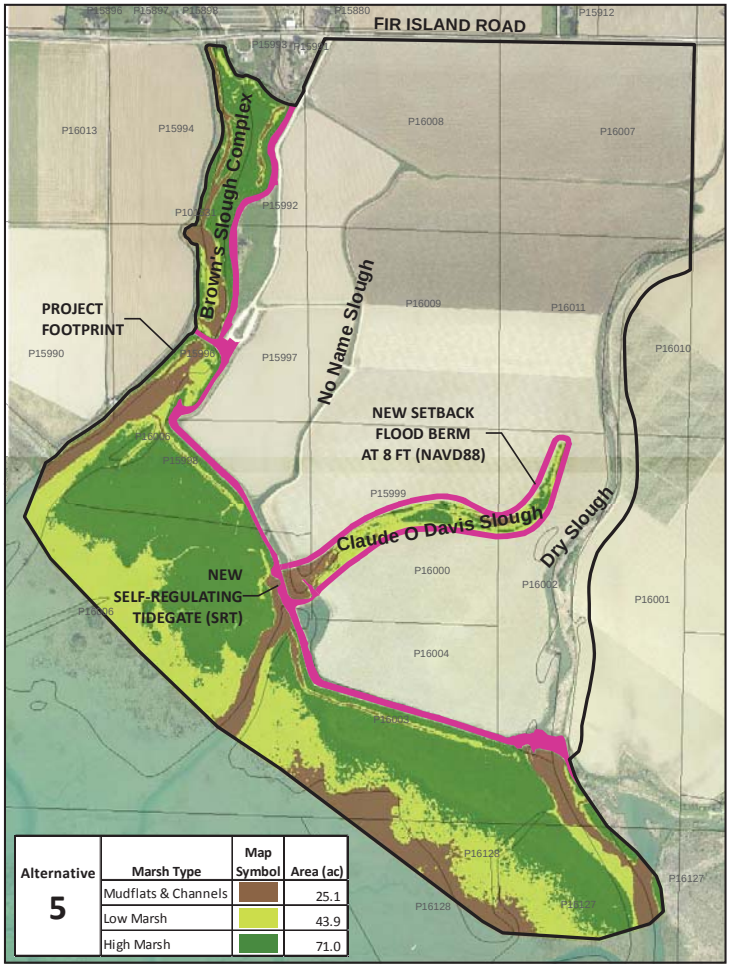
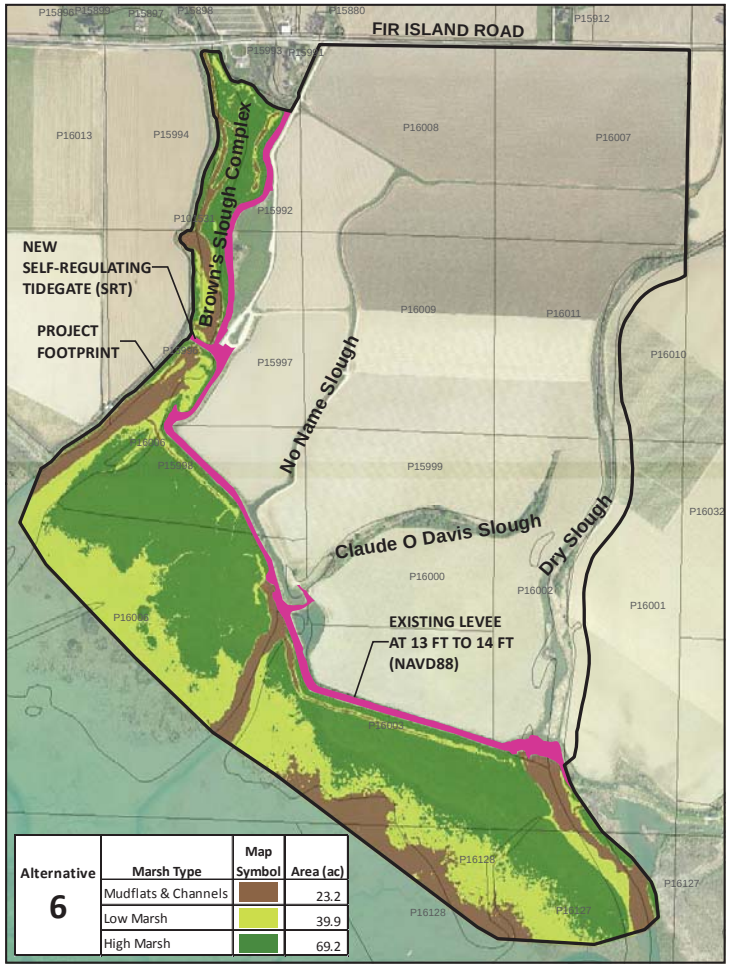
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

FIG. A-39

Filename: I:\WIP\21-1\12318 FIR ISLAND\GIS\MXD\FIF_ALTS_3-4_MARSHTYPES.mxd Date: 12/29/2011 adh



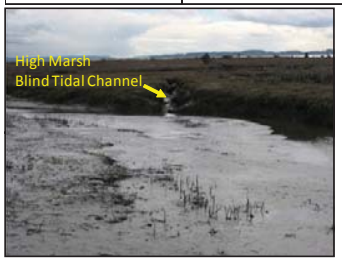
Alternative	Marsh Type	Map Symbol	Area (ac)
5	Mudflats & Channels		25.1
	Low Marsh		43.9
	High Marsh		71.0



Alternative	Marsh Type	Map Symbol	Area (ac)
6	Mudflats & Channels		23.2
	Low Marsh		39.9
	High Marsh		69.2

HIGH MARSH

Scientific Name	Common Name	Percent Cover
Agrostis stolonifera	Creeping bentgrass	65%
Argentina egedii	Pacific silverweed	20%
Carex lyngbyei	Lyngbye's sedge	15%



LOW MARSH

Scientific Name	Common Name	Percent Cover
Agrostis stolonifera	Creeping bentgrass	45%
Schoenoplectus maritimus	Saltmarsh bulrush	35%
Carex lyngbyei	Lyngbye's sedge	20%

0 400 800
Scale in Feet

Coordinate System:
State Plane Washington
North 4601 (feet)
NAD83/NAVD88

N W E S

Fir Island Farm Restoration
Skagit Snow Goose Preserve
Skagit County, Washington

MUDFLATS, CHANNELS & MARSH AREAS ALTERNATIVES 5 & 6

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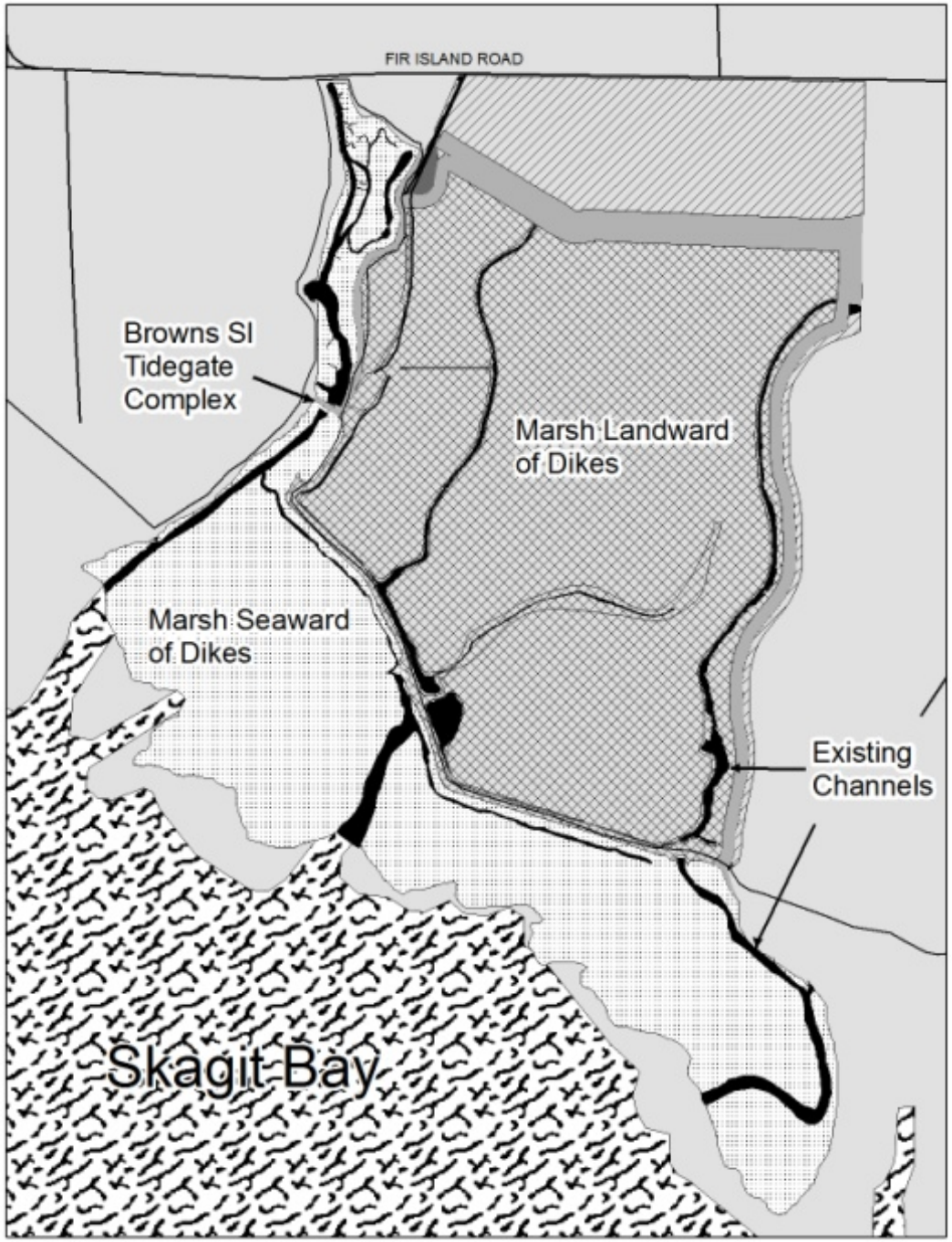
FIG. A-40

Filename: I:\WIP\21-1\12318 FIR ISLAND\GIS\MXD\FIF_ALTS_5-6_MARSHTYPES.mxd Date: 12/29/2011 adh



Fir Island Farm Restoration
Skagit Snow Goose Reserve
Skagit County, Washington

Marsh Tidal Channel Area Components

Source: WDFW, 2011

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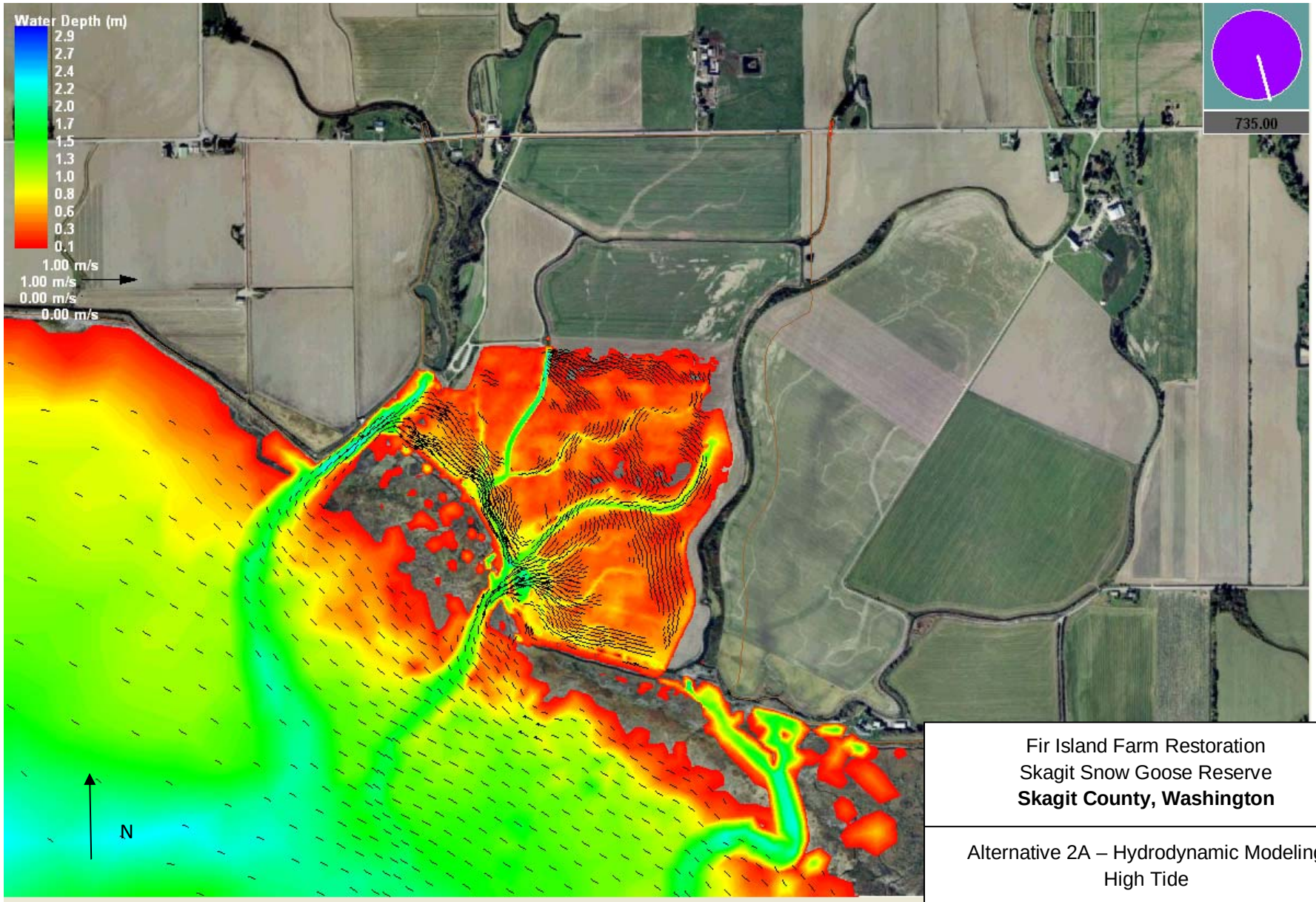
Fig. A-41



Fir Island Farm Restoration
Skagit Snow Goose Reserve
Skagit County, Washington

Alternative 2A – Hydrodynamic Modeling
High Tide

Source: PNNL Memo, October 21, 2011

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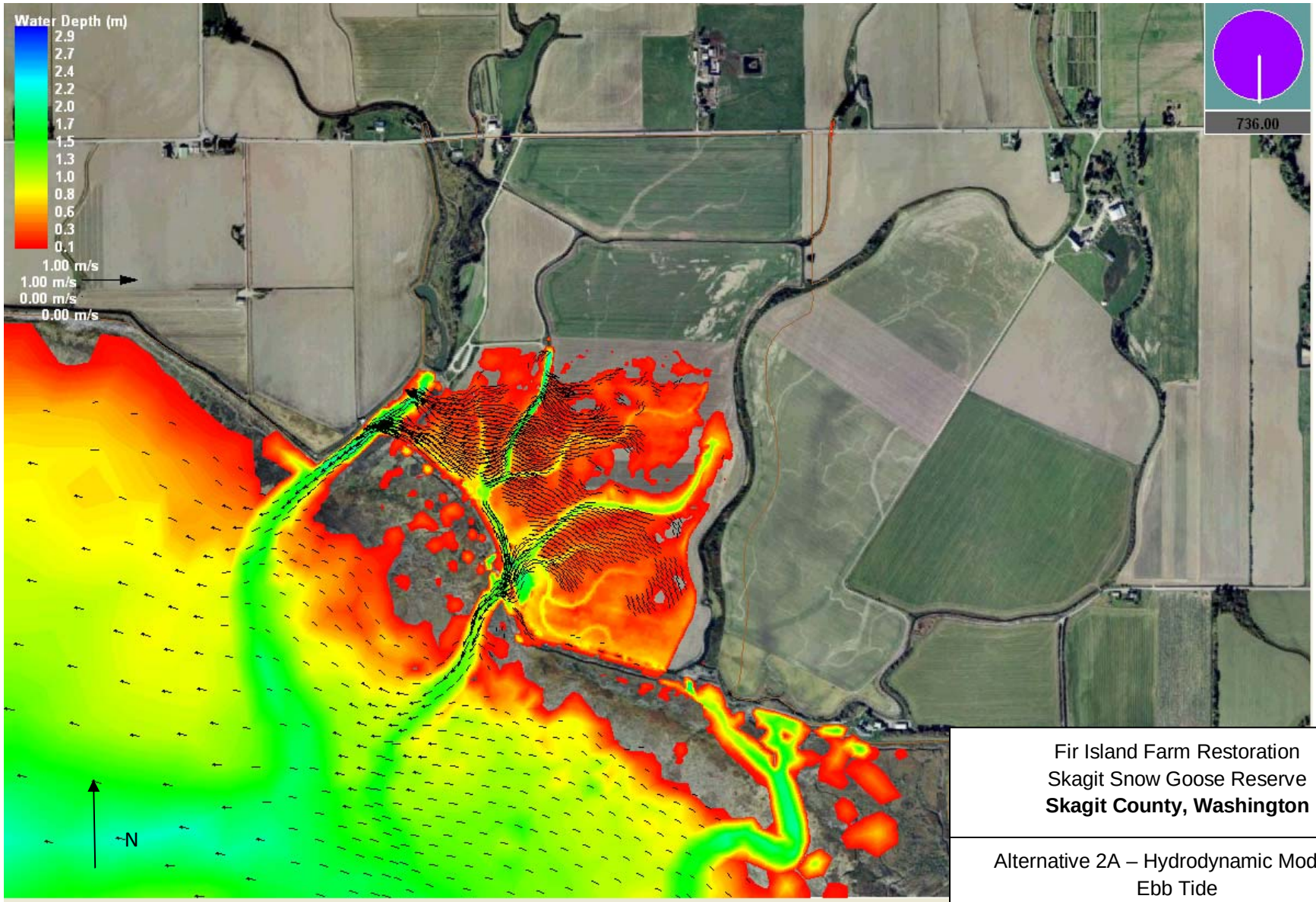
Fig. A-42



Fir Island Farm Restoration
Skagit Snow Goose Reserve
Skagit County, Washington

Alternative 2A – Hydrodynamic Modeling
Ebb Tide

Source: PNNL Memo, October 21, 2011

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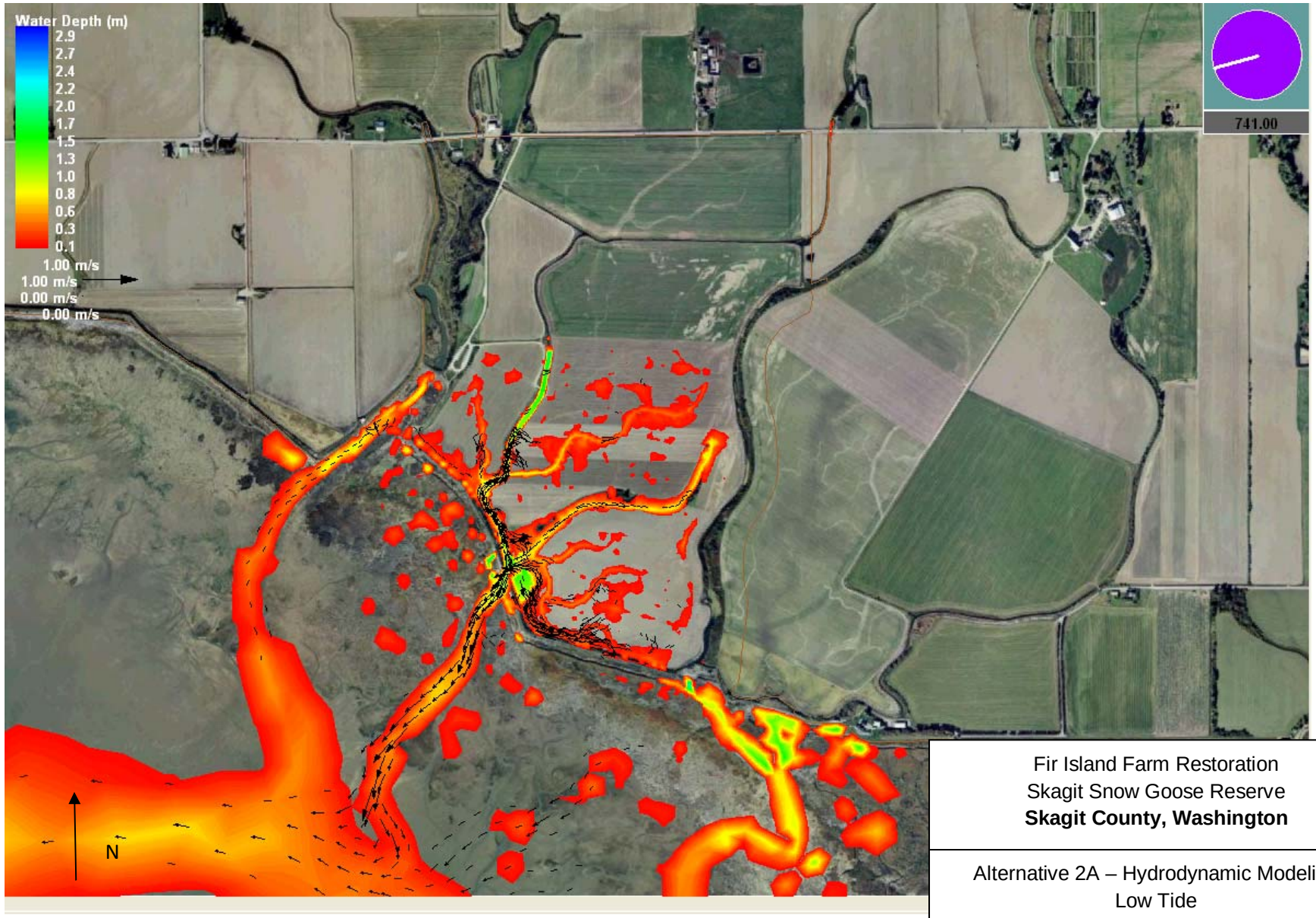
Fig. A-43



Fir Island Farm Restoration
Skagit Snow Goose Reserve
Skagit County, Washington

Alternative 2A – Hydrodynamic Modeling
Low Tide

Source: PNNL Memo, October 21, 2011

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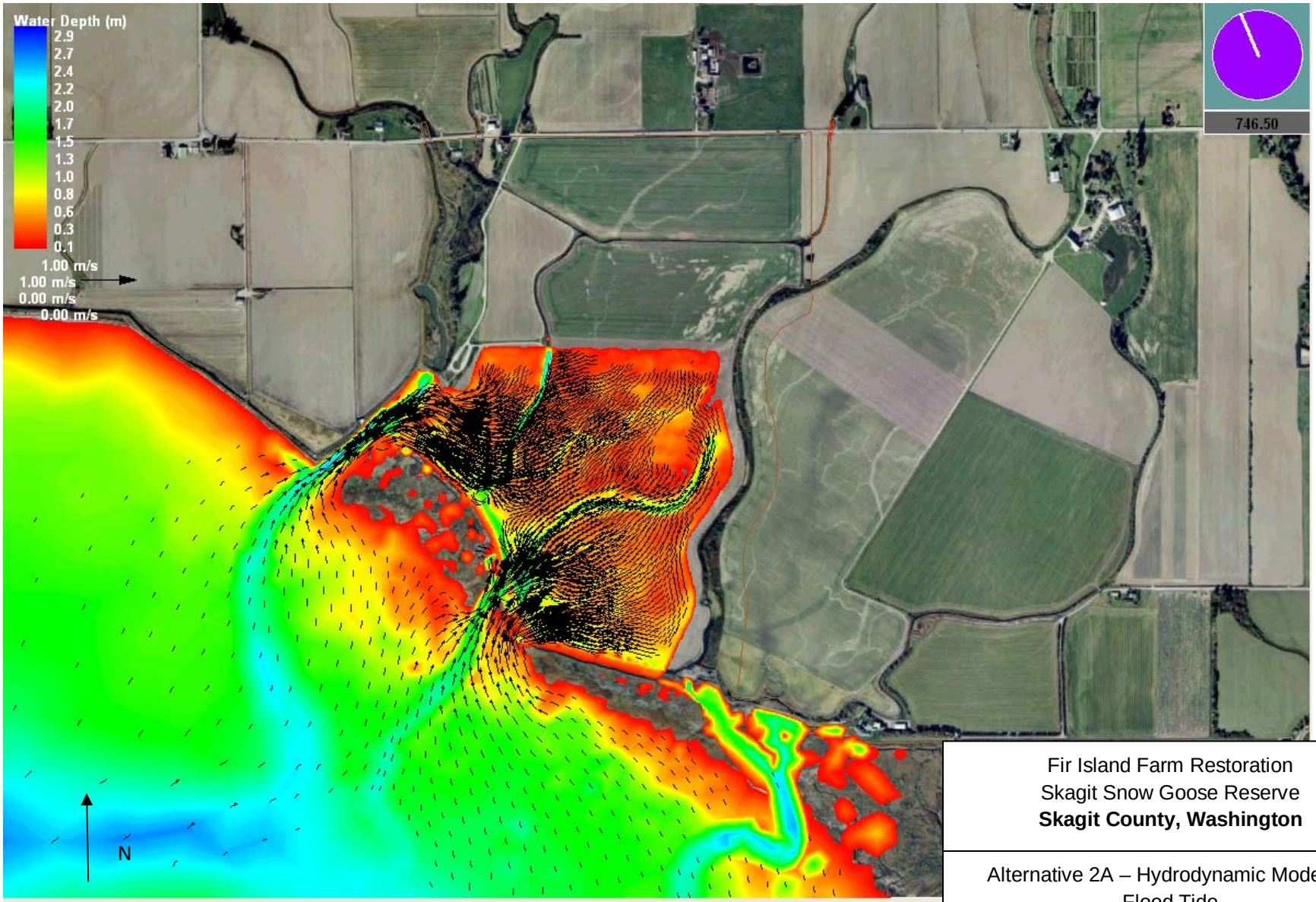
Fig. A-44



Fir Island Farm Restoration
Skagit Snow Goose Reserve
Skagit County, Washington

Alternative 2A – Hydrodynamic Modeling
Flood Tide

Source: PNNL Memo, October 21, 2011

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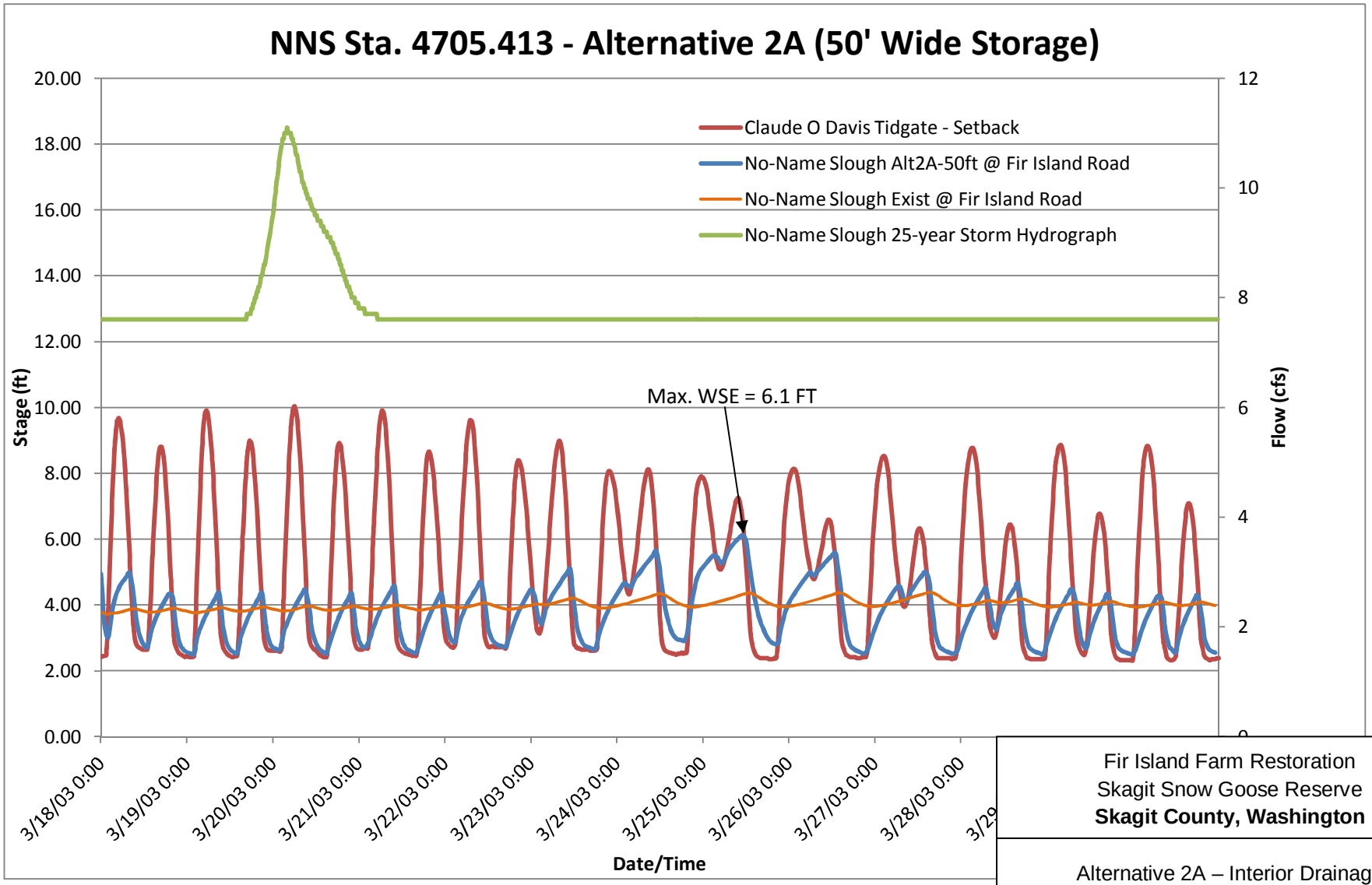
Fig. A-45



Fir Island Farm Restoration
Skagit Snow Goose Reserve
Skagit County, Washington

Alternative 2A – Interior Drainage
50ft Wide Storage Pond

Source: S&W Interior Drainage Memo 3.3

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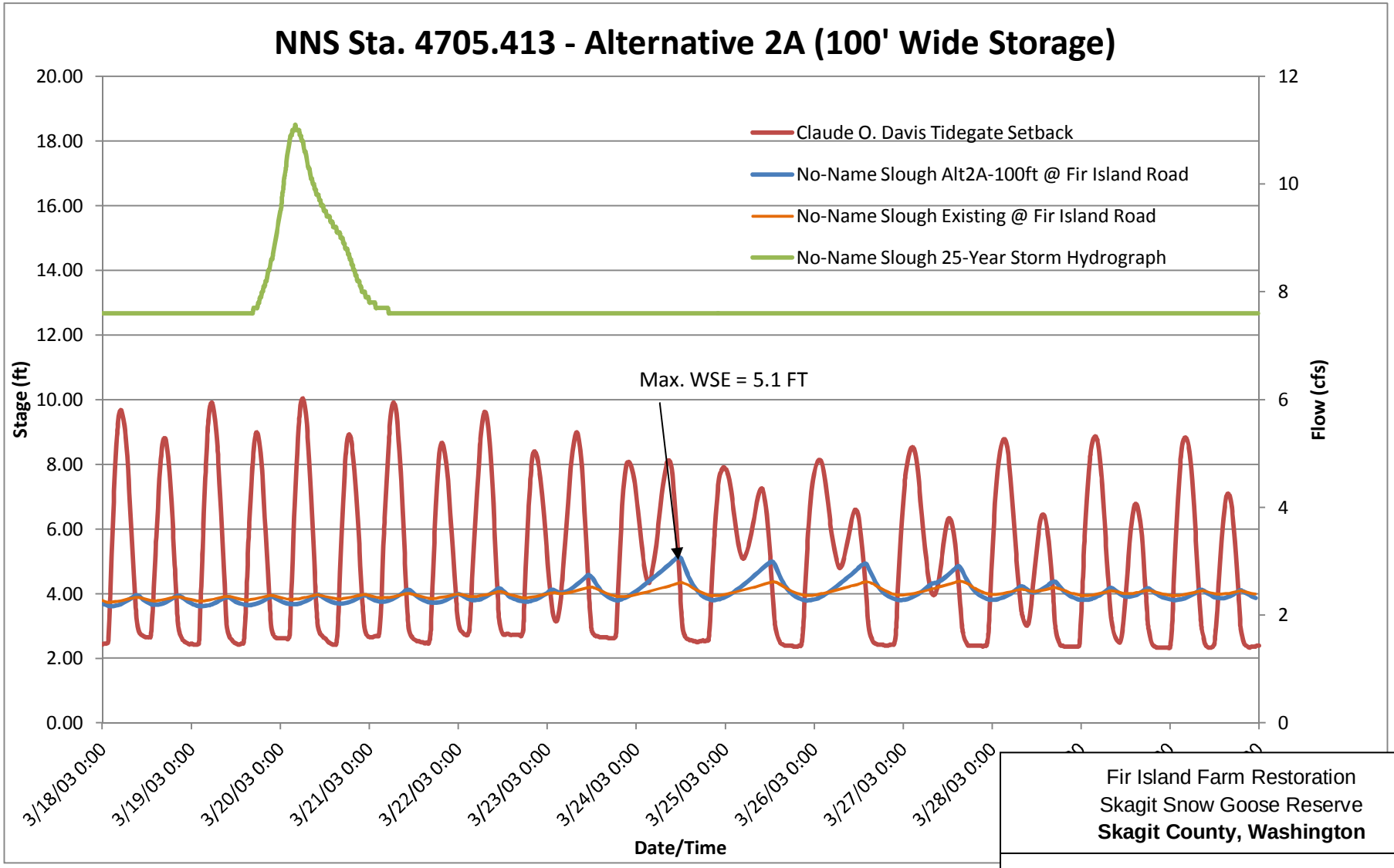
Fig. A-46



Fir Island Farm Restoration
Skagit Snow Goose Reserve
Skagit County, Washington

Alternative 2A – Interior Drainage
100ft Wide Storage Pond

Source: S&W Interior Drainage Memo 3.3

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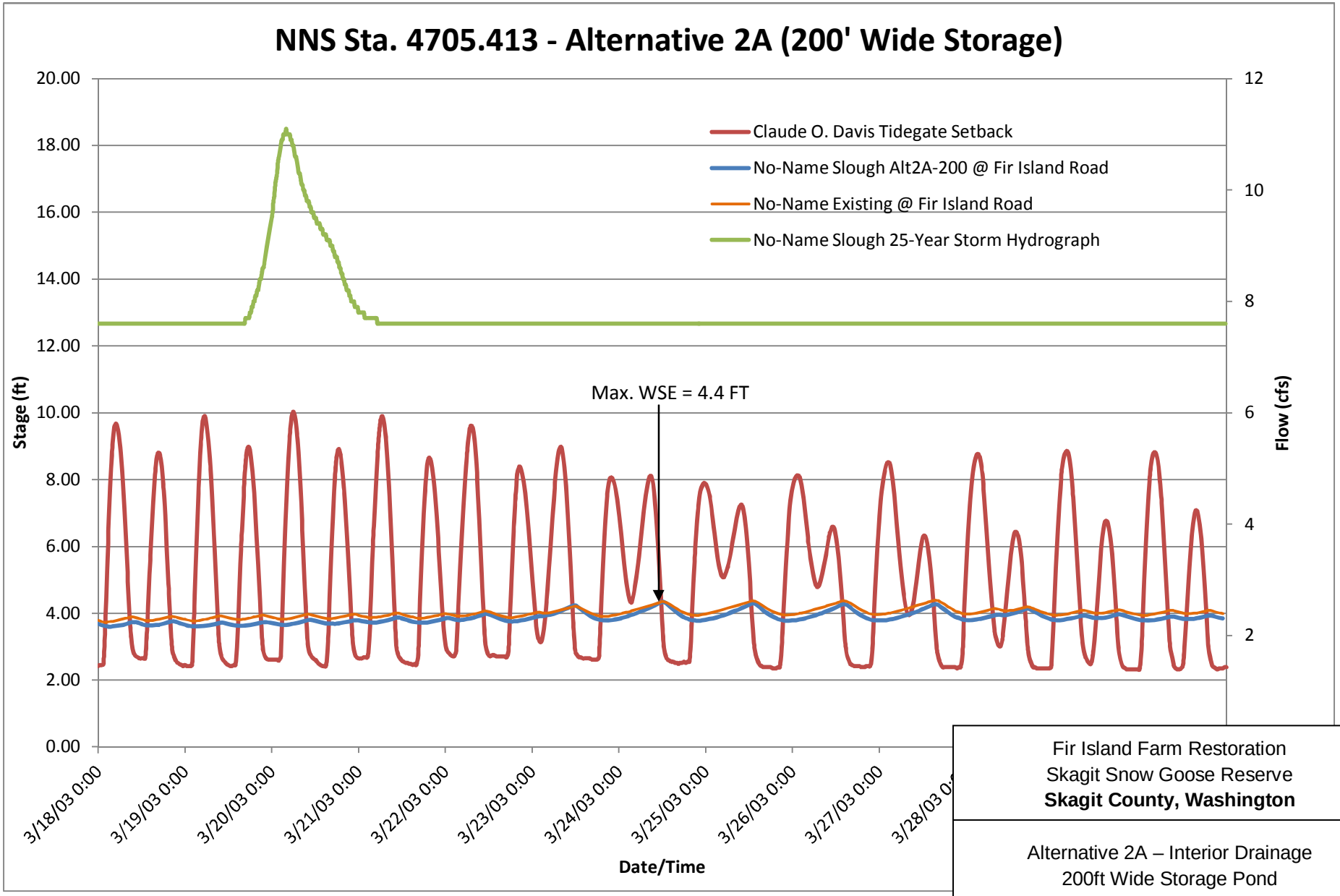
Fig. A-47



Fir Island Farm Restoration
Skagit Snow Goose Reserve
Skagit County, Washington

Alternative 2A – Interior Drainage
200ft Wide Storage Pond

Source: S&W Interior Drainage Memo 3.3

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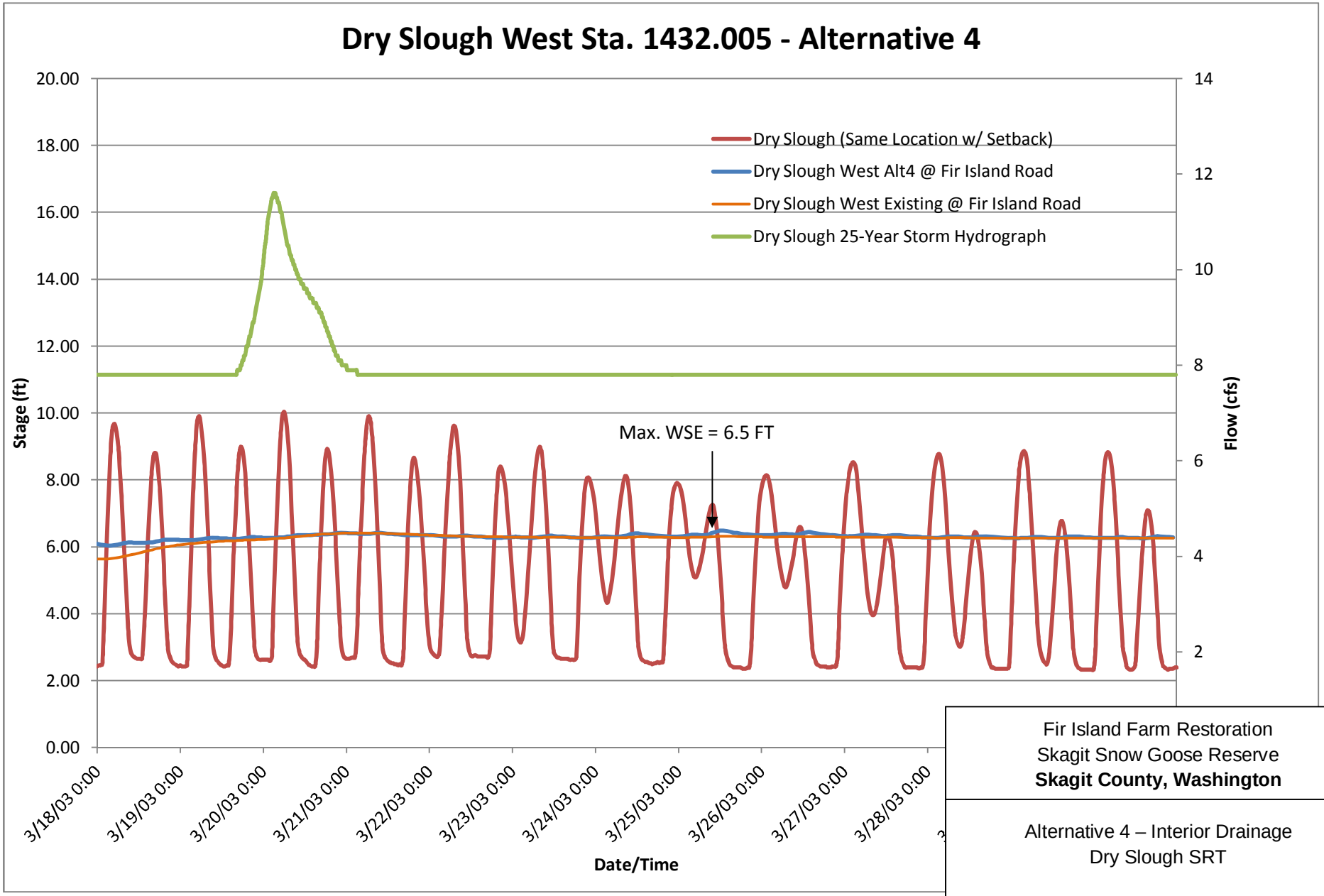
Fig. A-48



Fir Island Farm Restoration
Skagit Snow Goose Reserve
Skagit County, Washington

Alternative 4 – Interior Drainage
Dry Slough SRT

Source: S&W Interior Drainage Memo 3.3

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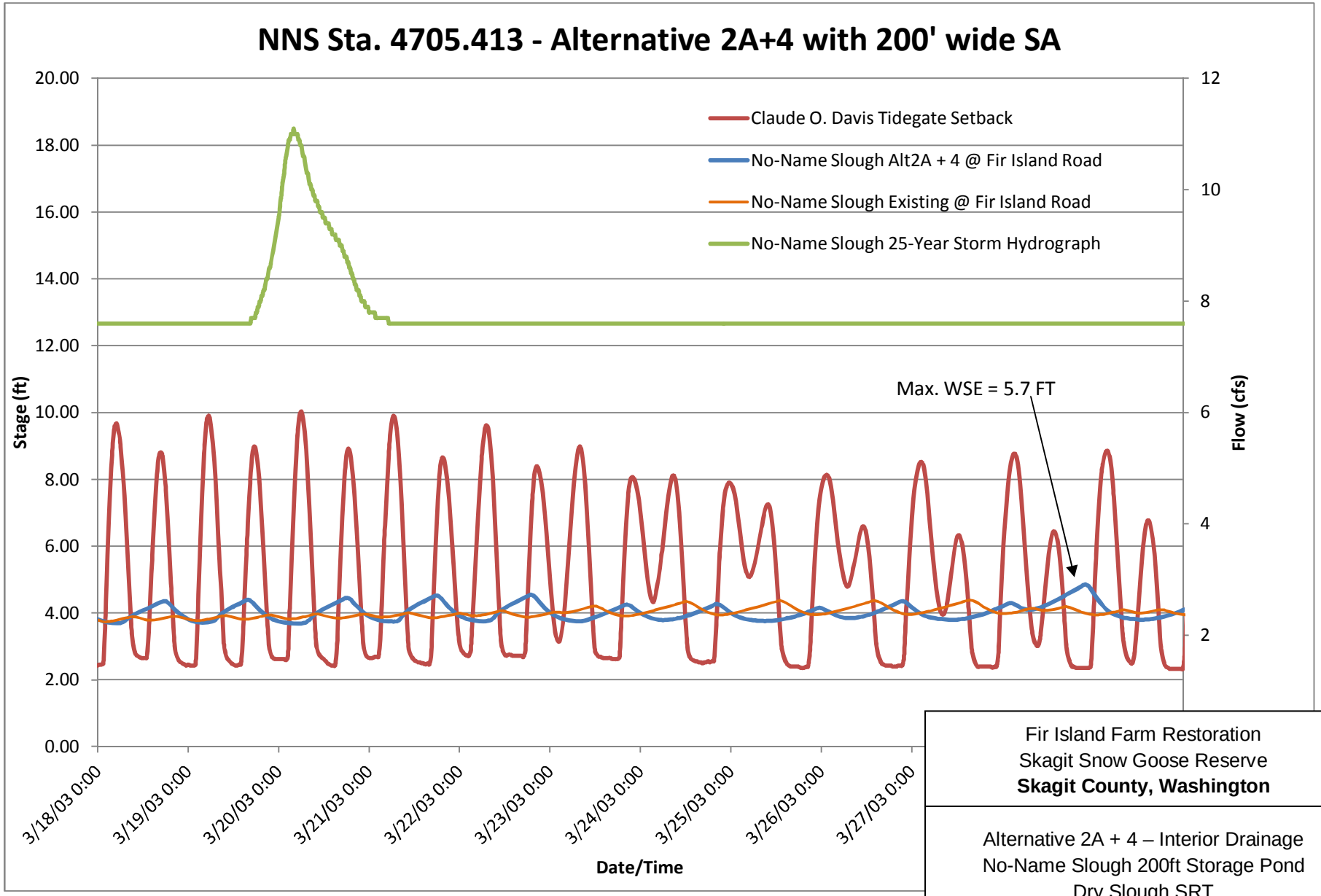
Fig. A-49



Fir Island Farm Restoration
Skagit Snow Goose Reserve
Skagit County, Washington

Alternative 2A + 4 – Interior Drainage
No-Name Slough 200ft Storage Pond
Dry Slough SRT
Source: S&W Interior Drainage Memo 3.3

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Fig. A-50